SUPPLY CHAIN PERFORMANCE EVALUATION AND MODELING: CASE OF SIDAMA COFFEE FARMERS' COOPERATIVE UNION

MSc. THESIS

BY

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HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA.

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ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled "*Supply chain performance evaluation and modeling: Case of Sidama coffee farmers' cooperative union"* submitted in partial fulfillment of the requirements for the Degree of Master of Science with specialization in Industrial Engineering and Logistics management, the Graduate Program of the Department of Industrial Engineering, and has been carried out by Gassa Magara Mamo, ID NO: IELM-R/006/09, under our supervision. Therefore we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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EXAMINER'S APPROVAL SHEET-1

We, the undersigned, members of the Board of Examiners of the final open defense by Gassa Magara Mamo have read and evaluated his thesis entitled "*Supply chain performance evaluation and modeling: Case of Sidama coffee farmers' cooperative union*", and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the Degree of Master of Science in Industrial Engineering and Logistics Management.

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AUTHOR'S DECLARATION

I hereby declare that this MSc. thesis entitled as the *"Supply chain performance evaluation and modeling: Case of Sidama coffee farmers' cooperative union"*. The thesis is submitted to the School of Graduates, Hawassa University for award of Degree of Masters of Science in Industrial Engineering and Logistics Management. This thesis is in my original work, prepared under the supervision of my Principal Advisor Fasika Bete Georgise (Dr.-Ing.) and my Co-Advisor Habte Bekele (MSc.). All sources of materials used for the thesis have been properly acknowledged. I further confirm that this study has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

Gassa Magara Mamo	----------	----------
Name of student	Signature	Date

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LIST OF ABBREVIATIONS

ABC	Activity-Based Costing
APICS	Advancing productivity, innovation and competitive success
BSC	Balanced Scorecard
ECFF	Environment and Coffee Forest Forum
ECX	Ethiopia commodity exchange office
ETO	Engineer-To-Order is a type of production strategy that designed and Produced based on customer order
EVA	Economic Value Added
FLO	Fair-trade labeling organization
GSCF	Global Supply Chain Forum framework
ICT	Information communication technology
KPIs	Key Performance Indicators
MTO	Make-To-Order is a type of production strategy that standard parts are not
MTS	Make-To- Stock is a type of production strategy that standard parts are Produced and stocked before a customer order is received Produced until a Customer order is received
SASC	Strategic Audit Supply Chain
SC	Supply chain
SCC	Supply chain council
SCFCU	Sidama Coffee Farmers' Cooperative Union
SCM	Supply chain Management
SCOR	Supply chain operation reference
SNNPRS	South nation nationalities and people regional state
Std. Dev.	Standard deviation
UNDP	United Nations Development Program
USAID	United States Agency for International development

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ABSTRACT

This thesis aims to propose a supply chain (SC) performance evaluation model in the coffee processing industries: Case of Sidama coffee farmers' cooperative union (SCFCU). Coffee is a major agricultural export commodity of Ethiopia, particularly the Sidama Zone, which has a high potential for specialty coffee. From Sidama Zone, SCFCU has major contribution supplying coffee product to domestic and export market unifying 61 coffee farmers' cooperatives and being the second-largest union in the country. However, the primary coffee farmers' cooperatives are facing enormous challenges at the current time in sourcing methods and production processes decreasing SC performance associated with quality of raw material and costly production making them unable to be a competitive and unprofitable business. They have no suitable SC performance evaluation model, standardized business operation process and methods that can improve their inter-organization and SC performance in a sustainable way. To solve these problems, the thesis study on SC performance evaluation and modeling was conducted. To achieve the study goal, investigation and reviewing of an appropriate SC performance evaluation model were carried out to have comprehensive knowledge. From several SC performance evaluation models, the SCOR model is identified as an appropriate SC evaluation model being dynamic, balanced and universal model. Significance of the study, using the SCOR model is believed to give an insight for the primary coffee farmers' cooperatives as well as other concerned bodies about the existing challenges of coffee processing industries SC suggesting possible solutions to the problems and enabling them to improve SC performance. Because SCOR model designated to analyze SC performance and optimize the various processes in SC and it can play an important role in identifying problem-solving ways being starting points to find better ways to improve SC performance, in coffee processing industries making them more optimal and sustainable performance improvement. To achieve the study goal, a descriptive research design was employed and 13 cooperatives were selected unified in SCFCU from Sidama Zone in five Woreda within three clusters from the total population 182, the sample size was 125 respondents using Yamane sample size decision model and random sampling system. The primary data were collected using semi-structured questionnaires, interviews and field observation. Secondary data were collected from different published and unpublished sources. Data analysis was on the basis of qualitative and quantitative research approaches. The result was a high performance of reliability and responsiveness, the poor performance of Plan and Source process having moderate overall SC performance. Using the study result, SC modeling was made considering suitability for coffee processing industries. Finally, from data analysis and result discussions, conclusions were drawn and recommendations made on gaps.

Key Words: Supply chain, Performance evaluation, Modeling, Coffee farmers' cooperatives, SCFCU

1. INTRODUCTION

The focus of this chapter is mainly addresses the background of the study, problem statement, objectives of the study, research questions, significance of the study and scope of the study.

1.1. Background

Of the various products traded in the international market, coffee is one of the most valuable agricultural commodities next to petroleum. Coffee in today's time is one of the most valuable sources of export for the East African nations of Ethiopia, Uganda, Kenya, and Tanzania. Ethiopia is known to be the birthplace and the primary center of diversity of coffee Arabica (Asmelash and Umeta, 2017). As Abayneh and Zena (2017), coffee has a great social, cultural and livelihood importance for the majority of the Ethiopian population and to the national economy. The country produces more than 30% of the total coffee production in Sub-Saharan Africa and it also consumes nearly 50% of the total production with complex socio-cultural settings. Due to these reasons, the coffee sub-sector has appreciated higher attention under the current agricultural commercialization strategy. Therefore, the study on the SC performance in coffee industries is seen as very important to upgrade this sector.

Coffee SC starts from coffee-growing farmers and it has long SC up to export it to sold global markets and deliver to end-user. It includes farmers as suppliers' suppliers, private coffee processors and primary cooperatives as manufacturers, transporters, warehousing activities, wholesalers, retailers, other intermediaries and customers themselves. Buying red cherry or dry coffee from farmers, primary coffee farmers' cooperatives will process to get green coffee suitable for export. Primary coffee farmers' cooperatives sell a coffee product to Coffee farmers' cooperative union at the central market price. Final the Union exports quality product and low graded sell to domestic traders (Bossolasco, 2009; Albastroiu and Felea, 2013).

Sidama coffee farmers' cooperatives union (SCFCU) works as an exporter by developing linkages between farmers sometimes remote area producers and domestic buyers including foreign importers. SCFCU is the second largest coffee producing cooperative union in Ethiopia (Bossolasco, 2009). By their cooperation among Union and primary coffee farmers' cooperatives serve their members most effectively and strengthen the cooperatives by working together through local, national and regional having international market structures support exporting coffee product through union (Boot, 2011; Asmelash and Umeta, 2017). As a principle of

cooperatives, a Union is a secondary level cooperative society established may be by two or more primary cooperative societies having a similar objective to produce, provide service or to engage in both activities that are beyond the capacity of the Primary cooperative society. The major activities of the cooperatives union are; coordinating all the activities associated with primary cooperative societies, offering centralized services such as grading, standardization, processing, etc., taking advantage of the current market trend to the members and providing technical advice and supervision (Kodama, 2007; Boot, 2011; Asmelash and Umeta, 2017). According to Kodama (2007), cooperative activities could play an effective role in supporting coffee farmers by sharing the price information, capital, and transportation to farmers.

Based on cooperative union principle SCFCU found in Sidama Zone because of proximity to raw materials and availability coffee as raw materials it was established in 2001 and unified with 47 primary coffee farmers' cooperatives (Asmelash and Umeta, 2017). Nowadays it is grown to be 61 primary coffee farmers' cooperatives increasing from time to time (Sidama Zone Cooperatives Office, 2018). Since, Sidama Zone is a major coffee producing area as compared to the other annual and permanent crops in this area, because of its suitable agroecology and the farmers have closed the cultural coffee production system in Sidama Zone. As Atinafu and Mohammed (2017) and Asmelash and Umeta (2017), SCFCU produces approximately about 10,000 tons of high-quality Organic Arabica beans per year and 95% of the washed coffee product. Hence, cooperatives grouped many farmers' associations and play an important role in finding coffee markets for farmers.

1.2. Problem statement

The goal of a supply chain (SC) is to maximize overall SC performance minimizing cost. To achieve a low SC cost, the company need to have excellent internal and external performance having suitable SC evaluation models. In many companies, the challenge is developing suitable performance evaluation measures, systems and tools. To have excellent SC performance, companies should have performance evaluation metrics and models (Chopra and Meindl, 2007).

According to SCC (2010) and Angelos (2017), lack of suitable SC performance evaluation system make companies unable to have common language of SC performance evaluation result by differing one organization performance evaluation result to another. Even though, there are different KPIs within different teams and departments in the same organization. Lack of suitable organizational, SC performance evaluation models and know-how make unable to have common

performance result within organization and throughout SC. This can affect the organizational and SC performance of companies (Kleverlaan, 2008; SCC, 2010; Wei, 2014; Parmar and Shah, 2016; Ebrahim *et al.*, 2016). According to Lampathaki *et al.* (2013) and Angelos (2017), when firms can't evaluate a performance it cannot tell results, success and failure. Also if a firm cannot see success, it cannot learn from success, cannot reward and cannot be successful. This leads unable to correct failure and unable to have right management.

In the context of SCFCU, lack of suitable organizational and SC performance evaluation models and know-how has been affecting them unable to improve their organizational and SC performance. For this reason the coffee farmers' cooperatives were encountered enormous challenges starting from sourcing up to delivery process in their business operation processes. The challenges were extremely on sourcing and production process being costly especially red coffee cherries being supplied immature level. Therefore, to solve these challenges the important solution can be conducting research in coffee processing industries to improve SC performance in a sustainable way.

In addition, there was limitation of SC performance evaluation researches and application in agro-industries business sectors, especially in study area at the coffee SC performance evaluation. Consequently, having limitation and gap between research and application in SC performance evaluation, there was inability improving their SC performance of SCFCU and primary coffee farmers' cooperatives. These limitations have been causing insufficient focus on asset management focusing only on operation and neglecting cost minimization make the organization unable to connect with improved SC performance. Hence, a researcher motivated to conduct a thesis entitle as SC performance evaluation and modeling to address these limitation reviewing related literatures with this study to provide the awareness of an appropriate SC evaluation model and metrics and using SCOR model as it is one of the most recognized universal, balanced and dynamic model to ensure the success of an enterprise.

1.3. Objective of the study

1.3.1. General objective

The general objective of this study is to propose a supply chain performance evaluation model for Sidama Coffee Farmers' Cooperative Union (SCFCU).

1.3.2. Specific objectives

The specific objectives of the research are:

- To investigate and review what metrics and models can be used in supply chain performance evaluation.
- To review supply chain modeling in business operation process.
- To assess and analyze existing supply chain performance of SCFCU
- To recommend an appropriate supply chain performance evaluation model

1.4. Research questions

This study should answer these following essential questions:

- What are metrics for supply chain performance evaluation?
- How is supply chain modeling in business operation process?
- What is existing supply chain performance of SCFCU?
- What is an appropriate supply chain performance evaluation model?

1.5. Significance of the study

The Significance of this study was to give an insight for the primary coffee farmers' cooperatives as well as other concerned bodies about the existing challenges of coffee processing industries SC, suggesting possible solutions to the problems and enabling them to improve their SC performance using the SCOR model. Because SCOR model is designated to analyze SC performance and optimize the various processes in SC and it can plays an important role in identifying problem-solving methods, being starting points to find better ways to improve SC performance; making more optimal and sustainable performance improvement in coffee processing industries SC. Therefore, it was primarily focused on the assessment of SC performance to bring solutions solving various operational and planning processes and aimed to overcome the problems encountered in achieving business operation processes of the coffee production industry such as coffee sourcing, processing, and delivery processes in SC of SCFCU. This study was also provide baseline information for the concerned body and can be served as a base, supportive resource and point of departure for further research for academicians.

1.6. Scopes of the study

A researcher believed that it would be appropriate to conduct the study on a large scale. However, SCFCU is one of the largest unions in Ethiopia unifying members 61 primary coffee farmers' cooperatives spread across the Sidama Zone having its office and warehouse in the capital city of the country in Addis Ababa. Therefore, it is not possible to cover the whole aspects of the study area personally and conducting the study on a large scale would be unmanageable in terms of time and finance. Hence, the scope of the study was delimited to categorize the study area of geographical location into 3 clusters purposively and selecting randomly 13 cooperatives from three categorized clusters Bansa, Aleta Wondo, and Dale districts and SC from production station up to delivering in Addis Ababa SCFCU at a warehouse.

1.7. Organization of thesis

The organization of this thesis paper has five chapters. Chapter one is introductory chapter and is focused on background of the study, statement of the problem, objective of the study, significance of the study and scope of the study. Chapter two is literature review include SC, concept of SC performance evaluation, metrics, classification of SC performance model and identification of appropriate SC performance evaluation model. Chapter Three is research methodology focus on, description of the study area, sampling technique and procedure, data collection methods, data analysis procedure and model specification. Chapter four contain data analysis and result discussion, the existing SC performance assessment of SCFCU and primary coffee farmers' cooperatives, analysis of SC operation process enablers, best practices and lastly SC modeling to improve business operation process. Chapter five: Consists of conclusion, recommendation and future research studies.

1.8. Ethical considerations

This thesis study permission was provided by research advisors and the Department of Industrial Engineering. During data collection and sampling, verbal permission was obtained from each respondent and interviewer. The researcher informed the participants about the aim of the study and they were participating based on their own willingness. Privacy and confidentiality were maintained and respondents were assumed that the data was collected in this study would not be used for any other purpose except for academic purposes.

2. LITERATURE REVIEW

2.1. Introduction

This chapter presents a literature review related to the supply chain (SC) performance evaluation and modeling. Also, this part was guided by the research questions in part one which are a definition of SC, the classification of SC performance evaluation models and metrics and benefits of performance evaluation.

2.2. Supply chain and supply chain performance evaluation

2.2.1. Supply chain

The SC is defined as the network of interdependent organizations that work together to enable the flow of products into markets. A SC is also a system whose constituent parts include material suppliers, manufacturing centers and production facilities, warehouses, distribution services, retailers and customers linked together via a feed forward flow of materials and feedback flow of information and finance flow, raw materials, work-in-process inventory and finished products that flow between the facilities (Michael, 2009; Sillanpää, 2010).

According to Kleverlaan (2008), SC consists of multiple firms, both upstream (supply) and downstream (distribution) and the ultimate consumer. As Kleverlaan (2008), a SC can be seen as a network consisting of raw material suppliers, manufacturers, product assemblers, distributors and wholesalers, retailer merchants, customers, transportation companies are all members of a SC. In a SC normally, several independent firms are involved in manufacturing a product and placing it in the hands of the end user.

The study conducted by Gisilla (2013), defines that SC includes the activities from the procurement of raw material then processing these materials to final products and then delivering the product to consumers. As Wei (2014), SC involves all the activities related to moving goods from the raw material stage up to the end user. It includes many different companies, for example, those engaged in processing raw materials, wholesaling and retailing, transportation, warehousing, information processing, and materials handling. Functions that are carried out through the SC include sourcing, procurement, production scheduling, manufacturing, order processing, inventory management, warehousing, and customer service.

According to Kleverlaan (2008) and Rosiana *et al.* (2017) at the operational level, SC activities network supports three types of flows that require careful planning and close coordination are:

1) Material flows, which represent physical product flows from suppliers to customers as well as the reverse flows for product returns, servicing and recycling;
2) Information flows, which represent order transmission and order tracking, and coordination of the physical flows; and
3) Financial flows, which represent credit terms, payment schedules and delivery.

2.2.2. Global coffee supply chain

Bamber *et al.,* (2017) described that the global coffee SC dividing into five categories. The first category is production starting from seedlings using fertilizer on farmland with technical assistance and in the form of extension services as well as input, provision has played a role in helping these networks. The second level chain is processing including wet and dry coffee processing and packaging. The third level is traded by traders and distributors as wholesalers. The fourth level chain includes retails and roasting. Finally and fifth-level chain is marketing include supermarkets, food services, and coffee bars.

In coffee production process harvesting is labor-intensive and the best quality can be obtained from selective picking in which only red, ripe cherries are gathered by hand in successive picking rounds until most of the crop has been harvested. Coffee production to be certified as organic, growers may only use particular types of approved organic fertilizers. To improve the production of coffee, unifying and organizing cooperatives can strengthen especially in recent years in some Arabica coffee production regions (USAID, 2010; Bamber *et al.,* 2017; Palomino *et al.,* 2017). There are several benefits unifying coffee farmers' cooperatives. Benefits and challenges were listed for primary coffee farmers' cooperatives as follows.

According to USAID (2010) and Bamber *et al.* (2017), by organizing cooperatives there are several benefits including increased productivity, lower unit costs with high quality, maximizing profit using economies of scale of production, increase competitiveness of local coffee producers and processors, increased opportunity for product differentiation, higher unit value income, finally this all farmers allow to build-up of skills to potentially engage export market i.e. facilitating entry into specialty coffee market, encourage environmental upgrading by reducing water pollution associated with wet processing, build new specialty coffee reputation and brand based on sustainable practices, create source of inexpensive organic fertilizer.

However, as gained benefits by cooperating together, primary coffee farmers' cooperatives have the challenges are low yields due to aging coffee trees, outdated production techniques, limited access to quality seedlings, farmers' limited knowledge of production and harvesting techniques required to maintain quality which requires training, transportation and logistics problems, inability of adequate financial capacity building (USAID, 2010; Bamber *et al.*, 2017).

2.2.3. Sidama coffee farmers' cooperative union supply chain

The basic SC network of Sidama coffee farmers' cooperative union is starting from the individual farmer who grows coffee on his land. When the time comes for harvesting the farmers collect coffee beans (or hire labor for help) and sell the raw coffee to primary cooperatives. The primary coffee farmers' cooperative buys the coffee from its members i.e. from farmers at a price set by the local market. Then they perform some processing activities like pulping, washing coffee, drying, sorting and sacking/packing, finally sell it to the union and export can be carried out by SCFCU (Boot, 2011; Asmelash and Umeta, 2017).

Quality control and standardization of coffee are done in the Union's own separate cupping lab. The union further processes the coffee and then the processed coffee product as it is packed by jute bag then transported through the Ethiopian Commodity Exchange (ECX) to SCFCU warehouse and make ready for the export market. Here the union has different alternatives to sell the coffee. It can sell directly to the international importer or to the domestic exporter. The unions contact ECX for grading systems and to follow the rules and regulation of the government of Ethiopia (Asmelash and Umeta, 2017).

When the union buys the coffee from the primary coffee farmers' cooperatives, they pay the current market price set at ECX for the specific kind of coffee. When the union sells the coffee to foreign importing companies or internal customers, 70% of the net profit is paid back to the primary cooperatives. In turn, the primary cooperatives pay back 70% of their net profit as a dividend to the farmers and 30% is reinvested in the cooperative, for the purpose of expansion, investment and social services (Kodama, 2007; Asmelash and Umeta, 2017).

2.3. Concepts of performance evaluation

Before defining SC performance it is essential to understand the meaning of performance. Also, this topic explains what does mean performance evaluation, the purpose of performance evaluation, its metrics used to measure SC performance and how they help companies in

achieving their goals. To understand what performance evaluation and measures are, the first step is to know what performance is.

Taking into consideration this concept several researchers defined performance evaluation as a systematic and objective assessment. For example, Kessir and Tanburn (2014) defined the performance evaluation is a systematic and objective assessment of an ongoing, completed project or program, its design, implementation, and results. The aim is to determine the significance, consequence, and fulfillment of objectives. As Sillanpää (2010), performance can be viewed as being subjective and it depends on the targets and goals that each firm set for them and it is the ability to meet certain criteria, the time it takes and the path used to get there. Whereas the performance measures should be indicators of how well work is being done.

As Tulema (2014), performance evaluation used to forecast performance, gather information for early warning, identify lessons, asses output, track progress, asses the project activities, asses objectives, enhance teamwork and collaboration, mobilize stakeholders, practice benchmarking, ensure accountability and plan program improvement. According to Hardlife and Zhou (2013), the definition of performance evaluation is the assessment of how results are achieved, assessment of effectiveness, efficiency and it is systematic and periodical gathering, analyzing and interpreting of inputs; assessment of information on the effects in order that it may be adjusted where and when necessary. Its main purpose is to provide better means for learning from past experience, improving service delivery, planning, allocating resources and demonstrating results as part of accountability to stakeholders.

According to Njuki *et al.* (2010) and Peyser *et al.* (2012), performance evaluation is in-depth formal assessment of a task's results at particular points in time i.e. performance evaluation is a time-bound exercise that attempts to assess the consequence and success of ongoing processes and completed events. The evaluation examines if the task is having the desired impacts or outcomes within the participant organization. Evaluation involves comprehensive analysis with the aim of adapting strategy, planning, revising future policies and programs. It usually takes place at certain points in time, for example, mid-term and summative evaluations (annually or after completion of program) and leads to more fundamental decisions. The process of evaluation gives explanations on why results, targets, and outcomes were achieved/succeed, or failed/were not achieved. Evaluation requires a more in-depth process of data collection and analysis, often through interviews with task participants. Evaluation should be performed at least once per year.

2.3.1. Supply chain performance evaluation

Considering the philosophy that you cannot measure, you cannot manage; measuring and evaluating the SC performance becomes a very important process for companies and their SC in order to stay competitive. SC performance evaluation is a useful tool in managing the interrelationships and linkages throughout the SC. In a SC the performance assessment is used in order to evaluate the performances in which objective measures for example return on investment, profit, sales, etc. or subjective measures such as customer satisfaction to improve performances in the future (Lampathaki *et al.*, 2013; Cheung, 2013).

SC performance evaluation usually focuses on developing measurement metrics for performance evaluation and it can be performed by choosing appropriate performance indicators. Developing a system for measuring the performance of SC requires the proper selection of indicators (Aramyan, 2007; SCC, 2010; Kamau, 2014). These key performance indicators are divided according to the level of the decision-making process: strategic, tactical, and operational. They are also divided into cost and non-cost or financial and non-financial ones. Among these approaches using the already well-established method and models are one suitable model is the SCOR model (Georgise *et al.*, 2013; Pasanen, 2015).

SC performance evaluation is used to get output that reduced SC costs and to maximize profit throughout SC. To improve a company's SC as any other area, it is important evaluating its performance. Many companies have realized that SC needs to be assessed to become efficient and effective. Without measures, it is highly difficult to form a clear direction for improvement and to facilitate an organization can achieve its goals. SC performance evaluation helps the companies to provide products and services of appropriate quality in specific quantities and at the appointed time and minimize the total cost of products and services in SC (Berg and Choroszynski, 2008).

Several researchers' studies of performance evaluation indicate that the basic criteria are efficiency and effectiveness. For example, the study was conducted by LEOŃCZUK (2016) shown that there are two basic criteria of performance evaluation is effectiveness and efficiency. As Angelos (2017) and Wei (2014), the word ''Efficiency'' represents the measure of how well the resources expended are utilized i.e. efficiency is how well a company optimizes the SC to maximize profitability.

As Krauth and Moonen (2005) and Pettersson (2008), effectiveness is defined as measures of the capability of producing an intended result and it is the extent to which goals are accomplished. Having an excellent SC performance a company can provide high-quality products to its customers, at low cost, within short lead-times and can give the requested customer service. So, effectiveness is related to satisfaction with the results. Whereas efficiency is the relationship between efforts and resources involved in the operation and the actual utility value as a result of the action and it is linked to the achievement of objectives at a lower cost.

Taking into consideration of effectiveness and efficiency, SC performance evaluation can be categorized into parts internal and external customer perspectives. Internal performance is within an organization also can be categorized into two categories cost and asset. The external performance focuses on customers' services and satisfaction. Customer service means it is all activities and performance that adds value for the customer include short lead-time and accurate delivery dates are important for a customer.

Each of the performance measures has different goals and purposes. A cost measure consists of reduction of obsolete inventory, energy usage, and waste elimination, cost minimization of direct production cost and indirect cost, within SC and in an organization to maximize profit. Resource measures include return on investment, inventory levels, personnel requirements, equipment utilization. The external performance includes customer satisfaction, product availability, responsiveness to the customer, on-time delivery, short lead-time, delivery reliability, quality and the quantity of final product produced. From the customers' perspective flexibility measure a system's ability to accommodate volume and schedule fluctuations from suppliers, manufacturers, and customers (Aramyan, 2007; Cheung, 2013; Kamau, 2014).

According to Pasanen (2015), SC performance measurement serves as an indicator of how well the SC system is functioning and performance measurement is a powerful tool that assists firms or organizations to evaluate resource utilization so that they can strategically manage and continuously control to achieve their objectives and goals. As Pettersson (2008), the challenge for companies is to combine the cost minimization with the improvement of performance (short delivery times, high delivery precision, satisfied customers, short lead times, short days of inventory) and optimize both of them to get the best result for the company. Pettersson (2008) and Pasanen (2015) illustrated, the SC performance using "The Supply Chain Triangle" to show the conflict between cost and performance as shown in Figure 2.2 that the main objective for a

company is to provide quality product and service to the final customer and at the same time minimize the cost with maximizing profit.

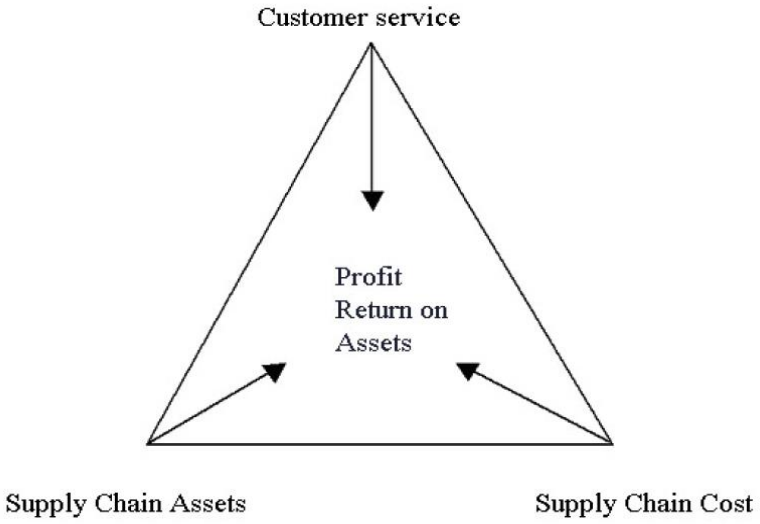


Figure 2.1: Supply chain triangle (Petersson, 2008; Pasanen, 2015)

2.3.2. Benefits of supply chain performance evaluation

According to Berg and Choroszynski (2008), SC performance evaluation develops more performing capabilities being more competitive. Some of the following reasons are benefits of performance evaluation within an organization (Sillanpää, 2010; Erkan and Akyuz, 2010; APICS, 2017; Alemu, 2017) helping to:

1) Identify of success or failure and identify what improvement targets should company follow?
2) Identify whether the company are meeting customer requirements and help to coordinate, control, monitor the processes that most likely cause the performance gaps;
3) Identify bottlenecks, problems, and opportunities for development;
4) Improve programs and answers how closely meeting its objectives?
5) Ensure and help to make decisions based on facts, not on assumptions or emotions;
6) Create conditions for development;
7) Track the progress of the improvements showing if plan happened actually;
8) Improve and facilitate open communication and cooperation.
9) Helps waste minimization and ultimately cost reduction;
10) Improve flexibility, efficiency and on-time delivery to customers;

11) Helps to evaluate, facilitate involvement and motivation human resources
12) Helps Individual and organizational learning i.e. "learning by measure and by error"

Performance measurement assists in directing management attention, revising company goals and reengineering business processes to have continuous improvement (Kamau, 2014). Therefore, taking into consideration of the literature review, benefits of SC performance evaluation provide a chance to fulfill customer requirements, increase opportunities for collaboration, increase opportunities for information sharing, increase profitability, increase optimization of the business operation process.

2.4. Supply chain modeling

The SC modeling fundamental aim is to increase profitability, reduce cost and increase customer satisfaction (Alemu, 2017). Modeling is widely used to represent SC to improve the efficiency and effectiveness of SC. Whereas the SC model is an abstract representation of the real world that reduces complexity and represents only the detail that is necessary for a specific purpose only (Kasi, 2005). The main aims for SC modeling are assisting with the analysis of complex SC representing in a uniform way, to design and specify SCM processes across the entire SC network, to communicate and agree on the vision to be shared by SC partners. Thus, SC modeling supports SC integration facilitating SCM (Manataki, 2012).

As Irfan *et al.,* (2008), the SC modeling approach can be separated into three areas:

1) Simulation-based: a method by which a comprehensive SC model can be analyzed, considering both strategic and operational elements.
2) Network design modeling: a descriptive and normative model for more strategic decisions. It focuses on design, establishment and associated flows of networks. A normative model is referred to as a process reference model in the business process.
3) Rough cut: policy modeling to guide operational decisions.

Taking consideration into accounts the types of modeling approaches for this study, network design modeling including the normative model that can be appropriate and suitable because the SCOR model proposed to this study is in the category of the normative modeling approach.

According to Kasi (2005), the modeling process includes the process of problem formulation, model building, solution designing and solution implementing. As Koksharov (2016), other basic types of SC modeling are SC network design method, mixed-integer programming optimization modeling, heuristic methods, and simulation-based.

2.5. Classification of SC performance evaluation models

Desirable characteristics of SC performance measurement systems and model selection a number of suggestions have been offered by various researchers on the subject of designing performance measurement systems. According to Kazemkhanlou and Ahadi (2014), desirable numbers of characteristics that are found in effective performance measurement systems and models include the following important issues:

1) Inclusiveness (the measurement of all appropriate characteristics)
2) Universality (allow for comparison under various operating conditions)
3) Measurability (data required are measurable) and
4) Consistency (measures consistent with organization goals)

There are several models that have been applied for business analytics. Business analytics is one of systematic and comprehensive of the metrics to determine the performance of the SC modeling. BSC and SCOR are one of the most famous models of them that have extensively are applied by researchers (Jamehshooran *et al.*, 2015). As SCC (2010), the SCOR model provides a systemic approach for identifying, evaluating and monitoring SC performance. The model provides not only an opportunity to see how the firm is doing but also a common framework of reference and language across SC. According to Ouyang (2012) and Pasanen (2015), selecting the right measurements the organization can:

1) Check its position to know where it is and where it is going, confirm priorities; Since by measuring it can identify how far it is from its goal;
2) Communicate its position according to two perspectives, inter-organizationally communicates in order to thank individuals and teams. Externally organization communicates in order to deal with legal requirements or market needs;

Different researchers had been presented several well-known SC performance measurement models and their accuracies (Agami *et al., 2012*; Kazemkhanlou and Ahadi, 2014). From some of them listed below three are the most popular models for SCM, which adopt the operational approach, are the Supply Chain Operations Reference (SCOR) model, business Scorecard (BSC) model and the Global Supply Chain Forum (GSCF) framework (Kazemkhanlou and Ahadi, 2014; Manataki, 2012; Ouyang, 2012). Therefore, taking into consideration the literature some SC performance evaluation models are classified as follows.

2.5.1. Economic Value Added (EVA)

EVA was developed in 1995 in order to correct the deficiency of traditional accounting methods which focused only on short-term financial results providing little insights into the success of an enterprise towards generating long-term value to its shareholders. EVA is an approach for estimating a company's return on capital or economic value is increased when a company earns more than its cost of capital. The EVA measure attempts to quantify the value created by an enterprise basing it on operating profits in excess of capital employed (through debt and equity). EVA metrics fail to reflect operating SC performance since it only considers pure financial indicators (Agami *et al.*, 2012).

2.5.2. Activity-Based Costing (ABC)

ABC has been created in the1980s. It aims to analyze costs but goes beyond the simple calculation of return costs. It necessitates deep knowledge of the company. It groups activities by their process logic and interweaves accounting data into this concept (Manataki, 2012; Kazemkhanlou and Ahadi, 2014).

2.5.3. Strategic Audit Supply Chain (SASC)

SASC has been developed in 1999. It analyzes SC in terms of processes, information technologies, and organization at an organizational level. Its principle is to break the logistics chain down into six competencies: customer orientation, distribution, sales planning, lean production, supplier partnerships and integrated management of chain and to link competencies to information technology and organization of chain (Manataki, 2012; Kazemkhanlou and Ahadi, 2014).

2.5.4. Global Supply Chain Forum (GSCF) framework

GSCF has been developed by Ohio State University in 1994. It describes three levels (strategic, tactical and operational) and highlights links between SC process and structure. It focuses on eight processes: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management (Manataki, 2012; Kazemkhanlou and Ahadi, 2014).

2.5.5. The Balanced Scorecard (BSC) Model

According to Aramyan (2007 and Agami *et al.* (2012), the Balanced Scorecard (BSC) is a popular performance measurement system initially developed by Kaplan and Norton 1992. This BSC method employs performance metrics from financial perspectives, customer perspectives, business process perspectives, innovation and technology (learning and innovation) perspective. Combining these different four type perspectives, the BSC helps a manager to understand the interrelationships and adjustments between alternative performance metrics and leads to improved decision making. BSC Model is not specifically designed for SC but could be adapted to focus on SC performance. The Balanced Scorecard is more tactical and strategically being an operation oriented method.

2.5.6. Supply Chain Operations Reference (SCOR) model

The main goal of SC performance evaluation models is to support SCM to measure business performance, analyze and improve business operational efficiency through better decision-making processes (Ouyang, 2012; Paddeu, 2016). To evaluate SC performance suitable model selection is important. As SCC (2010) SCOR model is a balanced and universal SC performance model. According to APICS (2017) and Wei (2014), SCOR was developed to assist businesses in understanding and evaluating the performance of the supply chain.

As Aramyan (2007), SCOR Model is a standard SC process reference model designed to fit all businesses and it is one of the most recognized universal, dynamic and balanced systems. This model provides guidance on the types of metrics decision-makers can use a balanced approach towards measuring the performance of an overall SC. According to Kazemkhanlou and Ahadi (2014) and Kurien (2011), ‘‘Balance’’ refers to the need of using different measures and perspectives that tied together to provide a holistic view of the organization with financial and non-financial operational approaches. The most critical factor for this model is a universality and balanced approach. The concept of ‘‘dynamic’’ refers instead to the need of developing a system that continuously monitors the internal and external context and reviews objectives and priorities as a systematic approach identifying, evaluating and monitoring SC performance.

According to SCC (2010) and Jamehshooran *et al.* (2015), the SCOR model is developed by the Supply Chain Council in 1996 as the cross-industry standard diagnostic tool for SCM. SCOR enables the business organizations to address, improve and communicate SC practices within and between all interested parties in an extended enterprise. Also, the SCOR model enables

companies to benchmark themselves against others and influence future application development to improve business processes. Use of the SCOR model includes analyzing the current state of a company's processes and goals, quantifying operational performance and comparing company performance to benchmark best practices. Hence, SCOR has developed a set of metrics and best practices information that companies can use to evaluate their SC performance. SCOR is a powerful management tool, covering from customer to supplier.

SCOR has been widely used by many business organizations all over the world and it has become the standard model for the management of the processes that characterize the SC. It enables companies to analyze the performance of their SC in a systematic way by improving communication between the various members of the chain, while, at the same time, optimizing the network and the performance of each region and then of the SC as a whole. The SCOR Model directly addresses the needs of SC performance assessment at the operational level. It is a cross-industry model that decomposes the processes within a SC and provides a best-practice view of SC processes (Wei 2014; Simon *et al.*, 2015; Paddeu, 2016).

According to Pettersson (2008) and Palomino *et al.* (2017) in general, the SCOR model is a supply chain operation reference model and the purpose of the model is to:

1) Provide a standard language for SCM that can be used cross-industry
2) Facilitate internal and external benchmarking
3) Establish a basis for analyses of supply chain performance
4) Compare the current supply chain with the target for the future

The SCOR model has three levels:

1) Top-level or first level: defines the scope and content for the supply chain.
2) level II is configuration level: designs the supply chain (process categories)
3) Level III is process element level that gives detailed information on each process (decompose processes)

SCOR is based on hierarchical modeling. Figure 2.2 illustrated process categories and sub-process that can be used in SCOR model level II. In a SCOR model, the first level represents the core five processes, the metrics and measures corresponding to the processes. The five types of processes are represented in the SCOR model are Source, Make, Deliver, Return and Plan overall processes. The second level is the configuration level or the SC process categories as illustrated in Figure 2.2 (Kasi, 2005; Manataki, 2012).

The third level is operational or factory level that gives detailed information on each process and consists of process elements. The basic sub-processes for all processes have variants like Make-To- Stock (MTS), Make-To-Order (MTO) and Engineer-To-Order (ETO). MTS is a type of production strategy that standard parts are produced and stocked before a customer order is received. Make-To-Order is a type of production strategy that standard parts are not produced until a customer order is received. ETO is a type of production strategy that designed and produced based on customer order and Configure-To-Order (CTO) is subassemblies are first produced and stored, then assembled based on customer order (Manataki, 2012; Georgise *et al.*, 2013; Weyers, 2017).

According to Georgise *et al.* (2013), agro-processing industries do not operate Engineer-To-Order product production strategies. Thus, primary coffee farmers' cooperatives use Make-To-Order (MTO) strategies for export market based on their preliminary agreement with SCFCU and SCFCU with foreigner importers at the beginning of the production year. For local markets, on the other hand, they can use both MTS and MTO strategies.

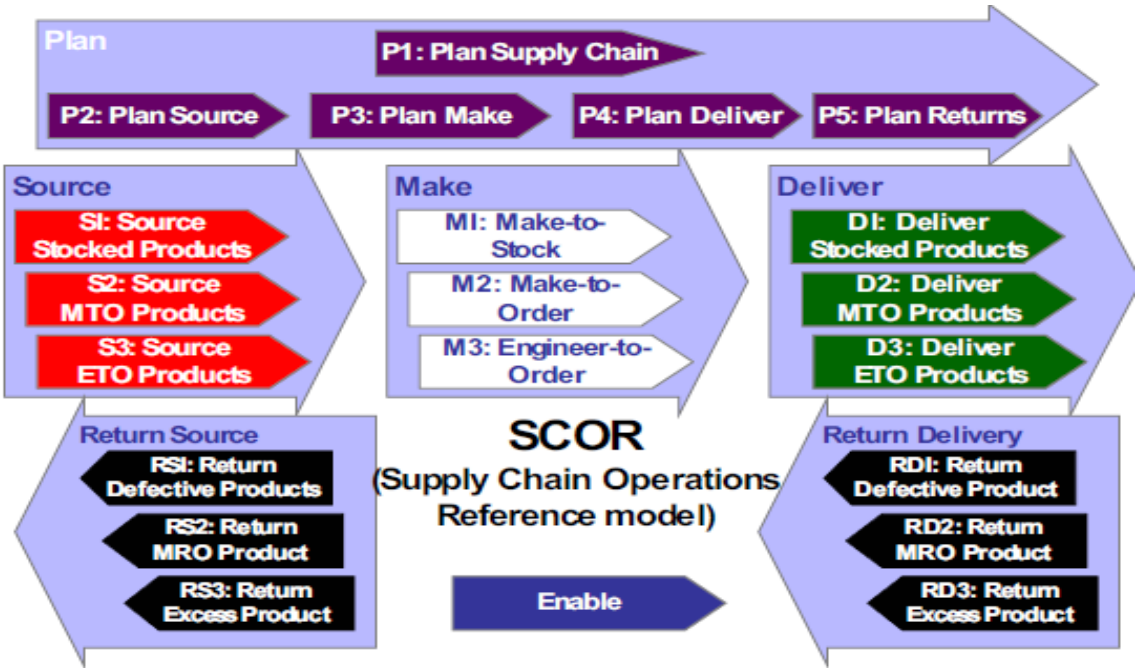


Figure 2.2: Level II SCOR model processes categories (Kasi, 2005; Manataki, 2012).

As SCC (2006), Jamehshooran *et al.* (2015) and APICS (2017), the SCOR model is SC process operation reference model and it consists of four main parts as shown in Figure 2.3.

1) Business process reengineering (BPR): SCOR model business process reengineering and improvement concepts capture the "As-Is" (existing) state of a process and derive the desired "To-Be" (needed to be in the future) state
2) Benchmarking: benchmarking concepts quantify the operational performance of similar companies and establish internal targets based on "best-in-class" results
3) Best practices analysis: characterize the management practices and software solutions that result in "best-in-class" performance
4) People: assess skills and performance needs and align staff and staffing needs to internal targets.

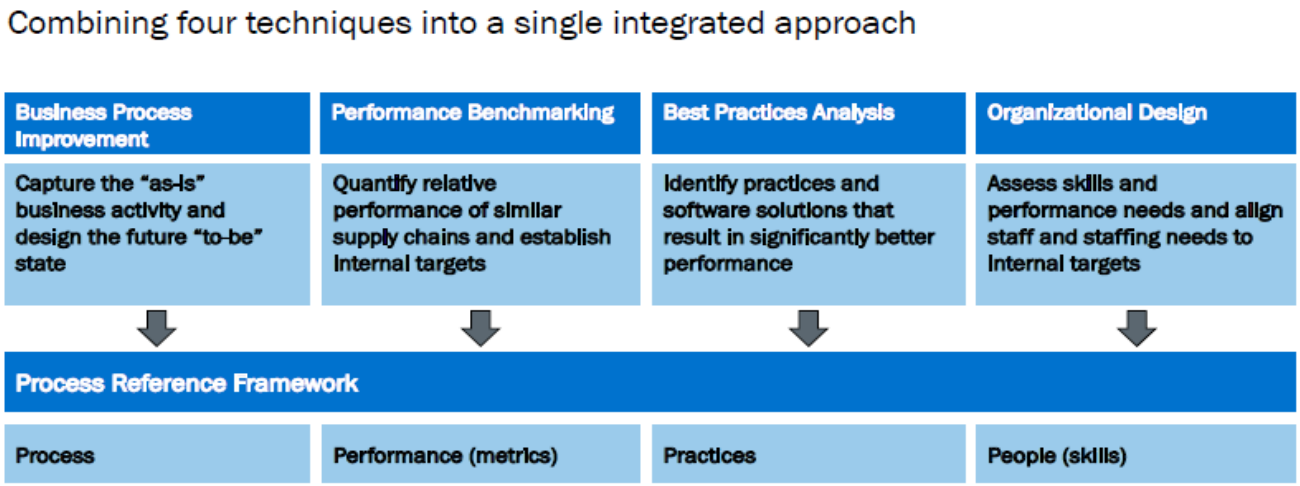


Figure 2.3: SCOR model (APICS, 2017)

2.6. SCOR model business processes

The SCOR model is composed of five processes or business activities associated with satisfying a customer's demand include plan, source, make, deliver, and return as shown in Figure 2.4. These processes have tasks and tasks are a set of activities. The activities are standardized to make a comparison between SC possible. Each process has its own definition. In addition to these basic processes, there are three process types or categories, enable, planning and execute (Kasi, 2005; SCC, 2010; Weyers, 2017; Palomino *et al.*, 2017).

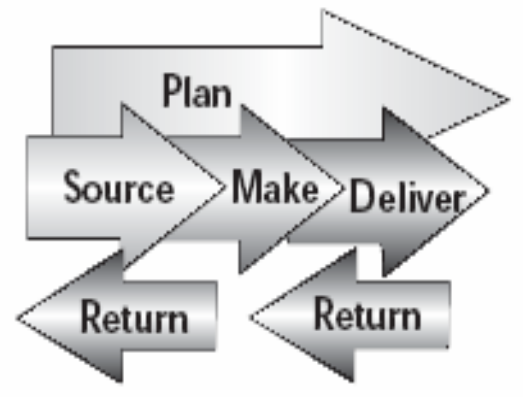


Figure 2.4: SCOR model business process (SCC, 2010).

2.6.1. Plan process

Plan process of SCOR model which is it involves including all the processes such as source, make, delivery and return processes within different time horizons planning (Zhou *et al.*, 2011). As Jamehshooran *et al.* (2015), the Plan processes define the planning activities associated with the business operation process in a SC. In the SCOR model, source process planning includes planning supplier evaluation program and plan of materials quality, lead times, orders, scheduling deliveries and receiving shipment, validation, and storage as described by (Jamehshooran *et al*., 2015; Weyers, 2017).

Make process plans include annually and quarter year production plan keeping, monthly production plan keeping, weekly production plan keeping, daily production plan keeping, production lead time, product quality, capacity utilization and level of inventories. Deliver plan process include planning delivery time, shipment time and perfect order fulfillment. The Return plan process includes a plan to minimize the return of the excess product, low-quality product, defective products, and customer claims. Additionally, identification of the need for a return, the scheduling of the return included in the Return process plan (Weyers, 2017).

According to Jamehshooran *et al*. (2015), the goal of SC planning is to match customer demands with resources. The Plan process focuses on analyzing data to predict market trends of products and services followed by identifying the actions required to correct any gaps. SC plan process is gathering customer requirements, collecting information on available resources and balancing requirements resources to avoid gaps. Plan process includes assessment of SC requirements, prioritization, and aggregation of SC requirements, identification of SC resources, SC resources balancing and lastly communication with SC plans (SCC, 2010; Weyers, 2017).

2.6.2. Source process

The source process procures goods and services to meet planned or actual demand ordering and receiving raw materials and products (Zhou *et al.*, 2011). According to Gamme and Johansson (2015), sourcing is a part of procurement which is consists of the purchasing function such as specification and determination, supplier selection, contracting, ordering, expediting, incoming inspection, quality control, and assurance, follow-up, and evaluation, transportation, and stores.

Broad applications in the Source process include the use of an agent-based procurement system with searching of a supplier, supplier selection on basis of experience of suppliers, the reputation of suppliers, cost, quality of raw materials or product/services, supplier evaluation and price negotiation (Weyers, 2017). At operation level of on basis of SCOR model source process include the schedule of raw materials deliveries, raw materials receiving activities, verification, transfer, and approval of supplier payment and finally authorization of supplier payment (Gamme and Johansson, 2015). Hence, the Source process as a component of the SCOR model might use as an indicator of SC performance.

2.6.3. Make process

Make process transforms the product to a finished state to meet planned or actual demand and it represents manufacturing, producing, repairing, modifying materials or products and recycling activity (Zhou *et al.*, 2011). As Jamehshooran *et al.* (2015), Make processes refer to the activities associated with the conversion of materials or the creation of the content for services. It focuses on the conversion of materials rather than production or manufacturing because make represents all types of material conversions such as assembly, chemical processing, maintenance, repair, overhaul, recycling, improvement, refurbishment, remanufacturing and other material conversion processes.

As a general guideline, these processes are recognized by the fact that one or more item numbers go in, and one or more different item numbers come out of this process. Make process as a component of the SCOR model might use as an indicator of SC performance. In operational level on basis of SCOR model Make process consists activities are production activities schedule for order fulfillment activities, product test or quality assurance, packaging product, stage finished product, releasing the finished product to deliver and recycle or waste disposal (Weyers, 2017).

2.6.4. Deliver process

Deliver process means receiving, programming and taking, packing and delivering products that are ordered by customers. The Delivery process provides to customers finished goods and services to meet planned or actual demand, typically including order management and fulfillment of customer orders, transportation management and distribution management. Its sub-processes include the order received, costing, order entry, order validation, consolidation of orders, scheduling and determination of delivery date, shipment route, selection of carriers, product receive from source or make, picking product, packaging product, loading and shipping product, receiving, verifying product by customer, service execution, invoicing and delivering product to retailer (Zhou *et al.*, 2011; Jamehshooran *et al.*, 2015; Weyers, 2017).

2.6.5. Return process

Return process refers to managing the logistics of returning products and goods not suitable for sale and packaging, due to quality problems and excess amount. It is the process associated with returning or receiving returned products for any reason as described by Zhou *et al.* (2011). According to SCC (2010) and Jamehshooran *et al.* (2015), the Return process associated with the reverse or flow back of goods from the customer. In this process repair, recycling, refurbishment, and remanufacturing processes are not described using return process elements.

2.6.6. Business operation process enablers

The enablers are tools to enable business operation processes facilitating linkages of intra-organizational and inter-organizational partnerships both in upstream and downstream SC. Enablers include managing of the activities such as SC business rules, SC performance, SC data and information, SC human resources, assets, SC contracts, SC risk, SC procurement and SC technology (SCC, 2006; APICS, 2017). As the enabler of a SC, the use of IT is very important to improve communication in SC providing up-to-date and timely information about market and demand. The enabler helps to facilitate each process includes enable plan (EP), enable source (ES), enable make (EM), enable deliver (ED) and enable return (ER) as shown in Figure 2.5.

The execution process helps to achieve all processes for each type of production strategies in each process categories including Source process for Source stocked product (S1), Source ordered product (S2), Source engineered product (S3), for Make process, Make stocked product (M1), Make ordered product (M2), Make engineered product (M3), for Deliver process, Deliver

stocked product (D1), Deliver ordered product (D2), Deliver engineered product (D3), for Return process, return delivered product of stocked product production strategies (R1), return delivered product of make to ordered product production strategies (R2) and return a product of engineer to order product production strategies (R3). Planning process helps to achieve all activities, having execution system to enable planned objective throughout SC and within the organization include plan supply chain (P1), plan source (P2), plan make (P3), plan deliver (P4) and P5 stands for plan return (SCC, 2006; Weyers, 2017; APICS, 2017).

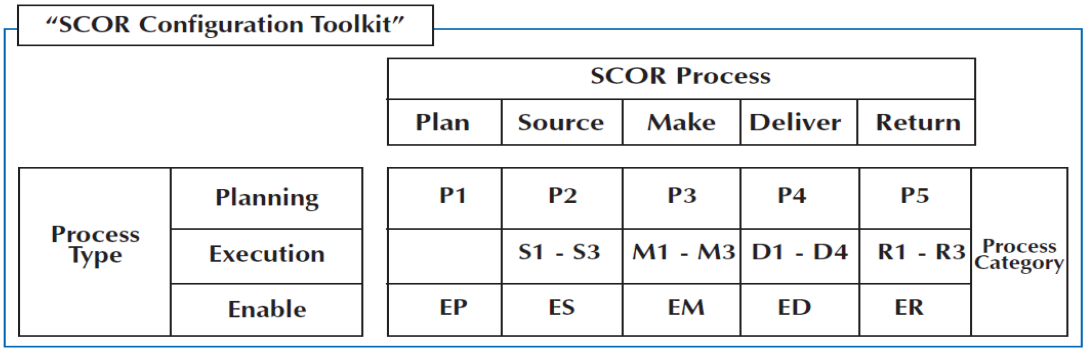


Figure 2.5: SCOR model enable process types and process categories (SCC, 2006).

2.6.7. Relationships of the supply chain processes

The planning process is expected to balance the aggregate market demand and supply. Effective SC planning practices are expected to influence positively the implementation of effective sourcing, production, and delivery practices. The ability to balance demand and supply in real-time can enhance a long-term relationship with suppliers who can better respond to the demand or supply changes (SCC, 2010; Zhou *et al.*, 2011). As SCC (2010) and Zhou *et al.* (2011) effective planning also supports the implementation of an effective sourcing and production system. Without good planning increased productivity would be impossible as shown in Figure 2.6. The inter-functional coordination such as the alignment between marketing and manufacturing is important for effective production. Lack of effective planning negatively influences in SC processes source, make and delivery. The following Figure 2.6 is used to illustrate the relationship of one process with each other. The SC plan covers all processes in SC to balances the demand and supply meet the sourcing, manufacturing and delivery requirements. Here in each process, there is its own plan to meet demand and resources.

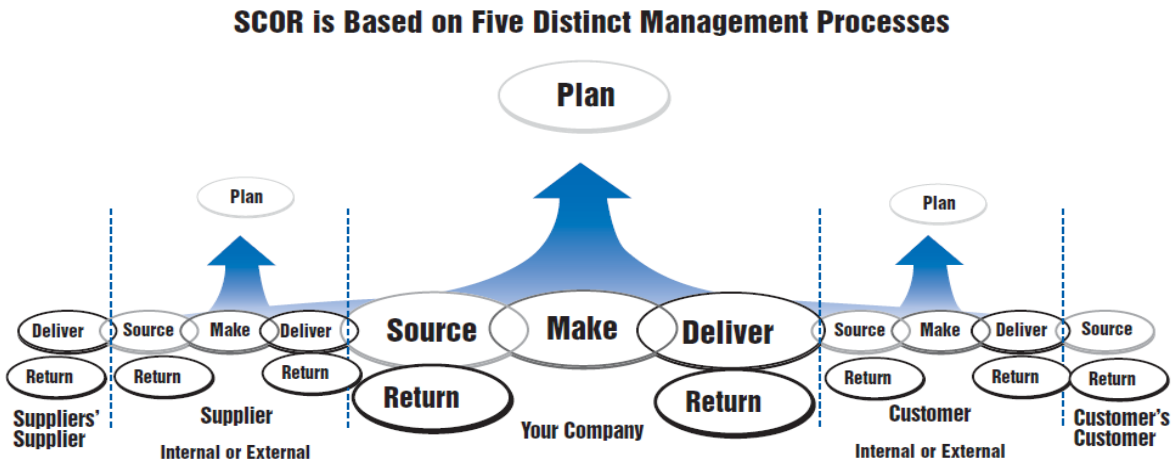


Figure 2.6: Relationships of business processes in SC (SCC, 2010)

2.7. Metrics and KPIs of supply chain performance

The definition of Key Performance Indicators (KPIs) is a term used to measure performance. The KPIs are applied to evaluate the success or not of a particular process or sector. Sometimes success is defined in terms of progress towards the strategic objectives. The questions reasonably arisen are: what to measure; how to measure; what technology and how can be used to minimize costs; and how it can help people work with it to achieve goals (SCC, 2010; Angelos, 2017). According to Aramyan (2007), KPIs in SC performance evaluation are:

1) A set of measures that combine to assess the performance of an organization as a whole and individual measure that quantify the efficiency and effectiveness of an action.
2) A supporting infrastructure that enables data to be acquired, organized, sorted, analyzed, interpreted and distributed.

A metric is a standard for measurement of the performance of a process and it is what we use to differentiate between acceptable and unacceptable performance. They are identified for each of the job elements and explain what satisfactory performance looks like (Berg and Choroszynski, 2008; Michael, 2009; Alemu, 2017). As Pasanen (2015), SC performance evaluation has become one of the key ways of achieving perfection. Therefore measuring the performance of the SC is crucial for better SCM. According to Paddeu (2016), KPIs of SC and SC performance evaluation metrics can be defined as a set of indicators used to measure the success of a company through the measurement of the performance of a particular activity or process. They may change depending on the evaluation criteria or priorities that the company associated with each area.

According to Aramyan (2007), KPIs should be easy to understand, essential and updated over time. Based on the values of the indicators, the manager can decide which action has to be taken to improve the performance of a specific area. Therefore, they can be considered as a real decision support tool. Thus, the KPIs are used to understand the extent to which an area or process is working against the objectives that the company is responsible to achieve. In SC performance evaluation KPIs can be used to measure the performance of a specific process of the SC, to supervise the progress of its performance over time to compare the SC performance of specific company business with those of the SC of the other competing companies.

2.7.1. KPIs of BSC model

2.7.1.1. Financial perspective

As Krauth and Moonen (2005) and Alemu (2017), the financial perspective focuses on the financial performance of an organization. It normally covers the revenue and profit targets of companies include budget, cost-saving, return on investment, return in fixed and working capital, cash flow and asset. The financial health of an organization is a critical perspective for managers to track. Financial perspective mainly focuses on the components as shown in Table 2.1.

Table 2.1: Financial perspective metrics (Chun, 2014; Wei, 2014; Angelos, 2017; Alemu, 2017; Banomyong *et al.*, 2017)

Financial perspective	
Net income maximization	Minimization of production costs
Total supply chain cost minimization	Minimization of human resource costs
Minimization of controllable and non-controllable expenses	Revenue maximization
Minimization of primary services price	Profit margins maximization
Minimization of resources waste	Overhead/administrative costs minimization
Minimization of maintenance costs	Minimization of fixed and variable asset costs
Inbound and outbound transport cost minimization	Minimization of inspection costs

2.7.1.2. Internal business processes perspective

Internal business processes perspective focuses on internal operational goals and it covers key processes necessary to deliver the customer as objectives. Typical example business process perspectives measures and KPIs are shown in Table 2.2 and 2.3 in detail include process improvements and quality optimization (Angelos, 2017; Alemu, 2017).

Table 2.2: Internal and stakeholders perspective (Wei, 2014; Chun, 2014; Angelos, 2017; Banomyong *et al.*, 2017)

Internal and stakeholders perspective	
Maximization of overall employees' satisfaction	Maximization of taxes to the national treasury
Overall society and stakeholders' satisfaction	Increase of morale, motivation of personnel
Minimization of percent of absent employees	Maximization of employees' satisfaction
Minimization of risk	Minimization environmental pollution problems

Table 2.3: Internal perspective (Chun, 2014; Wei, 2014; Angelos, 2017; Alemu, 2017)

Internal business process perspective	
Plan fulfillment	Long term plans availability
Working conditions maximization	Medium and short term plans availability
Minimization of total time in repair	Quality control
Minimization of overtime hours	Capacity utilization maximization
Perfect order fulfillment	Labor productivity maximization
Maximization of regular and new number of	Maximization of benefit per delivery
Maximization of continuous improvement rate	Maximization of goods safety
Maximization of production cost	Maximization of total number of orders
Maximization of reputation (status) of a company	Holding balanced quantity inventories
Minimization of percent of failed orders	Maximization of labor utilization

2.7.1.3. Learning and innovation perspective

As described by Krauth and Moonen (2005), Angelos (2017) and Alemu (2017), the learning and growth (innovation) perspective focuses on the intangible drivers of future and is often broken down into the following components:

- Human capital (skills, experience, talent, and knowledge)
- Information capital (databases, information systems, networks and technology infrastructure)
- Organization capital (leadership, employee configuration, teamwork, and knowledge management).

Typical example measures and KPIs include staff engagement, skills assessment, and performance management scores as shown in Table 2.4.

Table 2.4: The learning and growth perspective (Wei, 2014; Angelos, 2017; Alemu, 2017)

The learning and innovation perspectives	
Maximization of development of innovation technologies	Maximization of percent of information exchange through ICT
Higher percent of employees with IT training	Maximization of up-to-date information availability
Maximization of utilization of IT equipment	Maximization of availability of ICT equipment
Minimization of IT training costs	Maximization of product improvement
Maximization of possible types of communication	Minimization of information system costs
Maximization of use of innovation technologies	Maximization of cooperation with other companies
Minimization of information system costs	Sharing quality and timely information

2.7.1.4. Customer perspective

The customer perspective focuses on performance targets as they relate to customers and the market. It usually covers customer service targets, market share, and branding objectives. Typical measures and KPIs in this perspective include delivery performance in a committed date and with correct quantity, customer satisfaction, brand awareness and market share (Wei, 2014; Angelos, 2017; Alemu, 2017) as indicated in Table 2.5. In customer service most important are delivery speed and reliability. Delivery performance can be measured by on-time delivery. The measure of delivery performance determines whether a perfect delivery has taken place or not, delivery-to-request rate, delivery-to-commit date, flexibility of delivery systems, lead-time, quality and the way the information is exchanged, loss or damage rate minimization and the number of faultless invoices; thus delivery measures customer service.

Table 2.5: The external and customer perspective (Chun, 2014; Wei, 2014; Angelos, 2017; Alemu, 2017)

The external and customer perspective	
Customer perspective	Number of deliveries maximization
On-time delivery performance	Customer retention (maintenance)
Minimization of number of customer complains	Maximized market share
Minimization of customer service costs	Customer satisfaction
Maximization of transparency for a customer	Minimization of damages, faults and failure costs
Maximization of available types of goods insurance	Maximization of possibility to change order
High quality of shipped product and documentation	Short lead time to have short response time

As Wei (2014), within external perspective metrics, information sharing capability within the company, information sharing capability among the organization, uniformity of systems within the company, uniformity of systems among the organization, trust within the company, trust among the organizations, environmental friendliness also considered in external and customer perspectives.

2.7.2. SCOR model supply chain performance metrics

SC performance is measured with qualitative and quantitative attributes with the help of KPIs. The SCOR model identifies five basic attributes to determine SC performance (Pasanen, 2015; Wei, 2014; LEOŃCZUK, 2016; Angelos, 2017; APICS, 2017). According to Wei (2014) and Angelos (2017), types of performance measurements are discussed with a different focus. These approaches are categorized into: Quantitative and qualitative measurements, financial performance measurement (cost) and non-financial measurements, internal and external measurements and management levels (strategic, tactical and operational levels). Qualitative measures can be customer satisfaction, flexibility, information sharing and effective risk management. Among the quantitative measures are:

1) Metrics associated with the customer: prevention of product lateness, short customer response time, shorter lead time;
2) Metrics associated with the cost: cost minimization, profit maximization, obsolete inventory reduction and maintaining economic order quantity of inventory;
3) Metrics related to asset management: productivity, capacity utilization, resources utilization and return in investment maximization

The combined use of these indicators will help to further understand the overall performance of the primary coffee farmers' cooperatives and SCFCU while taking into account reliability, flexibility, responsiveness, and quality. The SCOR model's performance attributes consider both internal and external viewpoints to achieve excellent performance in all aspects of SC in business operation processes. Hence, the coffee processing industry should follow a strategy that creates coffee products at low-cost, and then the relevant key performance indicators could focus on costs, capacity utilization, labor productivity, and quality. Table 2.6 shows the key performance indicators for the SCOR model level I.

Table 2.6: SC performance first level metric (Angelos, 2017; Pasanen, 2015; APICS, 2017).

	Attribute	Definitions and metrics
Customers perspective	Reliability	Perfect order fulfillment, order fulfillment rate, percent of orders shipped complete, raw material quality and product quality and number of returned products
	Responsiveness	Responsiveness is related to the response time of the SC in satisfying the customer's requirement. Its metrics include order fulfillment cycle time and on time delivery.
	Flexibility	SC flexibility is flexibility in production volume, in time of delivery, in changing the variety of products, in dynamic change of market demand and overall value at risk
Internal performance perspective	Cost	Cost is related to financial performance including cost of goods sold (COGS), order management costs, costs of incoming material (raw materials cost), total SC cost, production cost and waste of resource.
	Assets	Asset Management is related to efficiency of resource use. Its metrics include capacity utilization, inventory turns over, cash-to-cash cycle time, inventory days, return on working capital, return on supply chain fixed assets

According to Angelos (2017), perfect order fulfillment is the right product delivered to the right place at the right time satisfying the customer. On-time delivery is the proportion of orders delivered on or before the date requested by the customer. As Kachru (2013), Cash-to-Cash Cycle time is **t**he time required to convert raw material or inventory purchases into sales revenue is referred to as Cash-to-Cash cycle time or cash-to-cash conversion time. Cash-to-cash cycle time is a period of time taken from cash spent on materials to cash generated as revenue. Cash conversion is generally related to inventory turnover. As Tilahun (2007) Inventory turns over is the ratio of total annual sales to average inventory. The higher the inventory turn, the quicker the cash conversion. A goal of SC is to reduce delivery lead time accelerating inventory turns**.** Inventory days are defined as how fast inventory is produced and then sold to customers.

SCOR model Level II KPIs:

As we go down through the hierarchy, the number of indicators at each level grows, thus providing more detailed measures for each combination of performance attribute and business

processes. The second level contains indicators to measure the performance of the enterprise for the same performance attributes and business processes, but the KPI is more than it is at the first level. The key performance indicators presented in level II for the Plan process include the following processes: Annual Plan, Plan Source, Plan Make, Plan Deliver, and Plan Return. In this level also all the five attributes such as reliability, responsiveness, flexibility, cost, and asset were included. Customer satisfaction surveys KPIs include customer complaints and quality due to claims of quality fails (raw materials and product). Cost and asset performance measurement is for an internal point of view (Kurien, 2011; Georgise *et al.*, 2013; Weyers, 2017).

SCOR model Level III KPIs:

The KPIs for level III level is related to the operations at the factory level or routine operations of the enterprise. The level III KPIs complement the high levels of the hierarchy with further details, i.e. level II. For example, for measuring the time consumed in the making process, there is one key performance indicator in the first level which shows the order fulfillment cycle time of the SC (Georgise *et al.*, 2013). In the SCOR model Plan process KPIs are planning including all the processes such as Source, Make, Deliver and Return processes plan within different time horizons (Zhou *et al.*, 2011). Source process measurement KPIs in detail consists of raw materials delivery lead time, raw materials quality and raw materials cost (Weyers, 2017). Make process KPIs are manufacturing cost, productivity, capacity utilization, economic order quantity of inventory (inventory level), the effectiveness of master production schedule, production process cycle time and waste minimization (Kurien, 2011; Weyers, 2017).

According to Kurien (2011), KPIs of delivery performance including delivery lead time, the number of faultless deliveries; effectiveness of delivery invoice methods, information richness in carrying out the delivery, response to the number of urgent deliveries and total distribution cost. According to Jamehshooran *et al.* (2015) and Weyers (2017), return process KPIs include its sub-processes such as defective or excess product source to return, identification of the need for a return, the scheduling of the return, request defective or excess product return, authorization of defective or excess product return, schedule defective or excess product return, shipment receipt of the returned goods, receiving defective or excess product including verification, defective or excess product transfer and deliver returned defective or excess product.

2.8. Benchmarking

A formal definition of benchmarking is that it consists of a systematic procedure for identifying the best practice and modifying actual knowledge to achieve superior performance. Benchmarking is a process for comparison against best practices. It is important with common metrics that can be used when comparing companies. Benchmarking has five basic purposes include: setting objectives and targets based on best practice, strategy (planning for long term), forecasting, introducing new ideas or new thoughts and process comparisons (Petterson 2008; Kazemkhanlou and Ahadi, 2014). Benchmarking can be used both internally within the own company and externally. The internal benchmarking can be used to compare different departments, but also check how one department changes over time. External benchmarking and best practices can be used to compare the own company with competitors or with companies that have high performance (APICS, 2017).

2.9. SCOR model practices

In this topic important issue is to understand that different practices have different performance expectations. The classification of a practice can be varying by industry. For some industries, a practice may be common, whereas the same practice may be considered a leading or best practice in another industry (SCC, 2010). There are different practices of the SCOR model. According to APICS (2017), four types of SCOR practices are:

1) Leading and emerging practices: a practice that introduces new technology, knowledge, or radically different ways of organizing processes
2) Best practices: practices that are current, structured, and repeatable and have proven and positive impact on SC performance
3) Common or standard practices: practices that have been used by a wide range of business over a long period of time and that produce acceptable positive results
4) Poor or declining practices: practices that have been used for long periods of time but have become obsolete and even harmful to business and SC performance.

According to SCC (2010), the best practice is a unique way to configure a process or a set of processes. The uniqueness can be related to the automation of the process, a technology applied in the process, special skills applied to the process, a unique sequence for performing the process, or a unique method for distributing and connecting processes between organizations.

The SCOR Best Practices section contains management practices, software solutions, and definitions associated with each process. These practices can contribute to best-in-class performance in supply chain optimization, supply chain risk management, and environmentally responsible supply chain management.

2.10. Identification of appropriate supply chain evaluation model

To analysis SC performance evaluation model using appropriate model, an investigation was carried out which model can be appropriate from several SC performance evaluation model was reviewed extensively in the section from 2.5 up to 2.7 based on criteria of the specific objective of the study. There were up to sixteen models SC performance evaluation models. From these several models, six models are most often used in business organizations in different countries in the world as listed in the following Table 2.7.

Even though these models were implemented in different business organizations there is the existence of limitations, incompleteness and inconsistencies in performance measurement and metrics failing to reflect a balance between financial and non-financial measures. Some of them are concentrating on financials measures only neglecting non-financial performance, the others are concentrating on operational performance measures neglecting financial performance. The only financial performance measurement model is failed being, a traditional one. Modern SC performance evaluation models should be balanced having financial and non-financial metrics Thus, most of SC performance evaluation models lost comprehensive evaluation ability being only financial (Aramyan, 2007; Erkan and Akyuz, 2010; Agami *et al.*, 2012; Kazemkhanlou and Ahadi, 2014; Jamehshooran *et al.*, 2015).

Based on knowledge gained from literature review, BSC and SCOR models are more appropriate SC performance evaluation models as management tools being holistic, balanced and universal performance evaluation management tools. However, BSC is static, strategic and tactical only neglecting the operational level. According to Aramyan (2007) and Agami *et al.* (2012), the BSC model is not specifically designed for SC but could be adapted to focus on SC performance and it is more tactical and strategically being an operation oriented method. Whereas, SCOR model is designated to measure supply chain performance and provides a basis for how to improve those processes (Georgise *et al.,* 2011; Agami *et al.*, 2012). As Aramyan (2007) and Agami *et al.* (2012), and Palomino *et al.*, (2017), in the SC performance evaluation, SCOR model is recommended being more suitable, balanced, holistic and comprehensive, having financial and

non-financial performance metrics. For that reason, SCOR model is widely used in any industries, for manufacturing and service sectors in business operation process, particularly in developed countries. Considering the literature review in this thesis, a researcher believed that the SCOR model is useful for any manufacturing industries, services, in agro-processing industries especially in coffee industries to evaluate internal and external SC performance.

Table 2.7: Identification of appropriate SC performance evaluation model

Models implementation level	**Model types**					
	GSCF	**BSC**	**SCOR**	**ABC**	**SASC**	**EVA**
Decision Levels						
Strategic	✓	✓	✓		✓	
Tactical	✓	✓	✓	✓	✓	✓
Operational level	✓		✓	✓		✓
Types of flow						
Physical flow	✓		✓		✓	
Information flow	✓	✓	✓		✓	
Financial flow		✓	✓	✓		✓
Level of supply chain maturity						
Intra-organizational	✓	✓	✓	✓	✓	✓
Inter-organizational	✓	✓	✓	✓	✓	✓
Multi-chain		✓	✓			
Types of benchmarking						
Internal	✓	✓	✓	✓	✓	✓
External			✓			
Models						
Industry		✓	✓	✓	✓	✓
Service		✓	✓	✓	✓	✓
All sectors	✓	✓	✓	✓	✓	✓
Quality factors			✓			
Haman capitals		✓	✓			
Sustainability		✓	✓			

Source: (Aramyan, 2007; Erkan and Akyuz, 2010; Agami *et al.,* 2012; Kazemkhanlou and Ahadi, 2014; Chun, 2014; Jamehshooran *et al.,* 2015; Pasanen, 2015; Dalu and Sirsath, 2015).

2.11. Knowledge gaps of literature review in previous studies

Aramyan Aramyan (2007) and Ouyang (2012) highlighted that proposing the understanding in the whole agri-food sector for measuring the SC performance is limited only in agro-processing industries without showing how measurement can be implemented in coffee processing industries. Also, they used already existing SCOR model framework as a basis but do not consider the aspect of contextual differences between the agri-food industry and coffee

processing industry having limitation comprehensive performance indicators inclusions. Chun, (2014), Pasanen (2015), Nguyen (2016) and Palomino *et al.* (2017) also tried SC performance measurement development and used SCOR model for measuring SC performance using five business processes include plan, source, make, deliver and return, but they not focused on the level II and III performance indicators part of SCOR model in the SC and not considered problems in coffee processing site in-depth being inadequate KPIs. SC mapping also focused only on a level I SCOR model neglecting level II and Level III SCOR model missing solution at the operational level.

Thus, many problems that arise in the coffee processing industries SC are missed. Similarly, raw materials suppliers are not considered and it is easier to see how raw material supplier problems affect SC performance causing more problems on the coffee processing site. Therefore, the previous studies knowledge gap can be summarized as a lack of coffee SC mapping in each level and process element in the coffee processing industry SC. According to Palomino *et al.* (2017), the SCOR model is simply understandable and implemented being suitable in coffee SC in Peru coffee farmers' cooperatives to evaluate internal and external performance. As a management and performance evaluation tool, the SCOR model is used in business organizations and in the academic area to evaluate SC performance in manufacturing industries and service sectors. But in Ethiopia particularly in the study area, for the coffee processing industry, the SCOR model is not practiced and implemented to evaluate SC performance. Therefore, to adapt the SCOR model for coffee farmers' cooperatives, this study aims to propose the SCOR model.

Furthermore, in previous time, the research studies conducted related to SC performance evaluation and modeling in the coffee processing industry SC using the SCOR model were so limited in the study area. Consequently, having limitations between research and application in coffee processing industries of SC performance evaluation, the coffee farmers' cooperatives have no standardized coffee production processes and unable to improve SC performance in a sustainable way. Having these limitations missing the way that how is the SCOR model adaptation and implementation existed in Sidama Zone coffee farmers' cooperatives; although, the model is suitable for agro-processing industries particularly the coffee processing industry SC. Thus, this thesis study believed to fill these gaps addressing and mapping each process element in coffee industries SC to bring a solution for problems that coffee farmers' cooperatives are facing at the current time. Therefore, it was believed conducting a research study in coffee industries SC using the SCOR model can solve these problems.

3. METHODOLOGY

3.1. Introduction

This chapter describes the methodology used to achieve the objectives of the study. It also includes the descriptions of the study area, research design, study population, sampling size, sources and types of data, data collection techniques, methods of data processing and analysis and model specification employed to this study. Generally, this part describes the systematic and scientific methodological aspects that are appropriate for this study.

3.2. Description of study area

Sidama Zone neighboring boundaries are in the North with Arsi Oromo and in the West with Gedeo, Burji, Guji zones, Bilate River which separates the Wolaita zone and Kambata zone. Also, the Sidama Zone boundary is in the South with Guji Zone, in the East and Southeast with Bale Zone of Oromia region. Sidama zone found geographic coordinates of longitude between $38^0$0'31'' E to $39^0$7'27'' E and latitude between $6^0$8'48" N to $7^0$9'1" N. The distance from Addis Ababa Capital city of Ethiopia, Sidama Zone administration center is 275 km.

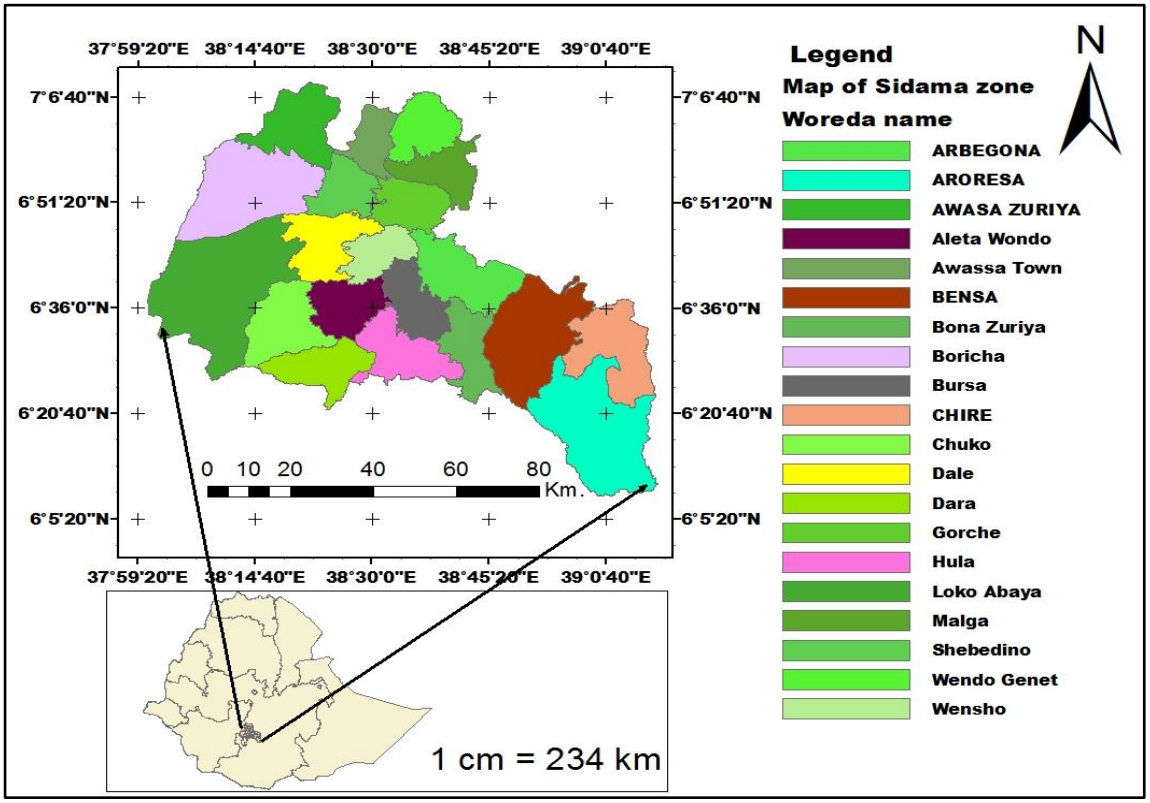


Figure 3.1: Sidama Zone Geographical location

3.3. Research design

Research design guides how a researcher reaches to finding and shows what procedures follow to reach the final goal and objectives of the research (Wei, 2014; Hoang, 2017; Asmelash and Umeta, 2017) as shown in Figure 3.2. Taking this idea into consideration, the researcher constructed the following conceptual framework of research design.

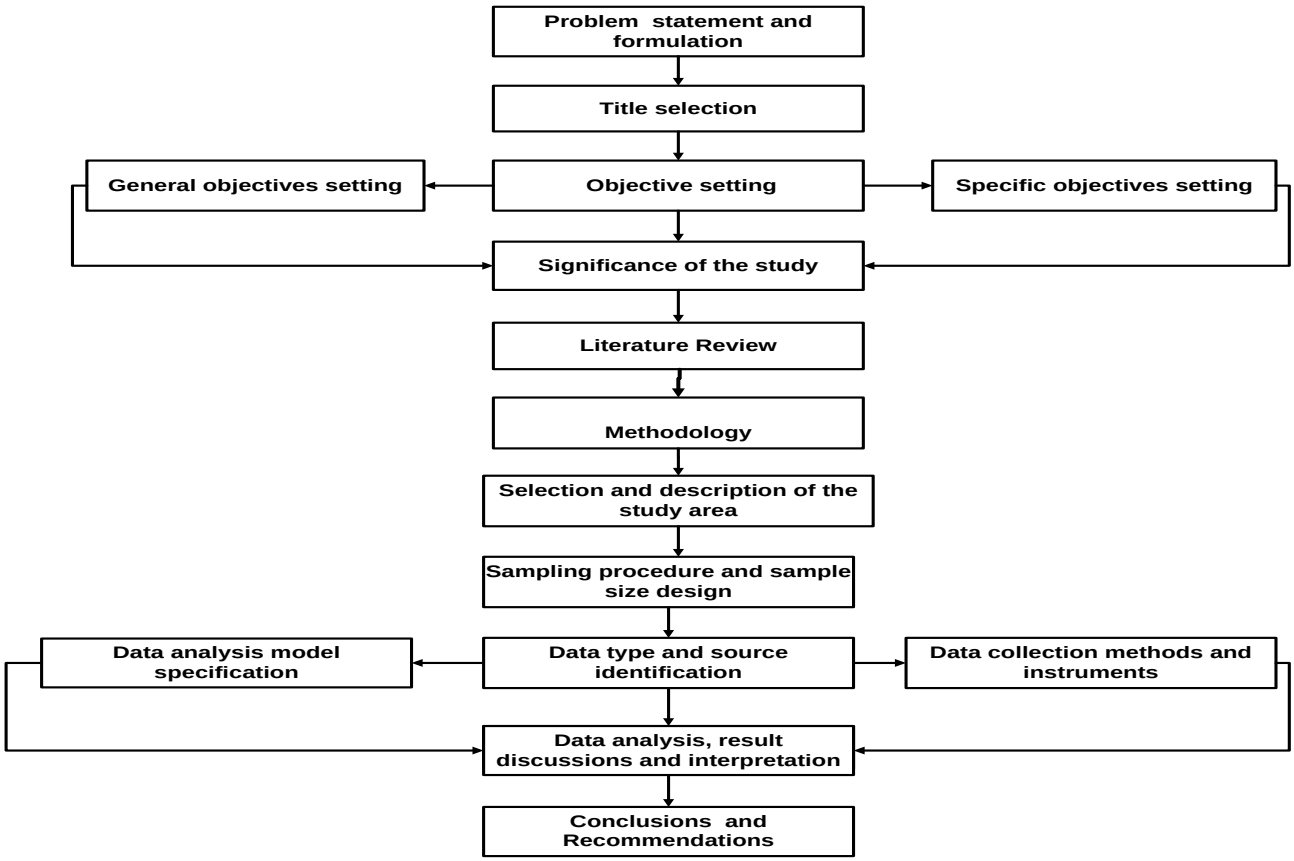


Figure 3.2: Research design methodology

A research design is a plan explaining how a researcher collects, measure and analyzes data by specifying the steps of the study to be in a clear and logical way. Depending on the purpose of the research, research design can be classified into several categories. As described by Asmelash and Umeta (2017), research design can be categorized as descriptive, exploratory, or causal and effects. The descriptive design focuses on describing accurately the characteristics of a particular individual, situation or a group; an exploratory design deals with gaining familiarity with new ideas or achieving new insights about a phenomenon. The casual design, however, is concerned with the cause-and-effect relationships between variables.

A research approaches can be categorized as a quantitative, qualitative and mixed-method approach. Quantitative research is a research approach used by a researcher based on the measurement of quantity or amount. In addition, quantitative research approach is used by researchers to gain knowledge by using observations and measurements to check the pre-established theories by implementing survey techniques and experiments that provide knowledge by proving or disproving the pre-established theories at the end of particular research studies; whereas, qualitative research is used to formulate knowledge based on some existing historical and social views to establish a particular pattern that is observed through techniques like observing a phenomena, theories and case studies. It is a research approach used by a researcher to gain an in-depth and interpreted understanding of attitudes, opinions, and behavior. The mixed-method approach, on the other hand, is a research approach used by a researcher to seek knowledge by combining both quantitative and qualitative research approaches (Asmelash and Umeta, 2017).

This study employed a descriptive research design because a researcher can only describe what has happened or what is happening. Also, this research employed both qualitative and quantitative types of research approaches. In the initial stage of the study, questionnaires and an unstructured interview were carried out with members of primary coffee farmers' cooperatives senior experts and management through the face-to-face interview schedule. Hence, in order to answer the research question developed in this study, a survey research design was employed. This helped a researcher to understand the nature and operating characteristics of a picture of Sidama Coffee farmers' Cooperative Union SC performance and situation what looks like because it enabled a researcher to collect relevant primary data from primary coffee farmers' cooperatives and Sidama coffee farmers' cooperative union to assess the existing SC performance. In addition, secondary data from various published and unpublished documents were included in the study.

3.4. Sampling procedures and sample size

A sample is a subset of a population (Ajay and Micah, 2014). For this study, multi-stage sampling procedures were used to select the sample of primary coffee farmers' cooperatives and members in the Sidama zone that was unified in SCFCU. At the first stage, Sidama Zone was purposively selected from SNNPRS based on the agricultural product especially based on the potential of the Arabica coffee supply. Hence, there are three clusters used in coffee production

in Sidama zone such as in Dale woreda cluster included were Dale, Loka Abaya, Wonsho and Shebedino. In Aleta Wondo woreda cluster included were Aleta Wwondo, Aleta Cchuko, and Dara Woreda. In Bensa Woreda cluster included were Bona, Chire and Aroressa Woreda. However, from these clusters five Woredas (districts) Dale, Aleta Wondo, Bensa, Chire, and Aroressa Woreda were chosen for this study. Because of sun-dried coffee processing sites are only in these three clusters and Geographical locations are also low land from Dale to Aleta Wondo and highland from Bensa-Chire-Aroressa. The transportation access also low-land from Chire-Bensa-Hawassa and Aroressa- Bensa-Hawassa. Whereas the transportation access moderately fills requirements from Aleta Wondo-Hawassa-Addis Ababa and Dale-Hawassa-Addis Ababa.

In the second stage, according to the primary coffee farmers' cooperatives, currently, there are 61 primary coffee farmers' cooperatives and out of 61 primary coffee farmers' cooperatives, by using a systematic sampling method, 13 primary coffee farmers' cooperatives were selected from these five Woredas. In this study, due attention was given to the quality and representativeness of the sample to the total population for the better generalization of the finding and determination of sample size. According to Yamane (1967), the sample size determination can be calculated and decided as Equation 3.1, as cited in Singh and Masuku (2014). In this research, we used Equation 3.1 with a sampling confidence coefficient of 95% of the total population and sampling error precision is 0.05. From the total population (N) 182, the sample size (n) can be calculated as follow:

$$n = \frac{N}{1 + N\,(e)^2} \quad \text{---------- 3.1}$$

Where:

n - The sample size (respondent size)

N - The total population size

e - The acceptable sampling error

$$125 = \frac{182}{1 + 182\,(0.05)^2}$$

In the third stage, from the primary coffee farmers' cooperatives, here the total study population (N) used was 182 and using Equation 3.1 of sampling size decision model the sample size (n) can be 125. This means out of 182 primary coffee farmers' cooperatives production center workers and managers, 125 respondents were selected random sampling.

3.5. Types and sources of data

According to Asmelash and Umeta (2017) besides questionnaires in survey studies, data collection methods and procedures include methods like face-to-face interview schedule, telephone interviews, emails, and web surveys that can be used to collect data in a cross-sectional survey approach. Since this study has been used a survey method consisting of a questionnaire as a common data collection instrument. Additional data collection instrument used was a face-to-face interview schedule, field visiting and observation.

3.5.1. Primary data

In this study, the research common instruments were used to collect data includes semi-structured open and closed questionnaires and interviews to obtain primary information. In addition, the field visiting and observation was carried out to collect primary data. The importance of collecting and considering primary data was used from different sources to make the data and the result of the research to be reliable in order to recommend strongly and the reader to understand the outcome more comprehensively. Collected data was interpreted in different ways such as in number, frequencies, mean, standard deviation, ranges, figure charts, and graphs.

3.5.1.1. Questionnaires

The questionnaire is the appropriate instrument to collect data from a relatively large sample size. The questionnaire was employed as a primary tool for collecting data from Primary coffee farmers' cooperatives. The questionnaire contained many close-ended items. Five-point Likert's scale was applied in the construction of questionnaires to show the level of agreement: 1 = strongly disagree (SD), 2 = Disagree (D), 3 = neither agree nor disagree (ND), 4 = Agree (A) and 5 = strongly agree (SA). Such type of questionnaire provides a great uniformity of responses. The questionnaire was translated from the English language into the Amharic language in order to easily collect reliable data.

3.5.1.2. Interviews

In addition to the questionnaire, the researcher has used the interview as another instrument of data collection. This instrument is crucial to collect data that can't be obtained using the questionnaire. Moreover, it provides a chance to respondents in order to express their views three

key informants were selected purposively from each organization and governmental offices. Among these Woreda agriculture and natural resource development office, Sidama Zone agriculture and natural resource development office, Cooperative promotion office, SCFCU office two senior experts and three ECX Hawassa branch office work process coordinator and the senior experts were interviewed. The main aim of conducting the interview was to get more information from their experience and knowledge on the primary coffee farmers' cooperatives and union on SC performance, to increase the validity and reliability of information collected from different sources.

3.5.2. Secondary data

The relevant principles, theories, concepts, and ideas were taken from different relevant sources such as different published and unpublished sources, books, thesis, journals, and research of various scholars on the topic of study.

3.6. Methods of data analysis and interpretation

In this study, both quantitative and qualitative research approaches were used to analyze data. To accomplish the study result a descriptive statistics were used to analyze collected data from a survey study. The categorization of SC performance on the basis of a SCOR model processes includes plan, source, make, deliver and return process performance perspectives variables. This was carried out using descriptive statistical analysis such as frequencies, mean, standard deviation, range, tables, charts, and figures. Data test was carried out to determine significant differences with the confidence level 95% and error less than 5%. The study result also interpreted on the basis of a Likert's five-point scale response criterion as shown in Table 3.1.

Table 3.1: Likert's five-point scale response criterion (Al Sayaad *et al*., 2006; Mohammed, 2016; Tekliye, 2017)

No	Mean range	Response option for agreement	Response option for performance
1	[1.00-1.80)	Strongly disagree	Very poor
2	[1.80-2.60)	Disagree	Poor
3	[2.60-3.40)	Neither agree nor disagree	Moderate
4	[3.40-4.20)	Agree	High
5	[4.20-5.00)	Strongly agree	Very high

For the descriptive statistical analysis, the standard deviation is an important one. According to Paddeu (2016), the standard deviation has widely used the measurement of the variability of diversity used in statistics of probability theory. It shows how much variation or "dispersion" there is the average (mean value) and standard deviation. A low standard deviation indicates that the data points tend to be very close to the mean; whereas a high standard deviation indicates that the data are spread out over a large range of values. The mean is used to show the majority of respondents as predictors of the population and hence to conclude for the other.

3.7. Model specification and data Analysis

To analyze responses of the respondent on data collected based on questionnaires using Likert's five-point scale procedure is essential for performance assessment of survey study as described by (Boone, 2012). A researcher grouped and summarized variables based on the SCOR model business process during SC performance assessment using SPSS version 25.0 statistical applications, Excel 2010 and Microsoft Office Visio 2007 to draw graph and diagram.

3.8. Descriptive statistics

The general situation of the variables on basis of SCOR model processes such as plan, source, make, deliver and return and the activities like responsiveness, reliability, flexibility, cost, and asset management performance, a descriptive statistics was used in this study by a researcher. As Tabachnick *et al.* (2007), descriptive statistics are useful in describing sample characteristics and variables checking without violation of any of the assumptions underlying statistical techniques to be used in addressing research questions. Descriptive statistics typically comprised of the mean, standard deviation, and range of scores.

According to Paddeu (2016), descriptive statistics are used to describe data behavior in a study by providing simple summaries about the sample; they represent the foundation of quantitative analysis. Descriptive statistics stands for the conversion of the raw data into useful information which can be interpreted to explain a group of dimensions using range, mean and standard deviation. Statistics can also help to identify the existing relations among SC variables.

4. DATA ANALYSIS AND RESULT DISCUSSIONS

4.1. Introduction

In this chapter data analysis and results, discussions have been organized into different sections. Section one is the introduction part of this Chapter, section two is the analysis and interpretation of the demographic characteristics of the respondents' by using descriptive statistics. In sections three and four, analysis and interpretations were concerned about the existing SC performance assessment of primary coffee farmers' cooperatives and SCFCU. The last section is the analysis of SC operation process enablers, best practices and SC modeling on the basis of the SCOR model business operation process.

4.2. Return rate and demographic characteristics of the respondents

4.2.1. Questionnaires return rate

In this study, the number of questionnaires that were administered to primary coffee farmers' cooperatives was 125. Out of 125 questionnaires that were distributed, returned properly filling were 118 (94.4%) questionnaires and 7 (5.6%) of questionnaires were not returned. This represents an overall successful return rate of 94.4% as shown in Table 4.1. According to Mugenda (2003), the return rates of above 50% are acceptable to analyze and publish, 60% is good and 70% is very good. Based on these statements from popular scholars return rate of 94.4% (118) is very good for the study. Thus, analysis of the paper was made based on returned questionnaires 118 (94.4%) having very good return performance.

Table 4.1: Return rate of questionnaires by respondents (Field Survey result, 2019)

Response	Frequency	Percent
Returned	118	94.4
Unreturned	7	5.6
Total	125	100

4.2.2. Demographic characteristics of the respondents

Under this sub-topic, background characteristics of respondents were analyzed and interpreted and it is important to understand the profile of the respondents included in the study to ensure the reliability of the study. Accordingly, in this section, primary coffee farmers' cooperative members' sex, age, level of education status, position and personal experience in an organization

has been assessed and the results were presented and summarized by using Figures and simple descriptive statistics Tables: like frequency and percentage. In the following Figure, 4.1 and 4.2 describe the demographic data of the respondents' sex and age.

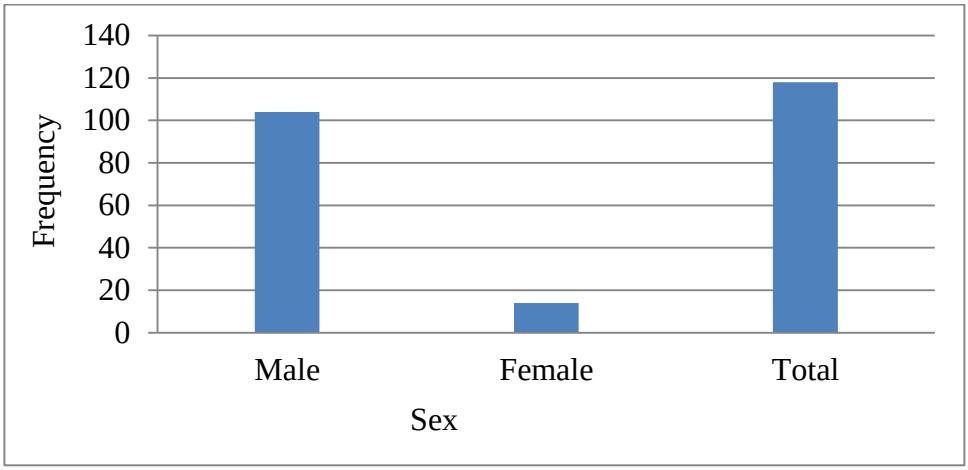


Figure 4.1: Sex of sample respondents (Field survey result, 2019)

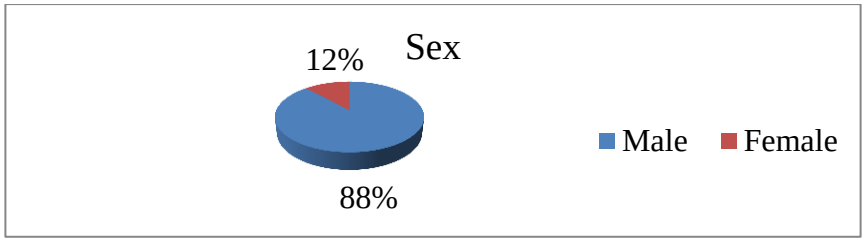


Figure 4.2: Sex of sample respondents in percent (Field survey result, 2019)

Primary coffee farmers' cooperatives are part of the community including both male and female household heads. As can be seen from Figure 4.1 and 4.2, accordingly, sex-wise distributions of the sample respondents were assessed and results found that the majority were male being 104 (88%), whereas 14(12%) of the female. Therefore, more respondents to the sample questionnaires were male. This indicated that male cooperatives members constitute a larger number in the sample population of the study area. Hence, the involvement of males in primary coffee farmers' cooperatives societies is higher than female this is because of the high responsibility of men for their family. This shows that the contribution of cooperatives becomes high by participating males in the economic activities and in the future female participants should be considered balanced participating in such economic activities.

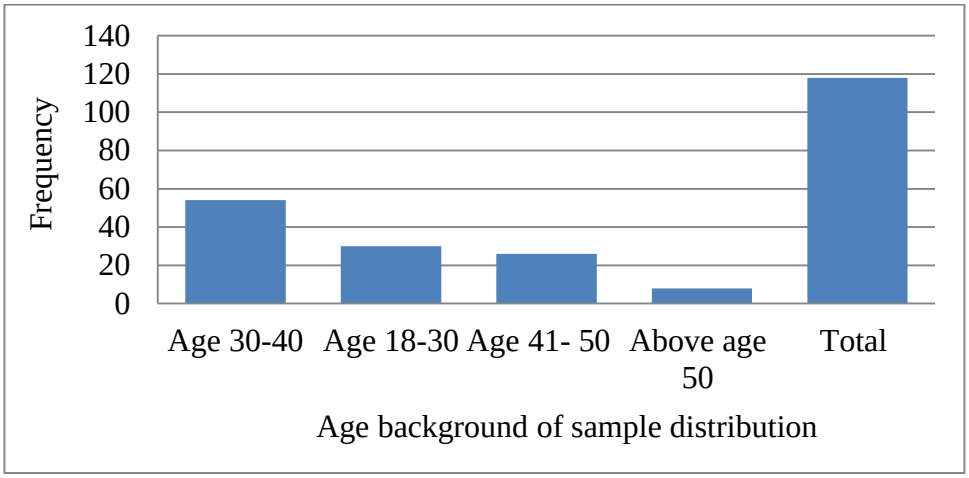


Figure 4.3: Age of sample respondents (Field survey result, 2019)

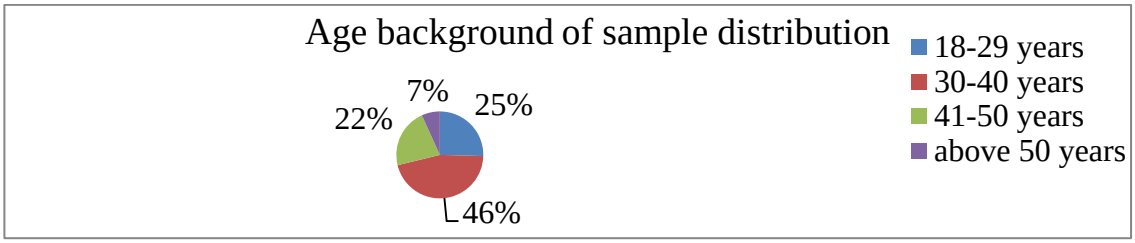


Figure 4.4: Age of sample respondents in percent (Field survey result, 2019)

As described in Figure 4.3 and 4.4, the respondents' age has been shown that the majority of the respondents 54 (46%) were under the age category of year 30-40. The rest 30 (25%) were under the age category of year 18-30 followed by under age category of years 41- 50 were 26 (22%) and above 50 were few of the respondents 8 (7%) respectively. This result was indicated that 71% were in the age below 40. Therefore, as a result, shown in this study, most of the respondents were younger as well as productive in the age category.

Table 4.2: Educational level of respondents (Field survey result, 2019)

Educational level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Illiterate	15	12.7	12.7	12.7
	1-10 grade	42	35.6	35.6	48.3
	Grade 11-12	32	27.1	27.1	75.4
	college diploma	19	16.1	16.1	91.5
	BA/BSc	10	8.5	8.5	100.0
	Total	118	100.0	100.0	

With respect to educational background as shown in Table 4.2, a large number of respondents 42 (35.6 %) were 1-10 grade those followed by 32 (27.1%) who were 11-12 grade those attended

preparatory, 19 (16.1%) hold diploma, 10 (8.5%) were those BA/BSc and the rest 15 (12.7%) were not attended the formal education. Here one can say that the majority of the primary coffee farmers' cooperatives members 62.7% were educated elementary level and high school level. Diploma holders' levels of education are accounts at 24.6%. In general, the above analysis of the demographic characteristics of the respondents' shown that most of the respondents were male, their age range was laid between 18-40, they are productive/youth people and educational level is elementary to high school level including Diploma level. This shows that primary coffee farmers' cooperative societies should give focus to those youths and with middle education level including higher-level education to target their objectives.

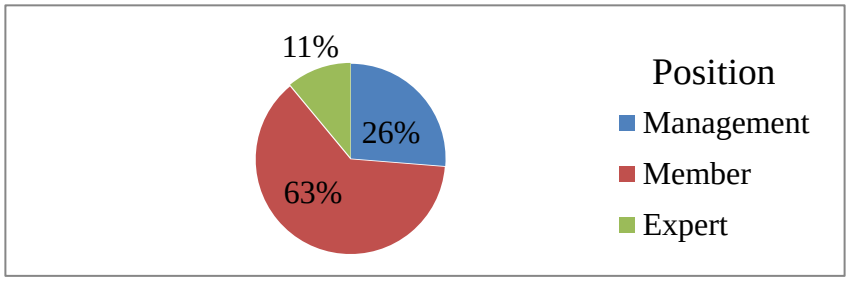


Figure 4.5: Position of responds in percent (Field survey result, 2019)

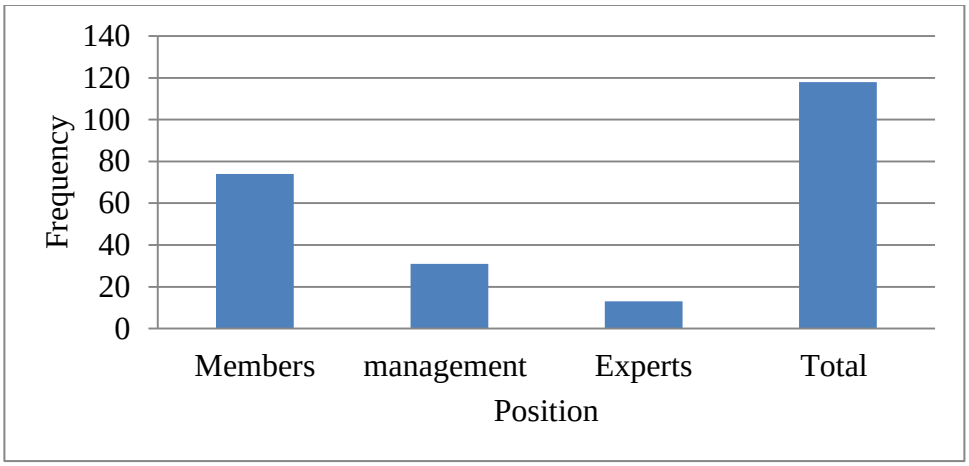


Figure 4.6: Position (Field survey result, 2019)

As can be seen from the Figure 4.5 and 4.6, position-wise distributions of the sample respondents were assessed and results found that the majority were 74 (63 %) members followed by those management committees 31 (26%) and the rest 13 (11%) were experts. the results indicate that the respondents were expected to give valid response since they had a better understanding as guided by their level of position which in this case majority having good knowledge about the primary coffee farmers' cooperatives and coffee SC performance as compared to others.

Table 4.3: Personal service years in coffee farmers' cooperatives (Field survey result, 2019)

Personal service years		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	29	24.6	24.6	24.6
	5-8 years	48	40.7	40.7	65.3
	9-10 years	34	28.8	28.8	94.1
	above 10 years	7	5.9	5.9	100.0
	Total	118	100.0	100.0	

With respect to experience background, a large number of respondents as can be seen from the above Table 4.3 the experience-wise distributions of the sample respondents were assessed and results found that the majority of respondents in the primary coffee farmers cooperative has long-time experience exporting with 1-5 years were 29 (24.6%), 48 (40.7%) were the years between 5-8, 34 (28.8%), and the years between 9-10 were 7 (5.9%) answered that they have more than 10 years' experience. This result showed that the majority of 89 (75.4%) having the long-time experience that means they have more than 5 years in coffee processing and they have good knowledge of coffee trading.

4.3. Map of coffee supply chain in Sidama Zone

Coffee SC starts from farmers up to deliver to end-user. It includes farmers as suppliers' suppliers, Primary cooperatives as processors, transporters, warehousing activities, wholesalers, retailers, other intermediaries and customers themselves. Buying red cherry from farmers, Coffee farmers' cooperatives process to get green coffee suitable for export and they sell a coffee product to SCFCU at the central market price. Final the SCFCU exports quality product and below the export standard level, they sell to domestic traders. The major activities of the union are; coordinating all the activities associated offering centralized services such as quality inspection, standardization, re-processing, re-packaging, etc., taking advantage of the current market, share market demand and price information to the members.

At the time quality inspection, high-quality product that passed export standard quality it can be exported selling to international importers and the rejected product i.e. failed due to being low-quality product can be sold for the domestic private traders. This shows that to fulfill exporting responsibility having improved SC performance supplying high-quality products starting from raw material supplier farmers up to delivered to ultimate end product users or customers. Because improved business operation process and product quality should be considered in coffee

farmers' cooperatives and SCFCU. Sidama coffee major importing countries are more than nineteen countries as interviewers' information. From these countries, Germany, Saudi Arabia, Japan, USA, Italy, and Rusia are major destination importing specialty coffee of Sidama. In this case, Coffee farmers' cooperatives and SCFCU have major role and contribution from Ethiopia exporting organic coffee product as shown in Figure 4.7 overview about SC of SCFCU.

Sidama organic (specialty) Arabica coffee is highly acceptable in exporting into different foreign countries that have many international customers and the interview result has proven the report of (Francom and Tefera, 2016). As Francom and Tefera (2016) report, from the Ethiopian coffee importing countries including Sidama coffee, Germany is the top country importing 19% of the total exported coffee in amount and Saudi Arabia followed importing 18% of the total exported coffee of Ethiopia. The USA and Japan follow importing 10% and 9% of the Ethiopian exported coffee product respectively. The others share 1-5% include Belgium, France, Italy, Sudan, South Korea, UK, Australia, Sweden, Jordan, Russia, Canada, Spain, Israel. The other remaining countries all together share 13% of Ethiopian coffee products each importing below 1%.

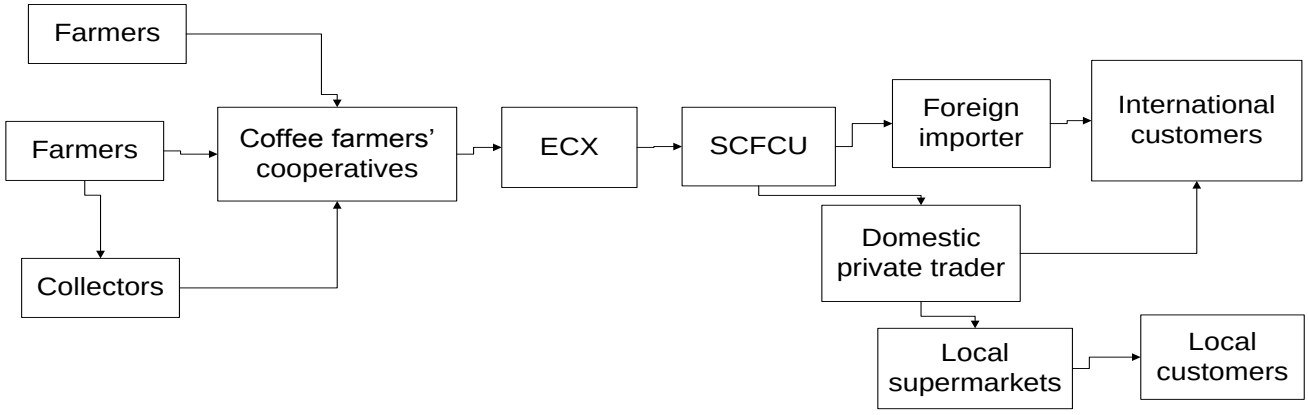


Figure 4.7: Existing SC of Cooperatives and SCFCU (Field survey result, 2019)

4.4. Analysis of existing SC performance of cooperatives

In this part for assessment of existing SC performance, field survey, interview, and questionnaires were used as an instrument to collect valuable data. On basis of questionnaires collected data the respondents were asked different questions, semi-structured close-ended to choice from five alternatives (from strongly disagree to strongly agree) and open-ended items concerning existing SC performance for the primary coffee farmers cooperatives. Thus, based on the responses obtained from the respondents the data organized as mentioned in the following sections. The data

were analyzed and interpretations were presented on the basis of SCOR model business processes. From field survey and interview the existing coffee SC of coffee farmers' cooperatives illustrated in Figure 4.7, the SC starts from the sourcing process up to delivering the product to customers. Sourcing process at cooperatives coffee processing sites includes activities like purchasing coffee red cherries from farmers and collectors to be processed using wet processing and sun-drying methods.

Coffee processing activity at the coffee farmers' cooperatives level the activities include purchasing fresh cherries from farmers and local coffee collectors, the production of a coffee product with wet processing methods for fresh cherries and sun-dried processing using a pulping method of coffee cherries takes place. The next processes are packaging, warehousing and finally transporting the product to SCFCU through ECX for exporting activities. At ECX the role of ECX is only grading and quality inspection. From coffee farmers' cooperatives, a SCFCU purchase the coffee product and the next activities are re-processing, re-packing, warehousing and exporting processes can be carried out at Union's facility. Finally, the foreign importers and domestic private traders purchase a coffee product from SCFCU to sell for distributors and whole sellers which can be sold at supermarkets and retailers to deliver either local customers or international customers.

4.4.1. Analysis of Plan process performance of coffee farmers' cooperatives

Plan process is crucial and plays a major role in any organization such as both governmental and business organization. As a business organization, primary coffee farmers' cooperatives produce and supply Arabica coffee product to the export market in a foreign country through SCFCU. To achieve this goal planning within an organization and throughout SC is very important. Based on the importance of the Plan process to assess the existing performance of coffee farmers' cooperatives the data was collected using developed questionnaires, the result obtained from respondents' responses indicated that the business operation plan process mean value is 2.41 as shown in Table 4.4. This value can be analyzed and interpreted as poor performance and disagreement of business operation planning within SC. For about defined performance indicators the mean value of respondents' responses scored as 1.97 showing that they have no defined performance indicators and a procedure implemented to measure how planned activities were performing in coffee farmers' cooperatives.

The interview result from primary coffee farmers' cooperatives revealed that planning process suffered due to lack of data, up-to-date information and methods of forecasting. They unable to forecasting accurately and have not practiced accurate forecasting systems using suitable forecasting models. Additionally, Computer application and database usage were poor performance levels for planning activities. The interview result of senior management and experts revealed that there was no adequately plan in different time horizons especially long term plans. But the short term production schedules in coffee farmers' cooperatives organization were practiced. Hence, this revealed there was inadequately planning; consequently, the improvement needed on the Plan process based on an appropriate forecasting method, having SC and organizational plan.

To solve the inability of accurate forecasting and planning the result revealed that they should use a suitable forecasting model and they should have awareness of forecasting and planning benefit. Forecasting is a tool used for predicting future demand based on past demand information. In the Plan process demand forecast is the basis of production planning and planning which is made without thinking about demand is not really planning. Similarly, purchasing will be more efficient by the demand forecast. In primary coffee farmers' cooperatives, accurate forecasting helps them in activities include in different time intervals (horizons) planning, budgets, and cost controls, production operations and marketing or for future sales. Likewise, forecasting can help them to determine the balanced quantity of inventory level and to have balanced human resources including blue-collar (labor force) and white-collar (professional i.e. skilled experts employers) to minimize production and administrative cost.

For this reason, a useful method is time-series statistical method that uses historical data to have accurate forecast result and forecasting is more accurate for shorter time periods, and this reduces usually uncertainty of demand for products. Therefore, accurate forecasting provides suitability to the primary coffee farmers' cooperatives at the operational level and within its strategic decision-making level. For the application of the right forecasting model to SC of primary coffee farmers' cooperatives, this study focuses on recommending on the usage of simple moving average model, linear regression forecasting model, and seasonal forecasting model.

A simple moving average forecasting model is a simple way to forecast using only mean or average value of historical data and based on the primary coffee farmers' cooperatives skill it is easily implemented. On the other hand, in a time series forecasting method, a linear regression

model and seasonal forecasting model are more accurate than the simple moving average model having more accurate forecast results, although they require somewhat mathematically skill on the computation of historical data. For seasonal forecasting model having a trend prediction factor of seasonality adjustment, seasonal forecasting trend factor is useful to predict trend more accurately and it helps to predict what will happen in the future in order to forecast accurately providing clear information to determine a gradual up or downward movement in the raw material supply, demand of the product and price fluctuation.

To solve the skill gap on a suitable forecasting model, it is recommended as they should use simple software such as Microsoft Excel and Excel QM. The practice of use of simple software like Microsoft Excel and Excel QM can help them not only as a tool of forecasting but also it helps to control the economic order quantity of inventory level and optimization modeling using linear programming providing the information on how they can maximize profit minimizing production cost..

Table 4.4: Plan process performance analysis (Field survey result, 2019)

Activity: plan process	N	Range	Mean	Std.Dev.
We have plan with different time horizons to balance demand and supply resource requirements.	118	3	2.47	.958
Our organization plans its business activities participating stakeholders to reduce information variation of demand and supply.	118	4	2.44	.992
Our organization uses historical data and information in developing customers demand forecasting.	118	3	2.76	.993
In our organization the demand management and plan process is based on timely customers' information.	118	3	2.91	.987
Cross functional team is functional and helps the plan department.	118	3	1.88	.669
There are defined performance indicators and procedures implemented to measure how planned activities are achieved	118	3	1.97	.722
Planning process performance	118	2.33	2.41	.512

Consequently, considering the questionnaires and interview result as any manufacturing and production business, for coffee farmers' cooperatives planning and accurate forecasting is important to carry out effectively balancing demand and supply requirement including source, make, deliver and return processes of business operation process management in coffee farmers' cooperatives to improve the SC performance. A planning team should be established and work with the manufacturing team to evaluate and adjusts forecasting periodically, actual demand and

the level of production capacity utilization. When they perform this way they can have synchronization to match the demand, forecast accuracy with the company's production, sourcing and distribution processes improving planning in logical ways.

Moreover, supply and demand management can be carried out only by having a clear and planned strategy in SC. Hence, several researchers' studies suggested the importance of plan indicating the cause of successful businesses is effective planning in different time horizons such as a long, medium and short term of their business operations. For example, Manataki (2012) stated that the plan and demand accurate forecasting identify the problems, strengths, weaknesses, opportunities, resources, and gaps required to be filled in SC business operations process with estimating future demand and manufacturing resource requirements across the different SC member. According to Simon *et al.* (2015) and Weyers (2017) absence of SC plan resulting problem is a lack of coordination and cooperation in SC consequently, leading to bullwhip an effect which is a magnifying effect of the demand order variability.

Therefore, this study has proven SC plan and execution having clear information of resource requirement in SC based on an established plan is very important to improve cooperation and coordination, accordingly, it reduces demand and supply variability for cooperatives.

4.4.2. Analysis of Source process performance of coffee farmers' cooperatives

In the business operation process carefully sourcing and purchasing is crucial in coffee production considering the quality of raw material. In coffee wet processing industries it is necessary purchasing ripe cherries of coffee to minimize longer processing lead time, loss of product quality as well as quantity due to immaturity and problems associated with cost.

To investigate the process associated with purchasing red cherries at the cooperatives level interview data collection system was carried out in this study. From the interview and field observation result the primary coffee farmers' cooperatives buy red coffee cherries from coffee grower farmers and local collectors as shown in Figure 4.8. Local collectors buy the coffee cherries directly from many coffee-growing farmers, transport and sell to primary coffee farmers' cooperatives and private traders. The local collectors negotiate prices based on local market price information. The collectors do not have their own Warehouse; therefore, they transfer the coffee to cooperatives and the private site immediately or after the second day as they bought coffee red cherries.

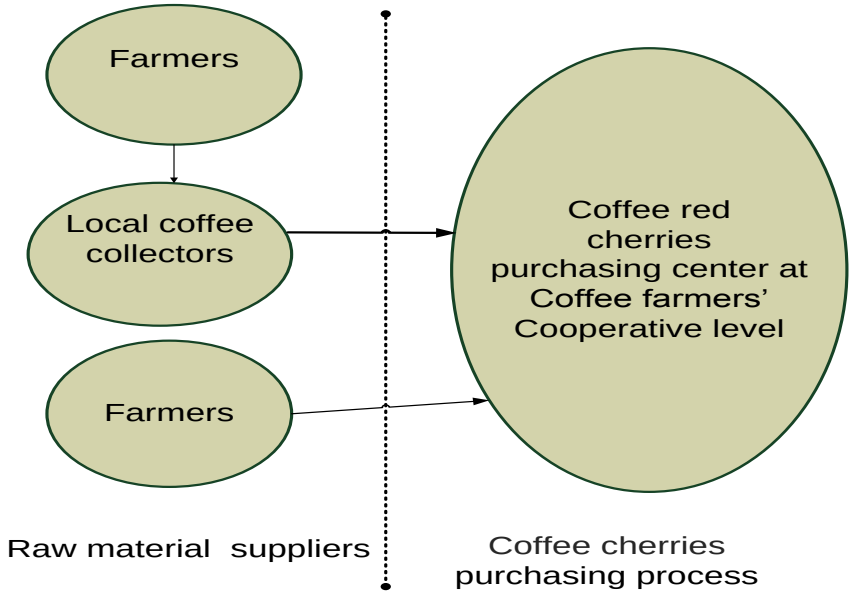


Figure 4.8: Source of coffee purchasing for cooperatives (Field survey result, 2019)

From the respondents' responses the primary coffee farmers have no defined sourcing process and purchasing activity performance indicators has shown the disagreement response scoring 1.90 and they have not practiced suppliers' performance evaluation scoring mean the disagreement decision value 1.87. This implies at the purchasing time of coffee cherries, to overcome the raw material quality and quantity problem properly sourcing should be carried out at primary coffee farmers' cooperative level having KPIs of the sourcing process. This can be achieved by planning all activities and process putting a logical and systematic way based on performance indicators. Then, evaluating suppliers' performance based on purchasing price and quality coffee cherries should be carried out carefully.

Similarly, the result obtains from respondents was scored 2.49 for primary coffee farmers' cooperatives receive on-time frequently their raw material revealed that the suppliers unable to deliver on-time as shown in Table 4.5. This implies that the result of the respondents' response has shown disagreement and poor performance of on-time delivery. Hence, the result implies that they should implement suppliers' performance evaluation system and this helps them to overcome and minimize lead time problem, cost, inconsistent quality, and quantity problem.

In addition to questionnaires data collection and interviews, a researcher tried to visit production sites of primary coffee farmers' cooperatives about quality of purchasing raw materials and production process to understand how their source process and production process was. It was seen that there were variations on the maturity of coffee cherries as shown in Figure 4.9, being

unripe coffee that may bring variations in the quantity and quality of a product. As a result, obtained from the survey, observation revealed that there was a raw material quality problem.

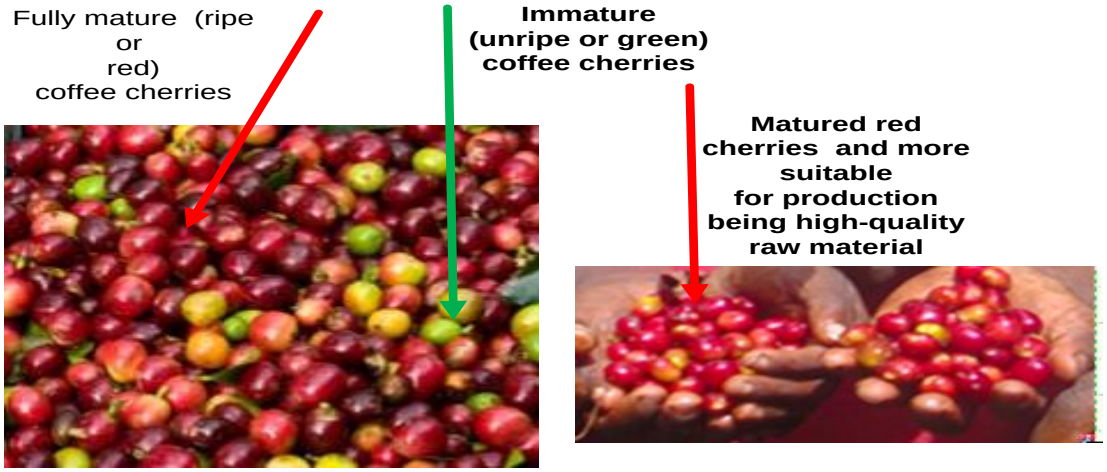


Figure 4.9: coffee cherries maturity (Field survey result, 2019)

For the problem of a high mixture of immature coffee cherries supply, the first reason was that harvesting varies from one farmer to another due to their inadequate know-how on coffee cherries maturity and quality importance. Another reason is some farmers bring coffee cherries to the local market or cooperatives' coffee preprocessing site to sell their coffee cherries for a daily need only without considering the quality of raw materials and its end product, whereas the others supply matured red cherries considering long term relationship with processors and quality. Consequently, the primary coffee farmers' cooperatives have experienced problems with inconsistent coffee red cherries maturity and low-quality raw materials supplies. Therefore, the result revealed that they should have a quality inspection team not only in production processes but also for raw material quality in the purchasing process.

From the cause of immature red coffee cherries, the effect becomes a challenge on production processes being no-removable during wet processing time that its original removable covers. Even though it may be removed easily it has a problem missing one bean. In this time the second bean being removed as waste part because of being low dense bean it can be removed with waste floating on water during washing time due to low size and weight. Otherwise, it can be cut by machine and then removed as waste. Thus, it cannot be suitable for a production system when immature raw coffee cherries were picked and purchased.

Furthermore, primary coffee farmers' cooperatives' should consider the selection of suppliers, quality of raw material, price of raw material and cost of production during purchasing red coffee

cherries as the input of production. Moreover, they should consider a quality inspection team at the purchasing time; otherwise, improper selection of suppliers and careless purchasing unable them to meet their product quality requirement.

The performance of the Source process analysis results obtained from respondents' responses shown that overall mean value scored to be 2.45 as shown in Table 4.5. This can be interpreted as a disagreement of Source process implementation on basis of SCOR model showing poor performance based on a five-point Likert's scale (Al Sayaad *et al.*, 2006, Tekliye; 2017).

Table 4.5: Source process analysis of respondents' responses (Field survey result, 2019)

Activity: Source process	N	Range	Mean	Std.Dev.
Our organization has long term relationships with supplier-buyer	118	3	2.25	.839
Our organization deliver on-time to its customers	118	3	3.05	.932
We receive raw material on-time from our suppliers	118	3	2.49	.814
Our organization has practiced suppliers' performance measurement	118	3	1.87	.661
We purchase high quality raw material frequently considering end product quality and cost	118	4	3.11	1.20
There are defined sourcing process and purchasing activity performance indicators	118	2	1.90	.646
Source process performance	118	2.00	2.45	.383

In general, the result obtained in this thesis about the quality of raw material reinforced the problems shown in the report of UNDP (2017). As UNDP (2017) report these problems are the inadequate quality and quantity of raw material supply, domestic raw materials prices fluctuations being higher, insufficient linkages between farmers and manufacturing industries. According to Georgise *et al.* (2013), price fluctuations create problems for raw material availability with respect to local purchases and supplier loyalty were bigger challenges in agro-processing industries. As Georgise *et al.* (2013) to solve this raw material quality and supply problem developing collaboration and integration with suppliers to enable continuous raw material supply from reliable suppliers to utilize full capacity. This also helps to revise the raw material and finished goods inventory control system decreasing the inventory system cost.

Therefore the study result and theory implied that the primary coffee farmers' cooperatives developing collaboration and integration with reliable suppliers to enable continuous raw

material suppliers are very important. However, the study conducted by Zhou et al. (2011) to overcome such type of raw material supply problem suggested that establishing long term relationships with supplier-buyer that as a best practice in sourcing process to overcome the challenges of raw materials quality rather than having inconsistent and short term relation with raw material suppliers.

Taking into consideration of result analysis and literature review a researcher concluded that it is important to establish long-term relationships with honest coffee growers' farmers to overcome the challenge of raw material quality and quantity rather than having inconsistent and short term relation with raw material suppliers. Moreover, the farmers should practice selective harvesting system to supply only matured and ripe coffee cherries. The study conducted by Debela (2013) and Hoang (2017) reinforced suggesting selective harvesting system as the farmers should harvest coffee by hand using selective picking only ripe cherry. Unripe coffee is left on the tree for a later time. After several weeks, farmers will harvest again. This process can be repeated until there is no more coffee to harvest considering raw material quality problem prevention.

4.4.3. Analysis of Make (production) process performance at cooperatives level

Primary coffee farmers' cooperatives who have the equipment and resources to buy red cherries and convert into a processed coffee product. Two methods used coffee processing are dry processing and wet coffee processing (washing) as illustrated in Figure 4.10. Under dry processing methods, unpulped cherries can be dried whole on raised beds in the sun under natural conditions after picking red cherries from coffee growers' farmland. Likewise, a wet processing method is a coffee production type that red cherries can be pulped by machine immediately after picking between two days and three days.

From the field, observation washing is used to remove the upper cover and slippery chemicals in coffee processing mills. The resulting parchment/cherry can be dried in the sun on raised beds prepared by using plastic materials, textile fabric, bamboo, and other local materials to be prepared before transport to SCFCU. Then after dried in sun one week up to ten days because dry weather conditions vary from cold to hot (sunny). The next processes are quality inspection and grading system sorting by machine with weight and size of coffee beans produced during wet processing activity.

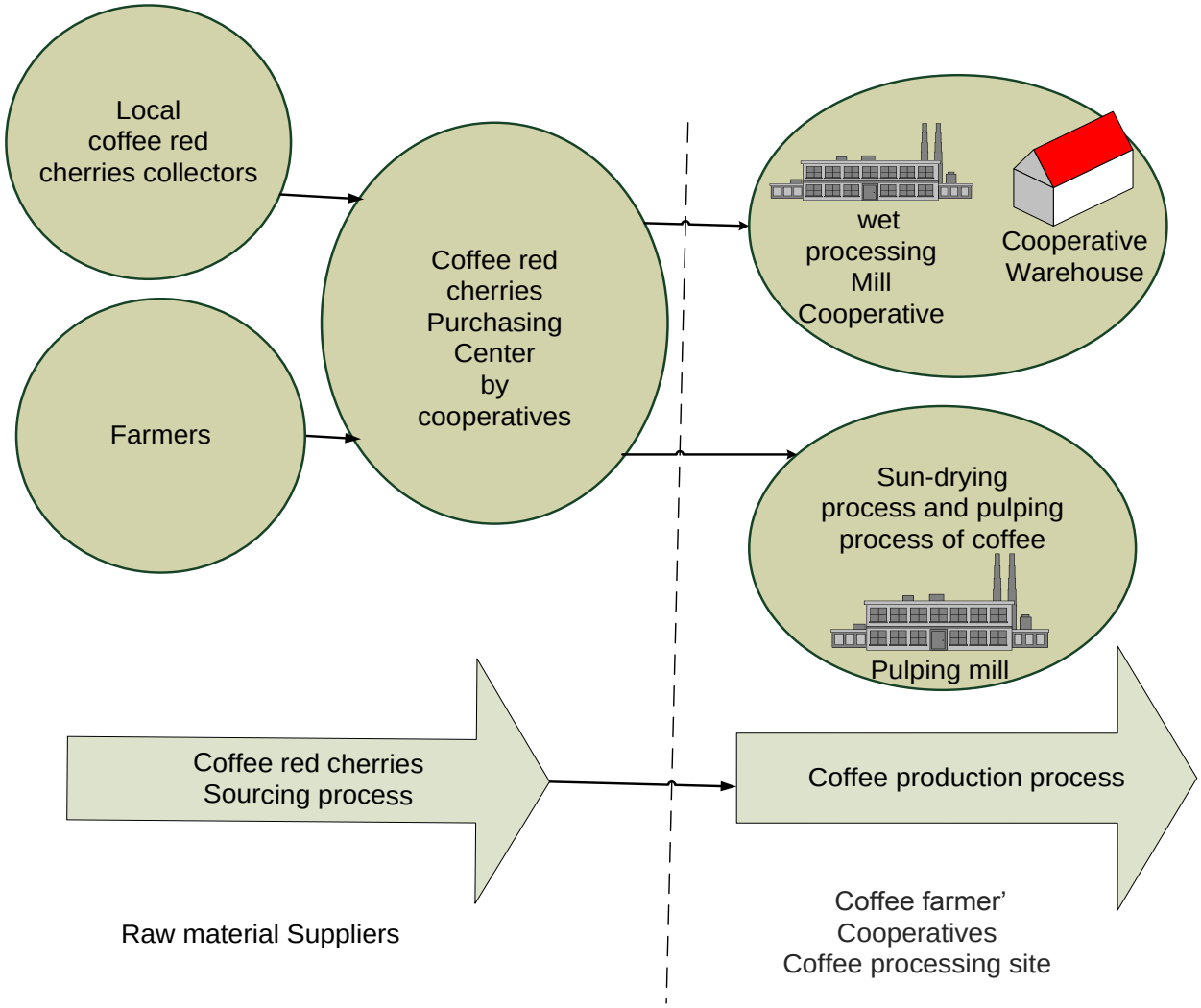


Figure 4.10: Purchasing and Make process of Cooperatives (Field survey result, 2019)

The The analysis of descriptive statistics result of respondents' responses based on developed questionnaires by researcher own has been shown in the following Table 4.6. The respondents' score for the production of the quality product mean value was 3.53. This result revealed that the primary coffee farmers' cooperatives have quality product production and defect rate minimization of high performance. Consequently, high product quality and defect rate minimization help them to reduce cost and maximize reliability as well as the profitability performance of an organization. From the respondents' responses the problem found in the production process as they unable to have economic quantity of inventory level scoring responses mean value of 2.30 which has low performance of inventory management and overall performance of make process was moderate by five-point Likert scale criteria (Al Sayaad *et al.*, 2006, Tekliye; 2017).

Table 4.6: Make process analysis of respondents' responses (Field survey result, 2019)

Activity: Make process performance	N	Range	Mean	Std.Dev.
We produce quality product frequently.	118	3	3.53	.993
We use economic order quantity of inventory in production.	118	3	2.30	.918
We have been utilizing our production capacity effectively to maximize productivity.	118	3	2.92	.975
We have implemented eco-friendly production system	118	3	3.78	1.022
We use suitable packaging and storage.	118	4	3.03	1.082
Make (production) process performance	118	2.00	3.11	.4579

In Make process high result and better performance responses that it has been scored eco-friendly production system and environmental pollution minimization. Eco-friendly production system and environmental pollution minimization were scored mean value 3.78 as shown in Table 4.6. This result described that they have considered and focused risk management related to environmental and business operation process in the production system. Hence, based on the result obtained for eco-friendly production system and as suggested by Montero *et al.* (2018) environmental protection improving production system, improved water use protecting environmental hazard can be considered as KPIs of the coffee industry and entire Agri-food SC.

Therefore, focusing on environment protection can help primary coffee farmers' cooperatives to follow increasing productivity, profitability and ensuring of business stability. Interviewing primary coffee farmers' cooperatives' senior experts how they produce finished coffee product and how they manage to Make process, they described that during sunny or hot weather conditions drying process takes from one week and during cold weather conditions it takes up to 10 days long. During this process time coffee should be dried 10%-10.5% moisture content when it is graded in ECX and SCFCU quality inspection tested but there is no testing instrument in a production site. ECX Hawassa branch office experts revealed that moisture content for cooperatives is not more than 11% although allowable moisture content for private traders in the range between 10% and 12% more than 12% is not allowed. This is because of primary coffee farmers' cooperatives and union required to supply only high quality in the grade level between 1 and 2 even though there are 1 up to 9 grading level in Ethiopia. Thus, a coffee product from cooperatives requires high dryness more than private traders to be more competitive in the market. If the moisture content is more than 12% it can be dried here staying an additional day and long delay and time consumption can be occurred having an extra cost.

This result obtained here, in Make process is similar to the finding of a study conducted by Hoang (2017) in Vietnam, drying of coffee after harvest for both sun-dried and wet-processed coffee is a critical stage in determining the quality of the coffee. As Hoang (2017) for wet-processed coffee, it must be dried until it reaches 11-12% moisture content and it takes on average around 6-8 days to be dried properly. Here, a researcher understands that the result showed the difference in time taken can be the difference in weather conditions and consumption of a long time during drying in primary coffee farmers' cooperatives it may require improvement of drying lead time. Furthermore, a researcher tried to observe in field how an actual production system of coffee farmers' cooperatives was. In primary coffee farmers' cooperatives processing site the next processes can be carried out packing by using 60 kg jute bags and warehousing takes place. The warehouse capacity, facility, and suitability for storage were shown poor quality.

For production method of Sun-dried coffee, it starts pulping processes after dried on Sun 25 days up to 30 days and waiting stored in cooperatives warehouse continuing this process purchasing red cherries with drying in Sun in the different period until wet processing coffee production stopped. After wet processing stopped the pulping process of Sun-dried coffee begins in each cluster of Sidama Zone and can be pulped to get green coffee. Then packaging activity takes place and packaging is using 60 kg jute bags and storage process can be carried out. From a cooperatives warehouse the transportation activity of the coffee product is the responsibility of cooperatives to SCFCU warehouse in Addis Ababa through ECX quality grading; next for reprocessing and exporting processes. As a problem in the production system, the interviewers described that some challenges like sometimes the moisture content balance problem in store. During day time coffee becomes well dried, whereas at night time it absorbs some amount of moisture deteriorating quality.

For the moisture absorption problem the solution is proper storage and the quality of the Warehouse is very important. During wet processing and damp conditions on the ground, the coffee product can reabsorb moisture, which would lead to a loss in quality. Therefore, coffee must be stored in dry conditions. Exposure to the moisture and then to Sun will result in a rapid deterioration in quality. Storage in an appropriate place will help preserve the quality of the coffee. Moreover, in this survey research study result about the storage of coffee in primary coffee farmers' cooperatives a researcher would like to suggest it is important that using pallets to prevent unnecessary moisture absorption rather than damping on the ground. In addition to

moisture preventions, pallets usage is suitable for loading and unloading as well as space-saving at the storage.

4.4.4. Analysis of the Delivery process of primary coffee farmers' cooperatives

The respondents' response to investigate deliver accuracy performance of the coffee product to SCFCU and customers on a committed date was scored to be 3.13 as indicated in Table 4.7. According to Al Sayaad *et al.* (2006) and Tekliye (2017), this result indicated moderate performance and on basis of agreement, the extent can be considered as neither agreed nor disagreed with on committed date delivery of the product to SCFCU.

From Table 4.7 delivery lead time determination based on primary coffee farmers' cooperatives industry norms and delivery time recording was scored to be 2.27 and 2.21 respectively having the meaning of the result as disagreement. This implies they cannot determine how long it takes up to they deliver product starting from production time up to delivering to SCFCU. There was no delivery lead time record and how often it was delivered on a committed date and how often it was taken a long time due to different reasons being unable to deliver at a committed date. A researcher would like to suggestions based on the respondents' response result having recorded information of how many orders were delivered at a committed date and how many orders were not delivered at committed date helps the organization to correct next time deliver performance and their customers' satisfaction regularly handling well.

The respondents' response to investigate the performance indicators have been determined for delivery process in the primary coffee farmers' cooperatives, has shown 2.31 mean value and overall delivery performance by respondents' response was scored mean value to be 2.48 as shown in Table 4.7. Hence, this result described that it was disagreement about delivery performance measurement practice and lack of suitable metrics in the organization. Therefore, the result implied that to have enhanced delivery performance in the business operation process they should have delivery performance measurement metrics. Similarly, the records of on-time deliveries from their suppliers and from them to their buyers help them to improve responsiveness and reliability by delivering on-committed date. Delivery records can be used for designing procedures to eliminate causes of delay and failure of delivering on a committed date implementing improvements in processes. So, lead time performance indicator measure is whether the orders from each supplier were received by buyers' on-time, on the contract delivery schedule, and with the correct quantity were received.

To focus on performance improvement of an organization using the right performance metrics and models reinforced the study conducted by (USAID, 2013; Pasanen 2015; and Simon *et al.*, 2015; Angelos, 2017; Banomyong *et al.*, 2017). Considering this right KPI, without using the right performance indicators the organization may not take the right measure and cannot improve performance. Therefore, the result and theory of the study indicated as the primary coffee farmers' cooperatives should focus on performance measurement of delivery having suitable KPIs.

Table 4.7: Delivery process performance of respondents' responses (Field survey result, 2019)

Activity: Delivery process performance	N	Range	Mean	Std.Dev.
We deliver product to our customers on committed date.	118	3	3.13	.812
Delivery lead time has been determined based on our organization industry norms.	118	3	2.27	1.067
Performance indicators have been determined for delivery process in our organization.	118	3	2.31	.947
We record product delivered time to take corrective measure.	118	4	2.21	.825
Delivery process performance	118	3.00	2.48	.70

A researcher used an interview system to understand how was delivery process management of coffee products by cooperatives to SCFCU. The interview result shown that they deliver coffee products from primary coffee farmers' cooperatives to SCFCU warehouse in Addis Ababa most of them by transporting products using private merchants' trucks through ECX Hawassa branch office by inspecting the quality and grading the product at ECX. Delivery lead time for transported products starting transportation from primary coffee farmers' cooperatives coffee processing site to SCFCU varies from one cooperatives' coffee production site to another cooperatives' coffee production site. This is due to the suitability of weather conditions for transportation and inspection time consumption at ECX.

However, during transportation time the average delivery lead time ranges from 4 days up to one week transporting product from coffee processing site up to SCFCU warehouse at Addis Ababa. This was because grading and quality inspection time in ECX branch in Hawassa office vary on the basis of coffee moisture content, quality level and congestion of supplied coffee product at ECX. When there is congestion in a place, the place is extremely crowded with supplied coffee loaded trucks and people which require to serve orderly which can consume long time and delay can occur.

Therefore, the delivery time precision as described by interviewers there was no fixed day to measure delivery time accuracy. This was because of coffee production in primary coffee farmers' cooperatives level probabilistic time considering production lead time and delay on road during transportation. Likewise, the interview results of the improvement requirement of lead time and long-time consumption during transportation activity at the distance of transportation between 320-450 km to deliver in SCFCU warehouse in Addis Ababa is very important. Because the distance is short but the process is time-consuming. So, it shows as it needed to be improved.

4.4.5. Analysis of the Return process of coffee farmers' cooperatives

The overall Return process performance of respondents' response was scored mean value to be 2.142 as indicated in Table 4.8 and the result has shown disagreement response as they have not implemented product Return back process from supplier and buyer on basis of five-point Likert scale criteria performance level decision (Al Sayaad *et al.*, 2006, Tekliye; 2017).

Interviewing senior experts and management of primary coffee farmers' cooperatives in the study area the result indicated they have no return process strategy when the product quality problems and excess quantity supply existed. Thus, as a literature review of the Return process on the basis of the SCOR model, return back to suppliers is an important and critical business operation process when quality problems and excess amount supply existed to maintain customers' satisfaction. From this description, anybody can understand that it is important adapting and implementing return process practice especially at primary coffee farmers' cooperatives particularly in the red cherries sourcing process level. If the return existed from buyers to cooperatives, the important activity is the identification of causes return; return recording, procedures for evaluation of the financial impact of return if the product returned from buyer to cooperatives. A return record can be used for designing procedures for eliminating causes of returns implementing improvements in processes and products.

Table 4.8: Return process performance respondents' responses (Field survey result, 2019)

Activity: Return process performance	N	Range	Mean	Std. Dev.
We have defined procedures and strategy of return product management.	118	2	2.05	.652
There are defined return process evaluation key performance indicators in our organization.	118	2	1.82	.700
We plan to minimize product return back.	118	3	2.53	.844
Cross-functional team is actively participating to help the return process management and resources requirement	118	2	2.16	.627
Return process performance	118	2.00	2.142	.369

A Return process implementation and practice are very important for a business organization as suggested by (Simon *et al.,* 2015; Pasanen 2015. As Simon *et al.* (2015) and Pasanen (2015) suggestion, the Return process is as one critical SC operation process in a different company. In this study taking into consideration of the return process literature review, a researcher believed that the primary coffee farmers' cooperatives can improve return process management strategy having a cross-functional team in the return process for product damage case, excess product or low-quality product return back from customers and raw material suppliers.

4.4.6. Reliability

Reliability is another indicator of external performance measures in SC. Reliability metrics is order fill rate i.e. orders filled completely. It is similar to perfect order fulfillment in delivery reliability and it is the percentage of Delivery performance with complete. From Table 4.9 the result of reliability activity performance obtained by respondents' response shown it was a very good performance on basis of five-point Likert's scale criteria of performance decision level and agreement extent decision level because of mean value scored was 3.43.

Table 4.9: Reliability activity analysis of respondents' response (Field survey result, 2019)

Activity: Reliability performance	N	Range	Mean	Std. Dev.
We measure customers' order completion performance and take improvement action recording order completion rate regularly.	118	3	3.54	.940
There is defined customers' complain solving procedures and system in our organization.	118	3	3.59	.908
We produce quality product to deliver our customer based on customer order specification.	118	3	3.58	.990
Our organization improve customers' satisfaction delivering right product with right quantity and at right time.	118	3	3.00	.978
Reliability activity performance mean value	118	2.75	3.43	.614

Order fill rate can be measured by dividing the number of the order delivered without complaints by total numbers of the order delivered as described by (Banomyong *et al.*, 2017). Therefore, from the Table 4.15 in this study average quantity of processed coffee product delivered to SCFCU warehouse from primary coffee farmers' cooperatives and fitted export quality standard was 6533 ton coffee and below export quality standard was 120 tons out of 6653 ton. Thus, the order fill rate is 98.2% with filling export standard quality requirements with high-quality coffee product supply having superior performance. According to APICS (2017) and Banomyong *et al.* (2017), the criterion of reliability performance is the excellent or superior performance of primary coffee farmers' cooperatives having reliability performance percentage in the range between 95% and 100%.

The other reliability performance metrics in SC are customer satisfaction and it is a crucial part of SC performance evaluation regarding the external performance point of view (Banomyong *et al.*, 2017). Hence, one of customer satisfaction measure is customers' complaint and it is needed to be minimized. Customers' complaints can be measured and computed dividing numbers of complaints from customers by numbers of total order and the result will be multiplied by a hundred percent to measure it systematically. In this study, on basis of customers' complaint, low-quality level and order were delivered below the export quality standard level of coffee product to SCFCU can be taken as compliant of a buyer on primary coffee farmers' cooperatives although it was not available in recorded form. From primary coffee farmers' cooperatives, the average delivered coffee in quantity below the required standard of the export level was 120 ton per year and total delivered order was 6653 ton per year. Taking this average quantity of coffee

product delivered to SCFCU; thus it can be computed using below the export standard level of the quantitative data as customer complaints and it has the result to be 1.8%. This result has shown that it was a very good performance. According to Banomyong *et al.* (2017), the criterion of customers' complains and performance evaluation criteria the result obtained revealed that customers' complaint performance and customers' satisfaction was very good ranging between 95% and 100%.

4.4.7. Responsiveness

On-time delivery is a measure of responsiveness performance and it is important to measure customers' point of view. From Table 4.10 the respondents' responses result of responsiveness activity performance shown very good because of mean value scored was 3.57 and this can be considered as a very good performance level on the basis of criteria designed for a five-point Likert scale as described by (Al Sayaad *et al.*, 2006; Tekliye, 2017). This shown that primary coffee farmers' cooperatives deliver quality products with the right quantity to their product buyers by responding to customers' needs making short production lead time as much as possible.

Table 4.10: Responsiveness activity analysis (Field survey result, 2019)

Activity: Responsiveness performance	N	Range	Mean	Std.Dev.
Our organization respond to customers' need making short production and delivery lead time as much as possible	118	3	3.59	1.015
We respond quickly to our customers regular and urgent order delivering before or on committed date	118	3	3.58	1.041
We deliver quality product with right quantity and at right time to our customers	118	3	3.53	1.068
Responsiveness performance mean value	118	3.00	3.57	.7031

However, in this study during interview and field observation, there was no availability of records on how many orders delivered on the committed date, after or before the committed date. Thus, on-time delivery metrics cannot be measured quantitatively except respondents' response due to unavailability of recorded data in the study area. Moreover, systematically on-time delivery can be measured orders delivered on a committed date divided by total orders shipped and the resulting value can be multiplied by a hundred percent as described by (USAID, 2013;

Banomyong *et al.,* 2017). Thus, considering these KPIs the study result revealed that the primary coffee farmers' cooperatives and SCFCU should measure the responsiveness performance recording how many on-time deliveries from their suppliers to improve responsiveness performance.

4.4.8. Flexibility

Flexibility is one type attribute of SC performance measurement from the customer point of view. From Table 4.11 a result of flexibility activity performance shown it was the disagreement level implementing flexibility practice based on respondents' responses scored mean value 2.53.

Table 4.11: Flexibility activity analysis of respondents' response (Field survey result, 2019)

Activity: Flexibility activity performance	N	Range	Mean	Std.Dev
Our organization responds to market and demand change quickly.	118	4	2.55	1.224
Our production volume is flexible based on market demand	118	4	2.48	1.189
Our organization is flexible to overcome supply and demand unbalance based on raw material availability	118	4	2.56	1.173
Flexibility performance mean value	118	4.00	2.531	1.031

From interviews of senior management and experts of Sidama Zone cooperatives office and Natural resources development office indicated during years between 2015 and 2016 somewhat the production and supply quantity of coffee product to SCFCU has been reduced and has not shown increment due to drought on basis of Illinois by climate change problem. The production quantity in 2015 was reduced by 11.73% from 2014 and in 2016 by 12% from 2014 as indicated in Table 4.15 and Figure 4.11.

Thus, to overcome this challenge SCFCU allowed participation of new primary coffee farmers' cooperatives and increased its supply and demand balance within a significant level. In the production years, 2017 and 2018 SCFCU had solved the problem increasing supply by responding to increased market demand increasing members with participating new cooperatives having 45% and 79.62% of increased supply respectively when compared with the 2016 supply. Here, 24% was increased supply in 2018 when compared to the 2017 production amount. The climate change and weather conditions were recovered in the years between 2017 and 2018 to its original conditions. Hence, this shown flexibility is a good performance overcoming conditional change.

4.4.9. Cost

Cost is an internal performance indicator of an organization in a SC showing if it is performing well or not of business operation goal. To have a practical cost performance picture in coffee farmers' cooperatives based on the SCOR model the respondents' response results shown in table 4.12.

Table 4.12: Cost analysis of respondents' response (Field survey result, 2019)

Activity: Cost performance	N	Range	Mean	Std. Dev.
Our organization has practiced cost minimization system	118	4	2.49	1.266
We use economic order quantity of inventory regularly.	118	4	2.35	1.229
Our organization use economies of scale during production and product transportation.	118	4	2.47	1.175
Cost minimization performance	118	4	2.44	1.13707

From the respondents' responses, the economic order quantity of inventory, transportation by using economies of scale and all scores for the responses were disagreement decision level regarding cost minimization activity having an overall value of the performance of cost minimization 2.44 as described in Table 4.12.

Consequently, the result has been showing they have poor performance on cost minimization. Cost minimization is important for primary coffee farmers' cooperatives to maximize profit. To achieve cost minimization several studies suggested how any business organization can minimize cost within the business operation process. For example, as suggested by Kachru (2013) and Langley (2008) economic order quantity of inventory is important to minimize production cost and holding cost. According to Rodrigue *et al.* (2013) economies of scale for any business organization have benefits for both production and transportation.

Considering the economies of scale in the production and transportation, a researcher can conclude and understand the larger production and transportation with the lower the unit costs can be spread over a larger quantity of load and production units. Therefore, in the primary coffee farmers' cooperatives by using economies of scale cost reductions can be achieved through size increase and the outcome is a decreased unit cost of production. Therefore, economies of scale are crucial points for the cost minimization in primary coffee farmers' cooperatives.

4.4.10. Asset management

Asset management is one type attribute of SC performance measurement regarding inter-organizational point of view. As shown in the Table 4.13 based on respondents' responses, the mean value scored 2.83 results of asset management activity performance and it was a moderate performance level on the basis of five-point Likert's performance level decision criteria according to Al Sayaad *et al.* (2006) and Tekliye (2017). The cash-to-cash conversion cycle time and inventory turnover performance moderate according to respondents' responses scoring mean value 2.91. Hence, a researcher concluded the result revealed that it needs improvement to have high or superior performance in primary coffee farmers' cooperatives of asset management performance.

To have a high performance of return on investment and accelerated cash-to-cash cycle time, fast inventory turnover is important. The inventory turnover is related to cash-to-cash cycle time and it is important to have accelerated time of cash-to-cash conversion for coffee farmers' cooperatives (Tilahun, 2007; Langley, 2008; Kachru, 2013; Banomyong *et al.*, 2017). Therefore in the coffee production system, the inventory turnovers have high benefits for a company to recover its inventory investment rapidly and to have reduced inventory holding cost. Therefore, the study result described the primary coffee farmers' cooperative should have high inventory turnover to have a fast return on their fixed and working capital investments.

Table 4.13: Asset management analysis of respondents' response (Field survey result, 2019)

Activity: Asset management performance	N	Range	Mean	Std. Dev.
In our organization inventory turnover is fast accelerating cash-to-cash cycle time.	118	4	2.91	1.23
In our organization there is high performance of return on investment of fixed and working capital.	118	4	2.72	1.3
Our organization practiced evaluation of asset management within given time interval to take corrective action.	118	4	2.85	1.24
Asset management performance responses mean value	118	4.00	2.83	.973

Inventory turnover is one of the measurements of the performance of asset management efficiency in SC. It measures the number of times that an enterprise turns over its stock per year and it indicates the amount of inventory required to support a given level of sales. Since, low turnover ratios mean those coffee farmers' cooperatives with large stocks on hand showing it is difficult to sell their product, and this may be an indicator that the management is not able to

control its inventory effectively. High turnover ratios mean that the cooperatives are able to recover their inventory investment rapidly and that there is a good demand for its products. In the last of the existing SC performance of coffee farmers' cooperatives, descriptive statistics summarizes the existing overall SC performance has indicated in Table 4.14 having performance level 2.7371 in section 4.3 and from sub-topics 4.3.1 up to 4.3.10.

Table 4.14: The existing overall SC performance of cooperatives (Field survey result, 2019)

Processes and activities	N	Minimum	Maximum	Mean	Std. Dev.
Planning process performance	118	1.50	3.83	2.4065	.51172
Sourcing Process performance	118	1.67	3.67	2.4464	.38207
Make process performance	118	2.00	4.00	3.1085	.45790
Delivery process performance	118	1.25	4.25	2.4788	.69995
Return process performance	118	1.25	3.25	2.1419	.36905
Reliability Performance	118	2.25	5.00	3.4301	.61402
Responsiveness Performance	118	2.00	5.00	3.5652	.70307
Flexibility Performance	118	1.00	5.00	2.5308	1.03137
Cost performance	118	1.00	5.00	2.4379	1.13707
Asset management performance	118	1.00	5.00	2.8248	.97306
Existing SC performance				2.7371	

4.5. Analysis of business operation process at SCFCU level

4.5.1. Source process at SCFCU level

The interview result from SCFCU experts shown what looks like a business operation process in the union. The result has been analyzed all business processes on the basis of the SCOR model using the interview as input for this study. Hence, a SCFCU purchases a coffee product from primary coffee farmers' cooperatives on the bases of the contract agreement with primary coffee farmers' cooperatives as suppliers and foreigner importers as buyers. The primary coffee farmers' cooperatives sell processed arabica coffee product to SCFCU and negotiate prices based on the coffee quality followed by central market price information, but there is no bidding systems except SCFCU accomplish bidding system after coffee has been purchased by SCFCU from primary coffee farmers' cooperatives fullfing their responsibility.

4.5.2. Make (Re-processing) process at SCFCU level

Make process at SCFCU can be carried out, sourcing processed coffee from each primary coffee farmers' cooperatives. Table 4.15 shows annual coffee production and supply of SCFCU from cooperatives of Sidama Zone. The coffee product purchased (sourced) from primary coffee farmers' cooperatives can be handled and re-processed by SCFCU to get a green coffee product in the Union's own facilities before export. The major activities are associated with make process of a coffee product are re-processing to get green exportable coffee beans, re-sorting by weight and size of beans and finally re-packing activities can be carried out. Here during re-processing time coffee product at SCFCU level should be sorted by quality, grade level, and weight of beans. Although, in Ethiopia context, the grading levels are 1-9 SCFCU exports high-quality coffee product the grade level 1-2. Below-quality grade level 2, they sell to only domestic private traders by means of either negotiation or bidding process.

Table 4.15: Annual coffee production of SCFCU (Sidama Zone Agriculture and Na/Re/Devt. Office 2018; Sidama Zone Cooperatives Office, 2018)

Coffee supply and demand from Sidama Zone coffee farmers' cooperatives to SCFCU in tons	Production year						
	2013	2014	2015	2016	2017	2018	Average
	4366	6326.1	5584.2	5567.4	8074	10,000	6653
Wet processed coffee in tons	3,944	5,368.41	5,005	4,734.4	7,061.9	8,800	5,769.51
Sun-dried coffee in tons	422	957.70	579.2	833	1,011.2	1200	834
Numbers of cooperatives	47	47	51	53	61	61	
Average supply quantity of each							109.1

Figure 4.11 has been used to illustrate annual coffee production and supply of SCFCU.

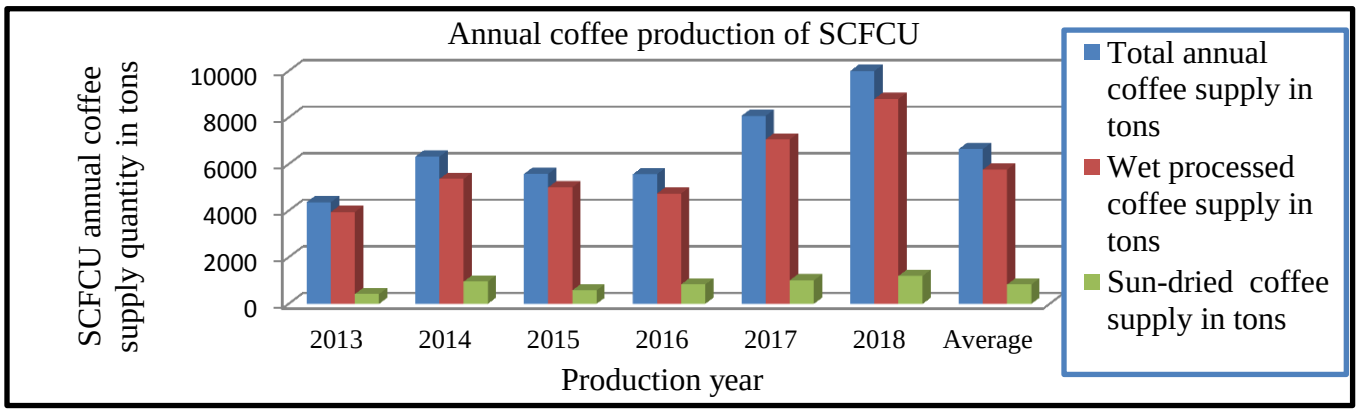


Figure 4.11: Annual coffee production of SCFCU (Field survey resul, 2018)

4.5.3. Deliver process at SCFCU level

The SC of coffee starting from farmers ends at the ultimate coffee product user as illustrated in Figure 4.12. Sourced coffee products from cooperatives by SCFCU, after re-processing activities are performed at SCFCU high-quality coffee products can be exported after a few weeks. This high-quality coffee product in the context of SCFCU means grade 1 up to 2 only as they conduct contract agreement with foreigner importers to supply high-quality coffee in a production year. The major activity is related to the Delivery process of the coffee at SCFCU is selling a coffee product to foreigner importers they transport a coffee product to downstream to deliver foreigner importers up to Djibouti port. The coffee product will deliver to roasters, retailers, and customers through foreigner importers. A low-quality coffee can be sold for domestic traders for domestic consumption.

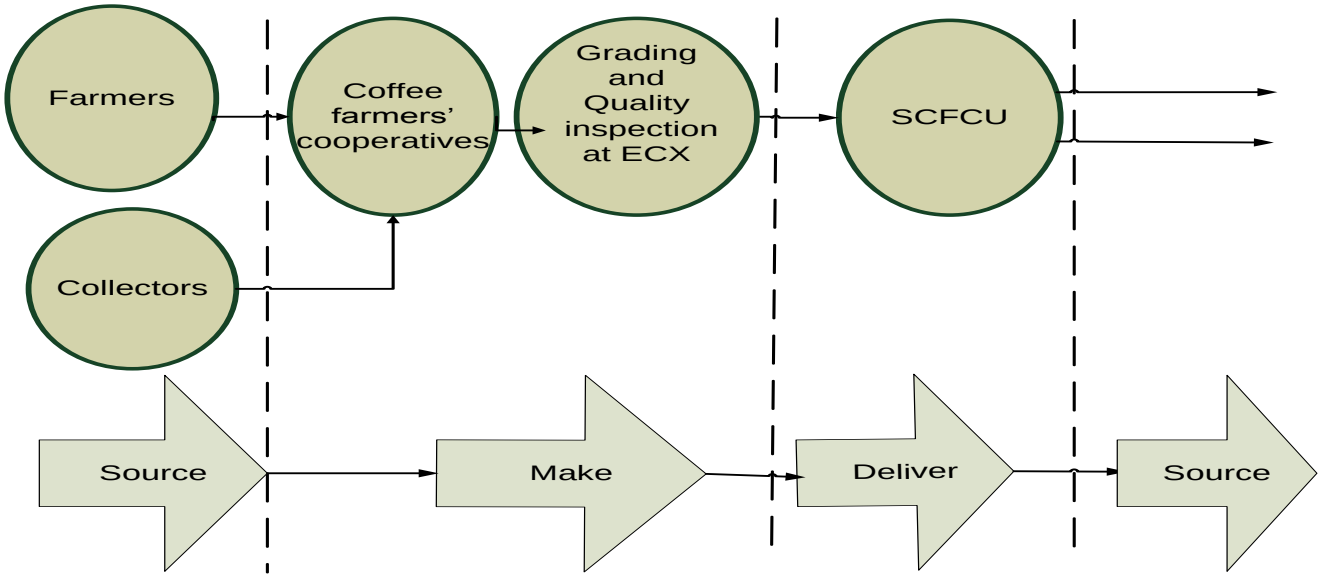


Figure 4.12: Source and Make process in SC of SCFCU (Field survey result, 2019)

4.5.4. Return process at SCFCU

The product received from primary coffee farmers' cooperatives, SCFCU sell for domestic private traders and exporter rather than return back. Here, a Return process is no critical business operation process as described by interviewers. However, starting from the interview result as a researcher would like to suggest, they should implement a Return process although selling a low-grade coffee product for domestic private traders is good practice; without having return process management strategy they cannot handle if the return case may happen, unfortunately.

4.5.5. Business operation process enablers of cooperatives and SCFCU

To investigate how SC performance management using enablers and in the primary coffee farmers' cooperatives how was their practiced; the interview and field observation result shown that there was no software that can automate their business processes to facilitate their operations at the primary coffee farmers' cooperative level. Whereas at SCFCU level there is a computer using practice and internet online service is a common system. In primary coffee farmers' cooperatives, the challenge was caused by financial problem and professional deficits. Because there were financial and professional manpower shortages and IT infrastructure challenges at the primary coffee farmers' cooperatives level unable them cannot properly facilitate and implement business management rules and enablers.

Additionally, as interviewers, there were challenges in the financial capacity of raw materials purchasing and production operation processes. In this survey study, some interviewer described that high financial challenges in coffee production and Delivery processes including high cost of material for constructing the raised drying beds, limited know-how, and lack of working capital are most critical problem of them followed by price instability and fluctuation like unbalanced price of coffee in local and the world market. To enable their SC operation processes most information collection and information exchange activities in SC was done mainly based on manual paper works, mobile telephone means at the Primary coffee farmers' cooperatives level.

Based on the information obtained from the interview on enabler and challenges, a researcher concluded and understood that the result has shown that they should have experienced professionals for their operational process and the government should support encouraging the financial provision and commercial bank services near them. Similarly, the study was conducted by Debela (2013) stated on coffee production financial problems, suggesting that the solution can be arranging credit facilities, gaining access to local banking services and government intervention in regulating the coffee market. Therefore, a researcher suggested that the coffee processing financial problem can be solved through the provision of financial resources to purchase the requisite equipment and training, hiring experienced professionals.

4.5.6. Best practices in SC of cooperatives and SCFCU

SCFCU has a better reputation and it is competitive in domestic and global market having different international awards including world specialty commodities award, Paris 2005, roasters guild, specialty coffee association of America award, Seattle 2005, Coffee Ethiopian

Competition 2005, International quality award, the Arch of Europe, Frankfurt 2004 and SCFCU is Certified Fair-trade at fair-trade labeling organization (FLO) with certification ID 2519 since 2003 as described by interviewer of SCFCU experts. This is also considered as best practices having product differentiation and uniqueness.

Furthermore, the SCFCU and cooperatives have their own logo and certification ID of FLO for each cooperative as well as barcoding technology to communicate effectively in their business commercialization process. Other coffee exporting enterprises around them have been using the SCFCU trade name negotiating with them nevertheless; the interview result indicated that there was inadequately automation of operation process enabling system and computerization at primary coffee farmers' cooperatives.

4.5.7. "As-Is" SC performance gaps of coffee farmers' cooperatives

To analyze data in "As-Is" situations the first step was started determining the problem within the SC by interviewing, visiting and using developed questionnaires as instruments of data collection. Using these instruments in this survey study, the problems founded shown in "As-Is" (existing) SC performance analysis in the previous section.

In "As-Is" SC performance, the identified problem extremely existed in raw material sourcing and production processes being costly production systems with unimproved SC performance and to a different extent were existed in plan and delivery processes. In the Source process, purchasing the raw material quality such as red cherries immaturity and associated cost is a challenging problem of coffee farmers' cooperatives. Likewise, in Make (production) process, the product quality associated with sourcing raw material and production cost was a challenge of primary coffee farmers' cooperatives. In addition, in the production process dryness of coffee product and moisture content unbalance was the main challenge in coffee processing activities of primary coffee farmers' cooperatives.

Similarly, product storage and warehousing have shown poor performance. In warehousing activity, moisture content of product considering product storage system was taken as challenges of the production system. The associated problems due to high moisture content and lack of fast service provision, the delay, and long-time consumption at ECX during grading and quality inspection problems existed sometimes. Furthermore, the delivery date and inventory level are undetermined at primary coffee farmers' cooperatives during the time of coffee product transportation to SCFCU due to lack of delivery schedules.

The planning and scheduling activities have shown poor performance in the existing SC performance. Due to poor planning performance, Primary coffee farmers' cooperatives unable to improve business operation processes performance in the SC such as Source, Make and Delivery processes. This shows that they need to have a suitable and accurately forecasting model to improve forecasting accuracy. In this case, it is recommended for Primary coffee farmers' cooperatives to use time series method of forecasting. In the time series method very simple method is a simple moving average which is suitable for them associated with their forecasting skill. Nevertheless, they can use linear regression and trend prediction using seasonal forecasting to adjust seasonal demand and supply as well as price fluctuation problems to have accurately forecasting results. With respect to performance evaluation models and metrics, the primary coffee farmers' cooperatives have no suitable SC performance evaluation models and standardized production process evaluation system. These challenges all are making the primary coffee farmers' cooperatives to be ineffective reducing the SC performance.

Therefore, based on the collected data, result analysis and best practices of the business operation process, it is recommended in this research study in order to improve SC performance gaps occurred in "As-Is" (existing) that holds back a business operation process performance in coffee processing industries as shown in the following Table 4.16 visualizing "As-Is" result summary and "To-Be" SC performance analysis of primary coffee farmers' cooperatives and in next topic.

Table 4.16: "As-Is" and "To-Be" SC performance of cooperatives (Field survey result, 2019)

"As-is" and "To-Be" SC performance of primary coffee farmers' cooperatives			
Business processes and activities	Respondents response mean value of existing Performance analysis	"As-is" or existing Performance	"To-Be" or future Performance
Planning process performance	2.4065	Poor	Superior
Sourcing process performance	2.4464	Poor	High
Make process performance	3.1085	Poor	High
Delivery process performance	2.4788	Poor	Superior
Return process performance	2.1419	Poor	Moderate
Reliability performance	3.4301	High	Superior
Responsiveness performance	3.5652	High	Superior
Flexibility performance	2.5308	Poor	High
Cost performance	2.4379	Poor	High
Asset performance	2.8248	Moderate	High
SC performance	2.7371	Moderate	High

Considering SC performance improvement in business operation process of coffee processing industries SC of coffee farmers' cooperatives, from the experiences gained personally improvement of all processes cannot be achieved at one time to have a superior SC performance but it can have superior performance step by step; while some critical processes performance may be required to be superior such as plan, source, delivery process, an activity such as reliability activity and responsiveness required to be superior performance in coffee SC.

4.6. Supply chain modeling on the bases of "To-Be" analysis

4.6.1. Supply chain modeling using SCOR model

In the SCOR model, "To-Be" analysis can be needed for SC modeling as it is one of the important steps to go forward with company-wide improvement initiatives. According to Georgise *et al.* (2013), there are different inputs that can be used to facilitate improvement activities. These inputs are the "As-Is" performance, gap analysis and best practices. The data analysis result and the "As-Is" performance revealed real practical and actual situations in the organization. This will be the basis of the "To-Be" model for further improvement activities.

SC performance evaluation and modeling is an important part of SC improvement initiative and SCOR model plays an important role in SC modeling as management tool. For that reason, to overcome the challenges were existed as a gap in "As-Is" SC performance of business operation process in coffee processing industries SC in the previous section, the solution can be as mentioned in the following in "To-Be" analysis of SC performance which is needed to be in the future time. In this case, five main processes proposed are including improvement of Plan, Source, Make, Deliver and Return processes.

The first process is Plan and it extends the planning involve other actors in SC. Consequently, to have excellent SC performance, they should plan at regular in periodic intervals having annual, quarterly, monthly, weekly and daily schedule with the standard activity performing time for their business operation process for both MTS and MTO production strategies. Here, the plan is recommended on the basis of the database. This enables them to revise a plan to reduce uncertainty increasing production and supply accuracy contributing to SC response time.

In the Source process, to have high quality and fully matured coffee cherries it should be considered harvesting should be done selective and in a proper way to reduce production cost and product quality problem. If the coffee cherries quality problem existed, they should negotiate

at the present time to maintain quality, quantity and price balance and for the next time improvement of incoming raw material. To minimize the cost in sourcing and production quality of red cherries and maturity level inspection and verification is important including quantity and price to succeed high-quality products at low cost. The inspection for quality control, check up in quantity and price then verification can be done having cross-functional quality inspection team in both purchasing and production process before receiving raw material and achieving payment.

In Make (production) process, properly drying of a coffee product during wet-processing should be considered to reduce delay problem in ECX and quality. Moisture content checkup system implementation should be considered in the production site by a cross-functional quality inspection team. The coffee product should be stored at appropriate moisture content using a pallet and racking systems introducing simple modern storage ways to prevent improper storage damping on the ground of coffee products and quality problems. Likewise, Warehouse management performance should be improved to maintain high-quality products improving product handling systems. In waste removal, the re-use system should be implemented in the production process.

To reduce transportation time and cost, it can be better identification of transportation alternatives in price and amount of product load to have economies of scale. In the Delivery process, they should have delivery schedules and should determine the inventory delivery date to improve inventory management. In the "To-Be" analysis, five attributes considered such as reliability, flexibility (agility), responsiveness, asset management considered and the first level SCOR model SC performance evaluation metrics recommended to be used in primary coffee farmers' cooperatives are shown in Table 4.17 to have an excellent SC performance.

Therefore, Primary coffee farmers' cooperatives can use these proposed level I metrics in Table 4.17 implementing easily in their business operation process to evaluate their SC and inter-organization performance in a suitable way. To measure order fill rate performance, they can measure by dividing the number of the order delivered without complaints by total numbers of the order and the result will be multiplied by a hundred percent. Similarly, customers' complaint can be measured dividing number of complaint from customers by numbers of total order and the result will be multiplied by a hundred percent. Responsiveness measurement in terms of on-time delivery, it can be measured orders delivered on a committed date divided by total orders and the resulting value can be multiplied by a hundred percent.

Table 4.17: Proposed SCOR model Level I SC performance metrics (Researcher, 2019).

	Attribute	Metrics
Customers perspective	Reliability	A reliability metrics include perfect order fulfillment, high-quality raw material supply (fully matured coffee red cherry), high-quality product supply, minimization of the number of returned products and customers complain minimization. Customers complain minimization also includes solving the way costumers complain about having complained management strategies. Doing so, they can achieve delivering the right product, to the right person, at the right time.
	Responsiveness	Responsiveness metrics include order fulfillment cycle time and on-time delivery are proposed to be used in coffee farmers' cooperatives.
	Flexibility	Flexibility in production volume, in time of delivery, SC risk management, changing the variety of products including producing wet-processed and sun-dried coffee products considering demand and cost are proposed to be used in coffee farmers' cooperatives.
Internal performance perspective	Cost	Cost metrics are related to financial performance including the cost of goods sold, minimization of raw materials cost, minimization of production cost, administrative cost reduction having the balance of manpower, resource waste minimization and holding an economic quantity of inventory level within SC and in production level.
	Assets	Assets metrics include machine capacity utilization, effective human resource utilization, high inventory turns over, fast cash-to-cash cycle time, determined inventory days, high return on working capital and fixed assets are proposed for coffee farmers' cooperatives.

4.6.2. Level III SCOR model business operation process mapping

Considering the result discussions and data analysis, a business operation process improvement is visualized mapping SCOR model level III in this study as "To-Be" analysis using sub-processes elements. "To-Be" analysis of results suggested that primary coffee farmers'

cooperatives can take improvement action to respond effectively to the challenges that currently facing in business operation processes holding back their SC performance.

4.6.2.1. Plan process mapping

Plan process mapping of the coffee processing industry is used to visualize and identify possible problems in the flow of material and problem-solving methods on the basis of the SCOR model proposing in a suitable way for coffee processing industries SC in business operation processes. Thus, integrating and communicating a Plan process in the organization and throughout SC they can execute and enable their business operation process. Here, the Return process (sR1, sR3, and sDR) is considered to be adapted and implemented in Primary coffee farmers' cooperatives to adjust process achievement mechanism when unfortunately a return process happened.

The primary coffee farmers' cooperatives' plan practices and capacity unable to handle the SC plan process. Thus, all processes are adapted modifying for coffee SC in business operation processes from the standard SCOR model in the following as shown in Figure 4.13 on the basis of suitability and capacity of primary coffee farmers' cooperatives. In the planning process, they also consider the execution system and enablers in terms of information communication technology that help them to perform activities in an effective way.

Therefore, a SC plan process is modified considering annual, quarterly, monthly, weekly planning and scheduling for the primary coffee farmers' cooperatives. Having a plan, the Primary coffee farmers' cooperatives can align the expected resources to meet demand balancing aggregated supply and demand. So they should plan at regular, periodic intervals contributing to SC response time (sP1). In the production process, they should balance the production resources with production requirements (sP3). The preparation of production plans and production activities should be scheduled and begin on the basis of scheduled activities having activities performing standard time. The production schedule and plan should be based on the database. Then plan enables the scheduling of production activities communicating SC coffee processing and supply activity.

When the primary coffee farmers' cooperatives' coffee processing industry gets an order i.e. they follow Make-To-Order product production strategies (MTO), the process of production scheduling and production begin aligning the expected resources to meet demand. This helps and enables them to revise the current planning system to reduce uncertainty in the coffee supply process increasing the accuracy of a Plan in the production operation. Then they Plan source

(sP2) and Plan Delivery (sP4) need to configure with the planning process to ensure appropriate mechanisms of performing the processes during purchasing right quality as well as right quantity with acceptable price to achieve low production cost and delivering product at the right time, at the right quantity and quality to a SCFCU and then to their customers. This allows on-time delivery and cost minimization alternative operations improving SC performance.

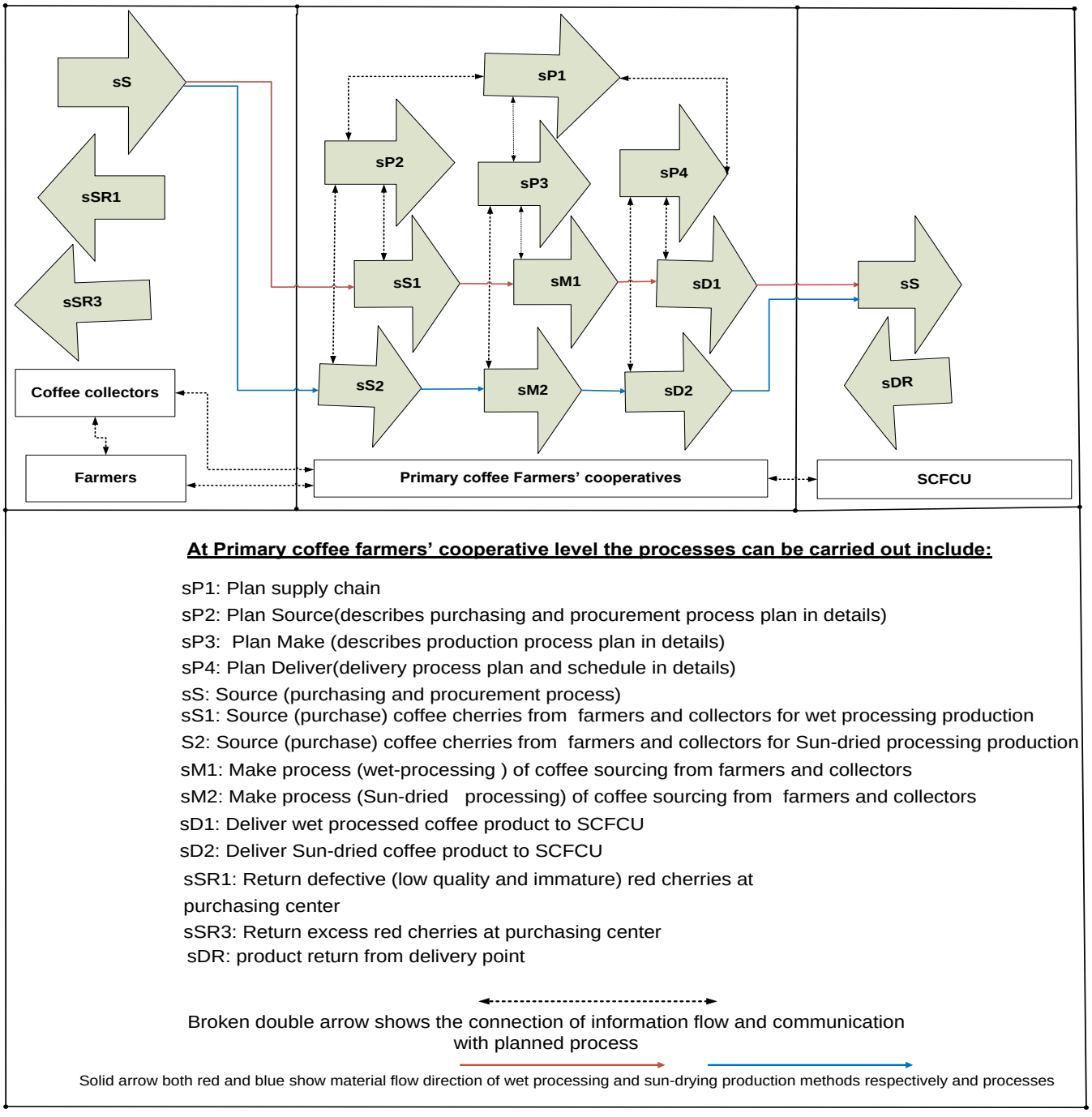


Figure 4.13: Coffee Source process elements of Cooperatives (Researcher, 2019).

4.6.2.2. Source process mapping

The coffee cherries quality is a challenging problem, frequently faced by production activities for primary coffee farmers' cooperatives. So, the coffee farmers' cooperatives for their coffee processing industries need to purchase from different suppliers i.e. one time from one supplier and another time from another to satisfy the needs of the customers and to minimize quality problems. To solve these problems with respect to having correct quality, quantity and cost; the result of the study shown how can be sourcing should be performed in the previous section.

The Source process (sS) is the second process of SCOR model and level III consists of process categories of sourcing stocked-product (sS1) and sourcing ordered product (sS2) for wet-processing and sun-dried coffee production respectively. In purchasing process to develop the most appropriate supplier having good relationships cooperating with suppliers, selecting best source of supply, managing of the source of supply to purchase correct quality coffee and identification suitable purchasing time when the local coffee collectors and farmers can deliver directly orders to primary coffee farmers' cooperatives. So, they should make made negotiation for Delivery time and purchasing process on the basis of local market prices.

On the basis of the "To-Be" analysis, the following procedures are recommended based on SCOR model level III business operation process elements. When the primary coffee farmers' cooperatives buy red cherries, they should have a schedule of receiving. Red coffee cherries arrived at processing sites, it can be considered as received for both MTS (sS1.2) and MTO (sS2.2) products respectively if there is no complaint on quality, quantity, and cost. As red coffee cherries are received verification and checking quality of red cherries in terms of maturity level, price and quantity of coffee cherries for both (sS1.3) of MTS and (sS2.3) of MTO should be performed respectively.

The supplier payment authorization (sS1.5 and sS2.5) takes place after the inspection and verification process. If the quality problem occurred they negotiate in purchasing price and improvement for the next time. Otherwise, they can return back to the supplier to maintain correct product quality. In the Source process, performance evaluation and decision making require performance indicators such as suppliers' performance evaluation on the basis of raw material quality, delivery lead time and cost. The next process is, red coffee cherries can be transferred to the production processes (sS1.4) of MTS and (sS2.4) of MTO as shown in Figure 4.13 and 4.14 after verification carried out, the production can begin (sM1.2. and sM2.2).

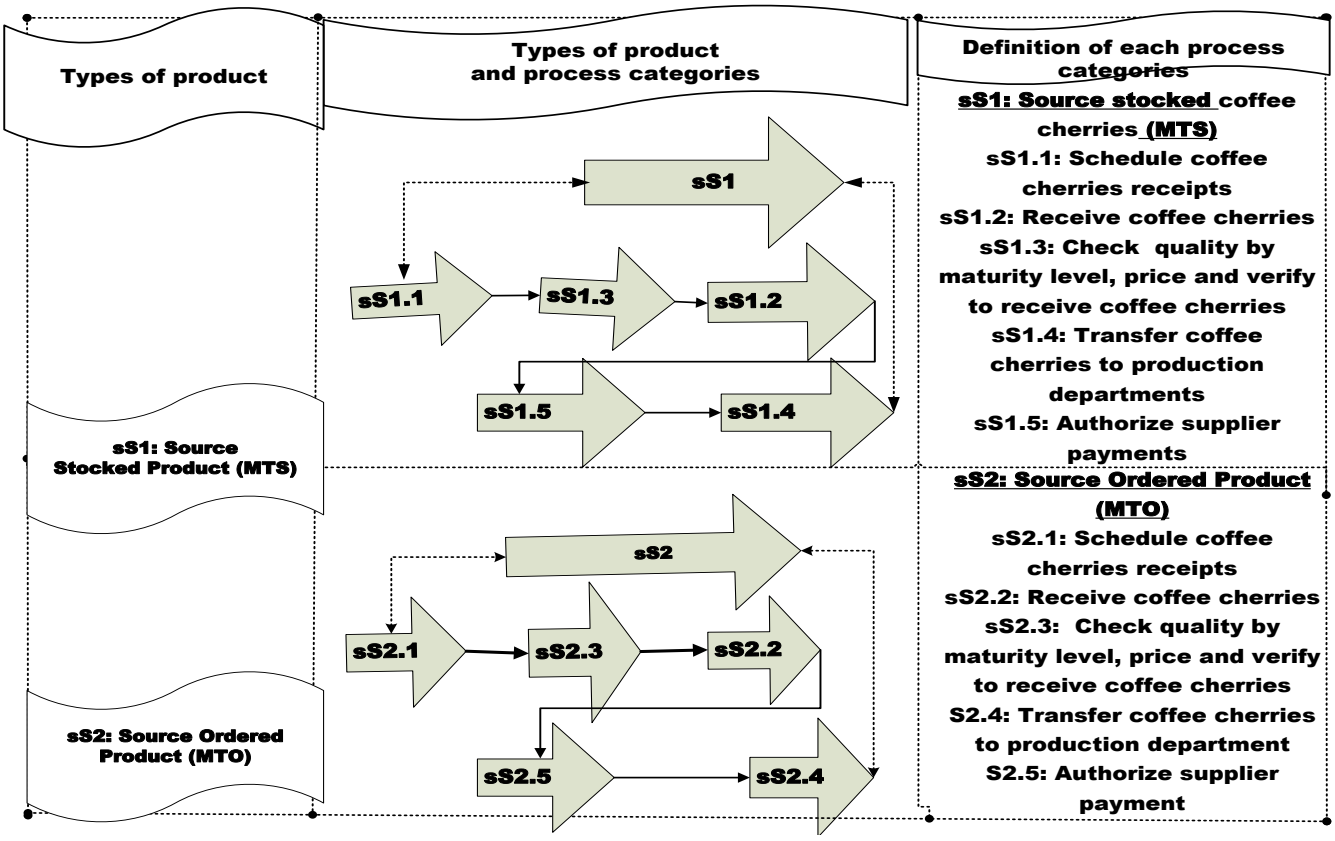


Figure 4.14: Coffee Source process elements of Cooperatives (Researcher, 2019)

4.6.2.3. Make process mapping

The existing production activities are mainly it was labor-intensive and the source of the costly process. Thus, in make process mapping of SC on the basis of the SCOR model level III process elements with modifying process element for coffee SC from standard SCOR model. The quality control is the main activity in the production process and mainly responsible by the production department. This should be suitable when it is incorporated into the quality control case team within the source and make processes in terms of verifying (sS1.3 and sS2.3) and produce and test (sM1.3 and sM2.3) activities as shown in Figure 4.14 and 4.15. Here, it is recommended as they should check the price of raw material is either acceptable or not on the basis of quality and quantity.

The quality control and assurance activity need to extend their coverage from raw material suppliers up to product delivery to SCFCU and then to customers. Other activities that need attention are the waste and waste disposal including re-using especially after coffee washed, the red cherries skins damped around the mill that can be environmental pollution should be re-used.

In coffee processing industries, even though the disposal of wastes is common practices to prevent environmental pollution; the production needs to be an eco-friendly production system. So, in a production process, the waste disposal activity (sM1.7) and (sM2.7) is recommended as it should consider re-use as fertilizer and the other means. Therefore, the Make process should be adjusted to control these challenges; they should use carefully disposal of the waste and waste re-using system to reduce the risk of environmental pollution maintaining an eco-friendly production system.

Here, in the production process packaging and warehousing activities needed to give attention to the production process. So, to have suitable packing, then the activity assigned as a package (sM1.4 and sM2.4) can be performed considering the quality of the product. This packaging activity should be using suitable jute bag and storage activities should be performed considering the prevention of moisture absorption for both MTS and MTO product respectively as illustrated in Figure 4.15.

During storage, it is recommended as they should use the pallet and racking system to prevent moisture absorption damping on the ground. If coffee damped on the ground without having a properly handling system it can absorb moisture easily; thus, without appropriate storage coffee can be infected quickly to deteriorate quality. During this survey study, warehouse management has shown poor performance. Goods are moved manually without mechanical assistance due to lack of modern material handling mechanism and equipment. So, it is recommended that a warehouse should be mechanized with modern material handling systems and equipment such as using pallets and racking system because it improves store management practice reducing space limitation (shortage) occupied by disorder arrangements of goods.

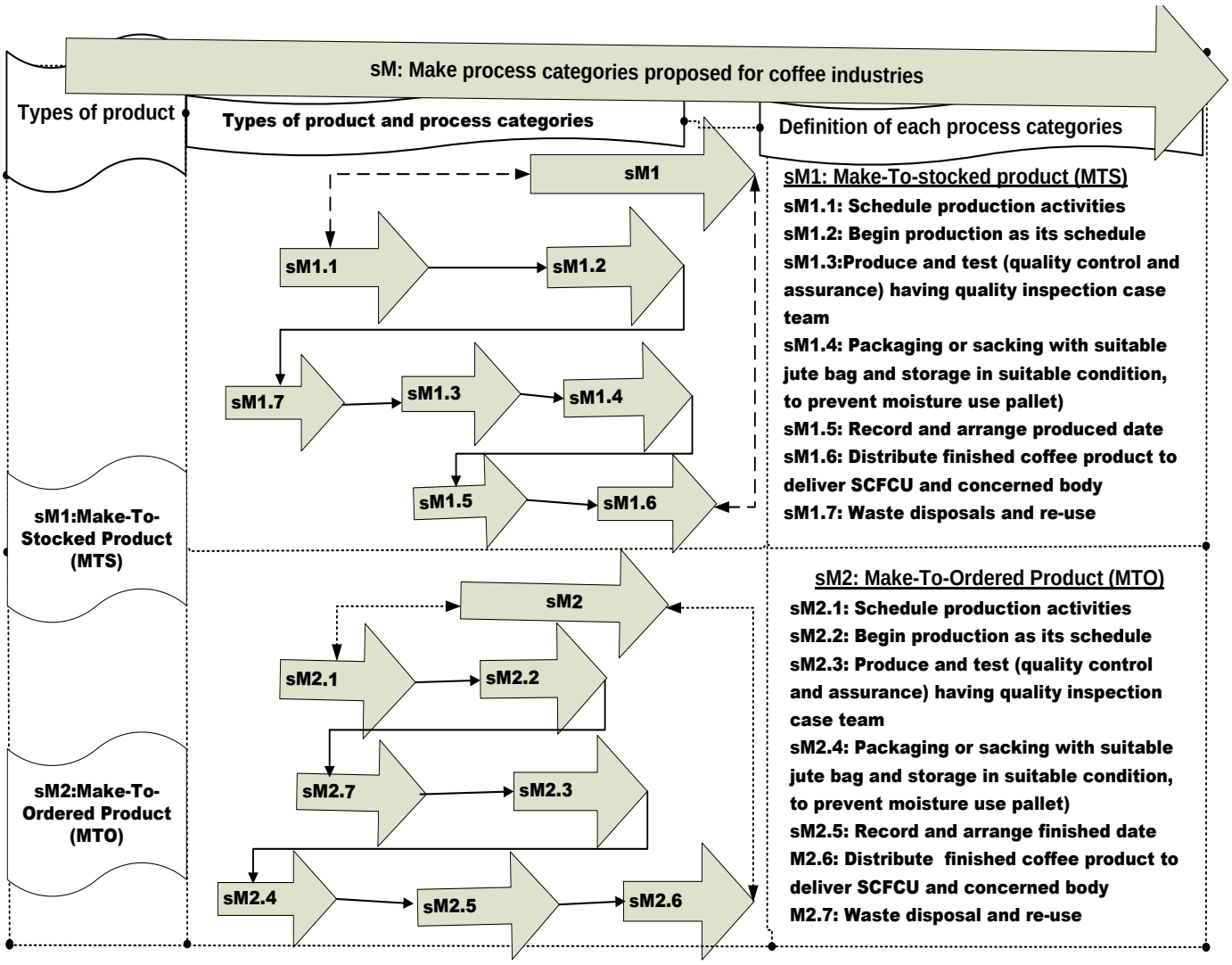


Figure 4.15: Coffee processing process model of Cooperatives (Researcher, 2019)

4.6.2.4. Deliver process mapping

In the field study, there were mainly three different types of delivery in the coffee processing industries business operation process, starting from coffee red cherries suppliers up to SCFCU then deliver to the domestic whole seller and foreigner importers. Primarily Delivery is from local coffee collectors and farmers to Primary coffee farmers' cooperatives for the coffee production process. The second delivery given attention, to map is coffee products Delivery process flow can be Delivery of product from Primary coffee farmers' cooperatives to SCFCU for re-processing activity and export purpose. Then, finally, the Delivery process is from SCFCU to domestic private traders and foreign importers after coffee product re-processed to reach its customers.

Therefore, the second type of delivery process focused to map on the basis of the SCOR model level III process elements modifying process element for coffee SC from the standard SCOR model. In this case, the Delivery process (sD) which is recommended with its process categories of Deliver MTS (sD1) and Deliver MTO product (sD2) as well as wet-processed and Sun-dried coffee product from processing site up to SCFCU as shown in Figure 4.16.

On the basis of the "To-Be" analysis, the coffee farmers' cooperatives start from process elements such as to receive, enter and validate order (sD1.2 and sD2.2), reserve inventory and determine the delivery date (sD1.3 and sD2.3) activities can be carried out one-to-one ordering their logical flow. Here, the characteristic that needs attention is inventory management practice. The inventory management should be optimized using an economic order quantity level in production and throughout SC.

To be cost-effective in transportation the selection of suitable vehicle (truck) in terms of cost or transportation rate (sD1.7 and sD2.7) and load size and should be considered. In transportation, a recommendable approach is using economies of scale to minimize transportation cost per unit load of a product should be considered. Next process element can be load product activity (sD1.11 and sD2.11), in terms of transporting product from production sites to SCFCU can be followed and receiving a product from source or make (sD1.8 and sD2.8) i.e. from cooperatives by SCFCU should be considered and then after pick product (sD1.9 and sD2.9) activities should be considered at SCFCU.

Finally, an invoice is then compared to the delivered quantity and quality (sD1.15 and sD2.15) by SCFCU and payment takes place. Purchase requirements for the processed coffee by SCFCU can be made through negotiation on the basis of national market prices or bidding to sell for domestic private traders and only bidding for foreigner importers. Here, from Delivery process elements and activities only used is critical for coffee processing industries in the channel from processing site up to SCFCU, modifying from standard SCOR model because of they were believed as important within-country SC and unimportant are ignored.

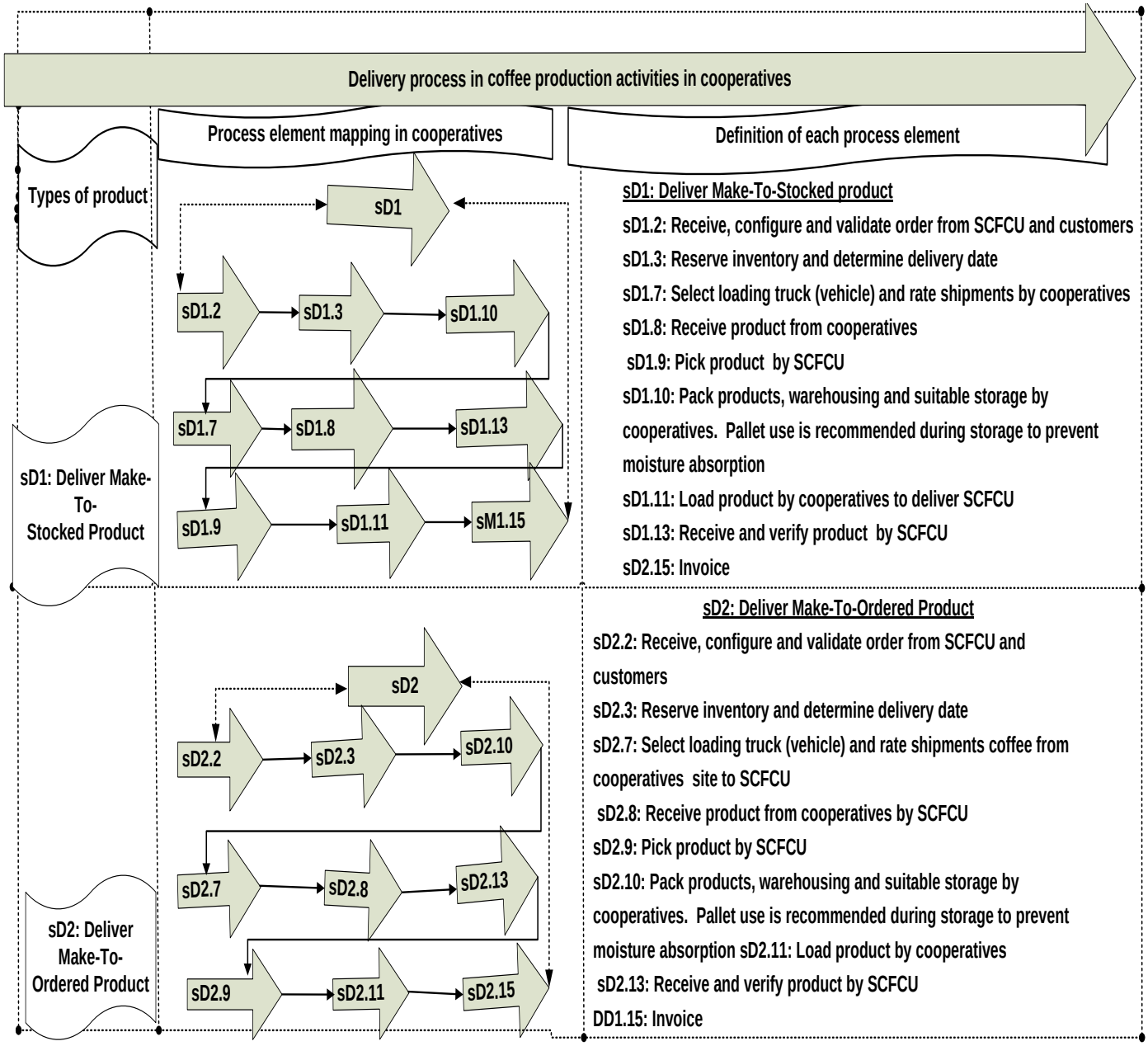
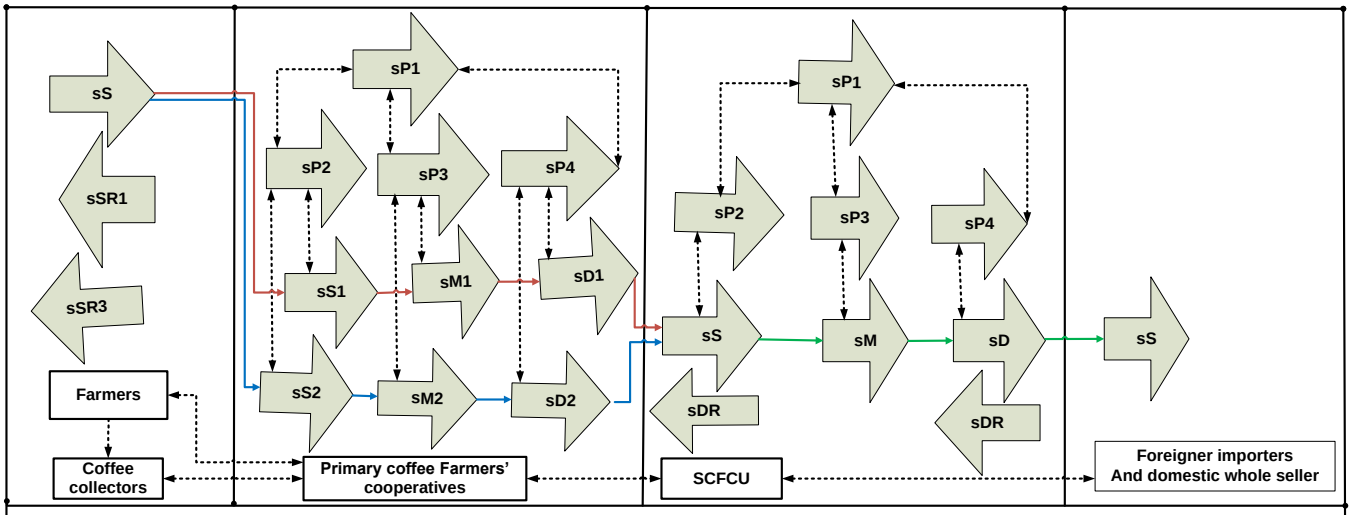


Figure 4.16: Coffee Delivery process of Cooperatives (Researcher, 2019)

4.6.2.5. Return process mapping

The last process of the SCOR model required to analyze can be focused on the return process of only cooperatives. Performance evaluation and performance indicators of the Return process are recommended at purchasing and decision making for coffee cherries on the basis of raw material quality and maturity. At this level, they should ensure the maturity level of coffee can be either it is fully ripe or not. Here, if there is red cherries quality problem existed; they should advise and

negotiate with raw material suppliers considering the next time improvement and at the current time to have balanced or acceptable price based on quality and quantity. If it is fully matured they can receive and otherwise there is a continuous problem in quality they should practice return back (sSR1) to the raw material supplier as illustrated in Figure 4.17.



At Primary coffee farmers' cooperative level the processes can be carried out include:

sS1: Source (purchase) coffee cherries from farmers and collectors for wet processing production

S2: Source (purchase) coffee cherries from farmers and collectors for Sun-dried processing production

sM1: Make process (wet-processing) of coffee sourcing from farmers and collectors

sM2: Make process (Sun-dried processing) of coffee sourcing from farmers and collectors

sD1: Deliver wet processed coffee product to SCFCU

sD2: Deliver Sun-dried coffee product to SCFCU

sSR1: Return defective red cherries at purchasing center

sSR3: Return excess red cherries at purchasing center

sP1: Plan Supply Chain

sP2: Plan Source (describes planning process of purchasing and procurement process in detail including MTs and MTO production strategies)

sP3: Plan Make (describes planning process of coffee production for both wet-processing and sun-drying method including MTS and MTO production strategies in detail including MTs and MTO production strategies)

sP4: Plan Deliver (describes planning of delivery process of coffee product for both wet-processed and sun-dried product including MTS and MTO production strategies in detail)

sS: Source (purchasing process from raw material suppliers or production centers)

At SCFCU level processes can be carried out include:

sS: Source coffee product from coffee farmers' cooperatives

sM: Re-process sourced coffee product from coffee farmers' cooperatives considering MTS and MTO production strategies

sD: Deliver re-processed coffee product to foreigner importers and domestic private traders considering MTS and MTO production strategies

sDR: product return from SCFCU i.e. from delivery point to cooperatives and from purchasing point i.e. domestic traders to SCFCU but it cannot return from importers to SCFCU due to the problem being costly and lack of handling mechanism.

Broken double arrow shows the connection of information flow and communication with planned process including product and finance flow

Red, blue and green solid arrow show flow of materials.

- **Red color arrow shows wet processing production method**
- **Blue shows sun dried coffee for sun-drying production method and**
- **Green arrow to shows re-processed coffee product (green coffee product) ready for export process at SCFCU level respectively.**

Figure 4.17: The SC business operation process of SCFCU proposed "To-Be" in future time

The other key point is here, to return back raw material (sSR3) is the excess quantity of raw material considering daily production capacity as well as the financial capacity of the organization as illustrated in Figure 4.17. Accordingly, they can consider how quantity and quality of raw materials delivered from red cherries suppliers are.

In the case of cost, the purchasing price variation being high they cannot agree to purchase and return back to suppliers without paying that price. At that time raw materials suppliers can sell their red coffee cherries to private trader coffee processors. When there is a return back of coffee red cherries to supplier and rejection has existed, it can be immediately during the negotiation and purchasing time at a local auction center. Whereas, the consideration of order is completed if the primary coffee farmers' cooperative does not show any complaint within specific time limits after its reception assuming it as perfect order fulfilled.

In this research study, from the mentioned opinions, the Return process has been excluded from SCFCU back to primary coffee farmers' cooperatives because there is no local market around Primary coffee farmers' cooperatives that they can sell. This type of product can be used by SCFCU selling for domestic consumption in the central domestic market if the product delivered below the export standard of quality and rejection of product as it cannot fit an export standard. From domestic traders, it can be returned easily because it is not so far as foreigner imports being more nearer to SCFCU. However, here from foreign importers return back the product to SCFCU can be a challenge from large distance from foreigner countries due to transportation facility, cost, and handling system; but it can be handled and managed by exporting only high-quality product without having excess quantity more than order with reducing any error. At this point, the Return process is not a critical part for SCFCU for the types of products they bought from cooperatives.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The final chapter of this thesis is conclusion and recommendation based on the finding of the study focusing on the SC performance especially related to SC performance of primary coffee farmers' cooperatives. Hence, the following conclusions are made from the discussion on the objective of the study, the result and analysis in Chapter four.

5.2. Conclusion

Due to its importance, it plays for the Sidama primary coffee farmers' cooperatives and SCFCU the SC performance assessment is very important. The finding identified the weakness of SC performance evaluation and the improvement to have superior SC performance in a sustainable way within an organization and throughout the SC is important. This can be achieved by having a suitable and appropriate SC performance evaluation model.

From the study result, a researcher determined that primary coffee farmers' cooperatives and SCFCU have no suitable SC performance evaluation model and standardized suitable business operation processes. Therefore, SC performance improvement is important in their business operation processes having a suitable SC performance evaluation model because without having a suitable performance evaluation model unable to have enhanced SC performance. In this thesis, the results have shown the poor SC performance mostly in source and make processes and in different extent plan, deliver and return processes in primary coffee farmers' cooperatives. To improve the external and internal performance in a SC of Coffee farmers' cooperatives and SCFCU, by implementing the SCOR model to evaluate SC performance.

For this reason, the SCOR model as recommended as an appropriate SC evaluation model. This SCOR model is easily understandable and it has a connection with primary coffee farmers' cooperatives day to day or routine activity in coffee processing activities. Here, the contributions of a recommended model for SC performance evaluation of coffee is suitable in coffee processing industries SC and in all business sectors being the universal, balanced and dynamic model as well as exploring internal and external performance problems encountered decreasing the SC performance. In this study, the recommended SCOR model is important to analyze and to perform basic modeling that can help the coffee farmers' cooperatives improving processes

solving the problems that they encountered sourcing, production and delivery process to achieve recognition for their product quality improving SC performance of SCFCU in a sustainable way.

In this study, primary coffee farmers' cooperatives challenges identified include the quality problem of red cherries in the sourcing and production process of coffee. This can affect the SC performance reducing quality and quantity coffee in the Cooperatives production system. The qualities of raw materials like improper red coffee cherries harvesting activity lose their profit being costly production system. During the product transportation from primary coffee farmers' cooperatives processing station to deliver SCFCU through ECX it takes a long delay up to one-week consuming time due to congestion of coffee from different suppliers to be served orderly at ECX on-road increasing the extra cost. Sometimes the delay can be occurred by quality problems due to moisture unacceptable content level.

To overcome quality and delay challenges the result has shown that they should consider quality improvement and lead time reduction because coffee is a commodity which easily deteriorates along the SC. So, the primary coffee farmers' cooperatives and stakeholders can improve performance identifying weakness, gaps, and opportunities to fulfill customers' satisfaction delivering a quality product within short lead time minimizing cost to enhance their business sustainability and competitiveness having improved SC performance. To have timely and up-to-date information sharing improving information communication system in the business operation process the result of a survey study revealed improvement using suitable software.

5.3. Recommendations

The following recommendations are forwarded based on findings of the study concerning SC performance evaluation and modeling case of SCFCU based on results and discussion in Chapter four. This study would like to suggest the following recommendation concerning to supply and production process of coffee industries as well as SC performance improvement in the future.

- The primary coffee farmers' cooperatives should have planned within different time horizons especially planning and scheduling daily, weekly, monthly, quarterly and annual for their sourcing, production and delivery process is very important.
- The coffee farmers' cooperatives should improve accurate forecasting performance having a suitable forecasting model for them from the simple moving average, linear regression and trend prediction using the seasonal forecasting model.

- To have high quality and fully ripened coffee cherries coffee harvesting should be done selectively and properly in a way at the farmers level
- Farmers should able to differentiate between fully ripened cherries versus the unripe ones of the quality and quantity difference as well as cost impact giving awareness either by governmental and non-governmental organizations.
- The primary coffee farmers' cooperatives should minimize production cost and problems related to coffee quality purchasing high-quality raw material and having quality inspection team to achieve quality production process in coffee processing activities.
- The coffee product should be stored at appropriate moisture content using pallet because of improper ways of handling, damping on ground and storage affect coffee quality. A warehouse should be mechanized with simple and modern material handling systems and equipment such as using pallets and racking system because it improves space limitation (shortage) occupied by disorder arrangements of goods and helps to prevent moisture content unbalance.
- A goal of a SC is to maximize overall supply chain profitability and customers' satisfaction. To achieve this goal of their business primary coffee farmers' cooperatives should follow the cost minimization system. For this reason, the approaches they should use economies of scale in the production and transportation process, economic order quantity level of inventory level, and resource waste minimization approaches are recommended as important.
- Time-consuming inspection and grading services at the ECX centers and staying a long time as the coffee loaded on the trucks should be improved to reduce delay time and cost.
- In the primary coffee farmers' cooperatives, information communication systems should be improved to share up-to-date information on market demand and price.
- Regarding SC performance, the primary coffee farmers' cooperatives should use the computerized system in a simple and suitable way for their business operation process to achieve timely information communication and excellent SC performance.
- The primary coffee farmers' cooperatives should use the SCOR model for SC performance evaluation as it is universal and balanced approach having suitability for all type of business. The use of this tool will facilitate the SC performance, evaluating internal and external performance improving business operation processes.

5.4. Recommendation for future research

Based on the result the researcher wants to suggest three points for further studies. First, the sample was drawn only 125 members. This study may be limited in its sample size. Thus future research should be more extended in sample size to cover more diversified members and should have drawn an increased number of sample respondents. Second, this study was conducted only in Sidama Zone primary coffee farmers' cooperatives, a researcher wants to suggest future researchers externalize their research out of Sidama Zone on the same subject matter in other agro-processing industries on supply chain performance evaluation and modeling, the challenges of suitable SC performance evaluation model implementation in agro-processing industries and other manufacturing sectors. Third, in this study the respondents' selection, the customers were not included due to the limitation of time and delimitation of the study scope of SC between cooperatives and Union. This also may have its limitations in respondents' selection. For future study, the researchers may include customers covering more diversified respondents in order to have more reliable findings. Fourth, in today's changing business environment a result studied today may be changed tomorrow. Thus, researchers should always struggle for better results, new ideas, new findings, and new measurements.

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APPENDICES

HAWASSA UNIVERSITY INSTITUTE OF TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF INDUSTRIAL ENGINEERING AND LOGISTICS MANAGEMENT

MSc. Thesis study Survey questionnaire to be filled by respondent.

Dear respondents

First of all I'm, **Gassa Magara Mamo** a postgraduate student conducting research for acquiring Masters of Industrial Engineering at Hawassa University. As a practical requirement of the post graduate program, the questionnaire is in support of fulfilling the Master's Degree Thesis on the title of "Supply Chain Performance Evaluation and Modeling: Case of Sidama Coffee Farmers' Cooperative Union". It is believed that the outcome of research is very useful to managers, decision makers, Sidama Coffee Farmers' Cooperative Union and primary cooperatives. The data collected will be used for academic purposes only and the aim is only academic. Due to this reason you are requested to fill these questionnaires with clarity and the answers you offer will be treated confidential. Dear Respondents, Thank you for allocating your precious time to answer these questionnaires.

Best regards!

Gassa Magara Mamo (The Researcher)

General Instructions

- There is no need of writing your name
- Where answer options are available please tick (√) in the appropriate box provided or you can put 'X' mark in the answer options box
- If you can't get any satisfying choice among the given alternatives, you can write your answer, in the space provided for the option if other, please specify;
- For the open ended items, give brief answer in the space provided.
- For the question answer prepared in the table put 'X' mark in the given options or put number from the given option that you agree.

Contact Address

If you have any comment, please contact me and I am available as per your convenience at e-mail: *gassamagara4@gmail.com***.**

Thank you!

APPENDIX 1

Original Questionnaires

Part I. General information and demographic profiles of respondents

1) Sex: i. Male ☐ ii. Female ☐
2) Age: i. 18-30 ☐ ii. 31-40 ☐ iii. 40-50 ☐ v. Above 50 ☐
3) Educational Status:

i. has no formal education ☐ ii. Grade 1 – 10 ☐ iii. Grade 11-12 ☐ iv. College Diploma ☐ v. BA/BSc ☐ vi. MA/MSc. ☐

4) Your position in the organization:

i. Management committee member ☐ ii. Member ☐ iii. Team Leader ☐ iv. Expert ☐

5) Your year of service in the organization: i. 1-5 years ☐ ii. 5-8 years ☐ iii. 9-10 years ☐ iv. Above 10 years ☐

Performance rating for the following performance evaluation questionnaires

Strongly disagree (SD) = 1, Disagree (D) = 2, Neither nor disagree (NA)= 3, Agree (A) = 4 and Strongly agree (SA)= 5.

Part II. Performance evaluation questionnaires

6) Please specify the extent of your agreement on the performance plan process.

Activity: Plan Process	SD	DA	NA	A	SA
1. We have plan with different time horizons to balance demand and supply resource requirements					
2. Our organization plans its business activities participating stakeholders to reduce information variation of demand and supply.					
3. Our organization uses historical data and information in developing customers demand forecasting.					
4. In our organization the demand management process and plan is based on timely customer information.					
5. Cross-functional team is functional and help the plan department					
6. There are defined performance indicators and procedures implemented to measure how planned activities are achieved.					

7) Please specify the extent of your agreement level on the performance of purchasing and procurement regarding to source process

Activity: Source process	SD	DA	NA	A	SA
1. Our organization has long term relationships with supplier-buyer					
2. Our organization deliver on-time to its customers					
3. We receive raw material on-time from our suppliers					
4. Our organization has practiced suppliers' performance measurement					
5. We purchase high quality raw material frequently considering end product quality and cost					
6. There are defined sourcing process and purchasing activity performance indicators					

8) Please specify the extent of your agreement level on the performance of production process

Activity: Make process	SD	DA	NA	A	SA
1. We produce quality product frequently.					
2. We use economic order quantity of inventory in production.					
3. We have been utilizing capacity effectively to maximize productivity.					
4. We have implemented eco-friendly production system					
5. We use suitable packaging and storage.					

9) Please specify the extent of your agreement level on the performance of delivery process

Activity: Delivery process	SD	DA	NA	A	SA
1. We deliver product to our customers frequently on committed date.					
2. Delivery lead time has been determined and short based on our organization industry norms.					
3. Performance indicators have been determined for delivery process in our organization.					
4. We record product delivered time to take corrective measure.					

10) Please specify the extent of your agreement level on the performance of product return back from buyers

Activity: Return process	SD	DA	NA	A	SA
1. We have defined procedures and strategy of product return management					
2. There are defined return process evaluation key performance indicators in our organization					
3. We plan to minimize product return back					
4. Cross-functional team is actively participating to help the return process management and resources requirement in our organization.					

11) Please specify the extent of your agreement on performance of reliability to your organization customers.

Activity: Reliability	SD	DA	NA	A	SA
1. We measure customers' order completion performance and take improvement action recording order completion rate regularly.					
2. There is defined customers complain solving procedures and system in our organization.					
3. We produce quality product to deliver our customer based on customer order specification.					
4. Our organization improve customers' satisfaction delivering right product with right quantity and at right time.					

12) Please specify the extent of your agreement on performance of responsiveness to your organization customers.

Activity: Responsiveness	SD	DA	NA	A	SA
1. Our organization respond to customers' need making short production and delivery lead time as much as possible					
2. We respond quickly to our customers delivering regular and urgent order before or on committed date.					
3. We deliver quality product with right quantity and at right time to our customers.					

13) Please specify the extent of your agreement on performance of flexibility to dynamic market and demand changes.

Activity: Flexibility activity	SD	DA	NA	A	SA
1. Our organization responds to market and demand change quickly.					
2. Our production volume is flexible based on market demand.					
3. Our organization is flexible to overcome supply and demand unbalance.					

14) Please specify the extent of your agreement on cost minimization performance of your organization.

Activity: Cost	SD	DA	NA	A	SA
1. Our organization has practiced cost minimization system					
2. We use economic order quantity of inventory regularly.					
3. Our organization use economies of scale during production and product transportation.					

15) Please specify the extent of your agreement on asset management performance of your organization.

Activity: Asset management	SD	DA	NA	A	SA
1. In our organization inventory turnover is fast accelerating cash-to-cash cycle time					
2. In our organization there is high performance of return on investment of fixed and working capital					
3. Our organization practiced evaluation of asset management within given time interval to take corrective action					

APPENDIX 2

Interviews

1) How is your business operation process planning in coffee supply? Do you use data base in planning process? What is your future market demand forecasting model?
2) How your organization does sources raw materials with respect to cost, quality and on-time delivery?
3) How is your organization coffee production process operation system?
4) Does your organization evaluate its business operation performance with in given time intervals in a year?
5) What are key performance indicators and metrics used to measure your organization business operation process in a supply chain?
6) Which supply chain performance evaluation model does your organization use to evaluate business operation process performance? i. SCOR model ☐
   ii. BSC ☐ iii. GSCF ☐ iv. Audit ☐ v. if there are others please specify ---
7) How is IT and information communication technology use? Does your organization share timely and up-to-date information from customers and suppliers?
8) How is best practice management in your supply chain?

APPENDIX 3

Sub-processes of SCOR model used for to be analysis

sP - Plan	
sP1 Plan Supply Chain	**sP4: Plan Deliver**
sP1.1: Identify, prioritize and aggregate supply chain	sP4.1: Identify, prioritize and aggregate
sP1.2: Identify, prioritize and aggregate supply chain resources	sP4.2: Identify, assess and aggregate delivery resources
sP1.3: Balance supply chain resources with supply chain requirements	sP4.3: Balance delivery resources and capabilities with delivery requirements
sP1.4: Establish and communicate supply chain plans	sP4.4: Establish delivery plans
sP2: Plan source	**sP5: Plan Return**
sP2.1: Identify, prioritize and aggregate product	sP5.1: Assess and aggregate return
sP2.2: Identify, assess and aggregate product and resources	sP5.2: Identify, assess and aggregate return resources
sP2.3: Balance product resources with product requirements	sP5.3: Balance return resources with return requirements
sP2.4: Establish sourcing plans	sP5.4: Establish and communicate return
sP3: Plan Make	
sP3.1: Identify, prioritize and aggregate production	
sP3.2: Identify, assess and aggregate production	
sP3.3:Balance production resources with production	
sP3.4: Establish production plans	

Plan sub-processes (SCC, 2006; APICS, 2017: Weyers, 2017)

Source sub-processes (SCC, 2006; Weyers, 2017; APICS, 2017)

sS - Source	
sS1: Source Stocked Product	**sS2: Source Make-to-Ordered Product**
sS1.1: Schedule product deliveries	sS2.1: Schedule product deliveries
sS1.2: Receive product	sS2.2: Receive product
sS1.3: Verify product	sS2.3: Verify product
sS1.4: Transfer product to production department	sS2.4: Transfer product to production department
sS1.5: Authorize supplier payment	sS2.5: Authorize supplier payment

Make sub-processes (SCC, 2006; Weyers, 2017; APICS, 2017)

sM - Make	
sM1: Make-to-Stock	**sM2: Make-to-Order**
sM1.1: Schedule production activities	sM2.1: Schedule production activities
sM1.2: Issue material (begin production)	sM2.2: Issue sourced /in-process product
sM1.3: Produce and test (quality assurance)	sM2.3: Produce and test (quality assurance)

sM1.4: Package	sM2.4: Package
sM1.5: Stage product (record and arrange produced date)	sM2.5: Stage finished product(record and arrange finished date)
sM1.6: Release product to deliver the order	sM2.6: Release finished product to deliver
sM1.7: Waste disposal	sM2.7: Waste disposal

Deliver sub-processes (SCC, 2006; Weyers, 2017; APICS, 2017)

sD - Deliver	
sD1: Deliver Stocked Product	**sD2 :Deliver Make-to- Order Product**
sD1.1: Process inquiry and quote	sD2.1: Process inquiry and quote
sD1.2: Receive, enter, and validate order	sD2.2: Receive, configure, enter and validate order
sD1.3: Reserve inventory and determine delivery date	sD2.3: Reserve inventory and determine delivery date
sD1.4: Consolidate orders	sD2.4: Consolidate orders
sD1.5: Build loads	sD2.5: Build loads
sD1.6: Route Shipments	sD2.6: Route shipments
sD1.7: Select carriers and rate shipments	sD2.7: Select carriers and rate shipments
sD1.8: Receive product from source or make	sD2.8: Receive product from source or make
sD1.9: Pick product	sD2.9: Pick product
sD1.10: Pack product	sD2.10: Pack product
sD1.11: Load vehicle	sD2.11: Load product
sD1.12: Ship product	sD2.12: Ship product
sD1.13: Receive and verify product by customer	sD2.13: Receive and verify product by customer
sD1.15: Invoice	sD2.15: Invoice

Activity sD1.15 and sD2.15 are removed because being they are not important for coffee product

Return sub-processes (SCC, 2006; Weyers, 2017; APICS, 2017)

sR - Return		**sDR- Return**	
sSR1: Source return defective product	sSR3: Source return excess product	sDR1: Deliver return defective product	sDR3: Deliver return excess product
sSR1.1: Identify defective product condition	sSR3.1: Identify excess Product Condition	sDR1.1: Authorize defective product Return	sDR3.1: Authorize excess Product Return
sSR1.2: Disposition defective product	sSR3.2: Disposition excess product	sDR1.2: Schedule defective return receipt	sDR3.2: Schedule Excess Return Receipt
sSR1.3: Request defective product return authorization	sSR3.3: Request excess product return authorization	sDR1.3: Receive defective product (includes verify)	sDR3.3: Receive excess product
sSR1.4: Schedule defective product shipment	sSR3.4: Schedule excess product shipment	sDR1.4: Transfer defective product	sDR3.4: Transfer Excess Product
sSR1.5: Return defective product	sSR3.5: Return excess product		