



ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

Analysis of Supply Chain of Domestic Steel Reinforcement Bar for the
Construction Projects in Addis Ababa

A Thesis Submitted to the School of Graduate Studies of Addis Ababa
Institute of Technology for the Partial Fulfillment of the
Requirement for the Degree of Master of Science in Civil
Engineering

By
Robel Awonchefew

June, 2018
Addis Ababa, Ethiopia

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Advisor

Girma Gebresenbet (Prof)

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Approved by Board of Examiners

GirmaGebresenbet (Prof.)-----

Advisor Signature Date

External examiner Signature Date

Internal examiner Signature Date

Chairman Signature Date

DECLARATION

I declare that this thesis entitled “ANALYSIS OF SUPPLY CHAIN OF DOMESTIC STEEL REINFORCEMENT BAR FOR THE CONSTRUCTION PROJECT IN ADDIS ABABA” is my original work. This thesis has not been presented elsewhere for assessment and award of any degree or diploma, and all sources of material used for the thesis have been duly acknowledged.

Candidate:

Name: RobelAwonchefew

Signature: -----

Place: Addis Ababa University

Addis Ababa Institute of Technology School of Civil and Environmental Engineering

Date of submission: June, 2018

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June, 2018

ABSTRACT

Domestic production and supply of construction raw materials such as cement, steel reinforcement bars, sheet metals, aluminum, glasses, etc. have been far less than the domestic demand, therefore, by resulting in widening gaps and increasing prices. There is lack of integration of producers, wholesalers and retailers for fulfillment of consumers' requirements with materials, cash and information flows. So, this research tries to show the flow of reinforcement bar across the supply chains with their bottleneck by identifying the major actors, levels of cost and lead times in the chain.

The Primary data was collected through questionnaires and interviews, while secondary data was from different sources through desk study. The collected data has been analyzed using Relative Importance Index (RII), Statistical Package for Social Science (SPSS) and Geographical Information System (GIS).

The finding shows that, the major stakeholders and in the supply chain networks of domestic steel reinforcement bar for the construction projects of Addis Ababa city. And also the flow network of material, information and cash between each parties. The research also indicates that the major factors that affect the performance of domestic steel reinforcement bars supply chain network in the city. The astonishing finding of the research is the cost of steel reinforcement bars increased by 84%, as it moves across the supply chain network. At the same time 95% of contractors complained with the high cost of domestic steel reinforcement bar. The average delay for contractors is 26, for retailers is 33 and for wholesalers is 52 days respectively.

In Addis Ababa city, the demand of domestically produced steel reinforcement bar has been increased in construction, throughout the years. There is a lack of integration between producers, wholesalers and retailers, in the supply chain network of domestic steel reinforcement bar. In order to develop successful and well-organized supply chain network of steel reinforcement bar for construction industry, first, the problems mentioned in the research be solved.

Keywords: -cost, performance, reinforcement bars, supply chain, stakeholders.

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LIST OF ABBREVIATIONS

- EEA= Ethiopian Economic Association
ESA=Ethiopian Standards Agency
GDP= Gross Domestic Product
GTP=Growth and Transformation Plan
GVPC= Gross Value of Production
GPS=Geographical Positioning System
GIS= Geographical Information System
GC=General Contractors
JIT= Just-In-Time
Kg =kilogram
Km = kilometer
MIDI= Metal Industry Development Institute
METEC=Metals and Engineering Corporation
MoFED= Ministry of Finance and Economic Development
MUDHC=Ministry of Urban Development, Housing and Construction
PHD=Doctor of Philosophy
RC=Road Contractors
RII= Relative Importance Index
SCM=Supply Chain Management
SC= Supply Chain
SRS= Simple Random Sampling
SPSS =Statistical Package for Social Science

CHAPTER ONE

1. INTRODUCTION

Construction industry is a huge sector which has great contribution for the development of a country, specially the developing ones like Ethiopia. Most of the capital budget of developing countries goes to the construction of infrastructures as infrastructure is the back bone for the economic growth of a country. This huge sector faces different types of debatable problems. Poor construction material flow network is one of the prominent issues among the parties involved in the construction industry. According to the Ethiopian Construction Industry Development Policy published in December 2014, the construction sector is growing yearly at an average of 12.43% and contributes 5.3 percent for the overall gross domestic product (GDP) of Ethiopia.

The main construction materials in construction industry include concrete, timber, stone, soil, reinforcement bar, etc. Hence, materials supply is an important element of operation of construction enterprises that affects the quality of construction projects. Lack of coordination and communication between the involved parties is seen as a key reason for the perceived poor supply chain performance in the construction industry. Therefore, any action towards rationalization of size, structure and organization of material consumption, delivery, and planning is important in terms of project efficiency and require proper management (Masod, 2007). Measuring the performance of supply chain network of steel reinforcement bars in the construction industry is important to perform successful construction activity.

1.1. Background of the Study

Supply chain encompasses all activities associated with the flow and transformation of goods and service from the raw material stage to the end user (customer) as well as the associated information and cash flow. It focuses on integrating and managing the flow of goods, service and information through the supply chain in order to make it responsible to customer needs while lowering total cost (Girma Gebresenbet and Techane Bosona, 2012). It is an essential process that supports and enables the primary business activity, like the construction of a building in a city, to be accomplished. Effective supply chain activity can lead to the effective execution of a construction project. The outsourcing and sub-contracting increases the number of organizations involved in the construction supply chain.

The information flow in construction is complex and the process is affected by various factors. Construction takes place mostly in confined sites; this situation is repeated for projects located in urban areas and in big cities where virtually no storage space exists.

A good management of supply chains in order to get materials, people, information, machines, and equipment to the work place in a lean manner (Just-in-Time) is vitally important to project success (Mossman, 2007).

Today, one of the key challenges of domestic construction companies is shortage of construction raw material to achieve the planned target in the industry in time. Shortage of construction materials, cash flow problems due to late and reduced payments, inaccurate data, unmet information needs, adversarial bargaining and other changes, deliveries not in conformance with planning, wrong and defective deliveries, long storage period, awkward packing, large shipments are among the major factors that have been affecting the timely completion of construction projects in Addis Ababa (BetelhemKebede, 2017). The local production capacity of reinforcement bar is increasing and the total supply of reinforcementbar is also increasing from year to year. There are 14 steel manufacturing industries that are involved in the productionof reinforcement bar in Ethiopia. Of these industries, three are under implementation phases, while therest are operational (Metal Industry Development Institute, 2010). Though, steel reinforcement bar of grade 40, 60 and 75 can be produced by the existing facility, they are currentlyproducing a steel reinforcement bar of grade 40 with a range of diameters from 6 to 32 mm due to relativelylow quality of raw materials and lack of adequate standard recognizing local market and enforcingpractices. The major local application of steel reinforcement bar is in buildings and other civil works to complementweak tensile capacity of concrete especially in tension zone during loading (Metal Industry Development Institute, 2010).

Polat and Ballard (2003) showed that, the problem in the rebar supply chain starts in the design phase and continue throughout the delivery process. Designing cut & bent rebar requires loads and architectural, mechanical, electrical etc. designs. Detailing and reckoning cut & bent rebar requires structural designs and so on. These interdependent and interrelated activities areperformed by the different supply chain participants, and the material and information flows are often interrupted.

1.2. Statement of the problem

Several construction activities are, not being completed in time and are faced with high cost. As a result, they have incurred additional financial cost and have taken longer time than initially planned. The existing few domestic construction materials producing enterprises have not managed to narrow the demand-supply gap adequately (Ethiopian Economic Association, 2006/07).

Supply shortage for steel reinforcement bar for the year 2017 is estimated to be 469,634 tons and 1,170,202 tons for the average industrial growth and GTP growth rate respectively; but the local production capacity of reinforcement bar is increasing and the total supply of steel reinforcement bar is seen to increase from year to year. Hence, the demand could be totally met by local production in the near future (Mohammed Muzeyin, 2014). But now a day, the price of domestic steel reinforcement bar increase by an average of 45% from the last four months and material supply shortage has occurred (Construction Proxy, 2017).

In most construction projects in Addis Ababacity, steel reinforcement bars are procured and delivered to the project site by contractors or owners of the projects. But, the construction sites are very crowded and confined in which steel reinforcement bars are being managed in a complicated way due to its shape and weight. In order to construct and fulfill the requirements, most wholesalers and retailers in the city stock the materials on the side of roads. Furthermore, the sellers don't have sufficient domestic products on the stock area and also the price of materials is fluctuating monthly. In addition there is lack of integration between producers and distributors to fulfill of consumers' requirements of materials, cash and information flows.

The inefficient supply chain network seen in the supply chain of domestic rebar in Addis Ababa construction industry needs to be researched.

1.3. Research questions

The research raised the following research questions to address the issue related to domestic steel reinforcement bars supply chain in Addis Ababa's construction industry. The questions are;

- ✚ Through the construction industry of Addis Ababa, how are the stakeholders involved in the supply-chain network?
- ✚ Who are the main stakeholders and how are they affecting the supply chain of reinforcement bar?
- ✚ What are the bottlenecks of the rebar supply-chain network?
- ✚ How long is the delay time and what are the costs it incurs in the rebar supply chain?

1.4. Objective of the study

The main objective of the study is to analyze the supply chain of domestic steel reinforcement bars for the construction projects in Addis Ababa city and address their weak point and strength by evaluating the main actors in the chain.

The specific objectives were to:

- ✚ Map out and assess the flow network of domestic steel reinforcement bar across the city;
- ✚ Identify the major stakeholders and their effect in the supply chain network;
- ✚ Identify the bottlenecks in the supply chain networks of domestic steel reinforcement bar for the construction projects in Addis Ababa;
- ✚ Evaluate the costs and lead times of the reinforcement bars through the supply chain from producers to the customers;

1.5. Scope of the study

The study addresses systematic and detailed research on the domestic steel reinforcement bar supply chain network systems, the challenges and their impact on the construction project in Addis Ababa. The study is limited to Addis Ababa city only for domestic steel reinforcement bar supply chain network which includes producers, wholesalers, retailers and consumers.

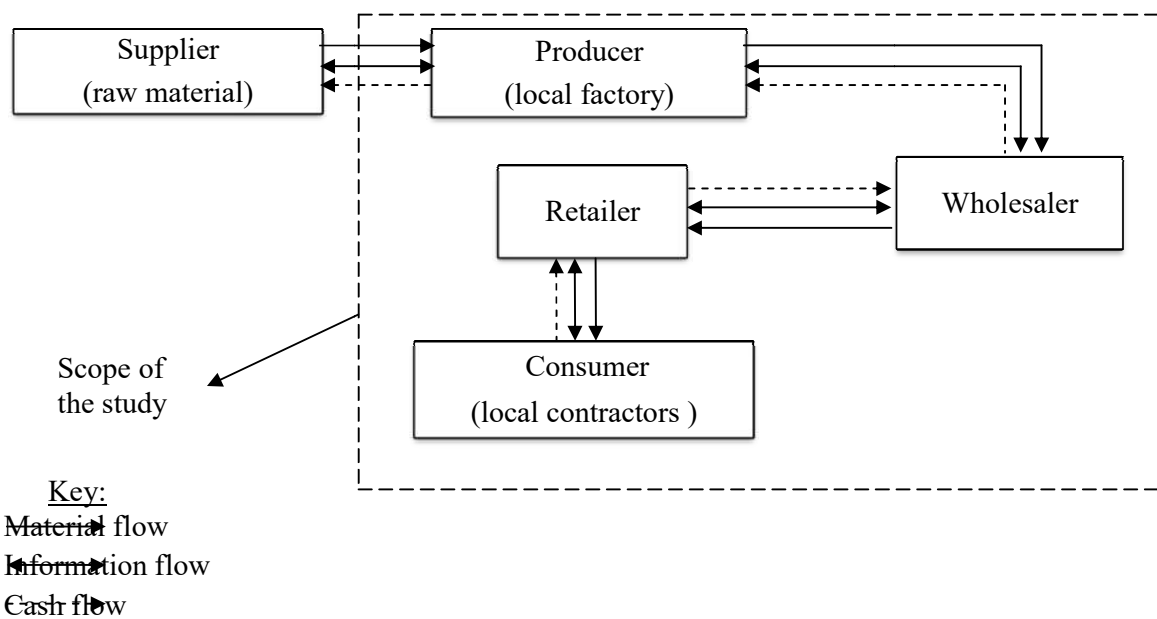


Figure 1.0: Basic supply chain for material, information and cash flow (Source - GirmaGebresenbet and TechaneBosona, 2012)

1.6. Limitation of the study

Supply chain of domestic steel reinforcement bar involves a numbers of members from producers up to end users. In this research, due to the limitation of budget, only 63 representative samples were selected from producers, wholesalers, retailers and contractors found in the ten sub cities of Addis Ababa.

1.7. Structure of the thesis

This thesis encompasses the following five chapters with coherent flow under the scope described above:

Chapter one contains a brief introduction / back ground information/, statement of the problem, research objectives, scope and limitation of the study.

Chapter two includes a literature review of relevant and important concepts of supply chain and supply chain management, material, information and financial flow system. It also includes background of domestic steel reinforcement bar supply chain for the construction projects, supply chain performance measures, supply chain structure of steel reinforcement bar from producers to consumers.

Chapter three covers the research methodology. The methodology consists of the overall research methods; the research design, study areas, population, sample size and sampling technique, type and methods of data collection, methods of data analysis and description of variables.

Chapter four contains results and discussion. It contains data collected from interview questions, general respondents characteristics, supply chain network of domestic steel reinforcement bar for the construction projects in Addis Ababa city, key domestic steel reinforcement bar supply chain actors with their bottlenecks, the major bottlenecks in the supply chain network of domestic steel reinforcement bar for the construction projects in Addis Ababa city, investigate whether the contractors receive domestic steel reinforcement bar in lowest cost possible and shortest lead-time.

Chapter five contains research conclusions and recommendations.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Supply chain

2.1.1. Definition

A supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer. In other words, a supply chain consists of multiple firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the ultimate consumer (Mentzer et al., 2001). A supply chain not only includes suppliers and manufactures but also the distributors, transporters, retailers and customers within each organization (Chopra & Meindl, 2001). It includes all the important functions i.e. order management, planning, shop floor operations, inspections, packaging and dispatch, etc. A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers (Ganeshan & Harrison, 1995).

Mentzer et al. (2001) stated that, there are three degrees of supply chain complexity: a “direct supply chain,” an “extended supply chain” and an “ultimate supply chain.” A direct supply chain consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information (figure 2.0). An extended supply chain includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information (figure 2.1). An ultimate supply chain includes all the organizations involved in all the upstream and downstream flows of products, services, finances, and information from the ultimate supplier to the ultimate customer (figure 2.2).

Types of supply chain channel relationships diagrams:

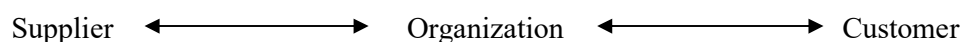


Figure 2.0: A direct supply chain network (Source - Mentzer et al., 2001)

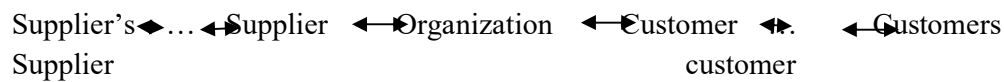


Figure 2.1: Extended supply chain network (Source - Mentzer et al., 2001)

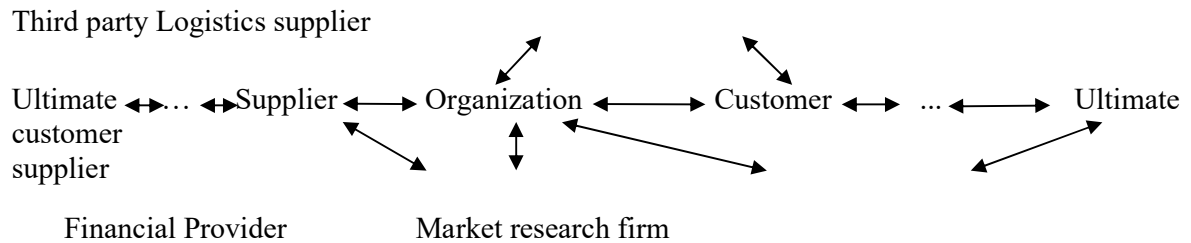


Figure 2.2: Ultimate supply chain network (Source – Mentzer et al., 2001)

Generally, supply chain is defined as a set of three or more entities (organizations or individuals) directly or indirectly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a consumer.

2.1.2. The main members of supply chain

Chopra and Meindl (2007) described supply chain as consisting of the parties who are involved in satisfying the customer demands. The members of supply chain are not limited to the manufacturers and suppliers. Warehouses, retailers, transporters and customers are all players of supply chain. The research of La Londe and Masters (1994) defined the supply chain more clearly as one firm producing a raw material and selling it to the second firm which then uses raw material and turns it to a component. The third firm buys this component from the second firm and assembles the component into a product sold to the fourth firm which might be a wholesale distributor. This firm distributes the product to the retail merchants who finally sell this product to the end users (customers). The set of firms which pass these materials forward can be referred to as a supply chain.

2.1.3. Collaboration in supply chain

Collaboration can have a variety of meanings but for the purpose of this research the researcher adopt the definition from Cohen et al. (2004) that is: collaboration is the means by which companies, within their supply chain, work together toward mutual objectives through the sharing of ideas, information, knowledge, risk and rewards. Practically, coordination and collaboration of upstream and down-stream of a supply chain is difficult because of uncertainty

in demand and supply and the lack of communication between members of a supply chain which is amplified through successive linkages (Lee, 2000).

In fact a very immediate and available opportunity when two or more companies involve in a chain is, the situation where partners would be able to recognize each other's competencies and combinethem in order to satisfy the customer requirements. Some other features which many participants anticipate when entering in a partnership are joint planning, management and measurement; and sharing goals, objectives, benefits, resources, information, and risks with partners. Collaboration is a recognized term which could explain and entail all of the above features (Sunil et al., 2004). Some companies have achieved integration through information sharing and inter organizational collaboration. In a study to measure the degree of integration among the companies it was found that information sharing and inter-organizational integration were the underlying factors for integration with suppliers and customers in areas like supply chain design, inventory management, and customer relationship management (Bagchi& Chun, 2005). But from time to time firms have been struggling to balance their competitiveand cooperative relationships with other firms and stakeholders in the supply chain (Morgan et al., 2007).

So, best supply-chain performers are deeply involved in relationships that call for tight links between partners. As companies migrate toward more extended supply chains, collaboration is becoming their most strategic activity.

2.1.4. The difference between supply chain and value chain

Christopher (1998) stated that,the primary difference between a supply chain and a value chain is a fundamental shift in focus from the supply base to the customer. Supply chains focus upstream on integratingsupplier and producer processes, improving efficiency and reducing waste, while value chains focusdownstream, on creating value in the eyes of the customer.Both chains overlay the same network of companies and made up of companies that interact to provide goods and services. When we talk about supply chains, however, we usually talk about a downstream flow of goods and supplies from the source to the customer but value flows the other way.

Generally, Supply chain focuses on integrating and managing the flow of goods, service and information through the supply chain in order to make it responsible to customer needs while lowering total cost whereas value chains is the creation of values for customer which include:

- Good quality,
- Fair price
- Fast and accurate delivery

2.2. Supply chain performance

Gunesekaran et al. (2004) specified that, the efficiency of the process is one of the key factors of supply chain, the amount of missing /wrong/ damaged / defective products are important to minimize the unit cost of the product. To increase the profitability of the project, the amount of missing/wrong/damaged/defective products should be minimized.

Responsiveness to customers is directly related with the time between the demand request and its delivery to the customer. It is important for customer satisfaction and schedule performance of the project (Chen et al., 2004).

This section focuses on the factors that have impacts on the steel reinforcement bar supply chain performance and construction project performance in order to determine the participants of the steel reinforcement bar supply chain. The main participants of steel reinforcement bar supply chain are main contractors, who undertake the construction of the project, distributors including wholesalers & retailers and manufacturing companies and others. The information gathered from literatures for the factors affecting the supply chain in domestic reinforcement bar are summarized in the following sections.

2.2.1. Manufacturing plant related factors

According to Mohammed Muzeyin (2014), research cost, quality, technological, marketing and delivery time are the critical challenges in the steel manufacturing industries that affect their competitiveness. Since most steel products produced in the Ethiopian Steel Manufacturing Industries are consumed almost by construction sectors, there are limited trends to build large scale industries that reduce the consumption of hard currency and the different burdens relied by the sector. Raw materials shortage, foreign currency (hard-currency) shortage, electrical power supply, interruption and fluctuation, availability of skilled manpower, marketing and

technological problem, standardization and quality problems, insufficient competence level of employee, insufficient trends on research and development seriously affect the Ethiopian Steel Manufacturing Industries.

2.2.2. Contractor related factors

According to Polat (2005) point of view, activities of contractors in steel reinforcement bar supply chain can be listed as follows:

- Analyzing the projects (architectural, mechanical, electrical)
- Preparing quantity surveys,
- Preparing the order according to master supply schedule
- Laying out the procurement process of steel reinforcement bar
- Negotiating with the steel reinforcement bar fabricator and having the deal approved
- Controlling the installed steel reinforcement bar,
- Planning and managing the financial issues about the procurement of suppliers and sub-contractors

Problems related to managing the flow of materials can be found in every organization. Materials account for a big part of products and project costs (Perdomo-Rivera, 2004). A number of attributes that will affect contractor related factors, including insurance cover, operating and machinery, communication system, efficiency of cash flow methods are related to the economic power of the contractor and have effects on supply chain success (Chan et al., 2004).

2.2.3. Supplier related factors

Suppliers play important roles in supply chains. Perdomo-Rivera (2004) specified that, the relationship between the contractor and supplier is crucial for the success of a construction project. The researcher added that good relationship with the suppliers, increase the expectation of better prices and more reliable delivery dates and also important for lower costs. Ordering materials with lower prices are made possible to the dealers is in good terms. On the other hand, bad relationships cause late and wrong deliveries which affect the total cost and completion date of the product.

Briscoe et al. (2001) determined supplier communication as a skill requirement for effective supply chain in the construction industry. Since the profitability of the companies in the chain

determined by the ability to obtain supplies of right quality, at the right time with the most favored prices and product knowledge were found to be important attributes.

2.3. Supply chain management

2.3.1. Definition

Simichi-Levi (2008) defined supply chain management as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores; so that goods are produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements. The definitions of supply chain management differ across authors; they can be classified into three categories: a management philosophy, implementation of a management philosophy and a set of management processes. Supply chain management defined as a management philosophy; under this philosophy supply chain management takes a systems approach to viewing the supply chain as a single entity, rather than as a set of fragmented parts, each performing its own function. According to Mentzer et al. (2001) point of view, supply chain management is defined by a management philosophy as follows;

1. A systems approach to view the supply chain as a whole, and to manage the total flow of goods inventory from the supplier to the ultimate customer;
2. A strategic orientation toward cooperative efforts to synchronize and converge intra firm and inter firm operational and strategic capabilities into a unified whole; and
3. A customer focused philosophy to create unique and individualized sources of customer value, leading to customer satisfaction.

Supply chain management defined as implementation; under this philosophy many researchers have suggested various activities necessary to successfully implement a supply chain management philosophy as follows;

1. Cooper and Ellram (1993) argued that, to be fully effective in today's competitive environment, firms must expand their integrated behavior to incorporate customers and suppliers. Related to integrated behavior, mutually sharing information among supply chain members is required to implement a supply chain management philosophy, especially for planning and monitoring processes.

2. Cooper et al. (1997) also believe about implementation, effective supply chain management is made up of a series of partnerships and, thus, supply chain management requires partners to build and maintain long-term relationships and the relationship time horizon extends beyond the life of the contract perhaps indefinitely and, at the same time, the number of partners should be small to facilitate increased cooperation.
3. La Londe and Masters (1994) proposed that, a supply chain succeeds if all the members of the supply chain have the same goal and the same focus on serving customers. Establishing the same goal and the same focus among supply chain members is a form of policy integration.

According to La Londe (1997), supply chain management is defined as a management processes as follows:

1. Supply chain management is the process of managing relationships, information and materials flow across enterprise borders to deliver enhanced customer service and economic value through synchronized management of the flow of physical goods and associated information from sourcing to consumption.

Generally, for the purposes of this research, a supply chain management is defined as a series of activities like planning, coordinating and controlling movement of materials, parts, products, information and financial flows from the suppliers to the customer. In Ethiopia, this issue is a major area of economic activities that concerns, directly or indirectly, private and public institutions, investors, contractors, national and international organizations as well as the diplomatic community. So, supply chain management study of reinforced bar is one of the key challenge for construction industry in Ethiopia.

2.3.2. Objective of supply chain management

The objective of supply chain management is to maximize the overall value generated, minimize the cost, effective and timely distribution of products needed by ultimate customers. Supply chain profitability in abstract is one of the objectives, which means profit sharing among partner organizations. Profitability due to low cost to all partners creates value to customers. Value is created by means of same or higher quality in lesser costs as compared to competitor's products. Supply chain responsiveness is another most sought supply chain objective. Responding to wide range of customers demand, short lead times and wide ranges of products in appropriate cost creates value to customers (Gupta & Sahay, 2007).

2.3.3. Supply chain management in the construction industry

Supply chain management plays a major role to improve the efficiency and productivity of companies. The actors of construction industry (contractors, supplier and customers) should interact and compromise to enable the essential adjustments (Dubois and Gadde, 2000).

Since, contractors, suppliers and customers are very significant element of supply chain management, collaboration between those sector players is very essential. Total management of supply chain enhances the competitive edge of all players therein (Berry et al., 1994). Contractors have key role to establish and develop the supply chain management. Their role includes the activities and tasks leading to preparation of the production on site involving construction clients and design team (Dubois and Gadde, 2000). Sustainable cash flow and data flow among both the upstream and downstream of chain are provided by contractors. There are some features of the construction industry differing from the other industries which might prevent the proper application of supply chain management in construction industry.

Vrijhoef and Ridder (2007) pointed out that, the difference of SCM in construction industry from the other industries occurs at the end-customer stage, since clients are involved in the chain both at the start and at the end for construction project. Construction is a multi-organization process, which involves owner, contractor, supplier, consultant etc. It is also a multi-stage process, which includes conceptual, design, construction, maintenance, replacement.

2.3.4. Challenges of SCMin construction industry

The nature of construction industry evolves significant problems such as lack of communication, knowledge sharing and infrastructure, which are obstacles for the improvement of supply chain management in construction. Chinowsky et al. (2007) indicated that, knowledge sharing infrastructure is one of the primary barriers preventing the successful implementation of organizations. If an infrastructure can't be established for sharing the information, exchanging knowledge will only be restricted among individual.

Fawcett (2001) stated that there are top ten barriers to supply chain management. These are: Inadequate information sharing, poor/conflicting measurements, inconsistent operating goals, organizational culture or structure, resistance to change-lack of trust, poor alliance management practices, lack of supply chain understanding, lack of managerial commitment, constrained resources, no employee empowerment.

Currently, companies are striving for lower cost so that they will be competitive in the market while they have to maintain their service level. The key factor to offering the features that the customers want at the level of service they are willing to pay for is to minimize the lead time. One approach suggested to solve this problem is synchronized material movement where all parts of the supply chain have access to the information at the same time (Waters, 2003).

2.3.5. Material, information and financial flow in SCM system

Materials, in the process of passing through material flow system are either in transit through various transportation modes, or are waiting in areas, which may be called warehouses. Even processing at production work centers is similar to storage for a period of processing. Therefore the materials within a material flow system are in either transit or storage mode (Mentzer et al., 2001).

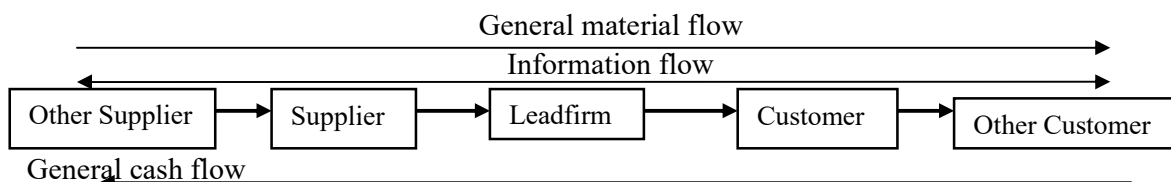


Figure 2.3:Flow of material, information and cash in a supply chain management (Source - Mentzer, et al., 2001)

Supply chain management involves integrating three key flows across the boundaries of the companies supply chain that are:

- A. Product/material flows
- B. Information flows, and
- C. Financial-cash flows.

Successful integration of the above three flows improves efficiency and effectiveness.

2.4. Lead time

2.4.1. Definition

According to Kuhlman et al.(2011), lead time is the duration of time (minutes, hours, days etc.) needed by any process to change the inputs (materials, customers, cash,data) into outputs (products, services).Proper management of lead time can result in higher customersatisfaction albeit at an additional cost (Liao &Shyu, 1991).Generally, lead-time comprises functions such as planning manufacturing, assembling delivering of products and services.

Silver et al. (2008) have also described lead time as the time that passes by between when the product requests are placed and the time that the items requested are received into stock and that when effectively done, an efficient lead time can impact positively or negatively on customer satisfaction depending how effective it is implemented by a firm and inventory costs.

2.4.2. Types of lead time

Lead time exists in several forms within the supply chain. According to Kuhlmann et al. (2011), lead time is categorized into four groups, which are: - order handling lead time, delivery lead time, supplier lead time and manufacturing lead time.

A. Order handling lead time

Beside to the classification of Kuhlmann et al. (2011), Rajaniemi, (2012) defined as, order handling lead time is the time required from the minute of receiving a customer order (example by email or text) and ends when the order has been entered, completely processed into the enterprise resource management system and is confirmed. This kind of lead time relates to information flowing from upstream in the supply chain (from purchaser to seller). It contains information about the delivery address, the request delivery date, products, quantities and prices comprises order processing activities such as inventory check, inventory assignment, credit check, a check of the agreement and in the subsequently, returning back an order confirmation to the client (Naylor et al., 1999)

B. Delivery lead time

Delivery lead time begins right at the time when the enterprise resource planning system releases the order to the expedition unit until the moment of real delivery. The delivery lead time can be decreased to a certain degree, principally by a reduction of the waiting time or non-value adding activities. The real transport time is generally static and relies on upon the distance to the client and selected transport methods (Gunasekaran et al., 2001).

C. Supplier lead time

According to Gunasekaran et al. (2001), supplier lead time is the delivery lead time of the supplier contracted. It is the time in hours, minutes and seconds from the period when raw materials are ordered to the period when the ordered materials are received.

D. Manufacturing lead time

The manufacturing lead time is the time from the minute a purchase order is sent and changed into a manufacturing order, entered into the enterprise resource planning system, until the minute that the products are produced and are accessible to be purchased in the distribution center (Rajaniemi, 2012).

2.4.3. The effects of lead time in supply chain

According to Ray and Jewkes (2004), the costs of products and services are interlinked with lead time. From the perspective of demand side, lead time is said to have a positive effect in terms of the quantity required and the level of stock deemed safe enough to forestall stock outs (Vernimmen et al., 2008). Having long lead times leads to higher expenditure on safety stock as a result of tying up capital, oldness, defective items and higher warehousing cost, and also makes it difficult for firms to coordinate and plan their operations and it also negatively affects cash flow since it locks up capital in the form of resources (Christopher, 2004).

According to Tersine and Hummingbird (1995) research, a reduction of lead times ultimately leads to higher firm performance and the addition of value for customers. And again these researchers view that, a shorter lead time engenders the reduction of risks associated with ordering for products enables firms to plan better, and overall, lead to trust among channel partners since there is reliability and dependability.

2.4.4. Factors influencing lead time

The key factors influencing lead time in supply chain network are: delays, insufficient planning, inadequate facilities and equipment, inadequate financial resources, poor motivation of employees, cumbersome bidding and tendering processes etc. (Kagiri, 2005).

In addition to the above mentioned factors, Bartezzaghi et al. (1993) also listed out the factors that affect lead time as follows;

- Uncertainty or level of knowledge of the input
- Execution pace of the resources
- Demand-capacity ration
- Location and layout of the resources
- Parallelization of consecutive exercises

- Leadership and problem solving attributes
- Erratic flow material or unevenness of demand
- Variety or mixed of products

2.5. Supply chain cost

2.5.1. Definition

Different kind of grouping of cost can be found in the literature. According to Chen (1997) research, that supply chain cost can be placed in the five categories; which are production costs, transportation cost, warehousing cost, inventory carrying cost and internal material handling cost. And also, Byrne and Heavey (2006) break down the supply chain cost into five different categories as transportation cost, order processing cost, production setup cost, inventory cost and backorder cost.

Even if the above researcher grouped the cost in different ways, the definitions given to each are similar. Transportation cost is the shipment cost between finished stock in Company *A* and the stocking location of the distributor. Order processing cost is the cost for processing the orders. Production set-up cost is the cost associated with an order being set-up in the processing areas. Inventory cost is the cost for holding stock for one period. The period can for example be one month or one year. Backorder is the cost for backorders for one period.

2.5.2. Measurement of supply chain cost

Solvang (2001) says that, cost is one of the most important performances of a supply chain. There are different ways of measuring supply chain cost. Quinn (1998) study shows that, improved delivery precision, lower supply chain cost and shorter order-cycle time for companies considered being best practice companies compared to the average competitor. According to Hoole (2005), the total supply chain cost can vary by 5 percent to 6 percent of annual revenues between companies in the same industry sector. Byrne and Heavey (2006) write that improved information sharing and forecasting techniques can lead to total cost savings up to 9 percent. Christopher and Gattorna (2005) discuss supply chain cost savings as a result of creative pricing strategies combined with efficient supply chain management. The supply chain cost savings provide opportunities for increased profits. Kumar and Kropp (2006) found in their study that new customers and new products could drive up the supply chain cost.

Product cost calculating is an important part to supply chain cost. Product calculation is used to set a manufacturing cost, to estimate the value of items in inventory, to check if a product is profitable, to support the decisions of sales prices, and a part in analysis of customer profitability.

Supply chain cost is concentrating on the costs connected to the supply chain as described above. However this cost can in practice are estimated in different ways and with different accuracy. Rough mark-ups can be used to cover for example transportation costs, order-processing costs etc. Actual costs can be reported directly to a customer order or a customer project. The last is naturally to prefer if an accurate supply chain cost is preferred and supports for correct decisions are wished. But even for the most accurate supply chain cost a mixture of standard costs, from the companies' budgets and cost accounting systems, and actual invoiced costs is necessary.

2.6. Domestic steel reinforcement bar supply chain

2.6.1. Background of steel reinforcement bars raw material in Ethiopia

The Central Statistics Agency (2011) reported that, direct raw materials for the steel reinforcement bar manufacturing are basically gathered from scraps and iron ore. However, in Ethiopian context, since there is no iron ore extraction facility, the main source of direct raw materials is scraps. Most of the scraps are from local source. Some factories also import scraps as well as billet as direct raw materials. Insurance companies and Metals and Engineering Corporation (METEC) are also a major supplier of scrap for steel reinforcement bar local manufactures. However, some factories collect scraps by using collection shop in different regions established for such purpose and/ or others are purchasing from local scrap collectors.

Factories with recycle facility and a scrap waste are also the local suppliers of scraps. Most scrap collectors and sellers are located around Addis Ababa, specifically in market place called Markato/Menyaleshe Tera. Some local factories import scraps from China, Ukraine, Turkey, and...etc. Billets are also imported as raw material input by steel reinforcement bar manufacturing plants especially by those plants without melting shop or furnace.

The Central Statistics Agency (2011) reported that, the major problems and challenges of raw material (scraps) collected domestically are the following;

- Inadequate skilled manpower in the area

- The marketing system of scrap isn't adequate enough to reward according to the quality of the scrap.
- Inadequate system of scrap supply management and hence there is tendency to collect the majority of the scraps and trying to sell it back at a very high price without adding value. This problem is currently minimized by government measure of giving directives for METEC to collect all scraps from government sources and manage its supply.
- Inadequate quality of local scraps especially for high quality products such as grade 60 and 75 reinforcement bar.
- The local supply of scraps is inadequate as compared to the increasing trend of investment and demand of scraps.
- The scrap import cost is increasing over the years.

2.6.2. Production processes of domestic steel reinforcement bar at industry

Steel reinforcement bars manufacturing process in Ethiopian usually starts from iron making with an input of scraps as local iron ore extraction isn't started yet though some studies indicate ore reserve in the country (Metal Industry Development Institute, 2010).

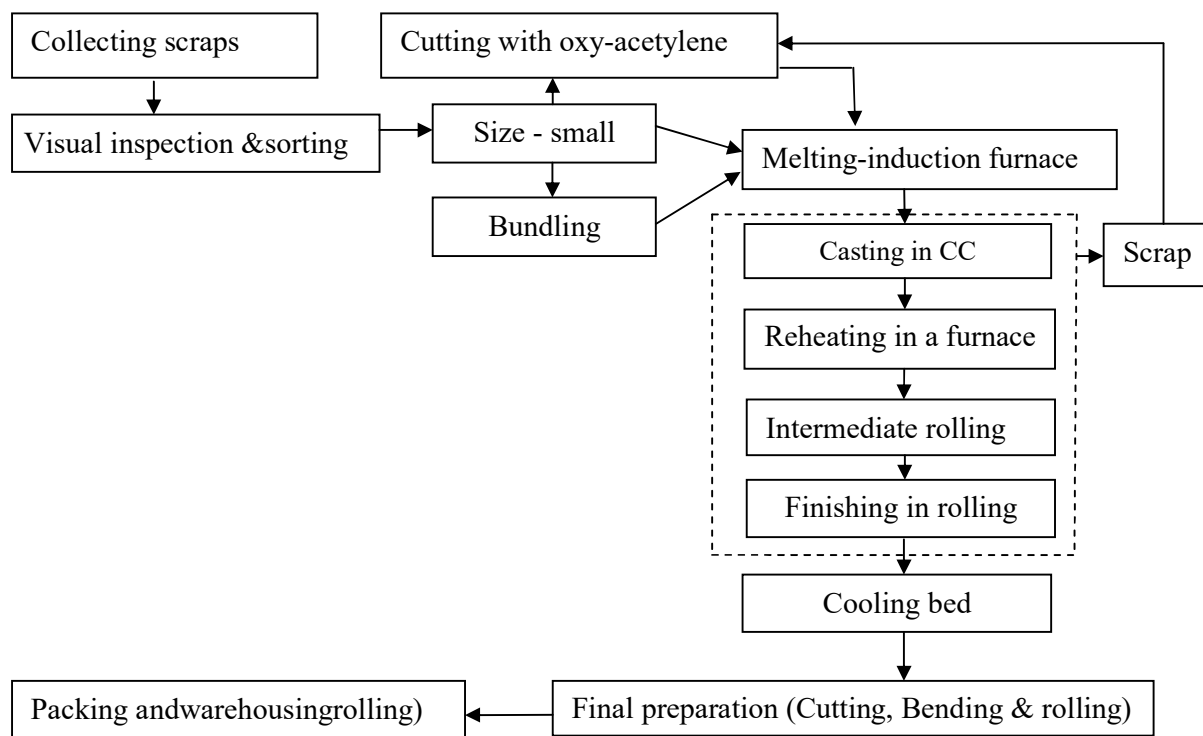


Figure 2.4: Process flow diagram for steel reinforcement bar in production (Source - Metal Industry Development Institute, 2010)

From the above figure 2.4, the production process starts with raw materials selection, visual examination and chemical analysis. Once cleared, they are cut into their required sizes. The materials are then melted in an induction furnace and pass through a continuous casting facility, where the billets are formed. They then pass through pre-heating and soaking zones in the furnace to reach the required temperature. Conveyors are used to feed the materials to a roughing mill, specific to bar diameter. After the exit, the materials are fed to the finishing mill for manufacturing small diameter bars. Materials obtained from finishing mills then pass through the cooling system with predetermined cooling parameters to produce steel reinforcement bars. The treated bars are left on the cooling bed to acquire the desirable mechanical properties through tempering of the water-quenched surface. The bars then pass through a shearing machine to cut them into desired lengths.

Quality testing is done as per the defined norms. Afterwards, the bars are bent, bunched, tagged and stored for dispatch (Metal Industry Development Institute, 2010).

2.6.3. Demand and supply of steel reinforcement bar in Ethiopia

The average rate of growth achieved in the years 2005/06-2009/10 for the industry sector was about 10.4%. In the growth and transformation plan one (GTP-1) period, the industrial sector has received the highest level of support and the growth in the industry sector is expected to grow at 19.6% on average.

According to Mohammed Muzeyin (2014), the supply shortage of reinforcement bar in the year 2013 is estimated 526,228 and 659,037 tons for the average industrial growth (10.4%) and growth and transformation plan (19.6%) growth rate respectively. Similarly in the year 2017, supply shortages are 469,634 and 1,170,202 tons, respectively. In these five years, demand projected for the aforementioned product exceeded the projected supply throughout the projected years of 2013- 2017.

Based on average industrial growth (10.4%) and growth and transformation plan growth (19.6%) rate the projected supply, demand and their differences in the year 2013 to 2017 is shown in table 2.0.

Table 2.0: Projected demand-supply gap for reinforcement bar (Source: Mohammed Muzeyin, 2014).

Year		2013	2014	2015	2016	2017
Projected supply (ton)		238,750	316,750	361,750	596,750	666,750
Projected demand (ton)	Past trend	698,337	762,791	827,245	891,700	956,154
	10.4% average growth	764,978	844,536	932,367	1,029,334	1,136,384
	19.6% GTP growth	897,787	1,073,753	1,284,208	1,535,913	1,836,952
Demand gap with (ton)	Past trend	459,587	446,041	465,495	294,950	289,404
	10.4% average growth	526,228	527,786	570,617	432,584	469,634
	19.6% GTP growth	659,037	757,003	922,458	939,163	1,170,202

2.6.4. Material, information and cash flow in supply chain network

Material flow studies are concerned over delivering goods and related services to the market, at the right time and place. Research on material flow revolves around issues like purchasing, remanufacturing, recycling, transportation and stock replenishment processes along the

chain(Sahin and Robinson, 2002). Research on information flow is mainly focused on order information and its propagation along the chain (Lee et al., 1997). Generally, material flow includes movement of goods from supplier to consumer, as well as dealing with customer service needs such as input materials or consumables or services like housekeeping. Information flows in the supply chain are bidirectional. Financial funds flow from the final consumer (who is usually the only source of real money in a supply chain), back through the other links in the chain (typically retailers, distributors, processors and suppliers).

Every manufacturing system has its own material, information and financial flow system in order to collect as well as distribute raw materials/finished products, information and finance. Based on Mohammed Muzeyin (2014) research, the flow of material, information and cash in steel rebar manufacturing project in Ethiopia are summarized in figure 2.5 below.

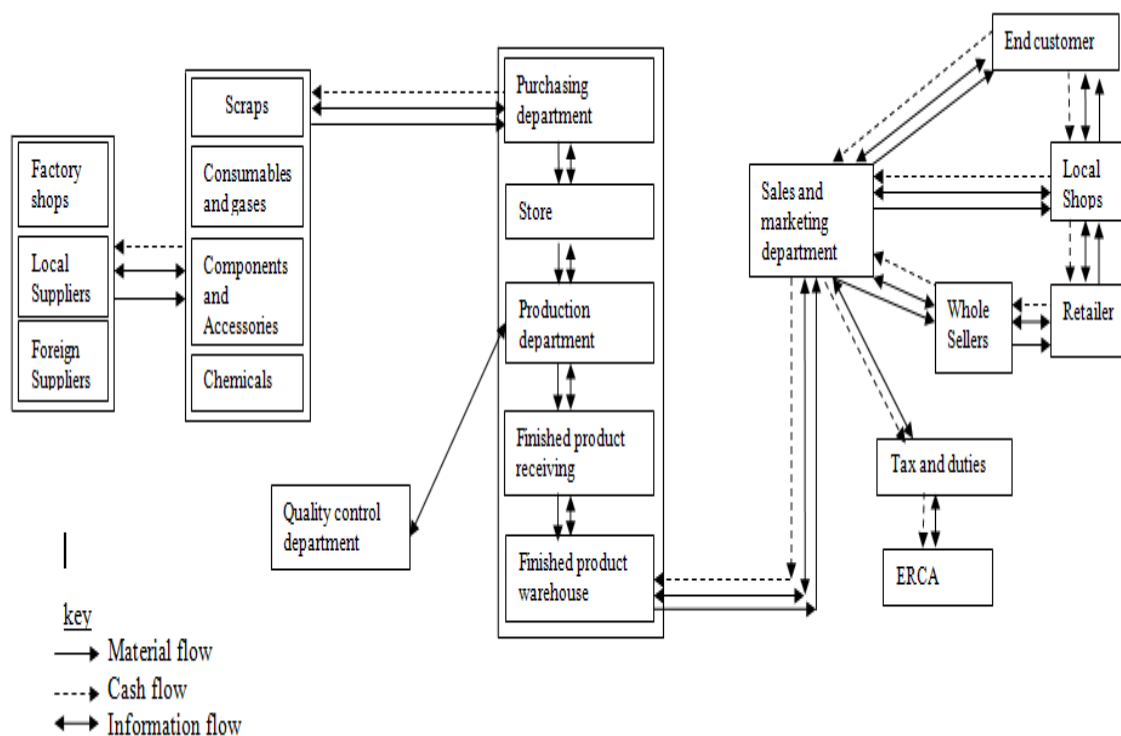


Figure 2.5: Material, information and cash flow network in manufacturing plant

2.6.5. Contractor consumption and delivery system in construction industry

Construction is a multi-organization process, which involves client/owner, designer, contractor, supplier, consultant, and so on. It is also a multi-stage process, which includes conceptual activities, design, construction, maintenance, replacement, and decommission.

Many researchers consider that the construction industry nowadays is highly fragmented and this could lead to significant negative impacts; low productivity, cost and time overruns conflicts and disputes, resulting in claims and time-consuming litigation (Latham, 1994). To overcome industry fragmentation, there has been a growing recognition that it is important to integrate the various participants in a construction project, and this includes aspects of integrating all the members of the supply chain (Anumba, et al., 2002).

The construction supply chain is not a real chain but a network of multiple organizations and relationships, which includes the flow of information, the flow of materials, services or products, and the flow of funds between client, designer, contractor and supplier (Xue, et al., 2007).

Construction contractors are increasingly engaged in supply of material from diverse sources around the world and this process starts with design and engineering pursued at manufacturers' workshop and ends with a series of journeys from factories to the construction site.

Planning such a long supply chain requires examining all the stages involved in terms of time and costs (Wegelius - Lehtonen, et al., 1996). Late deliveries of construction materials and components have been identified as one of the main causes of delay in major industrial construction projects. Therefore, timely delivery of materials is essential to ensure meeting completion date of construction activities (Fallahnejad, 2013).

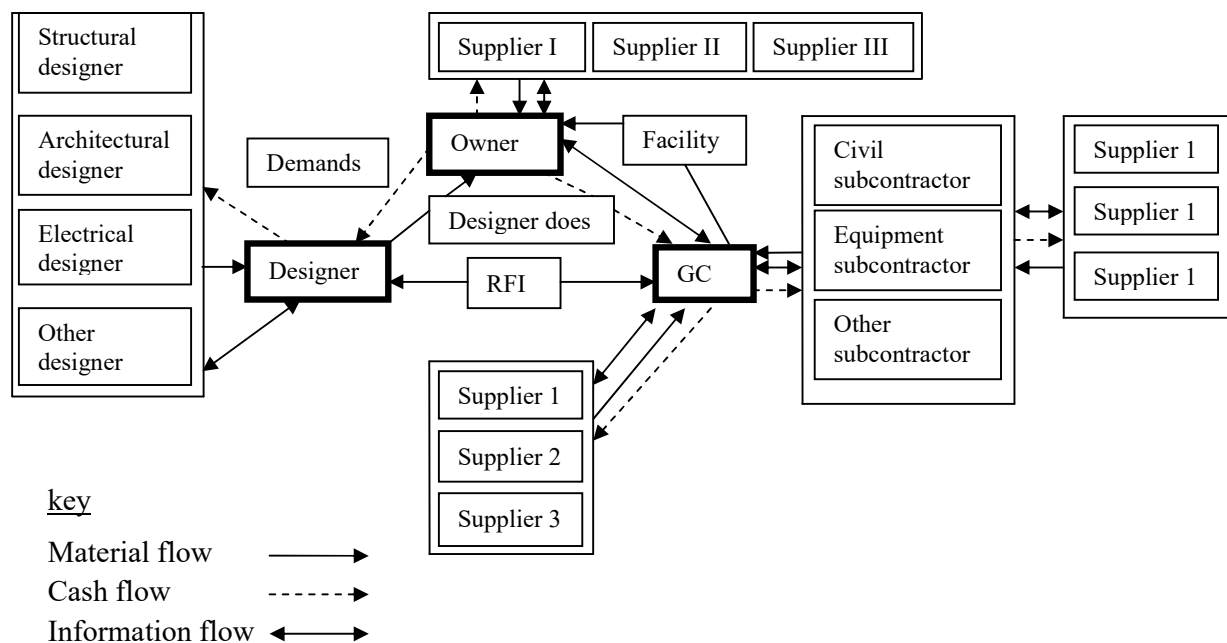


Figure 2.6: Supply chain network in construction industry (Source - Xue, et al., 2007)

In summary, the literature review includes five areas; concepts of supply chain, supply chain management, lead time, costs and supply chain of domestic steel reinforcement bar for the construction industry. Supply chain is defined as a set of three or more entities (organizations or individuals) directly or indirectly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a consumer. In contrast, supply chain management is a series of activities like planning, coordinating and controlling movement of materials, parts, products, information and financial flows from the suppliers to the customer. Lead time in the supply chain is the time from the moment the customer places an order (the moment the supplier learns of the requirement) to the moment it is ready for delivery (Liao & Shyu, 1991). From the review inaccurate data transfers among the participants, delays and interruptions in information flow, lack of coordination among the parties, non standardized format of data, inflexible production systems, etc. are the main reasons for long lead times in supply chain activity. Supply chain cost is defined as all cost in a supply chain network. Analysis of supply chain cost can be performed in different ways. Some cost drivers must distribute indirect costs. Therefore measuring an accurate supply chain cost can be difficult. One reason for the difficulties in measuring supply chain cost is that the set up of the accounting systems in a company are not adjusted to supply chain cost measurements.

Construction contractors are increasingly engaged in supply material from diverse sources around the world and this process starts with design and engineering pursued at manufacturers' workshop and ends with a series of journeys from factories to the construction site. Furthermore, even if there are many problems during domestic steel rebar supply chain process, measuring the competitiveness and the performance of Ethiopian Steel Manufacturing Industries and the supply chain management of public building construction projects in Addis Ababa are identified by many researchers. But, I found there is lack of detailed study of supply chain network system specifically domestic steel reinforcement bars. This led to the motivation for this research.

In order to study in detailed, analysis method of supply chain of domestic steel reinforcement bar for the construction projects of Addis Ababa will be carried out in the next chapter. The major bottlenecks, the flow network, costs and lead time of supply chain network also presented and analyzed in Chapter 4.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Introduction

Both qualitative and quantitative data are collected to examine and measure the performance of domestic steel reinforcement bars supply chain network for the construction projects in Addis Ababa city. The collected data are summarized and analyzed to reach into a meaningful conclusion and recommendation

3.2. Study Areas

The research was conducted in Addis Ababa within different sub-cities, which are the production, distribution and consumption area of domestic steel reinforcement bars. Addis Ababa, with an area 540 square kilo meters, is divided into 10 sub cities and 117 woredas. The city is the capital city of Ethiopia and the diplomatic capital of Africa. The city has five main gates, which are Ambo, Bishoftu (kality), Dessie, Gojjam and Jimma gate. The annual average daily traffic (AADT) for freight vehicles estimated to be 10,725 for entering and 12,890 for leaving the city (Abel Kebede, 2017).

These gate, serve as entry points of domestic steel reinforcement bars from different factories and regions in to the capital. The production capacity per year and specific location of domestic steel factories are shown in table 3.0. Among numerous projects created in Ethiopia, the majority of private and public building construction projects are in Addis Ababa.

Table 3.0: Production capacity of Ethiopian factories (source - Mohammed Muzeyin, 2014)

No	Name of factories	Location	Production (tone/year)
1	Abyssinia integrated steel plc	Bishofitu	120,000
2	C&E brothers steel mills plc	Bishofitu	720,000
3	East steel plc	Dukem	300,000
4	Ethiopian iron and steel factory	Akaki	Not specify
5	Habesha steel mills pc	Dukem	72,000
6	Huano manufacturing plc	Koka	50,000
7	Qiyi Wei proprietorship	Adama	3000
8	Steely RMI plc	Bishofitu	270,000
9	Walia steel industry	Alemgena	34,564
10	Yesuplc	Gelan	180,000
11	Zuqualla steel products factory	Bishofitu	90,000



Figure 3.0:Map of Addis Ababa city

3.3. Population, sample size and sampling technique

The population of the research includes the main actors from domestic production factory of steel reinforcement bar to final consumers. Representative samples have been selected from main participants; local factories, wholesalers, retailers and local contractors.

According to Metals Industry Development Institute (2010), a total of 11 active domestic steel reinforcement factories are registered in Ethiopia. Among the total 11 factories three have been encompassed in the research.

The population of domestic steel reinforcement bar wholesalers and retailers in the city is too large. Hence, for populations that are large, and particularly for those with unknown members amongst them, the sample size required to be taken into account is calculated as follows (Krejcie and Morgan, 1970)

$$N = \frac{Z^2}{e^2} * p * (1-p) \dots\dots\dots [3.1]$$

N= sample size

Z= at 95% confidence interval

P=degree of variability

e= precision rate

In this research a confidence interval of 95% ($Z = 1.96$) is used and since the variability is unknown, a degree of variability of 0.5 is used. A precision rate of 5% is selected. With these parameters the number of sample size is approximately ≈ 385 .

According to Ministry of Urban Development, Housing and Construction (2008), a total of 132 contractors are registered under grade one category in Ethiopia. Amongst those contractors 118 are found in Addis Ababa. Using 95% confidence level and 5% confidence interval the sample size required is calculated as follows (Krejcie and Morgan, 1970)

$$S = \frac{X^2 NP (1-P)}{d^2(N-1) + X^2 P (1-P)} \dots \dots \dots [3.2]$$

S=required sample

X^2 =the table value of chi-square for 1 degree of freedom at the desired confidence level

N= the population size

P=the population proportion (assumed to be .5 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (.05)

The sample size determined based on the above formula is approximately 91. However, the clustered sample size of grade one contractors, wholesalers and retailers in each sub city is too large to conduct due to time and resource limitation. So, the sample sizes of contractors, wholesalers and retailers are reduced to 60 by random sampling technique.

Generally, the research used only 63 representative samples that were selected from producers, wholesalers, retailers and contractors found in ten sub cities of Addis Ababa.

Table 3.1: Number of population and representative sample in the study

It. No.	Name of company	Total population	Selected sample using 95% confidence interval	Samples clustered under each ten sub-city	Select two representative sample randomly from each sub city	Total sample
1	Grade one contractor	118	≈ 91	≈ 9	2	20
2	Wholesalers	Too large	≈ 385	≈ 39	2	20
3	Retailer	Too large	≈ 385	≈ 39	2	20
Total number of sample size						60
Total representative sample in the research including producers						63

3.4. Types and methods of data collection

- **Primary data:** -The primary data was collected through questionnaire and face-to-face interview. Questionnaires and interviewware designed and distributed for factories, wholesalers, retailers and contractors respondents selected on the basis of their position, work experience and educational background. The questionnaires consisted of two parts. The first deals with general information about the respondents and their company whereas the second part focuses on detailed information about domestic steel reinforcement bar supply chain.
- **Secondary data:** -Secondary sources of data that the research included different relevant profile document, manuals, articles and journals (such as production capacity of domestic factory, loading capacity of different vehicles).

3.5. Methods of data analysis

Generally, descriptive statistics are used to analyze the collected data and represent and interpret the data using table, chart, graph and percentage. Statistical Package for Social Science (SPSS) software was used in order to determine the correlation between the variables in the chain and Relative Importance Index (RII) methods to arrange variables in terms of importance.

The research used the following specific methods;

1. **To map out and assess the flow network of domestic steel reinforcement bars across the city, the following steps are used**
 - ✓ Collect the X, Y co-ordinate of the company location using GPS;
 - ✓ Import the map of the city onto GIS map;
 - ✓ Locate the flow network using the above X, Y co-ordinates of the company on city map;
 - ✓ Assess the flow network based on the reality;
 - ✓ Put the exact flow network in figure and chart;
2. **To identify the major stakeholder and their bottlenecks in the supply chain network;**
 - ✓ The research calculated Relative Importance Index (RII) in percentage to arrange variables in terms of importance & agreement using the following formula.

$$RII = \frac{\sum_{i=1}^N f_i * w_i}{N * A} \dots \dots \dots [3.3]$$

RII =Relative importance index (%)

N =total number of respondents

A=the maximum scale

w_i =the variable expressing the frequency of the i^{th} response

f_i =frequency

3. To identify the major bottlenecks in the supply chain network;

- ✓ The research used Statistical Package for Social Science (SPSS) software to correlate variables within the chain network and Relative Importance Index(RII) to arrange variables in terms of importance and agreement.

4. To investigate whether the contractors receive domestic steel reinforcement bar in lowest cost possible and shortest lead- time;

The research used the following steps to evaluate cost in supply chain network;

- ✓ Collect current factory wholesalers and retailers selling cost and contractor purchasing price;
- ✓ Calculate the most important cost (labor, warehouse, transport and employees average cost) at wholesalers, retailers and contractors area;
- ✓ Examine the level of cost increment at wholesalers, retailers and contractors stage based on above average cost;
- ✓ Compute and contrast the final contractor's average purchasing cost with factory, wholesaler and retailer average selling cost and average incremental cost;

The research used the following steps to evaluate lead-time in supply chain network;

- ✓ Collect the required days that needed for ordered and transport at each actors when collect material at different area;
- ✓ Select preferred months of the year for distribution and receiving the product and also consumers demand requested time at factory area;
- ✓ Investigate the lead-time chain network of domestic steel reinforcement bar based on the above output;

3.6. Description of variables

The dependent and independent variables for the study have been identified. The dependent variables are steel reinforcement bar supply chain practices and the performance of main actors in supply chain network in the construction project and the main barrier in the chain. The independent variables include, product delivery cost, time & quality, place of delivery, product delivery quantity, selected month for delivery, main challenge for delivery, contractor, factory, wholesaler & retailer involvement in demand determination, occurrence of storage area of steel reinforcement bar.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. General respondents characteristics

Table 4.0: General respondent rate

It. No	Name of respondents	Number of questioners that distributed	Numbers of response	General response rate
1	Factories	3	3	6%
2	Wholesalers	20	10	20%
3	Retailers	20	17	34%
4	Contractors	20	20	40%
Total		63	50	100%

Out of the 63 questionnaires distributed to factories, wholesalers, retailers and contractors, 50 responses were received with 79.37% return rate. Table 4.0 shows distribution of the respondents, i.e. factories 3(6 %), wholesalers 10(20 %), retailers 17 (34%) and contractors 20 (40) on interview questions.

Table 4.1: Work experience of main actors in supply chain activity

work experience years	Supply Chain Main Actor									
	Factories		Wholesalers		Retailers		Contractors		Total	
	N	%	N	%	N	%	N	%	N	%
1-5 years	0	0.0%	3	30%	12	70.6%	2	10%	17	34%
6-10 years	1	33.3%	4	40%	3	17.7%	5	25%	13	26%
11-15 years	0	0.0%	1	10%	1	5.9%	4	20%	6	12%
≥15 years	2	66.7%	2	20%	1	5.9%	9	45%	14	28%
Total	3	100.0%	10	100%	17	100.0%	20	100%	50	100%

Regarding the work experience of factories, wholesalers, retailers and contractors on domestic steel reinforcement supply chain activity, 50 respondents (3 factories, 10 wholesalers, 17 retailers and 20 contractors) had answered the questions. Table 4.1 shows those years of work experience for the surveyed respondents in the construction industry of Addis Ababa. Accordingly, the characteristics of the respondents can be summarized as; about 17(34%) within the range of 1-5 years of experience, 13(26%) have 6-10 years, 6(12%) have 11-15 years of experience and the rest 14(28%) have been in the business for over 15 years.

This shows that the relationship between suppliers and distributors especially retailers to be 70.6% short in time relationship and practice on steel reinforcement bar supply activity.

Table 4.2: Respondents educational background

Education Level	Supply Chain Main Actor									
	Factories		Wholesalers		Retailers		Contractors		Total	
	N	%	N	%	N	%	N	%	N	%
≤12 Grade	0	0.0%	1	10%	4	23.5%	0	0.0%	5	10%
Diploma	0	0.0%	4	40%	10	58.8%	0	0.0%	14	28%
Degree	1	33.3%	5	50%	3	17.7%	15	75%	24	48%
Master	2	66.7%	0	0.0%	0	0.0%	5	25%	7	14%
PHD	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	3	100%	10	100%	17	100%	20	100%	50	100%

Based on educational background of respondents in the supply chain activity of domestic steel reinforcement bar for Addis Ababa city construction project, different variable of the respondents have been encountered. As can be observed from table 4.2, the characteristics of the respondents; about 24(48%) of the respondents have bachelors degree, 14(28%) have diploma, 7(14%) have masters degree, 5(10%) have grade twelve education level or less and none with PHD levels. Education improves supply chain actors knowledge, acceptance of technologies and use of other scientific methods to build up successful and well-organized supply chain mechanisms. However, this study discovered that about 58.8% of retailers have received diploma educational level; even if the other main actors have bachelors and masters degree.

Table 4.3: Position of respondent in the company

Position of Respondents	Supply Chain Main Actor									
	Factories		Wholesalers		Retailers		Contractors		Total	
	N	%	N	%	N	%	N	%	N	%
Owner	1	33.3%	4	40.0%	8	47.1%	1	5%	14	28%
Purchasing division head	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.00%
Sales manager	2	66.7%	6	60.0%	9	52.9%	1	5%	18	36%
Project manager	0	0.0%	0	0.0%	0	0.0%	6	30%	6	12%
General manager	0	0.0%	0	0.0%	0	0.0%	4	20%	4	8%
Site engineer	0	0.0%	0	0.0%	0	0.0%	7	35%	7	14%
Supply manager	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.00%
Other	0	0.0%	0	0.0%	0	0.0%	1	5%	1	2%
Total	3	100%	10	100%	17	100%	20	100%	50	100%

Based on position of respondents in their corresponding company different variable of the respondents have once again been encountered. In table 4.3, the characteristics of the respondents was found to be about 18(36%) sales manager, 14(28%) owners, 7(14%) site engineers, 6(12%) project managers, and 4(8%) general managers. Further, purchasing division heads& supply manager are nil.

4.2. Supply chainnetwork of domestic steel reinforcement bars for the construction projects in Addis Ababa

From the respondents' point of view, different main actors give different flow of material, cash and information throughout the network. From factories, wholesalers, retailers and contractors respondent point of view the raw material and the final product are collected and distributed using the following figure 4.0.

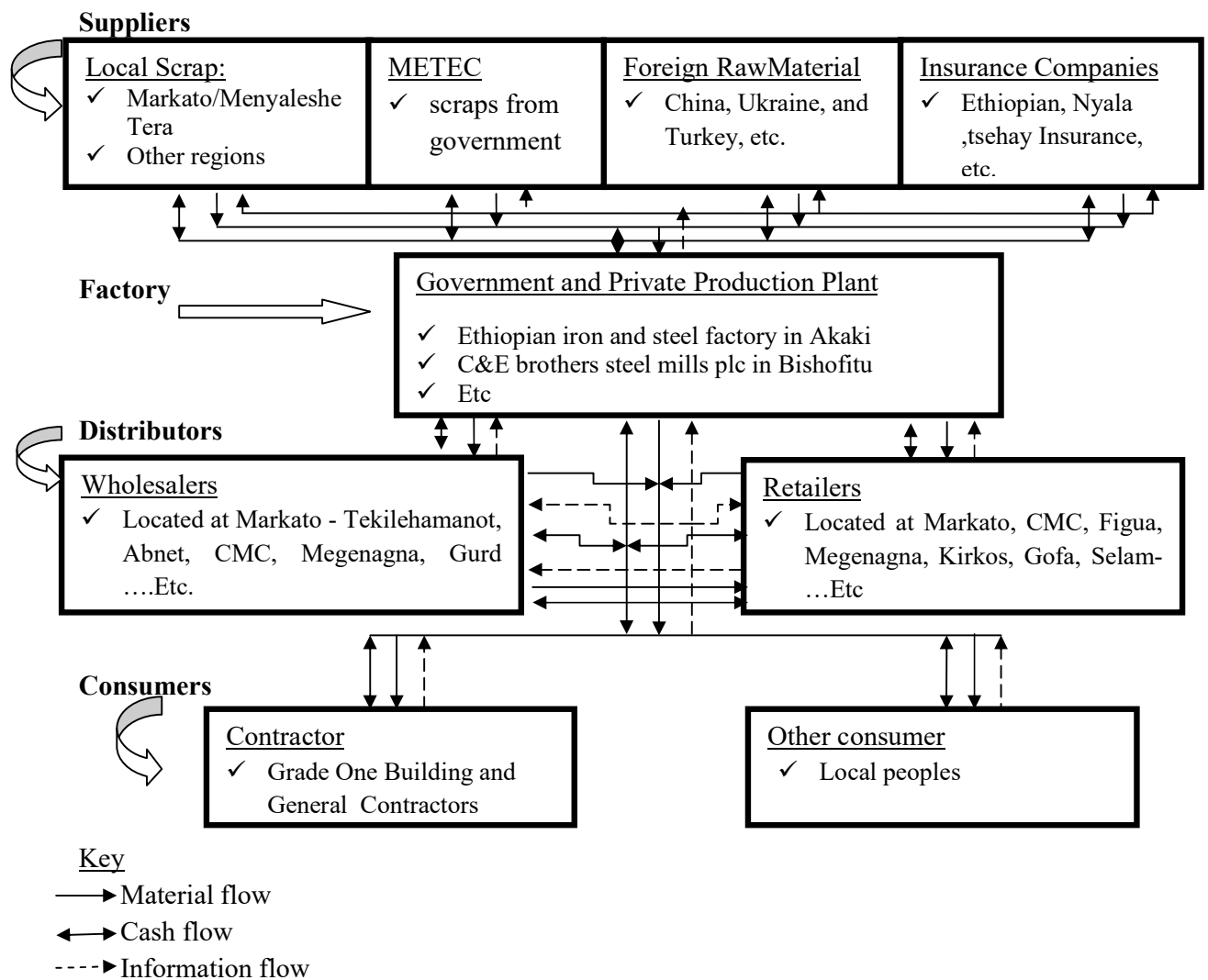


Figure 4.0: Material, information and cash flow of domestic steel reinforcement bar for the construction projects in Addis Ababa city.

Legend: - Units= Meters, Datum=Adindan, Coordinate system= Adindan UTM Zone 37N

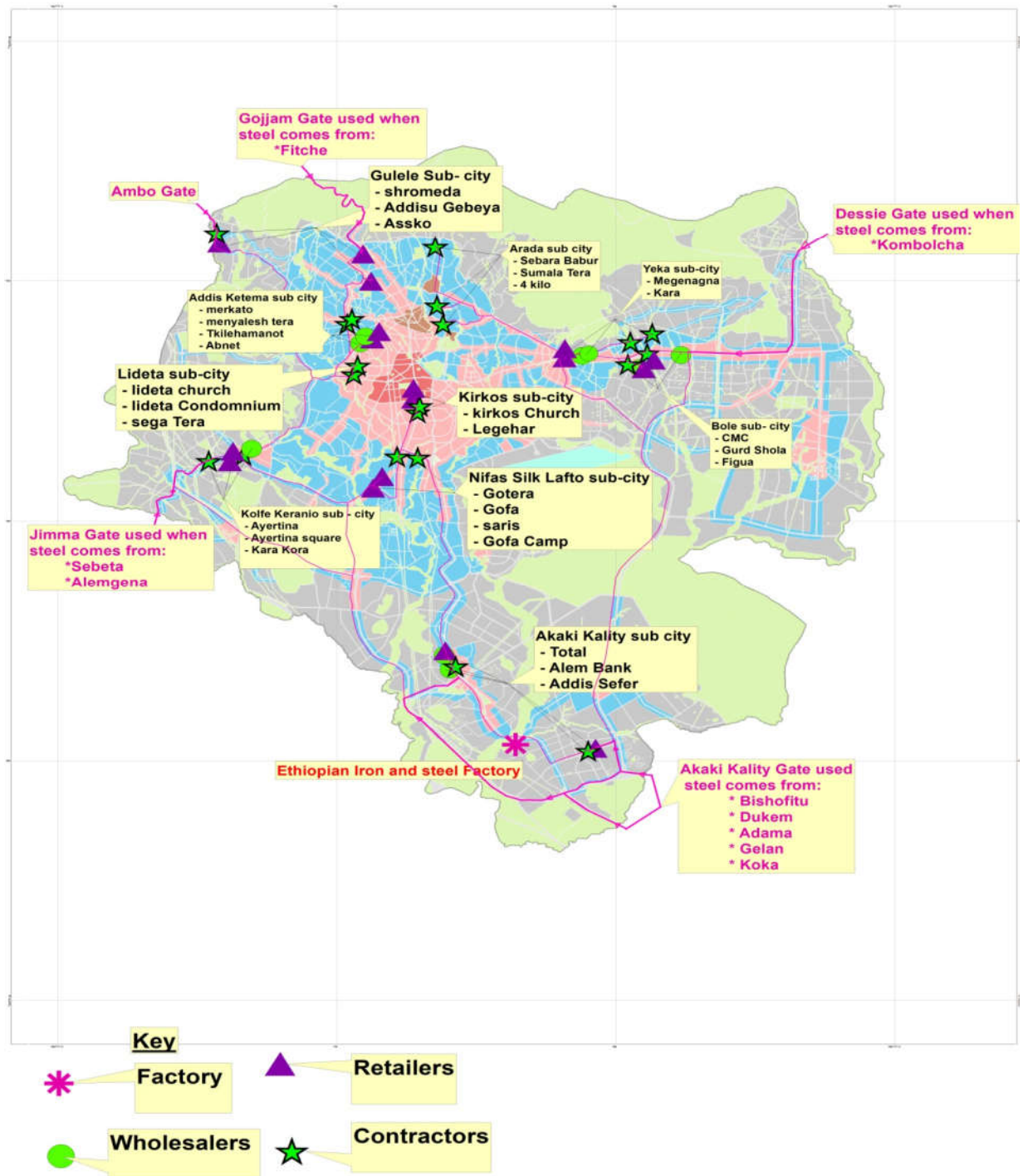
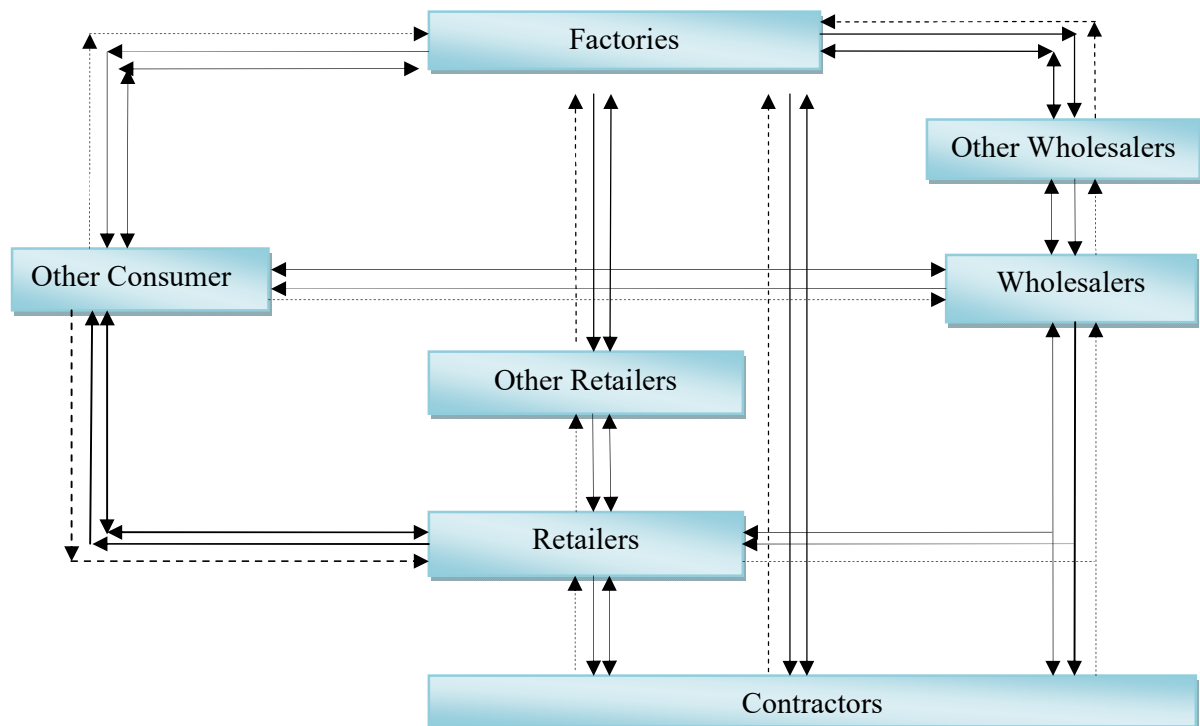


Figure 4.1: Flow network of domestic steel reinforcement bar in Addis Ababa city.

As shown in figure 4.0 and figure 4.1, the flow of material, information and cash and location of suppliers and consumer in Addis Ababa city are mapped. Factories collect raw material from suppliers like local scrap collector, Metals and Engineering Corporation (METEC), foreign raw material & insurance companies and sell their produce to wholesalers, retailers, contractors and other consumers directly or indirectly. Wholesalers sell the product to other wholesalers, retailers, contractors and other consumers by collecting the product from factories and other wholesalers and also retailers distributing the product to other retailers, contractors and other consumers by collecting the material from directly from factories, wholesalers and other retailers and finally contractors collect the material from factories, wholesalers and retailers based on different quantity of product.

As presented in the figure 4.0, the domestic steel reinforcement bar supply chain cash and information flow from consumers to suppliers and reverse direction in Addis Ababa city. The cash flows are in the reverse direction of material flow but information flows in both direction, but the gap under this chain even if the factories gather information from wholesalers, retailers, contractors and other consumers the production of material are not produced based on demand request. From the respondents' point of view, in figure 4.2 the maximum flow of the produce was directly from factories to wholesalers, retailers and contractors. This movement are most of the time apply on all wholesalers, some retailers and almost all grad one contractors. Wholesalers, retailers and contractors transport their produce by themselves from factories stock area to wholesalers & retailers warehouse and contractors construction site within different means of transport and time. Wholesalers and retailers warehouse are open to contractors at any time, that is, even consumers have an access to buy steel reinforcement bar from wholesalers and retailers within short leading time, but most of the time contractor required quantity and item are not full fill and satisfy. From factories to wholesalers, retailers & contractors and also from wholesalers and retailers to contractors and other retailers used small to large trucks as mode of transport. The mode choice mainly depends on the quantity of product transported. According to the respondent's point of view, contractors are the ones who use large amount of products. Contractors prefer direct supply to their working locations from factories.

Mostly, available quantities of steel reinforcement bars at wholesalers and retailers storage area are not sufficient when compared to contractors demand. In addition, the price is also higher when the products are obtained from retailers as compared to factories.



Key
 Material flow
 Cash flow
 Information flow

Figure 4.2: Supply chain network of domestic steel reinforcement bars in Addis Ababa.

4.3. Domestic steel reinforcement bar supply chain main actors with their bottlenecks

4.3.1. Mainactors of domestic steel reinforcement bar supply chain

Products purchased from suppliers often involve variety of products from different sources. Getting a product to the market largely requires an effective marketing channel for companies that manufacture durable goods and other products. A supply chain typically features various middlemen between the manufacturers and the consumers. The common actors in the supply chain of domestic steel reinforcement bar in Addis Ababa are; raw material suppliers, factories, wholesalers, retailers, transporter, contractors, financiers, local peoples, brokers and etc. In this research we included only factories, wholesalers, retailers and contractors.

Factory or manufacturing plant

In this research only three factories are included, which are; Ethiopian Iron and Steel Factory, C&E Brother's Steel Mills plc and Walia Steel Industry. But active and under project factories are listed in table 4.4 below.

Table 4.4: List of factories and their specific location

No	Name of factories	Specific Location	Remark
1	Abyssinia integrated steel plc	Bishofitu	Operational
2	C&E brothers steel mills plc	Bishofitu	Operational
3	East steel plc	Dukem	Operational
4	Ethiopian iron and steel factory	Akaki	Operational
5	Habesha steel mills pc	Dukem	Operational
6	Huano manufacturing plc	Koka	Operational
7	Qiyi Weiproprietorship	Adama	Operational
8	Steely RMI plc	Bishofitu	Operational
9	Walia steel industry	Alemgena	Operational
10	Yesu plc	Gelan	Operational
11	Zuqualla steel products factory	Bishofitu	Operational
12	Hardim metal plc	Sebeta	Project
13	MSP group	Around Fitcha	Project
14	Tossa steel factory	Kombolcha	Project

Wholesalers

Many distributors provide discounts for a certain number of items purchased or the total amount spent on goods. In Addis Ababa city there are main wholesalers available in different area like; Markato, Tekilehamanot, Abnet, CMC, Megenagna, Gurd Shola, Figua, Akaki-Total, Akaki - Alem Bank, Ayertina. However those wholesalers are mostly located at Addis Ketema and Bole sub city (Markato, Tekilehamanot, Abnet, Megenagna, Gurd Shola, Figua and etc.). Those sub cities are more confined and not suitable for built warehouse for steel reinforcement bar.

Retailers

In Addis Ababa city there are main retailers are available in different areas including; Located at Markato, CMC, Figua, Megenagna, Kirkos, Gofa, Akaki Selam Sefer, Akaki - Total, Sebarababur, Asko, Addisugebeya... etc. even if those retailers are available in every sub city the performance to deliver and distribute to consumers are very low due to lack of storage and loading and unloading area.

Consumers

Consumers include construction companies (i.e. contractors) and private personals that use the produced goods. For this research active government and private grade one contractors are included from different areas; Located at Gerje, Megenagna, Markato, CMC, Lideta, AkakiSelamSefer, Addisugebeya, 4kilo, Gofa,... etc. 80% of contractors are used large volume of domestic steel reinforcement bar in construction activity and also 20% of them are under medium size.

4.3.2. The main challenges within individual main actors in the supply chain network of domestic steel reinforcement bars

In order to determine efficiency and effectiveness of the supply chain network of domestic steel reinforcement bar within factories, wholesalers, retailers and contractors, this research considered the following measuring variables.

- ✚ Delivery of raw material and final products in the right time, price, place, quality and quantity;
- ✚ Raw material and final products supply shortage occurrence;
- ✚ Demand estimation problem of raw material and final products;

I. Quality of raw material and final products

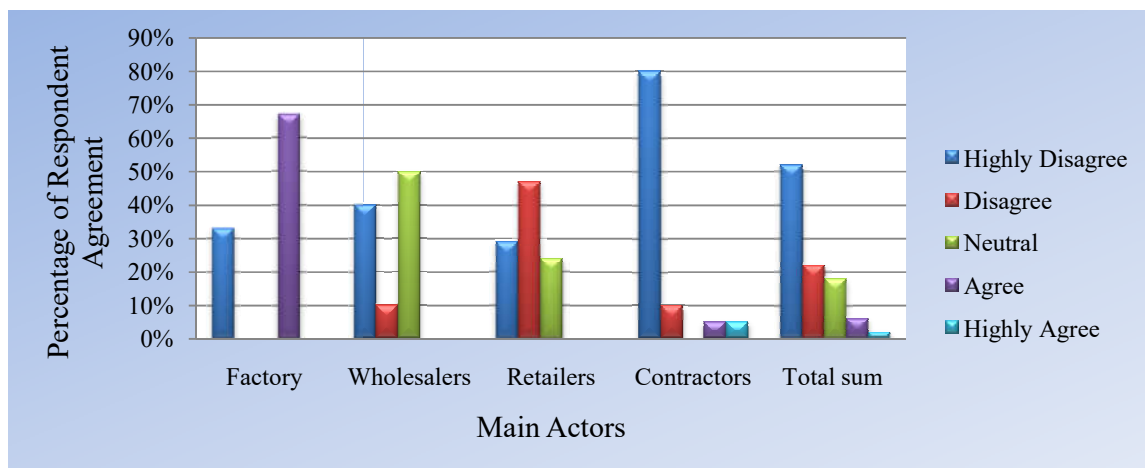


Figure 4.3:Agreement of respondents about delivery of right quality of raw material to factories and final product to consumers

As information obtained from figure 4.3, about 2(67%) factories report that, they received good quality domestic steel reinforcement bar raw material from overseas,

But the other 1(33%) received low quality raw material. About 5(50%) wholesalers and 13(76%) retailers report that they received low quality domestic steel reinforcement bars and most contractors do not prefer domestic products. Only 5(50%) wholesalers and 4(24%) retailers are not sure whether the qualities of the domestic steel reinforcement bar are good or not. About 18(90%) of contractors report that, they received low quality domestic steel reinforcement bar and 2(10%) of them are satisfied with the quality of domestic steel reinforcement bars supplied. So, qualities of raw material and final products must be given more attention to develop good and effective supply chain network in the city.

Generally the respondents made the following conclusions about quality of raw material and final products;

✚ Factories;

- Raw materials which are collected from local scraps (from Markato, MenyalesheTera, insurance companies etc.) didn't have enough quality.
- Most scrap collectors and sellers are located around Addis Ababa, specifically in a storage place called Markato/MenyalesheTera. The collections are composed of different steels with varying material properties, which are brought together without sorting.
- The sorting process is usually done using mere visual inspection without checking chemical characteristic of raw material.

✚ Wholesalers and retailers;

- Now a day's most contractors are, especially grade one prefer overseas products as compared to domestic products; due to this, most wholesalers and retailers are not interested in domestic products.

✚ Contractors;

- There are no sufficient quality controls in domestic a product, which means the responsible body; Ethiopian Standards Agency (ESA) didn't control products of factories quality within the required time interval.
- Clients or financiers of constructing buildings are not interested or proud of domestic product even if the quality of material is fully satisfied.

II. Quantity of raw materials and final products

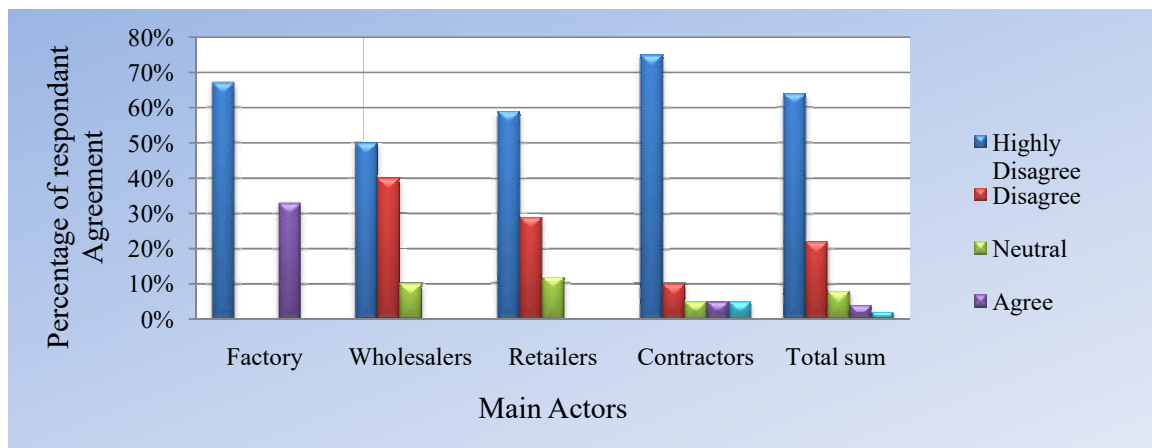


Figure 4.4:Agreement of respondents about delivery of right quantity of raw material to factories and product for consumers

In figure 4.4 above shows, about 2(67%) reinforcement bar factories didn't agree on the amount or quantity of raw material available for production process due to foreign currency problem. But other 33% of total factories satisfied about raw materials collect from local scrap collector, METEC & insurance companies; even if the quality is low and 9(90%) wholesalers and 15(88%) retailers had a different opinion regarding the amount or quantity of domestic steel reinforcement bar delivered to their respective shop and warehouse.

About 17(85%) of contractors also didn't agree about required quantity of domestic steel reinforcement bar delivered to their respective site or warehouse. But only 2(10%) contractors believe there is sufficient quantity of reinforcement bars in the local market.

Generally the respondents gave the following feedbacks about the delivery quantity of rebar;

🚧 Factories;

- The production performances of factories are lowered and/or vary from time to time due to raw material price, foreign currency inflation, policy instability, rise of total tax rate and inefficient government bureaucracy.

🚧 Wholesalers , retailers and contractors;

- Quantities of material delivered to warehouse are not sufficient due to the performance of factories production and warehouse problems typically at retailers' area.
- Location of warehouse and shop of most wholesalers and retailers are in main roads of the city and didn't have enough space for loading and unloading even if wholesalers and retailers are capable enough to supply large quantities of materials.

III. Delivery time of raw material and final products

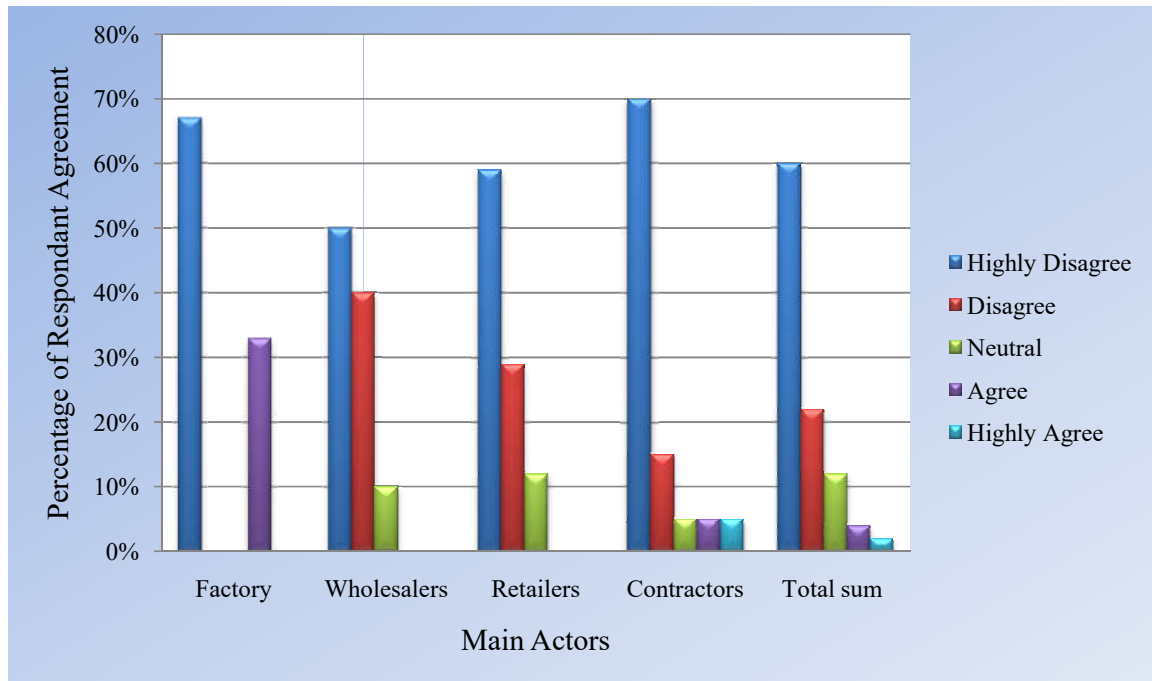


Figure 4.5:Agreement of respondents about right time deliveryof raw material to factories and final product toconsumers

Figure 4.5 shows, about 2(67%) factories are didn't agree the delivery of raw material within the right time in the factory area. But only 1(33%) factory satisfied about raw material delivery time and 9(90%) wholesalers & 15(88%) retailers also complained about final product delivery time to their respective warehouse. In the survey report wholesalers and retailers take, in average, 52 and 32 days for ordered material to be delivered supplied from factories respectively. About 17(85%) of contractors are not satisfied about delivery of material in time to their respective site. According to contractors' point of views, around 80% of contractor needed large demand of steel reinforcement bar, but supply from wholesalers and retailers supply ranges between small and medium and does not satisfy the demand of contractors. Due to this, most contractors prefer to have the material directly from factories.

Generally the respondents mentioned the following main problems about right time delivery of raw material to producers and final product to distributors and consumers;

- ✚ Factories do not base production on forecasts of demands of consumers.
- ✚ On time delivery systems are not developed in supply chain network of domestic steel reinforcement bar between suppliers and consumers.

IV. Delivery price of raw material and final products

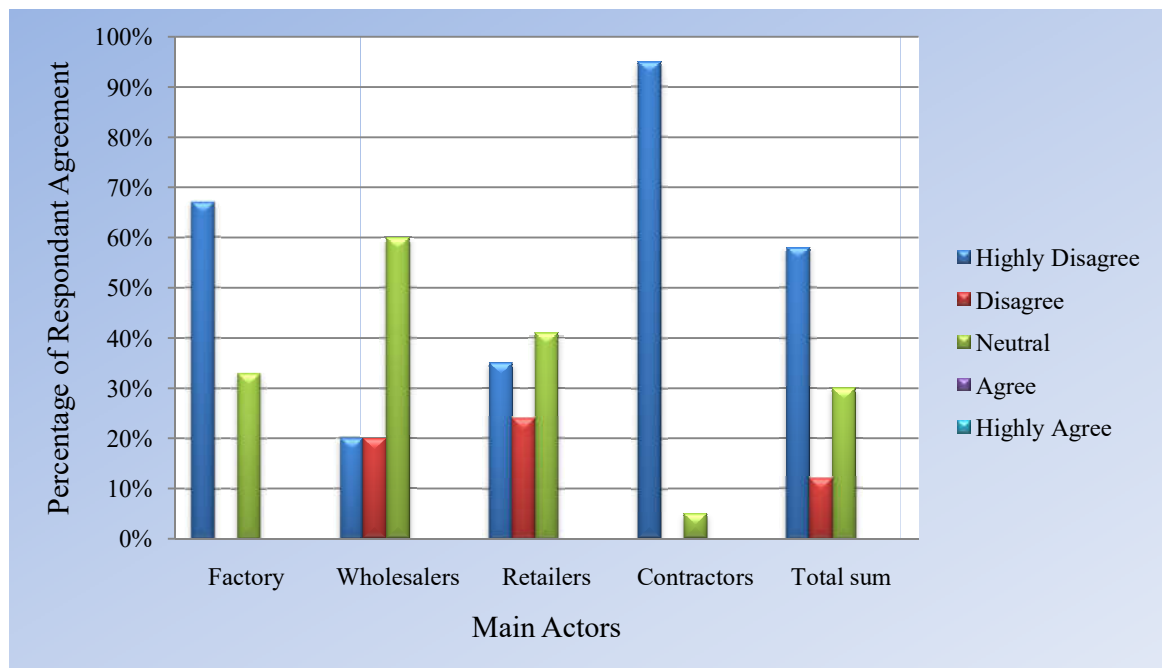


Figure 4.6:Agreement of respondents about lestoprice of raw material to factories and final product to consumers.

As shown in figure 4.6, 2(67%) of factories, 4(60%) wholesalers, 10(59%) retailers and 19(95%) contractors didn't agree about low price of raw materials and final products. And 1(33%) factory and 7(41%) retailers were not sure about the prices, which implies those factories collect raw materials from local marketers and retailers simply give little or no attention to the prices because they can merely compensate the price fluctuation on their customers. According to the survey report, averagely there is 21.14 birr/kilogram increase in material cost when contractors purchasing from retailers or wholesalers as oppose to directly buying from the factories. In order to overcome this price increment, most contractors are forced to factories directly.

Generally the respondents put the following point about lestoprice;

- ✚ The government does not deduct the taxes of rebar raw materials like other construction equipment's (excavator, loader, dump truck, etc.)
- ✚ Raw material suppliers and factories continuously increase the price of material without evidential reason, which means the government does not effectively control the market.

V. Raw materials and final products place of delivery

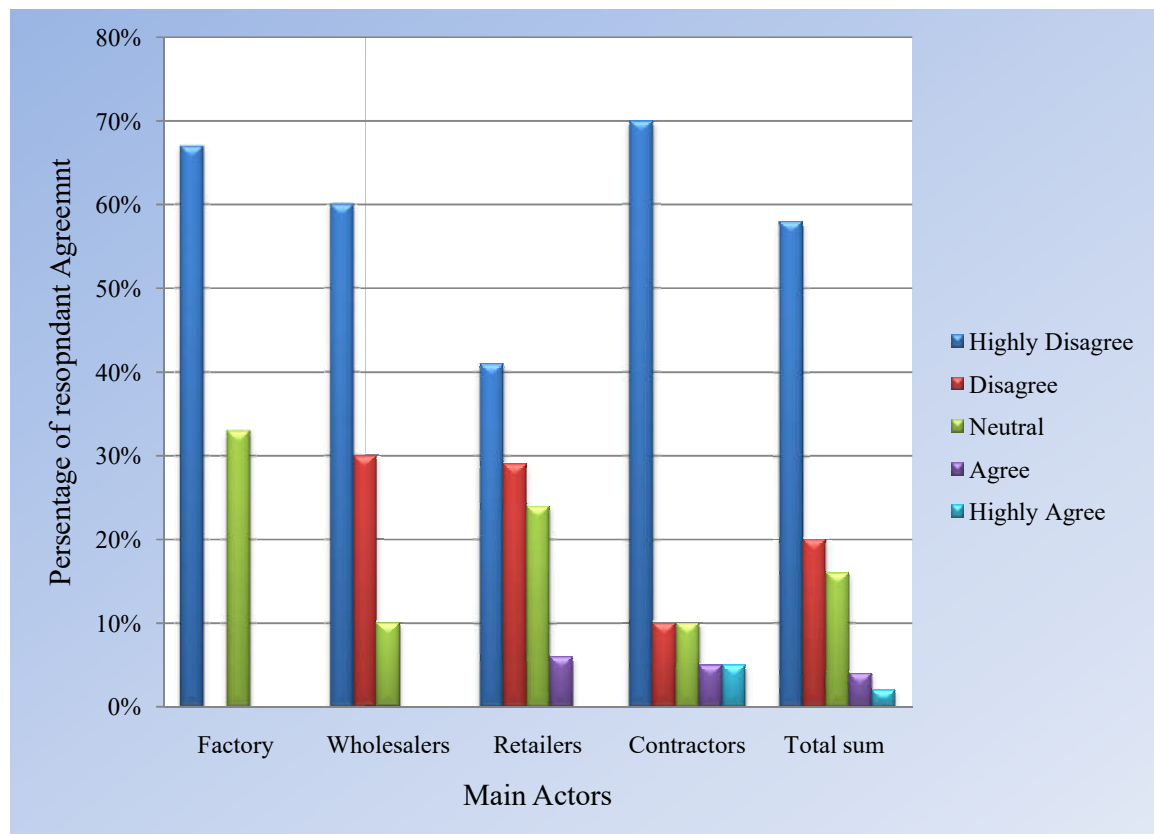


Figure 4.7:Agreement of respondents about delivery of raw material for factories and final product for consumers in right place.

In figure 4.7 shows, 2(67%) factories,9(90%) wholesalers, 12(70%) retailers and 16(80%) contractors had a negative response regarding delivery of domestic steel reinforcement bar raw materials and final product sit the required place.

From total 10 wholesalers 60% purchase materials by traveling more than 40km from Addis Ababa to Bushofitu,Dukem, Sebeta, Fitcha, Adama etc. to compensate the price range of material. But 10% of contractors, who showed small range of material demands, agree that the products are delivered at the right place.

Generally the following main points are given by the respondent about right place delivery.

- ✚ Most factories do not have their own central warehouse in Addis Ababa city.
- ✚ Government does not support distributors by providing warehouses in the capital with fair prices.

VI. Shortage of raw material and final products

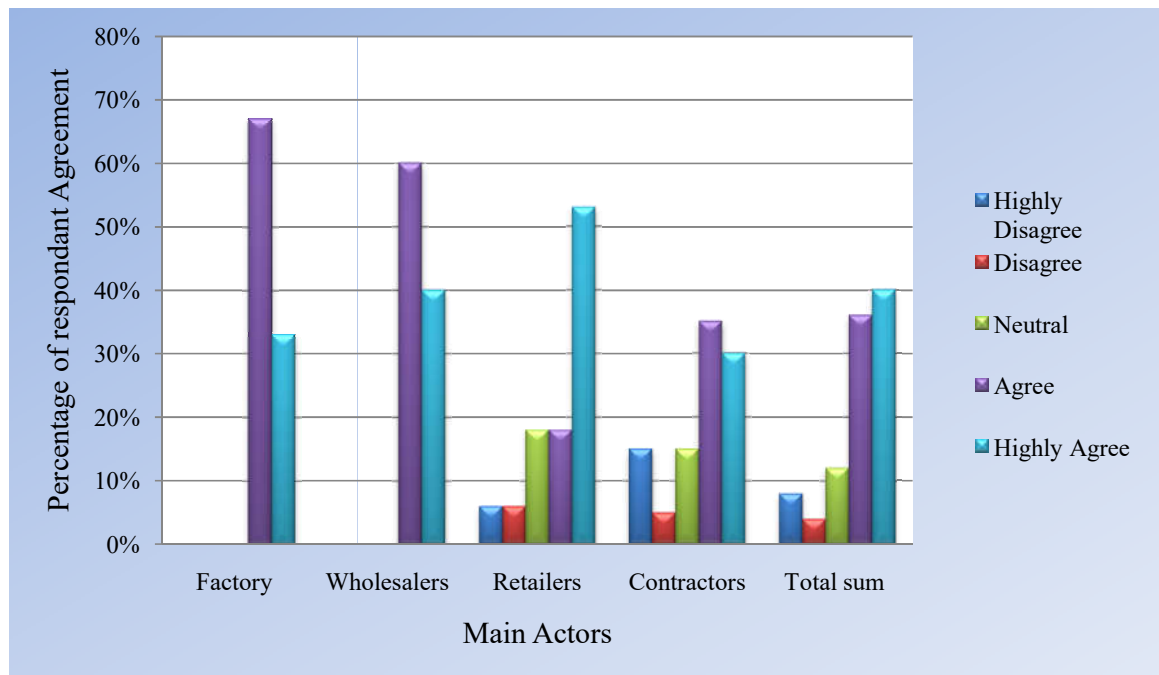


Figure 4.8: Agreement of respondents about occurrence of shortage of raw material in factories and final product in consumers

In the figure 4.8, majorities of the wholesalers 10(100%), contractors 13(65%) and retailers 12(71%) reported that there are shortages of domestic steel reinforcement bars in Addis Ababa. From total 50 respondent 38(76%) are not satisfied with the amount of total supply of domestic steel reinforcement bar.

Generally from the above point of view main suppliers and consumers list out the major cause for shortage of products as follows;

- ✚ wholesalers and retailers;
 - Government tax problems do not initiate the suppliers to apply the effective supply chain activity.
- ✚ Factories;
 - Government does not support private factories on the side of foreign currency exchange.
- ✚ Contractors;
 - Majority of wholesalers and retailers do not have analytically computed forecasts regarding demands hence repetitive questions are asked in different time.
 - Most contractors and suppliers do not use written agreements for the supply process.

VII. Demand estimation of domestic steel reinforcement bar

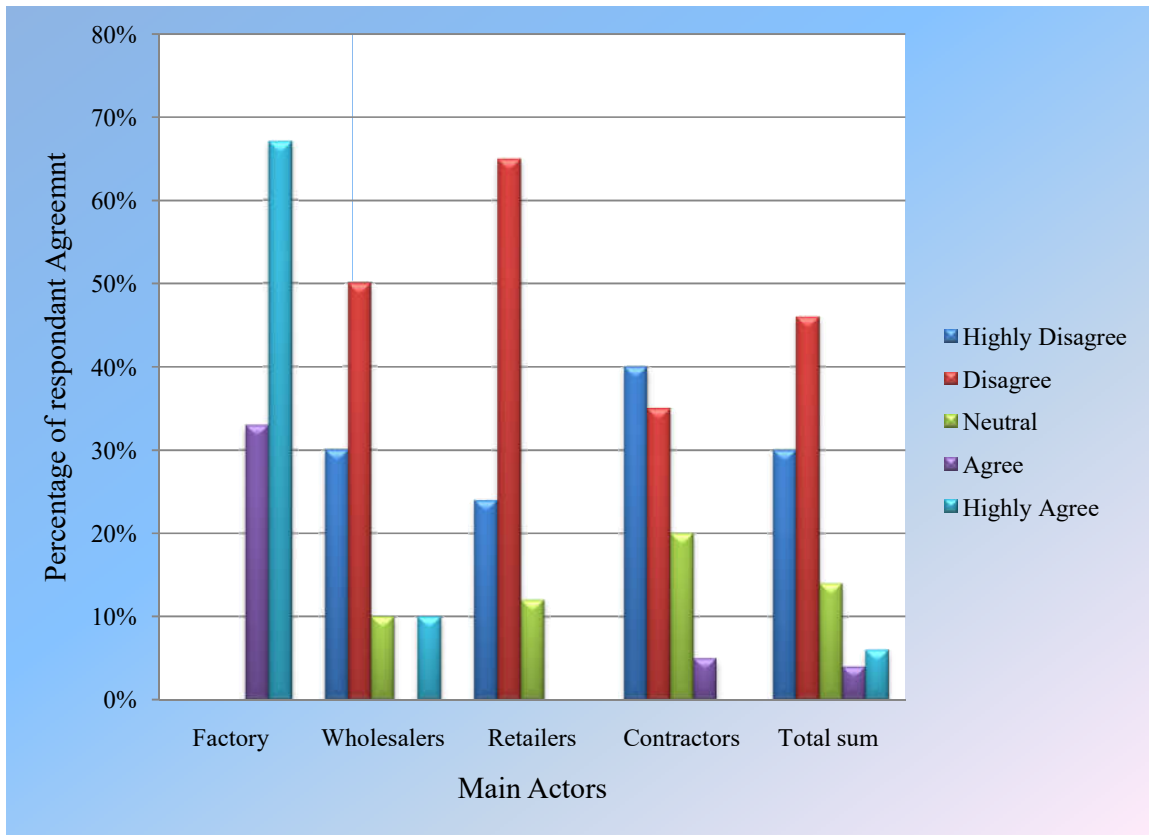


Figure 4.9: Demand estimation based on respondents requirement

As shown in figure 4.9, about 8(80%) wholesalers, 15(89%) retailers and 15(75%) contractors reported those demand estimation problems are occurred. That means most factories produce their products without surveying the market system and requirement of wholesalers, retailers and contractors. Due to this their supply varies from time to time and does not satisfy the consumer requirement. But 3(100%) of factories reported that there is no demand estimation problem about raw material and the required product that means most factories do make forecasts and ask the responsible body to deliver the raw material and consumers demand performa, but the price significantly increases and affect the schedule of factory production time.

Generally main suppliers and consumers list out the major problems for demand estimation as follows;

- ✚ Most factories have fixed production plan which is not updated based on consumers' requirement.

4.3.2.1. Relative Importance Index (RII) analysis

Table 4.5: RII analysis on factors affecting a successful SC networks on the side of factories

Factors	Factories response					RII	Rank
	Agreement	w _i	Frequency (f _i)	w _i *f _i	$\sum_{i=1}^{=5} w_i * f_i$		
steel reinforcement bar raw material delivery to factory in the right quality	Highly disagree	1	1	1	9	60%	3
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	2	8			
	Highly agree	5	0	0			
steel reinforcement bar raw material delivery to factory in the right quantity	Highly disagree	1	2	2	6	40%	4
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	1	4			
	Highly agree	5	0	0			
steel reinforcement bar raw material delivery to factory in the right time	Highly disagree	1	2	2	5	33%	5
	Disagree	2	0	0			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	0	0			
steel reinforcement bar raw material delivery to factory in the right price	Highly disagree	1	2	2	5	33%	5
	Disagree	2	0	0			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	0	0			
steel reinforcement bar raw material delivery to factory in the right place	Highly disagree	1	2	2	6	40%	4
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	1	4			
	Highly agree	5	0	0			
steel reinforcement bar raw material delivery supply shortage occur	Highly disagree	1	0	0	13	87%	2
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	2	8			
	Highly agree	5	1	5			
Demand estimated as factory requirement	Highly disagree	1	0	0	14	93%	1
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	1	4			
	Highly agree	5	2	10			

Table 4.6: RII analysis on factors affecting a successful SC network on the side of wholesalers

Factors	wholesalers response						
	Agreement	w_i	Frequency (f_i)	$w_i * f_i$	$\sum_{i=1}^5 w_i * f_i$	RII	Rank
Steel reinforcement bar delivery to wholesalers in the right quality	Highly disagree	1	4	4	21	42%	3
	Disagree	2	1	2			
	Neutral	3	5	15			
	Agree	4	0	0			
	Highly agree	5	0	0			
Steel reinforcement bar delivery to wholesalers in the right quantity	Highly disagree	1	5	5	16	32%	4
	Disagree	2	4	8			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	0	0			
Steel reinforcement bar delivery to wholesalers in the right time	Highly disagree	1	5	5	16	32%	4
	Disagree	2	4	8			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	0	0			
Steel reinforcement bar delivery to wholesalers in the right price	Highly disagree	1	2	2	24	48%	2
	Disagree	2	2	4			
	Neutral	3	6	18			
	Agree	4	0	0			
	Highly agree	5	0	0			
Steel reinforcement bar delivery to wholesalers in the right place	Highly disagree	1	6	6	15	30%	5
	Disagree	2	3	6			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	0	0			
Steel reinforcement bar delivery supply shortage occur	Highly disagree	1	0	0	44	88%	1
	Disagree	2	0	0			
	Neutral	3	0	0			
	Agree	4	6	24			
	Highly agree	5	4	20			
Demand estimated as wholesalers requirement	Highly disagree	1	3	3	21	42%	3
	Disagree	2	5	10			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly agree	5	1	5			

Table 4.7: RII analysis on factors affecting a successful SC network on the side of retailers

Factors	Agreement	Retailersresponse					RII	Rank
		w_i	Frequency (f_i)	$w_i * f_i$	$\sum_{i=1}^{=5} w_i * f_i$			
Steel reinforcement bar delivery to retailers in the right quality	Highly disagree	1	5	5	33	39%	3	
	Disagree	2	8	16				
	Neutral	3	4	12				
	Agree	4	0	0				
	Highly agree	5	0	0				
Steel reinforcement bar delivery to retailers in the right quantity	Highly disagree	1	10	10	26	31%	6	
	Disagree	2	5	10				
	Neutral	3	2	6				
	Agree	4	0	0				
	Highly agree	5	0	0				
Steel reinforcement bar delivery to retailers in the right time	Highly disagree	1	9	9	29	34%	5	
	Disagree	2	4	8				
	Neutral	3	4	12				
	Agree	4	0	0				
	Highly agree	5	0	0				
Steel reinforcement bar delivery to retailers in the right price	Highly disagree	1	6	6	35	41%	2	
	Disagree	2	4	8				
	Neutral	3	7	21				
	Agree	4	0	0				
	Highly agree	5	0	0				
Steel reinforcement bar delivery to retailers in the right place	Highly disagree	1	7	7	33	39%	3	
	Disagree	2	5	10				
	Neutral	3	4	12				
	Agree	4	1	4				
	Highly agree	5	0	0				
Steel reinforcement bar delivery supply shortage occur	Highly disagree	1	1	1	69	81%	1	
	Disagree	2	1	2				
	Neutral	3	3	9				
	Agree	4	3	12				
	Highly agree	5	9	45				
Demand estimated as retailers requirement	Highly disagree	1	4	4	32	38%	4	
	Disagree	2	11	22				
	Neutral	3	2	6				
	Agree	4	0	0				
	Highly agree	5	0	0				

Table 4.8: RII analysis on factors affecting a successful SC network on the side of contractors

Factors	Contractors response					RII	Rank
	Agreement	w _i	Frequency (f _i)	w _i *f _i	$\sum_{i=1}^{=5} w_i * f_i$		
Steel reinforcement bar delivery to contractors in the right quality	Highly Disagree	1	16	16	29	29%	6
	Disagree	2	2	4			
	Neutral	3	0	0			
	Agree	4	1	4			
	Highly Agree	5	1	5			
Steel reinforcement bar delivery to contractors in the right quantity	Highly Disagree	1	15	15	31	31.0%	5
	Disagree	2	2	4			
	Neutral	3	1	3			
	Agree	4	1	4			
	Highly Agree	5	1	5			
Steel reinforcement bar delivery to contractors in the right time	Highly Disagree	1	14	14	32	32.0%	4
	Disagree	2	3	6			
	Neutral	3	1	3			
	Agree	4	1	4			
	Highly Agree	5	1	5			
Steel reinforcement bar delivery to contractors in the right price	Highly Disagree	1	19	19	22	22.0%	7
	Disagree	2	0	0			
	Neutral	3	1	3			
	Agree	4	0	0			
	Highly Agree	5	0	0			
Steel reinforcement bar delivery to contractors in the right place	Highly Disagree	1	14	14	33	33.0%	3
	Disagree	2	2	4			
	Neutral	3	2	6			
	Agree	4	1	4			
	Highly Agree	5	1	5			
Steel reinforcement bar delivery supply shortage occur	Highly Disagree	1	3	3	72	72.0%	1
	Disagree	2	1	2			
	Neutral	3	3	9			
	Agree	4	7	28			
	Highly Agree	5	6	30			
Demand estimated as contractors requirement	Highly Disagree	1	8	8	38	38.0%	2
	Disagree	2	7	14			
	Neutral	3	4	12			
	Agree	4	1	4			
	Highly Agree	5	0	0			

In the table 4.5 above, factories describe the main three factors that affecting the supply chain network performance of domestic steel reinforcement bar for the construction project of Addis Ababa, which are listed as follow;

- ✚ Demand estimation problem
- ✚ Shortage of raw material
- ✚ Low quality of raw materials

Based on factories points, due to raw material, working capital, power and spare part shortage, quality of raw materials are reasons for insufficient amounts of product. The respondents also answered that demand estimation problems and lack of skilled man power as additional reasons for low amount of supply.

wholesalers describe that the main three factors affecting the supply chain performance of domestic steel reinforcement bar for the construction project of Addis Ababa as shown in table 4.6 listed as follows;

- ✚ Shortage of final products
- ✚ Final products are not delivery right price
- ✚ Most wholesalers are not participating in demand estimation activity

According to table 4.7, retailers describe that the main three factors affecting the supply chain network performance of domestic steel reinforcement bar for the construction project of Addis Ababa are listed as follows;

- ✚ Shortage of final products
- ✚ Final products are not delivery right price
- ✚ Final product of material quality are low

Based on retailers point of view even if the price and quality of product are not good there are no sufficient amount of product within contractor's requirement.

As presented in table 4.8, contractors describe that the main three factors affecting the supply chain performance of domestic steel reinforcement bar for the construction project of Addis Ababa are listed as follow;

- ✚ Shortage of final products
- ✚ Most contractors are not participating in demand estimation activity
- ✚ Final products are not delivery right place

Based on contractors point of view even if the price and quality of product are not good there are no sufficient amount of product within contractor’s requirement.

4.4. The major bottlenecks in the supply chain network

Table 4.9: Supply chain performance indicators with their problem rank

Main actors	Supply chain performance indicators variables	Problem rank	Main actors	Supply chain performance indicators variables	Problem Rank
Factories	Demand estimation	1	Retailers	Production shortage	1
	Production shortage	2		Delivery price	2
	Product quality	3		Delivery place	3
	Product quantity	4		Product quality	3
	Delivery place	4		Demand estimation	4
	Delivery price	5		Delivery time	5
	Delivery time	5		Product quantity	6
Wholesalers	Production shortage	1	Contractors	Production shortage	1
	Delivery price	2		Demand estimation	2
	Product quality	3		Delivery place	3
	Demand estimation	3		Delivery time	4
	Product quantity	4		Product quantity	5
	Delivery time	5		Product quality	6
	Delivery place	6		Delivery price	7

As shown in table 4.9, the four main actors which are factories, wholesalers, retailers and contractors are given different challenges with their problem rank within their own company in order to perform effectively and efficiently in the supply chain activity of domestic steel reinforcement bar. Using those different problem ranks, correlations have been investigated in order to find the cause of those problems and identify general bottlenecks of supply chain network on the construction projects of Addis Ababa.

4.4.1. Correlation analysis

The statistical treatment of the study included the determination of the correlation between the supply chain performance indicators like timely delivery and low cost of steel reinforcement bar, timely delivery and quality of steel reinforcement bar, quality of steel reinforcement bar and quantity etc. with each other. These were made of Pearson’s coefficient to determine the level of association. The level of association admeasured by Pearson’s co-efficient falls between -1.0 and +1.0, which indicates the strength and direction of association among variables. A correlation analysis with Pearson’s correlation coefficient (r) was conducted on all variables in this study for two purposes.

On one hand, it was used for conducting the correlation analysis to explore the relationships between variables and one the other hand, to rank the variables that have the strongest influence on supply chain performance. In order to interpret the strengths of relationships between variables, the strength of the association is described by a correlation coefficient (Dowdy and Weardon, 2003).

- r = 0 - 0.2 low, probably meaningless
- r = 0.2 - 0.4 low, possible importance
- r = 0.4 - 0.6 moderate correlation
- r = 0.6 - 0.8 high correlation
- r = 0.8 - 1 very high correlation

The bivariate correlation procedure was subject to a two-tailed test of statistical significance at the level of 95% significance, $p < 0.05$.

Table 4.10: Correlation analysis among supply chain performance indicators of factories, wholesalers, retailers and contractors

		quality	quantity	Time	place	price	shortage	Demand
quality	Pearson Correlation	1.000	0.174	-1.000	-0.471	0.816	-0.333	-0.258
quantity	»		1.000	-0.174	-0.739	-0.142	-0.522	0.674
time	»			1.000	0.471	-0.816	0.333	0.258
place	»				1.000	-0.481	0.000	0.000
price	»					1.000	0.272	-0.738
shortage	»						1.000	-0.775
demand	»							1.000

As shown in table 4.10, correlations among each variable indicated that there has been statistically significant association among them. The highest correlation has been observed between quality of raw material & final products with raw material and final product price, demand estimation of raw material & final product with quantity of raw material for factory & final product for consumers and also delivery place of raw material & final product with delivery time of raw material & final product by Pearson's correlation co-efficient of $r=0.816$, $r=0.674$ and $r=0.471$ respectively. This variable correlation indicates that when the producer produced high quality product with high quality raw material, those quality products demand extra investment and product component. Due to this reason, shortage & price of steel reinforcement bar is seen in the supply chain network. In addition, raw materials are seen to affect the supply chain network performance of wholesalers, retailers, contractors and factories. In the second place, factories, wholesalers, retailers and contractors involvement in demand determination process is found to be statistically and positively correlated with delivery of product and raw material at the right quantity to the responsible body ($r=0.674$), this correlation indicate that if the producer consider the demand of consumers by taking survey the quantity of material within the required diameter are available in all warehouse and site. Those the above different challenges in the main actors are related one another by different degree.

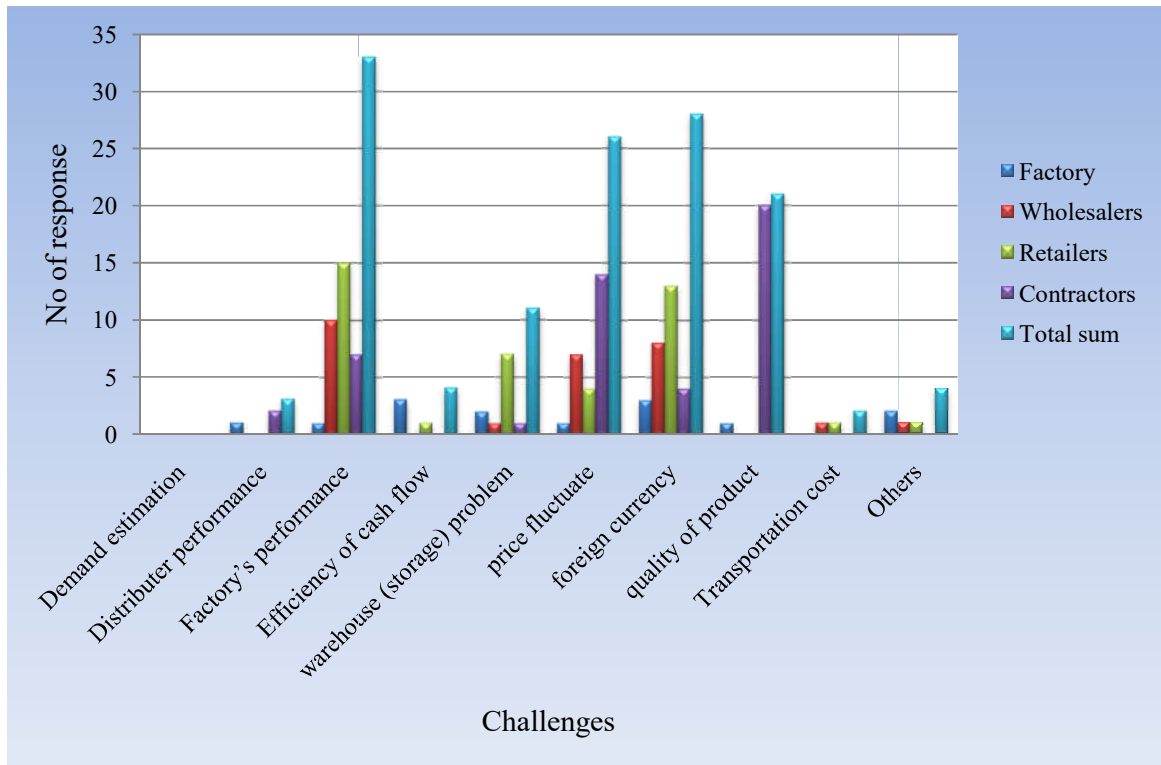


Figure 4.10: Graphical representation of supply chain network challenges

Figure 4.10above, gives the general challenges of supply chain activity of domestic steel reinforcement bar for the construction project of Addis Ababa city. The researcher asked 63 questions about the main challenges/bottlenecks/ in supply chain network of domestic steel reinforcement bar for the construction projects in Addis Ababa city and out of 50 fully answered, 33 respondents believed that the performances of factories are the most highly affecting factor in the supply chain performance.

This implies the production quantity is very low when we compare the consumer requirements and construction industry development. When the producer to increase the product and satisfy the demand requirement it needs highly amount of raw material for production process, but those raw material are much expensive to deliver in Ethiopia, so among 28 and 26 numbers of respondent out 50 gives foreign currency and price fluctuate are the 2nd and 3rd main bottleneck of supply chain activity of domestic steel reinforcement bar for the construction of Addis Ababa city respectively. Almost all Construction companies and others (21) respondents agreed that the qualities (interims of tensile strength and standard length of bar) of some raw material and final

product are low and didn't fulfill the engineering requirements even if the material are available and price are lower than foreign products. Moreover, about 11 of the respondents lack of central warehouse in the city and find the rental price to be very expensive.

In general from the respondents' point of views, the top five significant bottlenecks in supply chain network of domestic steel reinforcement bars for the construction project of Addis Ababa are;

1. Factories production performance
2. Foreign currency
3. Price fluctuation of raw materials and final products
4. Quality of raw material and final products
5. Warehouse (storage) problem

4.5. Analysis on whether the contractors receive domestic steel reinforcement bar in lowest cost possible and shortest lead-time

4.5.1. Total supply chain cost of domestic steel reinforcement bar

The total cost of domestic steel reinforcement bar summed up while the steel reinforcement bar moves from production up to end consumers include; direct and indirect material cost, purchase cost, transportation cost, insurance, bank charge, bank interest, warehousing, inspection, clearing cost, standard authority charges and other overhead costs etc.

In this study all cost variations have not been analyzed say the level of inefficiency in cost by each actor, the research use the following average cost per kilogram to show the level cost increment in the chain by examine the major costs at each actors.

The study use the following cost at each actors;

- ✓ Labor, transport and warehouse cost at wholesalers, retailers and contractors area
- ✓ Factories, wholesaler and retailer selling cost and Contractors purchasing cost

➤ Wholesalers

Direct material cost: -A cost which is directly invests on material purchasing or the amount of expenses incurred on final products of factories.

Daily labor for loading and unloading :-A total of 10 steel reinforcement bar wholesalers are used a total of 2 daily labors for loading and unloading with average salary of Birr 0.5 and 0.6

birr per 12 meter steel reinforcement bars which's diameters is below 16 and above 18 millimeter respectively.

Sales person: -Wholesalers are employee a sales person with averagely monthly salary 2,500 to 3,500 birr. Based on steel reinforcement bar supply in kilogram per month are grouped under small size (20%), medium (50%) and large (30%) size.

Transport cost: -A total of 10 steel reinforcement bar wholesalers are used different vehicles, like small truck (< 3 tone), medium truck (3 to7 tone) and large truck (7 to 12 tone) to transport domesticsteel reinforcements bars from production area to their warehouses. About 20% of wholesalers traveled 20 -30 km and 30- 40 km and 60% of them are greater than 40km.

Warehouse cost: - Wholesalers are used different open area as a warehouse purpose by paying 10,000 – 30,000 birr per month to the owner. The Size of wholesalers based on steel reinforcement bar supplied in kilogram per month are grouped under, 20% small, 50% medium and other 30% are large size.

In table 4.11 shown below, the average cost of material, labor, transport and warehouse in birr per kilogram are summarized.

Table 4.11: Average material,labor, transport and warehouse cost at wholesalers

It. No	Item	Material cost without vat (Birr / kilogram)	Labor cost (Birr/ kilogram)		Transport cost (Birr/ kilogram)	Warehouse cost (Birr/ kilogram)
			Staff	Daily labor		
1	Ø6	31.8	0.83	0.19	0.85	5.52
2	Ø8	26.54	0.83	0.11	0.85	5.52
3	Ø10	26.16	0.83	0.07	0.85	5.52
4	Ø12	24.93	0.83	0.05	0.85	5.52
5	Ø14	24.44	0.83	0.03	0.85	5.52
6	Ø16	23.94	0.83	0.03	0.85	5.52
7	Ø20	22.87	0.83	0.02	0.85	5.52
8	Ø24	23.09	0.83	0.01	0.85	5.52
9	Ø32	23.09	0.83	0.01	0.85	5.52

➤ **Retailers**

Direct material cost: - A cost which is directly invests on material purchasing purpose. So retailers purchased steel reinforcement bars from wholesalers using the following average cost.

Daily labor for loading and unloading :-steel reinforcement bar retailers are used a total of 2 daily labors for loading and unloading with average contract salary 0.5 and 0.6 birr per 12 meter steel reinforcement bars which's diameters is below 16 and above 18 millimeter respectively.

Sales person: -Retailers are employee a sales person with averagely monthly salary 2,500 to 3,500 birr. Based on steel reinforcement bar supply in kilogram per month are grouped under small size (59%), medium size (29%) and large size (12%).

Transport cost: -Retailers are used small truck (< 3 tone), medium truck (3 to7 tone) and large truck (7 to 12 tone) to transport material from wholesalers to their warehouse. Retailers traveled between 20 -30 and above 40 kilometer are 41%, but other 18% retailers are within 30- 40 kilometers.

Warehouse cost: - Retailers are also used different open area as a warehouse purpose by paying 10,000 – 20,000 birr per month based on location and size of area. During survey the Size of retailers based on steel reinforcement bar supplied ranked under small (59%), medium (29%) and large (12%) size.

➤ **Contractors**

Direct material cost: -A cost which is directly invests on material purchasing purpose.

Daily labor for unloading :-Contractors are used a total of minimum 2 daily labors for unloading with average contract salary 0.5 and 0.6 birr per 12 meter steel reinforcement bars which’s diameters is below 16 and above 18 millimeter respectively.

Transport cost: -Contractors are used small truck (< 3 tone), medium truck (3 to7 tone) and large truck (7 to 12 tone) to transport material from retailers to their site. 10%, 20 and 70% of contractors traveled 10 – 20, 30 – 40 and above 40 kilometer respectively to collect materials.

Table 4.12: Average material, labor, transport and warehouse cost birr/kg at retailers and contractors

It. No	Item	Retailers					Contractors		
		Material cost	Labor cost		Transport cost	Warehouse cost	Material cost	Daily labor cost	Transport cost
			Staff	daily					
1	Ø6	41.88	1.4	0.19	0.69	7.01	43.47	0.19	0.911
2	Ø8	40.87	1.4	0.11	0.69	7.01	47.68	0.11	0.911
3	Ø10	42.28	1.4	0.07	0.69	7.01	46.82	0.07	0.911
4	Ø12	37.29	1.4	0.05	0.69	7.01	46.61	0.05	0.911
5	Ø14	41.27	1.4	0.03	0.69	7.01	46.08	0.03	0.911
6	Ø16	38.96	1.4	0.03	0.69	7.01	47.43	0.03	0.911
7	Ø20	37.11	1.4	0.02	0.69	7.01	47.4	0.02	0.911
8	Ø24	36.73	1.4	0.01	0.69	7.01	46.13	0.01	0.911
9	Ø32	36.01	1.4	0.01	0.69	7.01	45.94	0.01	0.911

Table 4.13: Cost of domestic steel reinforcement bar in supply chain network

It. No	Item	Average incremental cost other than material (birr/kg)			Average cost (birr/kg)			
					selling			Buying
		Wholesaler	Retailer	Contractor	Factories	Wholesaler	Retailer	Contractor
1	Ø6	7.58	9.48	1.1	31.8	41.88	44.19	43.47
2	Ø8	7.42	9.32	1.02	26.54	40.87	49.69	47.68
3	Ø10	7.34	9.24	0.98	26.16	42.28	47.91	46.82
4	Ø12	7.3	9.2	0.96	24.93	37.29	47.03	46.61
5	Ø14	7.26	9.16	0.94	24.44	41.27	46.56	46.08
6	Ø16	7.26	9.16	0.94	23.94	38.96	49.3	47.43
7	Ø20	7.24	9.14	0.93	22.87	37.11	49.86	47.4
8	Ø24	7.22	9.12	0.92	23.09	36.73	48.61	46.13
9	Ø32	7.22	9.12	0.92	23.09	36.01	48.22	45.94
Average		7.31	9.22	0.97	25.21	39.16	47.93	46.39
Average increment of cost in the supply chain network (birr/kg)								21.19
Average Percentage increment of cost except material at wholesalers								29%
» at retailers								37%
» at contractors								4%
Average Percentage increment of total cost in the chain network								84%

There is big difference between steel reinforcement bar factories cost and contractor purchasing cost with averagely by 21.19 birr per kilogram and 84% average percentage within the chain (table 4.13). Almost all contractors have been paid high price about 84% of price even if the cost is increased by 29%, 37% and 4% in average at wholesalers, retailers and contractors area respectively within a chain network respectively.

4.5.2. Lead time analysis of domestic steel reinforcement bar

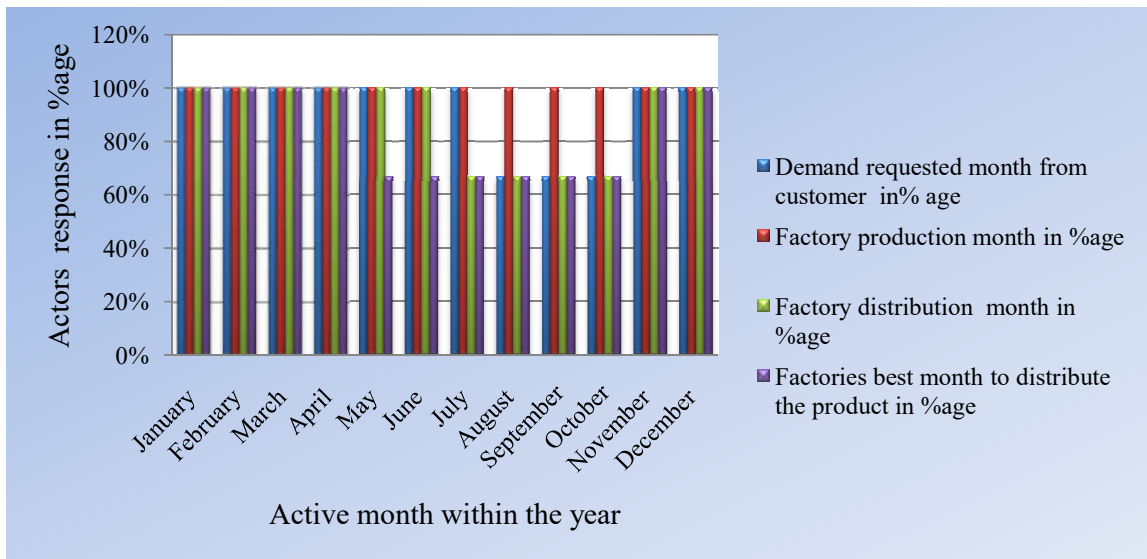


Figure 4.11: Factories demand requested, production and distribution month

As presented with the figure 4.11, all domestic factories are preferred to distribute the product to consumer and demand requested by consumer mostly between November to April even if they produced product throughout the year. But between May to October around 33% and above factories are not interested to distribute the product to consumer.

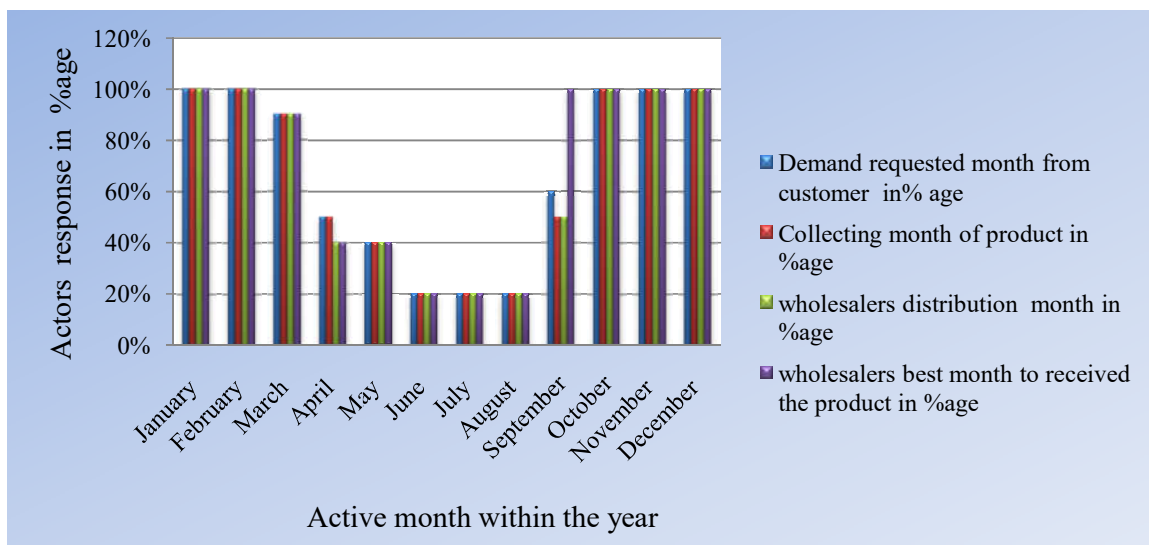


Figure 4.12: Wholesalers demand requested, collecting and distribution Month

In the figure 4.12above, 50% of contractors and retailers were request the wholesalers or the wholesalers collected consumer performa and distribute the product to consumer mostly

between September up to April, and also above 50% of wholesalers are start to distribute the product within September to march monthly interval.

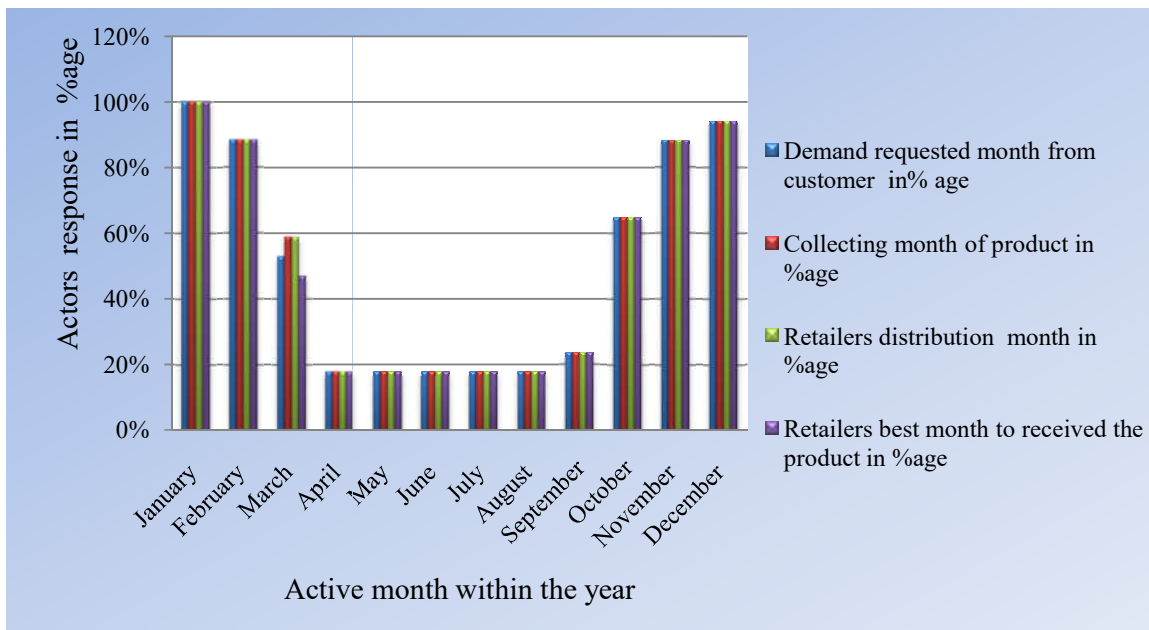


Figure 4.13: Retailers demand requested, collecting & distribution Month

As per the information obtained from retailers respondents 50% to 100% contractors and the retailers or the retailers collect consumer performance and distribute the product to consumer mostly between October up to March, and also about 50% to 100% of retailers are start to distribute the product within October to March monthly interval (Figure 4.13)

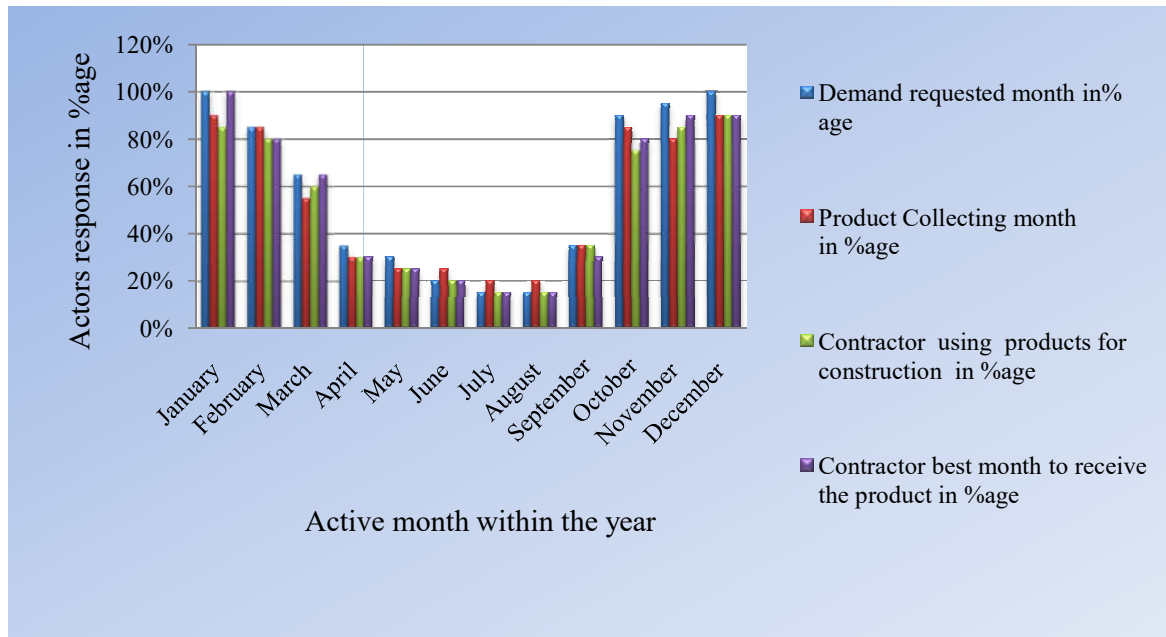


Figure 4.14: Contractor demand requested for suppliers, collecting & construction Month

On the side of contractors, 50% of contractors ask factories, wholesalers and retailers and collecting the product for construction mostly between October up to March, and also above 50% of contractors are mostly active on construction process as shown in figure 4.14.

Table 4.14: Numbers of days for transport and ordered when supplied form respondent

Required days for factories to produce 12 meter bar and ready for supply		
1 days		
Required days for wholesalers to transport and ordered		
Materials comes from factories	Materials comes from other wholesalers	
52 days	3 days	
Required days for retailers to transport and ordered		
Materials comes from Factories	Materials comes from wholesalers	Materials comes from retailers
33 days	3 days	1 days
Required days for contractors to transport and ordered		
Materials comes from factories	Materials comes from wholesalers	Materials comes from retailers
26 days	3 days	2 days

As presented in table 4.14, factories averagely take a day to produce one piece (12 meters) of steel reinforcement bar. From the report, contractors are averagely takes 2, 3 and 26 days when material supplied from retailers, wholesalers and factories respectively.

Whereas wholesalers and retailers were consume 52 and 33 days when material supplied from factories respectively. Those long time delays come from producers and consumers not using harmonized periodic time table for production, distribution and construction. Factories mostly use Novembers to June months for collect consumer performa for production purpose and also use the same period to distribute the product without having any safety stock in your company. But above 50% of wholesalers, retailers and contractors are use the same schedule for collecting the material from factory, distribute the product to in the next consumer and use for construction purpose.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Based on the analysis and results retrieved from the data, the following points are concluded;

1. The major stakeholders in supply chain of domestic steel reinforcement bar for the construction projects in Addis Ababa are suppliers of raw materials, production plants, wholesalers, retailers and contractors. Beside the above mentioned stakeholders, transporters, financial institutions, local peoples, brokers and etc., play a major role for supply chain activities. Under major stakeholders of the chain activity; raw material, working capital, electric power and spare part shortage, quality of raw materials and lack of skilled man power, are reasons for insufficient amounts of product in the factory site. Shortage of warehouse around Markato, Tekilehamanot, Abnet, Megenagna etc, affects the supply chain network of wholesalers and retailers area. In addition, contractors point out price and quality of final products affect the effectiveness of reinforcement bars supply chain network.
2. There are many bottlenecks identified within the supply chain network of domestic steel reinforcement bars for the construction projects of Addis Ababa. They are; shortage of steel production, shortage of foreign currency, price fluctuation, shortage of warehouse, low quality of raw material and final products.
3. The supply chain performance of domestic steel reinforcement bar, for the construction projects in Addis Ababa are inefficient with regards to cost. About 84% surcharges accumulated while domestic steel reinforcement bar moves across the supply chain. In addition, 95% of contractors complained about high cost of domestic steel reinforcement bar. This high average cost in the supply chain network occurs due to shortage of hard currency and government duty tax increment.
4. The lead time of domestic steel reinforcement bar is found to be 26, 33 and 52 days for contractors, retailers and wholesalers, respectively. The survey shows about 85% of contractors, 81% of retailers and 90% of wholesalers complain about the late delivery of domestic steel reinforcement bars. Hence reinforcement bar supply chain lack effectiveness.

5.2. Recommendations

To achieve well-organized and successful supply chain network in the city, I recommend the following:

- ✚ As it can be seen from the outcomes of the research, demand estimation of domestic steel rebar in production plants is a challenge to practice effective supply chain network. So, to avoid this problem, all stakeholders have to participate in production schedule. Producers should also collect demand performance from consumers and produce based on demand taking survey.
- ✚ In order to improve the quality of steel reinforcement bar, government or private organizations should be mandated to support rebar industries to develop awareness creation and training on steel reinforcement bar technology, for those people who are collecting wastage steel (scraps) to be recycled. And also Ethiopian Standards Agency (ESA) should supervise the private companies' competence and ability on the quality of product properly.
- ✚ Locations of wholesalers' and retailers' storage are typically concentrated in high density urban area in Addis Ababa; around Markato, Tekilehamanot, Abnet, Megenagna etc. But most of the time these areas are more urbanized and densely populated as well as affected by traffic jam along the main street. Thus, those wholesalers should relocate their storage area into the main gates of the city.
- ✚ To solve problems related to cost of domestic steel reinforcement bar, Ethiopian Revenues and Customers Authority (ERCA) must support local steel reinforcement factories by reducing duty tax rate from 10% to 5% for all raw materials that come from overseas. And also government should encourage export of goods and service by enabling local companies to participate in foreign market.
- ✚ To make the supply chain of domestic steel reinforcement bar well integrated and minimize long lead time, all the stakeholders; suppliers, importers, wholesalers, retailers, final users, etc. have to be in the same page about need, challenges and mitigating mechanisms. Those stakeholders all together have to engage in supply chain plan of domestic steel reinforcement bar and develop just-in-time delivery.

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APPENDIX

APPENDIX-A: Interview Questioners for Factory

I. General Information

1. How long has your company been worked in this sector?

- 1-5 6-10 years
 11-15years More than 15 years

2. Your Educational level:

- ≤12 Di a Des Mas PHI

3. Your Position in the company:

- phasing division Head
 Manager Other, Specify: _____

II. Information related to supply chain domestic steel reinforcement bar

The evaluated factory:

1. Size of factory based on steel reinforcement bar production in kg/month?

- Small *10³) Medium (7-12 10³)

2. Factory site distance from center of Addis Ababa city?

- 0-10 10-20 20-30 30-40 more 40km

3. Location of factory site:

- High ity urban area low d y urban area
Outsi e city

4. Steel reinforcement bar was supplied:

- t and bend in factory storage ithout cut and bend
 t and bend in factory storage and out of storage

5. Factory sitelocation name & x, y coordinate.....(X=.....Y=.....)

6. Please indicate your level of agreement with regard to domestic steel reinforcement bar delivery (tick \surd where appropriate)

1	2	3	4	5						
Highly disagree	Disagree	Neutral	Agree	Highly agree						
In Addis Ababa,					1	2	3	4	5	
Domestic steel reinforcement bar demand estimated as factory requirement.										
Steel reinforcement bar raw materials are delivered to factory in the right quality.										
Steel reinforcement bar raw materials are delivered to factory in the right quantity.										
Steel reinforcement bar raw materials are delivered to factory in the right time.										
Steel reinforcement bar raw materials delivered to factory in the right place.										
Steel reinforcement bar raw materials delivered to factory in the lowest price.										
Domestic steel reinforcement bare supply shortage occurs.										

7. Do you have enough storage facility for domestic steel reinforcement bar in Addis Ababa?

Yes No

8. If your answer for question number “7” is “No”, what measures should be taken to solve storage/ warehouse /problem?

9. In which month of the year demand of steel reinforcement bar requested?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

10. In which month of the year Steel reinforcement bar distributed to wholesalers?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

11. In which month of the year you start production process of steel reinforcement bar?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

12. In which month of the year is preferable for you to distribute steel reinforcement bar?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

13. Who do you think really decides on the demand of domestic steel reinforcement bar in Addis Ababa?

Contractors wholesaler
 Factor retail
 Others -----

14. How do you map the supply chain network of domestic steel reinforcement bar in Addis Ababa until it reach consumers?

15. How much selling costs/kg invest on domestic steel reinforcement bar?

Diameter	Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø32
Selling cost/kg									

16. There is a well-organized and successful steel reinforcement bar supply chain network performance in Addis Ababa?

Yes No

17. How many days you need for production of steel reinforcement?

Total Production time for 12m bar	
-----------------------------------	--

18. What are the main challenges/bottlenecks/ in supply chain network of domestic steel reinforcement bar in Addis Ababa?

<input type="checkbox"/> Demand estimation	<input type="checkbox"/> warehouse (storage) problem
<input type="checkbox"/> Distributer performance	<input type="checkbox"/> price fluctuate
<input type="checkbox"/> Factory's performance	<input type="checkbox"/> foreign currency
Efficiency of cash flow <input type="checkbox"/>	Transportation cost <input type="checkbox"/>
<input type="checkbox"/> Quality of product	Others, Specify _____

19. What is/are your suggestion to improve the supply chain network of domestic steel reinforcement bar in Addis Ababa?

1	2	3	4	5					
Highly disagree	Disagree	Neutral	Agree	Highly agree					
In Addis Ababa,					1	2	3	4	5
Domestic steel reinforcement bar demand estimated as wholesaler requirement.									
Domestic steel reinforcement bar are delivered to wholesalers in the right quality.									
Domestic steel reinforcement bar are delivered to wholesalers in the right quantity.									
Domestic steel reinforcement bar are delivered to wholesalers in the right time.									
Domestic steel reinforcement bar delivered to wholesalers in the right place.									
Domestic steel reinforcement bar delivered to wholesalers in the lowest price.									
Domestic Steel reinforcement bare supply shortage is occurs.									

7. Do you have enough storage facility of domestic steel reinforcement bar in Addis Ababa?

Yes No

8. If your answer for question number “7” is “No”, what measures should be taken to solve warehouse problem?

9. In which month of the year demand of steel reinforcement bar requested?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

10. In which month of the year Steel reinforcement bar collected from factory?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

11. In which month of the year you start distribution of steel reinforcement bar for construction?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

12. In which month of the year is preferable for you to receive domestic steel reinforcement bar?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

13. Who do you think really decides on the demand of domestic steel reinforcement bar in Addis Ababa?

Contractors wholesaler
 Factory retailers

Others -----

14. How do you map the supply chain network of domestic steel reinforcement bar in Addis Ababa until it reach consumer?

15. How mach purchasing &selling costs/kg invest on domestic steel reinforcement bar?

Diameter	Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø32
Purchasing Cost/kg									
Selling cost/kg									

16. There is a well-organized and successful steel reinforcement bar supply chain network performance in Addis Ababa city?

Yes No

17. How many days you need for ordered & transport until it reaches your storage or site?

When Purchasing from factory	
When Purchasing from other wholesaler	

18. What are the main challenges/bottlenecks in supply chain network of domestic steel reinforcement bar in Addis Ababa?

<input type="checkbox"/> Demand estimation	<input type="checkbox"/> warehouse (storage) problem
<input type="checkbox"/> Distributer performance	<input type="checkbox"/> price fluctuate
<input type="checkbox"/> Factory's performance	<input type="checkbox"/> foreign currency
Eff <input type="checkbox"/> iciency of cash flow	Tr <input type="checkbox"/> ortation cost
<input type="checkbox"/> Quality of product	Others, Specify _____

19. What is/are your suggestion to improve the supply chain network of domestic steel reinforcement bar in Addis Ababa?

1	2	3	4	5					
Highly disagree	Disagree	Neutral	Agree	Highly agree					
In Addis Ababa, ↻					1	2	3	4	5
Domestic steel reinforcement bar demand estimated as retailer's requirement.									
Domestic steel reinforcement bar are delivered to retailers in the right quality.									
Domestic steel reinforcement bar are delivered to retailers in the right quantity.									
Domestic steel reinforcement bar are delivered to retailers in the right time.									
Domestic steel reinforcement bar delivered to retailers in the right place.									
Domestic steel reinforcement bar delivered to retailers in the lowest price.									
Domestic steel reinforcement bare supply shortage is occurring.									

7. Do you have enough storage facility of domestic steel reinforcement bar in Addis Ababa?

Yes No

8. If your answer for question number "7" is "No", what measures should be taken to solve warehouse problem?

9. In which month of the year demand of steel reinforcement bar requested?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

10. In which month of the year Steel reinforcement bar collected from wholesalers?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

11. In which month of the year you start distribution of steel reinforcement bar for construction?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

12. In which month of the year is preferable for you to receive domestic steel reinforcement bar?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

13. Who do you think really decides on the demand of domestic steel reinforcement bar in Addis Ababa city?

Contr s wh aler

Facto ret s

Others -----

14. How do you map the supply chain network of domestic steel reinforcement bar in Addis Ababa until it reaches consumers?

15. How much purchasing & selling costs/kg invest on steel reinforcement bar?

Diameter	Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø32
Purchasing Cost/kg									
Selling cost/kg									

16. There is a well-organized and successful steel reinforcement bar supply chain network performance in Addis Ababa city?

Yes No

17. How many days you need for ordered & transport until it reaches your storage or site?

When Purchasing from factory	
When Purchasing from wholesalers	
When Purchasing from other retailers	

18. What are the main challenges/bottlenecks in supply chain network of domestic steel reinforcement bar in Addis Ababa?

<input type="checkbox"/> Demand estimation	<input type="checkbox"/> warehouse (storage) problem
<input type="checkbox"/> Distributer performance	<input type="checkbox"/> price fluctuate
<input type="checkbox"/> Factory's performance	<input type="checkbox"/> foreign currency
Efficiency of cash flow <input type="checkbox"/>	Transportation cost <input type="checkbox"/>
<input type="checkbox"/> Quality of product	Others, Specify _____

19. What is/are your suggestion to improve the supply chain network of domestic steel reinforcement bar in Addis Ababa?

APPENDIX-D: Interview Questioners for Contractors

I. General information

1. How long has your company been in the construction sector?

- 1- rs years
 11 years e than 15 years

2. Your Educational level:

- ≤12 Grade Diploma Degree Master PHD

3. Your Position in the company:

- her ject Manager
eral Manager engineer
hasing division Head ply Manager

Other, Specify: _____

II. Information related to supply chain domestic steel reinforcement bar

The evaluated project:

1. Type of construction

- Residential Commercial
 Educational Health
 Other -----

2. Size of project based on steel reinforcement bar need?

- Sma - $3 \cdot 10^3$) Medi $3 - 7 \cdot 10^3$) big ($> 7 \cdot 10^3$)

3. Construction site distance from steel reinforcement bar supply area?

- 0-10 10- m 20-30 30-40kr more 40km

4. Location of project site:

- High sity urban area low sity urban area
 Outs he city

5. Steel reinforcement bar was used:

- nd bend on site nd bend out of site
nd bend on site and out of site

6. Project site location name &x, y coordinate(X=.....Y=.....)

7. Please indicate your level of agreement with regard to domestic steel reinforcement bar delivery (tick \checkmark where appropriate)

1	2	3	4	5						
Highly disagree	Disagree	Neutral	Agree	Highly agree						
In Addis Ababa city, \Rightarrow					1	2	3	4	5	
Steel reinforcement bar demand is estimated as per contractor requirement.										
Steel reinforcement bar are delivered to contractors in the right quality.										
Steel reinforcement bar are delivered to contractors in the right quantity.										
Steel reinforcement bar are delivered to contractors in the right time.										
Steel reinforcement bar are delivered to contractors in the right place/location.										
Steel reinforcement bar are delivered to contractors in the lowest price.										
Domestic steel reinforcement bare supply shortage occurs.										

8. Do you have enough storage facility of steel reinforcement bar in Addis Ababa?

Yes

No

9. If your answer for question number “8” is “No”, what measures should be taken to solve storage (warehouse) problem?

10. In which month of the year demand of steel reinforcement bar required?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

11. In which month of the year steel reinforcement bar collected from retailers?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

12. In which month of the year you start using domestic steel reinforcement bar for construction?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

13. In which month of the year is preferable for you to receive the domestic steel reinforcement?

1= Jan 2= Feb 3=Mar 4=Apr 5=May 6=Jun 7=Jul 8=Aug 9=Sep 10=Oct 11=Nov 12=Dec

14. Who do you think really decides on the demand of domestic steel reinforcement bar?

Contr s

w esaler

Facto

r ler

Other.....

15. How do you map the supply chain network of domestic steel reinforcement bar in Addis Ababa until it reach in contractor?

16. How much purchasing costs/kg invest on steel reinforcement bar?

Diameter	Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø32
Purchasing Cost/kg									

17. There is a well-organized and successful steel reinforcement bar supply chain network performance in Addis Ababa city?

Yes No

18. How many days you need for ordered & transport of steel reinforcement bar until it reaches your storage or site?

When Purchasing from retailers	
When Purchasing from wholesalers	
When Purchasing from factory	

19. What are the main challenges/bottlenecks in supply chain network of domestic steel reinforcement bar in Addis Ababa city?

- | | |
|--|--|
| <input type="checkbox"/> Demand estimation | <input type="checkbox"/> warehouse (storage) problem |
| <input type="checkbox"/> Distributer performance | <input type="checkbox"/> price fluctuate |
| <input type="checkbox"/> Factory's performance | <input type="checkbox"/> foreign currency |
| <input type="checkbox"/> Efficiency of cash flow | <input type="checkbox"/> Transportation cost |
| <input type="checkbox"/> Quality of product | Others, Specify _____ |

20. What is/are your suggestion to improve the supply chain network of steel reinforcement bar in Addis Ababa city?

APPENDIX-E:Glossary

- **Supply chain:**is a network of connected and interdependent organizations mutually and cooperatively working together to control manages and improve the flow of materials and information from suppliers to end users.
- **Supply chain management (SCM):** is the process of planning, implementing andcontrolling the operations of the supply chain to satisfy customer requirements asefficiently as possible. It includes all activities related to coordinating and integrating theflow of product, information and finance from point of origin to point of consumption.
- **Wholesalers:** Are those who sell goods in large quantities to be retailed by others.
- **Retailers:** Are those who sell/distribute goods to the end users or consumers.
- **Consumers:** are end users of the product
- **Just-in-time (JIT):** an inventory strategy companies employ to increase efficiency and decreasewaste by receiving goods only as they are needed in the production process, thereby reducinginventory costs.
- **SPSS** - one of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions. It is designed for both interactive and no interactive (batch) uses.
- **Lead-time:**is the clock time spent by the supply chain from procuring rebar imports until placing it into the hands of contractors.
- **Total supply chain costs:**include all the supply chain costs, including material, transport, inventory, and facility and overhead costs.
- **Efficiency:**refers to whether the chain organization is able to deliver rebar with lowest costpossible.
- **Effectiveness:**refers to whether contractors are provided with rebar within shorter lead time,better quality, and appropriate quantity, in the right place and as per contractors' requirement.

APPENDIX-F: Summary of Surveyed Data

Site Distance to Each Other for material supply	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
0-10 km	0	0	0	0	0	0
10-20 km	0	0	0	2	2	4
20-30 km	1	2	7	0	10	20
30-40 km	0	2	3	4	9	18
≥40km	2	6	7	14	29	58
Total	3	10	17	20	50	100

Site location	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
High density urban area	0	8	13	19	40	80
low density urban area	1	2	4	1	8	16
Outside the city	2	0	0	0	2	4
Total	3	10	17	20	50	100

Methods of supply and used	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
Cut and bend on site	0	0	0	19	19	38
Without Cut and bend	3	10	14	0	27	54
Cut and bend on site and out of site/storage/	0	0	3	1	4	8
Total	3	10	17	20	50	100

Supply chain main actors		Diameter								
		Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø30
Factory	Selling costs/kg	31.8	26.54	26.16	24.93	24.44	23.94	22.9	23.09	23.09
Wholesaler	Purchasing costs/kg	-	-	-	-	-	-	-	-	-
	Selling costs/kg	41.9	40.87	42.28	37.29	41.27	38.96	37.1	36.73	36.01
Retailer	Purchasing costs/kg	-	-	-	-	-	-	-	-	-
	Selling costs/kg	44.2	49.69	47.91	47.03	46.56	49.3	49.9	48.61	48.22
Contractor	Purchasing costs/kg with vat	50.3	53.72	53.79	54.33	53.65	53.59	52.9	51.35	51.35

Enough storage facility	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
yes	1	2	5	9	17	34
no	2	8	12	11	33	66
Total	3	10	17	20	50	100

Addis Ababa Sub city	Supply chain main actor location											
	Factory			Wholesaler			Retailer			Contractors		
	No	x	y	No	x	y	No	x	y	No	x	y
Bole	1			1	482506	996998	1	481133	996417	1	481345	997045
	2			2	481076	996438	2	481183	996412	2	480667	996573
Arada	1			1	no	no	1	471432	1000025	1	474035	998231
	2			2	no	no	2	no	no	2	473814	999033
Addis Ketema	1			1	471127	997421	1	471458	997630	1	470690	998333
	2			2	471055	997485	2	471629	997797	2	470495	998110
Kirkos	1			1	no	no	1	472963	995117	1	473047	994517
	2			2	no	no	2	472919	995205	2	473136	994795
Yeka	1			1	478987	996920	1	478380	996866	1	480658	997439
	2			2	479050	996906	2	478409	996871	2	481467	997782
Gulela	1			1	no	no	1	465870	1001816	1	465828	1001857
	2			2	no	no	2	471165	1001148	2	473686	1001429
KolfeKeranio	1			1	467133	992853	1	466435	992708	1	465535	992476
	2			2	466955	992838	2	466346	992692	2	466846	992781
Nifas Silk Lafto	1			1	no	no	1	471849	991892	1	473084	992685
	2			2	no	no	2	471536	991513	2	472356	992673
AkakiKality	1	476645	980736	1	478443	960165	1	479498	980543	1	479173	980394
	2			2	474281	983889	2	474118	984314	2	474300	983807
Lideta	1			1	no	no	1	no	no	1	470779	996098
	2			2	no	no	2	no	no	2	470901	996327

Factory domestic steel reinforcement bar	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
→ demand requested	3	3	3	3	3	3	3	2	2	2	3	3
→ distributed to wholesalers	3	3	3	3	3	3	2	2	2	2	3	3
→ start production	3	3	3	3	3	3	3	3	3	3	3	3
→ preferable for distribute	3	3	3	3	2	2	2	2	2	2	3	3
Retailers domestic steel reinforcement bar	Month											
→ demand requested	17	15	9	3	3	3	3	3	4	11	15	16
→ collected from wholesalers	17	15	10	3	3	3	3	3	4	11	15	16
→ preferable for receive	17	15	8	3	3	3	3	3	4	11	15	16
→ preferable for distribute	17	15	10	3	3	3	3	3	4	11	15	16
Wholesalers domestic steel reinforcement bar	Month											
→ demand requested	10	10	9	5	4	2	2	2	6	10	10	10
→ collected from factory	10	10	9	5	4	2	2	2	5	10	10	10
→ preferable for receive	10	10	9	4	4	2	2	2	14	10	10	10
→ preferable for distribute	10	10	9	4	4	2	2	2	5	10	10	10

Contractor domestic steel reinforcement bar	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
→ demand requested	20	17	13	7	6	4	3	3	7	18	19	20
→ collected from retailers	18	17	11	6	5	5	4	4	7	17	16	18
→ preferable for receive	20	16	13	6	5	4	3	3	6	16	18	18
→ use for construction	17	16	12	6	5	4	3	3	7	15	17	18

In Addis Ababa city Steel reinforcement bar delivery to the contractors	Number and percentage of Respondents					
	Highly agree	Agree	Neutral	Disagree	Highly disagree	Total
	N	N	N	N	N	N
→ In the right quality	1	1	0	2	16	20
→In the right quantity	1	1	1	2	15	20
→In the right time	1	1	1	3	14	20
→In the right place/location	1	1	2	2	14	20
→In the lowest price	0	0	1	0	19	20
Domestic steel reinforcement bar supply shortage occurs	6	7	3	1	3	20
Demand estimated as contractors requirement	0	1	4	7	8	20
In Addis Ababa city Steel reinforcement bar delivery to the wholesalers	Number and percentage of Respondents					
	Highly agree	Agree	Neutral	Disagree	Highly disagree	Total
	N	N	N	N	N	N
→ In the right quality	0	0	5	1	4	10
→In the right quantity	0	0	1	4	5	10
→In the right time	0	0	1	4	5	10
→In the right place/location	0	0	1	3	6	10
→In the lowest price	0	0	6	2	2	10
Domestic steel reinforcement bar supply shortage occurs	4	6	0	0	0	10
Demand estimated as wholesalers requirement	1	0	1	5	3	10
In Addis Ababa city Steel reinforcement bar delivery to the retailers	Number and percentage of Respondents					
	Highly agree	Agree	Neutral	Disagree	Highly disagree	Total
	N	N	N	N	N	N
→ In the right quality	0	0	4	8	5	17
→In the right quantity	0	0	2	5	10	17
→In the right time	0	0	4	4	9	17
→In the right place/location	0	1	4	5	7	17
→In the lowest price	0	0	7	4	6	17
Domestic steel reinforcement bar supply shortage occurs	9	3	3	1	1	17
Demand estimated as wholesalers requirement	0	0	2	11	4	17

In Addis Ababa city Steel reinforcement bar raw material delivery to the factory	Number and percentage of Respondents					
	Highly agree	Agree	Neutral	Disagree	Highly disagree	Total
	N	N	N	N	N	N
→ In the right quality	0	2	0	0	1	3
→In the right quantity	0	1	0	0	2	3
→In the right time	0	0	1	0	2	3
→In the right place/location	0	1	0	0	2	3
→In the lowest price	0	0	1	0	2	3
Domestic steel reinforcement bar supply shortage occurs	2	1	0	0	0	3
Demand estimated as wholesalers requirement	1	2	0	0	0	3

work experience of respondents	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
1-5 years	0	3	12	2	17	34
6-10 years	1	4	3	5	13	26
11-15 years	0	1	1	4	6	12
≥15 years	2	2	1	9	14	28
Total	3	10	17	20	50	100

Challenges/bottlenecks	Supply chain main actor					
	Factory	wholesaler	Retailer	Contractors	Total	
	N	N	N	N	N	N
Demand estimation	0	0	0	0	0	0
Distributor performance	1	0	0	2	3	3
Factory's performance	1	10	15	7	33	33
Efficiency of cash flow	3	0	1	0	4	4
warehouse (storage) problem	2	1	7	1	11	11
price fluctuate	1	7	4	14	26	26
foreign currency	3	8	13	4	28	28
quality of product	1	0	0	20	21	21
Transportation cost	0	1	1	0	2	2
Others	2	1	1	0	4	4

Well-organized and successful steel reinforcement bar supply chain network are in Addis Ababa?	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
Yes	1	2	2	2	7	14
No	2	8	15	18	43	86
Total	3	10	17	20	50	100

Position of respondents	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
Owner	1	4	8	1	14	28
Purchasing division Head	0	0	0	0	0	0
Sales Manager	2	6	9	1	18	36
Project Manager	0	0	0	6	6	12
General Manager	0	0	0	4	4	8
Site engineer	0	0	0	7	7	14
Supply Manager	0	0	0	0	0	0
Other	0	0	0	1	1	2
Total	3	10	17	20	50	100
Enough storage facility	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
yes	1	2	5	9	17	34
no	2	8	12	11	33	66
Total	3	10	17	20	50	100
Demand decision maker	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	
	N	N	N	N	N	
Factory	2	9	9	18	38	
Wholesaler	1	1	2	0	4	
Retailer	0	3	1	1	5	
Contractors	3	4	11	15	33	
Other	0	2	1	0	3	
Educationlevel of respondents	Supply chain main actor					
	Factory	Wholesaler	Retailer	Contractors	Total	Percentage
	N	N	N	N	N	%
≤12 Grade	0	1	4	0	5	10
Diploma	0	4	10	0	14	28
Degree	1	5	3	15	24	48
Master	2	0	0	5	7	14
PHD	0	0	0	0	0	0
Total	3	10	17	20	50	100
Type of construction	Number of Contractors		Percentage (%)			
Residential	2		10			
Educational	3		15			
Commercial	13		65			
Health	0		0			
Other	2		10			
Total	20		100			

Traveled distance to each other for material supply	Supply chain main actor				
	Factory	Wholesaler	Retailer	Contractors	Total
	N	N	N	N	N
0-10 km	0	0	0	0	0
10-20 km	0	0	0	2	2
20-30 km	1	2	7	0	10
30-40 km	0	2	3	4	9
≥40km	2	6	7	14	29
Total	3	10	17	20	50

Demand decision maker	Supply chain main actor				
	Factory	Wholesaler	Retailer	Contractors	Total
	N	N	N	N	N
Factory	2	9	9	18	38
Wholesaler	1	1	2	0	4
Retailer	0	3	1	1	5
Contractors	3	4	11	15	33
Other	0	2	1	0	3
Purchasing	Contractors	Retailers	Wholesalers		
From Factory	26 days	32 days	52 days		
From Wholesalers	3 days	2 days	3 days		
From Retailers	2 days	1 days			