DESIGNING GREEN SUPPLY CHAIN MANAGEMENT SYSTEM FOR HORIZON ADDIS TIRE MANUFATURING P.L.C

MSc THESIS

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HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

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A THESIS SUBMITTED TO HAWASSA UNIVERSITY

DEPARTMENT OF INDUSTRIAL ENGINEERING, HAWASSA INSTITUTE OF TECHNOLOGY, SCHOOL OF GRADUATE STUDIES, HAWASSA UNIVERSITY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN INDUSTRIAL ENGINEERING AND LOGISTIC MANAGEMENT

JUNE, 2021

DECLARATION

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

Name: _____

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This MSc thesis has been submitted for examination with my approval as thesis advisor.

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ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled "Designing green supply chain management system for Horizon Addis Tire Manufacturing PLC" submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Industrial Engineering and Logistics Management, the Graduate Program of the department Industrial Engineering, and has been carried out by Leiso Liranso ID. No. IELMW/0006/11, under our supervision. Therefore we recommend that the student has fulfilled the requirement and hence hereby can submit the thesis to the department.

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EXAMINERS' APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Leiso Liranso have read and evaluated his thesis entitled "Designing green supply chain management system for Horizon Addis tire Manufacturing PLC" and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree.

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School Graduate Committee (DGC/SGC) of the candidate's department.

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ABSTRACT

The history of tire manufacturing goes back to early 19th century and in Ethiopia the tire manufacturing industry began in 1972 G.C, where Addis Tire S.C. is first of its kind and currently holds its new name "Horizon Addis Tire Manufacturing PLC". However, the company being the leading tire manufacturing company, it continued to waste inputs and operated at low level of capacity resulted by different internal and external factors. In an existing status where companies eliminate wastes from their manufacturing and natural environment, HATMPLC imports almost all of its inputs from abroad followed by packaging wastes, and this is the point where the situation needs scientific inquiry and solution. The general objective of this study is to design green supply chain management model in Horizon Addis Tire Manufacturing PLC. Data is collected using interview, document review and observation approaches. Observation was made to understand and structure the tyre production process, eight detailed key informant interviews were carried out and essential documents from the company were reviewed. Data were analyzed in descriptive analyses for performance measurements and waste study. As a result, the existing supply chain structure of the company was structured, and its supply chain processes were discussed. The company is extremely dependent on import from abroad where all of raw materials, except for part of the natural rubber, are imported, and it has a production waste of about 16,129,099.4 in 2011 E.C and 14,366,005.5 ETB worth in 2012 E.C just from tire defect. The company had 55.9% and 48.9% of capacity utilization in 2011 E.C and 2012 E.C respectively, and it improved the reliability and responsiveness performance attributes while cost and flexibility attributes sustained and asset turn over and total supply chain management cost dragged down. Following this, a green supply chain management is designed through the designs of green supply chain processes in accordance with green Supply Chain Operations Reference by applying best practices. To conclude, although HATMPLC is producing essential product, its waste management performance is below its target set. The company needs a governmental attention in consideration with environmental management and market place since the company plays important role in fulfilling the domestic tyre demand and equally contribute to waste accumulation in the country.

Key words: Green supply chain management, SCOR, Best practices, Waste management

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ACRONYMS AND ABBREVIATIONS

Abbreviations	Stands for
3PL	Third Party Logistics
ATC	Addis Tire Share Company
COMESA	Common Market for Eastern and Southern Africa
E.C	Ethiopian Calendar
EMS	Environmental Management System
EPA	Environmental Protection Authority
ETB	Ethiopian Birr
FDRE	Federal Democratic Republic of Ethiopia
G.C	Gregorian Calendar
GL	Green Logistics
GP	Green Procurement
GSC	Green Supply Chain
GSCM	Green Supply Chain Management
HATMPLC	Horizon Addis Tire Manufacturing Private Limited Company
ICC	Inventory Carrying Cost
ISO 14001	International Standards for Environmental Management System
MHC	Materials Handling Cost
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
OFLT	Order Fulfillment Lead Time
OTR	Off The Road Tire
PDCA	Plan Do Check Act
P.L.C	Private Limited Company
POF	Perfect Order Fulfillment
RCA	Root Cause Analysis
RL	Reverse Logistics

RMP	Raw Material Purchase
S.C.	Share Company
S. C. Council	Supply Chain Council
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
TC	Transportation Cost
VAP	Value Added Productivity
WIP	Work In Progress

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study and company

The concept of GSCM is to integrate environmental thinking into supply chain management (SCM) which aims to minimize or eliminate wastages including hazardous chemical, emissions, energy and solid waste along supply chain such as product design, material resourcing and selection, manufacturing process, delivery of final product and end-of-life management of the product. Additionally, GSCM is a green initiative to improve process and product performance based on requisite in environmental regulations. GSCM has important purposes related to environmental performance, such as risk control, meeting marketplace expectations, achieving good commercial enterprise performance and complying with environmental regulations. Making green the supply chain will create a good opportunity for those who are worried about sustainable consumption issues and environmental business operations. Some author claim that products should be recycled and reused after their end of life (as a strategy to reduce demand of raw materials) this change has many applications for companies and organization's long-term success depends on its ability to manage and coordinate relationships with suppliers and above all to making green its supply chain (Chin TA, 2015).

GSCM is also defined as an application of environmental management principles to the entire set of activities across the whole customer order cycle, including, design, procurement, manufacturing and assembly, packaging, logistics and distribution (Agi MA, 2017). Integrating environmental thinking into supply chain management, including ecological design of products, purchasing green materials and components, reengineering of manufacturing steps towards eco-friendly, reverse logistics management of the product after its useful life (Islam S, 2017).Integrating environmental consideration onto firms' supply chain including reverse logistics (Zhu Q, 2019). Reducing and controlling the harmful impacts of supply chain on the environment. Adoption of ecological design, sourcing green materials and chemicals, and provide green trainings to employees under ethical leadership (Khan SAR, 2016). Green

supply chain are integrating eco-friendly concept into supply chain management to improve environmental sustainability with different green practices including, green purchasing, green distribution and warehousing, green transportation with usage of bio-fuels, green manufacturing processes and the products' end-of-life management (Khan SAR, 2017).

The production of tires in Ethiopia goes back to 1972 G.C, where Addis Tire S.C. the first of its kind in the country as state owned company by the help of Czechoslovakian government. The factory yearly production capacity was 60,000 tires and 45,000 tubes and a total labor force of 260 people. Latter, as of 1973, government established a joint venture with the Japanese known tire company called YOKOHAMA, and jointly worked for about 22 years. In 1994, the JV agreement was dissolved and the government runs the business with full ownership up to May 2004.

After subsequent joint venture formation between Addis Tire S.C. (Government Owned) and the Slovakian renowned tire manufacturer, MATADOR Addis .S.C was established in June 2004 and the operation commenced in July 2004 with the hybrid trade name MATADOR-Addis Tire S.C. However, due to shift in business focus, MATADOR-Addis Tire S.C. transferred its share to Continental AG, the world known German tire manufacturer company, on October 23, 2007. Finally, in January 2011, the known investment group, MIDROC ETHIOPIA, had bought the share of Continental AG through one of its group companies, called Horizon Plantation P.L.C. and hold its new name "Horizon Addis Tire Manufacturing PLC" (HATMPLC, 2019).

The company has now created job opportunity for more than 800 Ethiopians and invested a lot to quip with state-of-the-art technology. Despite the improvement works done on the quality level of the existing products, the company has developed more than 40 different types of radial and bias construction new tires for different applications. Currently the factory's production has reached to 600 thousand and plus units of tire per annum (HATMPLC, 2019).

The company is relentlessly striving to ensure the quality of existing products, embarked on major expansion and product diversification projects that can significantly boost its output and hence strengthen the company for better competent power in the market and warrant the sustainability of the company business. In its expansion and product diversification projects,

the company also launched new products such as three wheeler tire, Farm tire, OTR tire and Industry tire and started delivering them to the local market. Moreover, Flotation Tires which are used by sugar factories are at the development stage. With improvement in production capacity, horizon Addis Tire Manufacturing PLC planned to secure and ensure 60% market share in the local market and 10% of its production volume export to the COMESA region in the year 2025 (HATMPLC, 2019).

Having facts mentioned above of Horizon Addis Tire Manufacturing PLC and considering the impacts of industrial operations on the environment which involves waste (all forms), energy use and resource use (material consumption), improving the company's supply chain management to a green supply chain management improve the company's performance as well as protects the environment.

1.2. Statement of the problem

These days, people are more concerned of world's environmental problems such as global warming and landfills. Growing attention is given to the development of environmental management strategy for supply chains (Bhattacharjee, 2015).

Horizon Addis Tire Manufacturing PLC being the leading tire manufacturing company in Ethiopia, the company faces wastage of inputs, underutilization of resources, less operational excellence (Quality, Productivity, Cost, and Delivery) and the rise of cost of quality. In addition to this the firm operated much below its capacity (Tesfaye., 2018)).

Although the above studies provide concerns to environmental problems and drawbacks to the company's overall performance, none has exclusively designed a green supply chain management to integrate environmental thinking to the supply chain in Horizon Addis Tyre Manufacturing PLC (HATMPLC). Thus, this study intended to design a green supply chain management in HATMPLC.

1.3. Research questions

Taking the above research problem into consideration, the present research is meant to answer the following major questions:

- How is the existing supply chain management performance of Horizon Addis Tire Manufacturing PLC?
- What are the wastes existing in the Horizon Addis Tire Manufacturing PLC?
- How to design green supply chain processes for Horizon Addis Tire Manufacturing PLC?

1.4. Objective of the study

1.4.1. General objective

The general objective of this study is to design green supply chain management system model for Horizon Addis Tire Manufacturing PLC.

1.4.2. Specific objective

The specific objectives of this thesis are raised as follows

- To assess the existing supply chain management performance of Horizon Addis Tire Manufacturing PLC.
- To study wastes existing in Horizon Addis Tire Manufacturing PLC.
- To design green supply chain processes for Horizon Addis Tire Manufacturing PLC.

1.5. Significance of the study

The study is beneficial for top managers, new researchers, Horizon Addis Tire Manufacturing PLC and the country as a whole. In that, it helps the top managers by giving an insight and improvement direction of the supply chain performance and environmental protection, new researchers can have optional design methods in greening the supply chain management of different sectors, Horizon Addis Tire Manufacturing PLC and the country as a whole can improve the environmental performance. And more or less the researcher gets expert in the subject matter with specific point of designing and greening supply chain management in any sector.

1.6. Scope and limitations for the study

The research is limited to the designing of green supply chain management in the context of Horizon Addis Tire Manufacturing PLC in consideration with its procurement, manufacturing, distribution and logistics.

The existing situation of COVID 19 spread has made the study difficult to cover at the intended period of time for there was no movement or transportation availability and that took plenty of time to having a face to face interview time.

1.7. Organization of the research

The study comprises five chapters. These include chapter one, which is introduction to the problem; chapter two, which emphasizes on the review of related literature; chapter three, which deals with the research design and methodology; chapter four, which emphasizes on data results and discussion; and finally chapter five, which provides, conclusions and recommendations of the study. And the figure below shows the overall flow of the research.

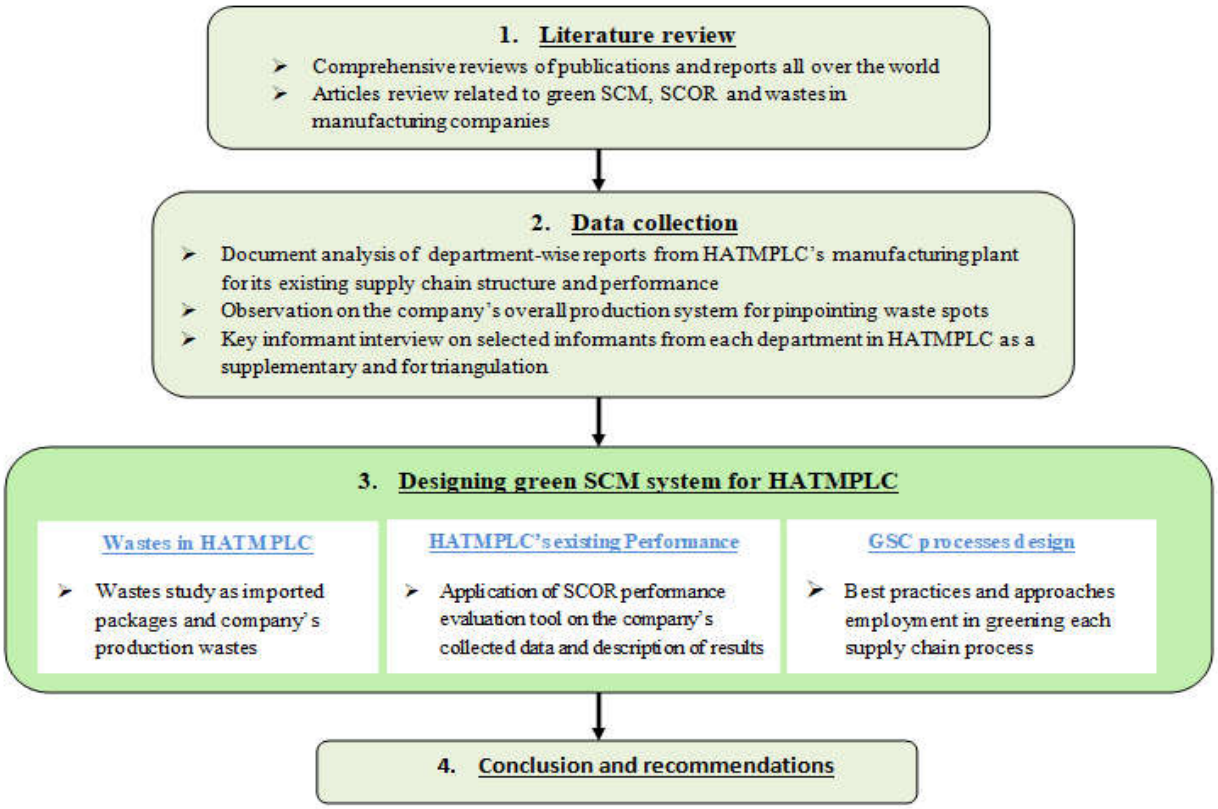

Figure 1.1 Overall flow diagram of the research

CHAPTER TWO

2. LITERATURE REVIEW

This part address relevant conceptual issues, theoretical framework and empirical review related to the topic of the study. It includes definition and concept such as supply chain management, green supply chain management, green practices in supply chain management, and green supply chain design and processes by focusing on previous research in this area and present reviewed literature relevant to this study.

2.1. Supply chain management

The term "supply chain management" arose in the late 1980s and came into widespread use in the 1990s. Prior to that time, businesses used terms such as "logistics" and "operations management" instead. Some definitions of a supply chain are offered below:

"A supply chain is the alignment of firms that bring products or services to market." (Lambert D, 2006). "A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request; it does not only contain the manufacturer and suppliers but also transporter, warehouse, retailer and the customer itself." (Patil DP, 2012)

"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." (Govindan K, 2017)

If this is what a supply chain is then it can define supply chain management as the things we do to influence the behavior of the supply chain and get the results we want. Some definitions of supply chain management are: "The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." (Min S, 2019), Supply chain management is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served. Effective supply chain management requires simultaneous improvements in both customer service levels and the internal operating efficiencies of the companies in the supply chain. Customer service at its

most basic level means consistently high order fill rates, high on-time delivery rates, and a very low rate of products returned by customers for whatever reason. Internal efficiency for organizations in a supply chain means that these organizations get an attractive rate of return on their investments in inventory and other assets and those they find ways to lower their operating and sales expenses.

A supply chain is a network consists of all parties involved (e.g. supplier, manufacturer, distributor, wholesaler, retailer, customer, etc.), directly or indirectly, in producing and delivery products or services to ultimate customers – both in upstream and downstream sides through physical distribution, flow of information and finances (Chin TA, 2015).

According to (Chin TA, 2015), a typical supply chain includes the following five stages: component/raw material suppliers, manufacturers, wholesalers/distributors, retailers and customers. These five stages are connected through flows of products, information and money. Managing a supply chain network is complex and difficult since the network involves various sub-systems, activities, relationships and operations. SCM practices include a set of approaches and activities utilized by a firm to effectively integrate supply and demand for improving the management of its supply chain.

The potential benefits of SCM include increased customer service and responsiveness, improved supply chain communication, risk reduction, reduced product development cycle time processes, reduction in duplication of inter-organizational processes, inventory reduction and improvement in electronic trading (Chin TA, 2012).

As the SCM practices become mature, governments along with firms and their supply chain partners are collaborating to reduce environment problems in order to reduce waste, energy and pollution, minimize environmental risks and improve community goodwill. The collaboration can promote mutual environmental learning (Darnall N, 2008).

2.2. Green supply chain management

2.2.1. Evolution

The environmental movement in the United States was catalyzed in the late 1960s due to the increased consumer concern about degradation resulting in the formation of the environmental protection Agency in the early 1970s, with the directives of enforcing regulations covering industrial manufacturing of all firms along supply chain. These resulted in an increasing need for the application of environmentally-sound decisions in supply chain management (SCM), shifting planning from reactive to proactive. Consequently, environmental performance standards have become increasingly incorporated into contracts guidelines for supply chain partners (Simpson D, 2007).

A firm's response to the environmental requirements of external stakeholders is directly influenced by their level of commitment related to both environmental awareness and performance. In such environmentally – based scenarios the supplier customer relationship is impacted by both existing transaction cost requirements as well as environmental commitment of both entities. Responding to growing needs for environmental compliance, GSCM evolved, reflecting an integration of environmental thinking. GSCM entails a comprehensive perspective, including product design, material sourcing and selection, manufacturing processes, delivery of final products to the consumers, as well as end of-life management of the products (Srivastava, 2007). According to the Srivastava, GSCM is growing in importance and driven by increasing environmental degradation, diminishing natural resources and rising pollution level.

2.2.2. Structure

Environmental practices are being more acceptable in the world of business. The number of organizations contemplating the integration of environmental practices into their strategic plans and daily operations is continuously increasing (Silva GM, 2019). Greening the supply chain is the process of incorporating environmental criteria or concerns into organizational purchasing decisions and long-term relationships with suppliers. Indeed, there are three approaches involved to GSC: environment, strategy and logistics. And, the concept of green productivity shows that for any development strategy to be sustainable it needs to have a focus

on environment, quality, and profitability, which form the triple focus of green productivity (Salim CC, 2017).

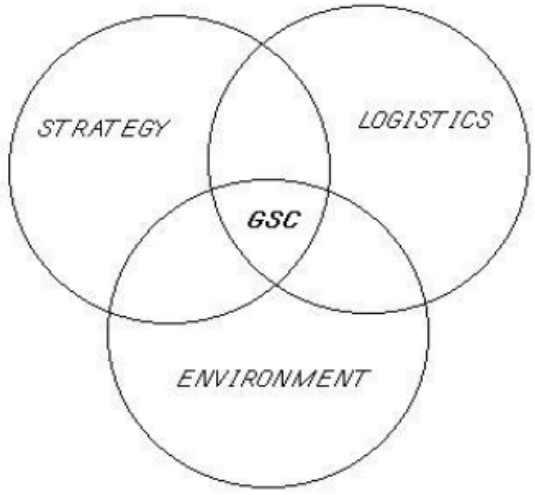

Figure 2.1: Approach of green supply chain (Silva GM, 2019))

For Silva GM, 2019, supply chain greening initiatives have benefits on the level of the individual firm as well as on the national level, because for individual firms, supply chain greening programs bring distinct competitive advantages in terms of lower costs, greener products, and better integration with suppliers.

Green supply chain management (GSCM) is considered as an environmental innovation. The concept of GSCM is to integrate environmental thinking into supply chain management (SCM).The ultimate objective of greening the supply chain is to allow consideration of the total immediate and eventual environmental effects of all products and processes (known as product and process stewardship, respectively). The stewardship concept is based on the recognition that the environmental effects of an organization include the environmental impacts of goods and processes from the extraction of raw materials, to the use of goods produced, to the final disposal of those goods (Khan SA, 2019).

GSCM aims to minimize or eliminate wastages including hazardous chemical, emissions, energy and solid waste along supply chain such as product design, material resourcing and selection, manufacturing process, delivery of final product and end-of-life management of the product (Chin TA, 2015). As such, GSCM plays a vital role in influencing the total

environment impact of any firm involved in supply chain activities and thus contributing to sustainability performance enhancement. GSCM is evolved from SCM. As competition intensified in the 1990s, the increased awareness of green practices has triggered firms to act in an ethically and socially responsible manner in their supply chains (Diabat A, 2011).

Green SCM measures give companies cost and risk advantages such as benefits in productivity, property value, and environment. Thus, raw materials and energy costs can be lowered, low emission production can be designed, and the company's image can be improved, which can lead to higher product sales and a high societal acceptance (Nikbakhsh, 2009). Therefore, consumers, environmental groups, and other organizations are motivated to Green SCM measures, but political statements also stimulate a restructuring to environmentally sustainable business processes (Wohlfahrt).

2.2.3. Impact of GSCM on organizational performance

Wu, 2013, confirmed that GSCM practices are the focal constructs in the theorized model with internal environmental management and green information systems as antecedents and environmental, economic, operational, and organizational performance as consequences. In addition, green information systems provide the information necessary to make decisions about green purchasing, the level of cooperation with customers, design of the product, and investment recovery. Changes made as a result of internal environmental management or green information systems impact the ability to implement green supply chain practices which will impact environmental performance, economic performance, operational performance, and organizational performance. Previous studies show that external GSCM practices such as supplier and customer collaboration will facilitate the adoption of internal GSCM practices, with the explicit purpose of improving environmental performance in supply chain-wide context (Vachon S, 2006). Also, developing collaborative relationships with suppliers is favorable for the adoption and development of internal innovative environmental technologies. Similarly, externally focused GSCM practices (e.g., green design of process with suppliers for minimizing wastes and customer cooperation for eco-design of product) need internal coordination mechanisms (e.g., specialized staff training on environmental management issues and cross-functional cooperation) to cascade the task requirements through the organizational hierarchy for these external practices to be effectively carried out. Whether GSCM and

corporate socially responsible practices can improve economic performance is still an open question (Seuring S, 2008). Some have shown that environmental management and GSCM have a positive relationship with an organization's economic performance. In general, inter-firm relations provide formal and informal mechanisms that promote trust, reduce risk and in turn increase cooperation, commitment and hence profitability. Others have suggested that economic performance is not being reaped in short-term profitability and sales performance when GSCM practices are implemented (Rao P, 2005). The literature over the past years seems to have divided views on whether there are joint gains, "win-win", or tradeoffs that must be managed for environmental and economic performance in sustainable supply chains (Seuring S, 2008).

2.3. Green practices in supply chain management

With numerous green practices adopted, companies in their business and supply chain operations improve their productivity with better environmental growth. While, some well-known green practices are as follows;

2.3.1. Green material sourcing

Green sourcing is sourcing or purchasing materials and components which have such enviable eco-friendly characteristics as reusability, recyclability and nonuse of hazardous/dangerous chemicals (Eltayeb TK, 2011). With more and more concerns on environmental protection, procurement professionals have been motivated to reconsider their existing sourcing, purchasing strategy and their impact on environmental sustainability (Govindan K, 2015). The role of eco-friendly purchasing is the involvement of recycling and remanufacturing. And further, emphasized green sourcing supporting waste reduction enhances recycling and remanufacturing and other activities in supply chain.

Craig C., 2008, did a research to explore the impact of green sourcing on firms' environmental and financial performance. They concluded that owing to the successful adoption of green purchasing strategy, products' cost is reduced and environmental performance and financial performance of firms is increased with positive reputation obtained in the market. (Zailani S, 2015), Highlighted that eco-friendly purchasing has positive relationship with firms' operational and environmental performance.

Green purchasing was categorized into five main facets: design operation management, supply chain management, environmental authentication, ecological, and external environmental management (Yang CL, 2010). (Chiau-Ching Chen, 2012), Confirmed that green purchasing improved to the overall firms' performance. The adoption of green purchasing in supply chain and business operations is a reliable tool in mitigating waste, air and water pollution.

2.3.2. Green marketing

The actions directed to all incorporates and consumers comprise green marketing, a broad range of marketing activities (e.g., planning, production, process, price, promotion and after-sale service) designed to illustrate the goal of organization to mitigate the harmful effects of their products (Groening C, 2017). Green marketing practice promotes the products with environmental friendly properties (Luthra S, 2016). It contains the activities that can satisfy human desires of minimum negative effects on the environmental beauty. In addition, green marketing enhances firms' competitiveness and financial and environmental performance with positive corporate reputation and image (Ko E, 2013).

2.3.3. Green management

Green management practices provide a firm with supplementary sources of information that can enhance their business and environmental objectives (Pane Haden SS, 2009). Adoption of green management practices help with improved firm image, increased efficiency, environmental compliance improvement, cost savings, achievement of societal commitment and reduction of carbon emissions etc. (Luthra S, 2014).

2.3.4. Green distribution and warehousing

Green distribution and warehousing can reduce the waste and play an important role in energy reduction and value addition of green products in warehousing significantly improve overall performance of organization with better corporate image (Khan SAR, 2016). And selection of distribution network design affects the inventory, material handling, transportation, and information (Chopra, 2003), Distribution network design options include

- ✓ Manufacturer storage with direct shipping
- ✓ Manufacturer storage with direct shipping and in-transit merge
- ✓ Distributor storage with package carrier delivery

- ✓ Distributor storage with last mile delivery
- ✓ Manufacturer / distributor storage with costumer pickup
- ✓ Retail storage with customer pickup

In *manufacturer storage with direct shipping*, product is shipped directly from the manufacturer to the end customer. All inventories are stored at the manufacturer. Information flows from the customer, via the retailer, to the manufacturer, while product is shipped directly from the manufacturer to customers. *TC's* are high because the average outbound distance to the end consumer is large and package carriers must be used to ship the product. *Response times* tend to be large when drop shipping is used because the order has to be transmitted from the retailer to the manufacturer and shipping distances are on average longer from the manufacturer's centralized site. The biggest advantage of direct shipping is the ability to centralize inventories at the manufacturer. The benefits from centralization are highest for high value, low volume items with unpredictable demand. Direct shipping is hard to implement if there are more than 20-30 sourcing locations that have to ship directly to customers on a regular basis.

In the *in-transit merge* pieces of orders coming from different locations are combined so that the customer gets a single delivery. Information and product flows for the in-transit merge network. Transportation costs are lower than direct shipping because of the merge that takes place prior to delivery to the customer. Overall supply chain facility and MHC's are somewhat higher than direct shipping. The main advantage of in-transit merge over drop shipping is the somewhat lower TC. In-transit merge is best implemented if there are no more than four or five sourcing locations and each customer order has products from multiple locations.

In *distributor storage with package carrier delivery*, inventory is not held by manufacturers at the factories but is held by distributors/retailers in intermediate warehouses and package carriers are used to transport products from the intermediate location to the final customer. TC's are somewhat lower for distributor storage compared to manufacturer storage. *Facility costs* are somewhat higher with distributor storage. *Response time* with distributor storage is better than with manufacturer storage because distributor warehouses are, on average, closer to customers. *Returnability* is better than with manufacturer storage because all returns can be

processed at the warehouse itself. Distributor storage can handle somewhat lower variety than manufacturer storage but can handle a much higher level of variety than a chain of retail stores.

Last mile delivery refers to the distributor / retailer delivering the product to the customer's home instead of using a package carrier. Last mile delivery requires the distributor warehouse to be much closer to the customer, increasing the number of warehouses required. TC's are highest using last mile delivery. Facility and processing costs are very high using this option given the large number of facilities required. Response times are faster than the use of package carriers. Product variety is generally lower than distributor storage with carrier delivery.

Manufacturer / distributor storage with costumer pickup, inventory is stored at the manufacturer or distributor warehouse but customers place their orders online or on the phone and then come to designate pickup points to collect their orders. Orders are shipped from the storage site to the pickup points as needed. Transportation cost is lower than any solution using package carriers. Facility costs are high if new pickup sites have to be built. The main advantage of a network with consumer pickup sites is that it can lower delivery cost.

In *retail storage with customer pickup*, inventory is stored locally at retail stores. Customers either walk into the retail store or place an order online or on the phone, and pick it up at the retail store. Local storage increases inventory costs. Transportation cost is much lower than other solutions. Facility costs are high because many local facilities are required. Very good response times can be achieved in this case because of local storage. Returns can be handled at the pickup site. Overall, returnability is fairly good using this option.

2.3.5. Green manufacturing

Green manufacturing practices are to implement socially and environmentally accountable practices to mitigate harmful effects of manufacturing and increased profitability of firms (Luthra S, 2016). This practice involves the application of the green resources, which may lead towards competitive advantage through reduction in products' cost and improvement in products' quality. Lean and green manufacturing industry both are working for eliminating waste and improving the efficiency of manufacturing processes (Prajogo D, 2012). And highlighted the benefits of green manufacturing: green practices in production processes

mitigate the bad effects of manufacturing processes on environmental sustainability, while green manufacturing improve operational, environmental and financial performance of firms.

2.3.6. Ecological design

Luthra S, 2016, highlighted that 80% impacts on environment from product and process related could be controlled with the adoption of ecological design in supply chain management. Ecological design incorporates many ideas such like using cleaner technology processes, green raw material and components (Eltayeb TK, 2011). Green design of products reduces ecological impacts of products during their life (Luthra S, 2016). In addition, green design of products also supports reusing, recycling and remanufacturing of products, which not only helps firms to improve their environmental performance but also provide opportunity to reduce their costs (Khan SAR, 2017).

2.3.7. Green transportation and reverse logistics

Green transportation and reverser logistics practices provide opportunity to organizations, to improve their image and reduce their costs (Khan SAR, 2018). Logistics overheads can be saved through promoting transportation system's efficiency and enhancement of customer association also can be obtained to create more profitability (Luthra S, 2016). The logistics activities integrated with rehabilitation comprise the practice of reverse logistics (reusing, recycling, and remanufacturing), which can produce the products that can be used again for customers. The benefits with having a good reverse logistics system is primarily the profits the company can make from it, next it keeps the customers satisfied by improving service which then leads to a competitive advantage. Other benefits are also to comply with environmental regulations, reduction of operating costs and to improve product uptime and quality (Govindan K, 2015). Green logistics (GL) practice helps firms to reduce their environmental impacts with improved quality and cost reductions (Mousazadeh M, 2014).

GL is focused on restricting damage to environment during the process of Logistics. At present, the term GL is often used interchangeably with reverse logistics (RL). However, in contrast to RL, GL resumes logistic activities that are primarily motivated by environmental considerations (Uriarte-Miranda ML, 2018).

2.4. Best practices in GSCM

The trend towards developing a green supply chain is now gaining popularity but most companies are still coming to terms with how this can be achieved and where do they start. For years businesses have been concentrating on improving supply chain visibility, refining efficiency and minimizing cost. Despite the focus being moving towards a green supply chain the goals of visibility, efficiency and cost reduction do not have to be discarded. By examining the companies who have already made ways towards to a green supply chain, some best practices can be seen that will help others to begin their own transition. (FL., 1999), Identifies five different approaches for a company to follow in order to incorporate environmental issues into their business: The first approach deals with product differentiation. The idea is for a company to create products or use processes that offer greater environmental benefits or cause smaller environmental costs than their competitors. Companies may be able to charge a higher price for these "environmental friendly" products or they may experience an increase in market share. Reinhardt identifies three conditions that are necessary for this approach to be beneficial to the company. A breakdown in any one condition will cause the product differentiation model to fail. First, they must be able to find customers willing to pay a premium for this type of product. Second, the company must be able to communicate the environmental benefits credibly. And third, in order to profit on this environmental investment, the company must be able to protect itself from competitors trying to imitate their idea.

The idea behind the second approach is for the company to work with the government or work towards creating private standards for environmental regulation. In order for this to benefit a company, they must be willing to take the risk that their increase in costs will be less than their competitors increase in costs. This approach works well for a product or service where the customer is unwilling to pay a premium for an environmental friendly product.

The third approach focuses on internal cost reduction. This approach is best explained by example. One such example is a company in the hotel industry. By replacing small bottles of shampoo and lotion with bulk dispensers, one company saved nearly $37,000 per year. Another example is Xerox's Environmental Leadership Program. This program included

waste reduction efforts, product take-back schemes, and design for environment initiatives. Reinhardt states, however, that had Xerox been an unchallenged market leader, this program might not have been conceived. He states that Xerox mirrors a common pattern: “dramatic cost savings are often found when a company is under tremendous pressure.”

The fourth approach deals with environmental issues being addressed from the risk management vantage point. The focus of this approach is to avoid potential costs stemming from an industrial accident, a consumer boycott, or an environmental lawsuit. Reinhardt lists several questions that a company can ask itself regarding its environmental insurance policies and risk management systems: “Is the company buying the right policies? Is it retaining risk when the coverage is overpriced? Is it rewarding managers who reduce risk in their own operations or subsidizing risky behavior by failing to police it adequately?” For this approach to work, management must fully embrace the idea and change the culture and employee’s attitudes towards environmental management.

The fifth approach is really a combination of one or more of the above approaches. By employing one or more of the above, Reinhardt believes a company can “rewrite the competitive rules in their market.” One example is Xerox, which follows the internal cost reduction approach as well attempting to change their business model. They differentiate themselves from their competition by taking responsibility for disposing of a customer’s used equipment as well as taking back products from customers that are superseded by new technology. These outdated machines are then harvested for their reusable parts and new technology is incorporated, and then resold as a new machine. Xerox is able to reduce their overall costs while differentiating themselves from competitors who lack their take back policies.

The bottom line is that when environmental issues are broken down and analyzed as normal business decisions, the company as well as the environment can benefit. Managers are urged to focus more on the long-term effects these decisions can have on their profits and costs reductions.

2.4.1. Align goals of green supply chain with business goals

BJ., 2014 Said, when green supply chain programs are properly aligned to corporate goals; successes become leading indicators of business success. Creating a green supply chain that has little to do with business will not help your company to achieve its business objectives. For example, if a company decides to use biodegradable packaging for its products that costs 25% more than traditional packaging, this goes against the businesses goals of reducing costs. If a business has an overall goal to reduce costs then the move to a green supply chain should dovetail with the business goal. A company should look at its overall business goals and identify how a transition to a green supply chain can help achieve those goals. For example if a business wants to reduce its energy costs it should start by looking at the consumption to see if a reduction can be made by using more energy efficient and greener equipment.

2.4.2. Use green supply chain to improve processes

BJ., 2014, pollution and waste represent incomplete, ineffective, or inefficient use of raw material. Green supply chain analysis provides an opportunity to review processes, materials, and operational concepts and as with continuous improvement programs, green supply chain analysis targets; wasted material, wasted energy or effort, under-utilized resources. Companies do not often change their businesses processes and it is this attitude allows inefficient processes to continue unabated causing unnecessary waste and pollution. For example ineffective processes in the US automotive industry allowed the innovative Japanese automakers to become market leaders. Businesses that want to transition to a green supply chain should take the opportunity to review all their business processes to identify areas where adopting a greener outlook can actually improve their business. Companies should review each process along the supply chain to identify if a more environmentally sound approach will help cure the inefficiencies that occur. Many companies that have been through this exercise have identified processes where raw materials were wasted; resources underutilized and unnecessary energy used due to inefficient equipment.

2.4.3. Green suppliers and material refurbishment

Companies reviewing their business processes should look beyond their factory walls. When reviewing purchasing processes the aim of any company, looking to transition to a green

supply chain, should be to find suppliers who have minimized their environmental impact without reducing the quality of their product or significantly raising costs. By purchasing products from green suppliers businesses can then begin their green supply chain before any material reaches their site. At the opposite end of the supply chain businesses should look at their return process. Many businesses have not developed a successful refurbishment program for their products that have been returned or exchanged. By offering refurbished items businesses can increase purchasing options to their customers and widen their customer base, whilst improving the environmental impact of their products. There are many ways in which businesses can transition to a green supply chain; however it is important to realize that it is difficult to achieve results without strong focused leadership. Senior management has to lead the effort to move to a green supply chain and provide the resources for the transition. Many businesses have documented an intent or plan to implement a green supply chain, but without the necessary resources, both financial and manpower, any impact will be minimal.

2.5. Tire manufacturing

2.5.1. Raw materials

Tire is a composite structure consisting of many layers. They usually consist of Inner liner, Body ply, Sidewall, Beads, Apex, Belt Package, Tread and Cushion Gum which use a broad variety of materials as an input, these are Rubber/Elastomers, Carbon black, Steel, Textile, Zink oxide, Sulphur, Additives, Carbon-based materials

2.5.2. Manufacturing process

According to the report of Arvind B, 2011, the tire manufacturing process involves the following steps where each step has its own effects on overall productivity.

Mixing, involves weighing and combining various ingredients (natural and synthetic rubbers, oil, carbon black, zinc oxide, sulfur, and other chemicals) to create a homogenous rubber compound that is discharged to a drop mill. Milling creates warm malleable sheets that are cooled and coated with an “Antitack solution.” These sheets are then fed into an extruder. Extruding, it forces the rubber compound through a shaped slot called a die that forms the compound into various shapes. Calendaring, involves coating fibers of cloth or steel with a rubber compound, and then curing it in an irradiation oven that bevel cuts it to a desired

length, width, and angle. Bead making, involves the creation of beads that provide a proper seal between the tire and the wheel rim when a tire is mounted on the rim and inflated. In the bead building process, bundles of wire are passed through an extrusion die where a coat of rubber is added, and the wires are then wound into a hoop. Cementing and marking, processes are used at various stages throughout the tire building process. Cements (adhesives or solvents) are added to improve the adhesion of different components to each other throughout the process. Cement usage can vary significantly among facilities depending on the type of tire being manufactured and the process being used. Marking inks are used to aid in identifying the components being managed. Typically they are applied to extruded tread stocks to aid in identifying and handling cured tires. Marking practices can also vary significantly among facilities. Cooling and culture, the various tire components go through cooling and culture prior to tire building. From the milling and extruding operations, the rubber sheets are placed onto long conveyor belts that, through the application of cool air or cool water, lower their temperature. Tire building, the two main components of the tire-building process is the tire carcass buildup drum and the tread application drum. These drum machines assemble the cut carcass plies and belts plus the extruded tread, sidewall, and beads into tires. The process begins with the application of a thin layer of rubber compound, the inner liner, to the innermost carcass ply. The carcass plies are placed on the drum one at a time, after which the beads are set in place and the plies (reinforcing layers of cord and rubber) are turned up around them. At this stage the belts and tread rubber are added. Lubricating, involves preparing the uncured (green) tire for curing. The green tire may be coated with a lubricant (green tire spray). The function of the green tire spray is to ensure the cured tire does not stick to the curing mold during extraction of the tire after curing. Curing, involves collapsing the drum and loading the green tire into an automatic tire press to be cured (vulcanized) at high temperature and pressure. The vulcanization process converts the rubber and also bonds the various parts of the tire into a singular unit. Tire finishing, may involve some of the following processes: trimming, white sidewall grinding, buffing, balancing, blemish painting, whitewall/raised letter protecting paint, and quality control inspections. Some facilities also apply a puncture sealant during production.

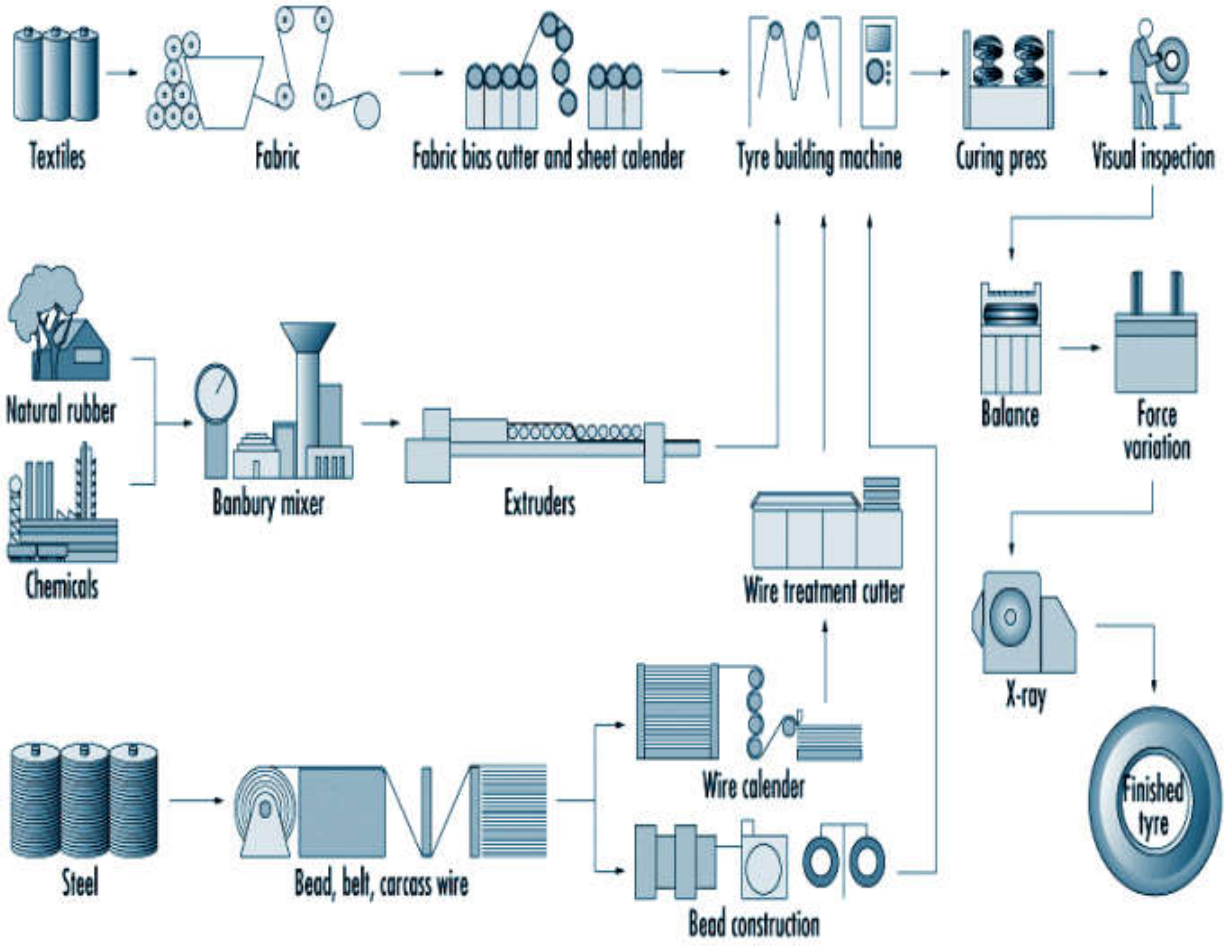

Figure 2.2: Tire manufacturing process (Arvind B, 2011)

2.6. Wastes of manufacturing companies

The Environmental Public Health Act (EPHA) defines waste as any substance which constitutes a scrap material or an effluent or other unwanted surplus substance arising from the application of any process; and any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled, and anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste unless the contrary is proved (EnvironmentalPublicAct, 2002).

There are various waste types which may be distinguished on the basis of their material composition in which case they would be classified as solid, liquid or gas. A further distinction is based on whether the waste is hazardous or non-hazardous. Some classifications

are based on the source of waste and hence, a distinction is made between domestic and industrial wastes. Figure-2.3 provides a simplified flow diagram for waste classification

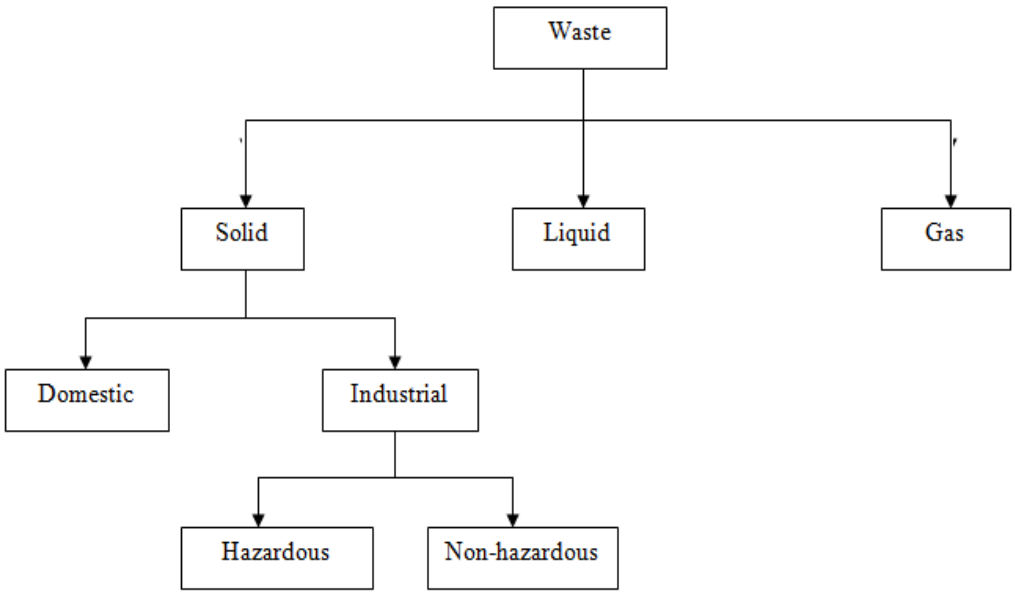

Figure 2.3: Schematic representation of source and classification of waste (Adopted from (Zakhele, 2017))

One of the major causes of an increase in domestic waste is the rise in packaging materials. Domestic goods including food, clothing and other household commodities are sold in paper, plastics, glass or metal containers. This containers end up in the form of waste classified as domestic waste. Management principles vary depending on the type of waste produced. Not all waste can follow all of the management principles. Waste management is all the actions required to manage waste. This includes individual steps in the waste management chain which can be divided into the following:

- Waste prevention, waste minimization and waste detoxification;
- Collection, transfer, transport and storage;
- Reuse and recycling;
- Waste treatment including waste disposal.

One cannot ignore the fact that a considerable amount of waste is still done away with in an unacceptable way. Waste is still disposed of by dumping it in the open or into the ocean, or by burning it on-site. Such ways of disposal have irreversible and potentially harmful effects on both human health and the environment. These are clearly not methods that belong to sustainable waste management.

2.7. Ethiopian environmental policies

The EPA (environmental protection authority) of FDRE in collaboration with the ministry of economic development and cooperation has developed a policy to control of hazardous materials and pollution from industrial waste (EPA).

a. To adhere to the precautionary principle of minimizing and where possible preventing discharges of substances, biological materials or their fragments from industrial plants and personal or communal appliances or any other external sources that could be harmful, and to disallow the discharge when they are likely to be hazardous;
b. To adopt the "polluter pays" principle while endorsing the precautionary principle since pollution is likely to occur, and ensure that polluting enterprises and municipalities and wereda councils provide their own appropriate pollution control facilities;
c. To establish clear linkages between the control of pollution and other policy areas including water resources, agriculture, human settlements, health and disaster prevention and preparedness;
d. To provide adequate regulation of agricultural (crop and livestock) chemicals and micro-organisms;
e. To ensure that pollution control is commensurate with the potency, longevity and potential to increase or reproduce of the pollutant;
f. To establish safe limits for the location of sanitary landfill sites in the vicinity of wells, bore holes and dams, and issue regulations to enforce them;
g. To review and develop guidelines for waste disposal, public and industrial hygiene and techniques to enable the cost-effective implementation of defined standards of control, and to issue regulations to enforce them;

h. To formulate and implement a country-wide strategy and guidelines on the management of wastes from the medical, agriculture and other sectors that may use potentially hazardous biological organisms, their fragments or chemicals, and to issue the necessary regulations to enforce them;
i. To establish a system for monitoring compliance with land, air and water pollution control standards and regulations, the handling and storage of hazardous and dangerous materials, mining operations, public and industrial hygiene, waste disposal, and water quality;
j. To maintain an up-to-date register of toxic, hazardous and radioactive substances, and to make the information available on request;
k. To maintain regular environmental audits to ensure the adoption of environmentally sound practices in all public and private development activities including industrial and mining operations;
l. To enforce the exhaustive labeling and detailing of the contents usage and expiry date of foods, drugs, cosmetics, other chemicals, and when any of the contents are poisonous or dangerous in any other way, the fixing of strikingly visible labels to that effect;
m. To promote waste minimization processes, including the efficient recycling of materials wherever possible;
n. To create by law an effective system of control, distribution, utilization and disposal after use or expiry of chemicals, biological organisms or fragments of organisms that could be hazardous but are required for use;
o. To prohibit from importation to and from transit through Ethiopia hazardous materials, organisms or fragments of organisms as agreed by African states in Bamako;
p. To hold as legally liable an employer who deploys employees in using or handling hazardous materials without adequately training them on how to deal with the hazard and without adequate equipment to protect each one of them for physical harm or disease that is caused by working conditions whether the harm or disease starts in the place of work or away from it;
q. To foster better understanding of the dangerous effects of chemicals and organisms and their fragments through the provision of information in a form understandable to users,

and provide or enforce the provision of information on the appropriate methods and technologies for the treatment and disposal of wastes.

2.8. Green supply chain design and SCOR

2.8.1. Green supply chain design

Supply chain design determines the structure of the supply chain and its processes. It comprises long term decisions, which are expensive to reverse (Meindl, 2010). It is necessary that a green supply chain combines the usual purchasing decisions and long-term relationships between buyer and supplier with environmental criteria and requirements.

Another definition is given by SK., 2007: SCM has to include environmental thinking regarding all steps related to the life cycle of a product. This includes "design, acquisition, production, distribution, use, re-use and disposal". All these activities from the design of the product or service to the distribution and reverse logistics are covered by GSCM. (Walker, 2008) Also saw all phases of the product life cycle involved, starting at the purchase of raw materials through the design until the disposal. The definition given by (Davies, 2007) resembles the definition above. According to their view, GSCM is more than just putting some green practices in place: the environmental performance on all levels of the supply chain management has to be improved as well as on the shop floor levels. It is the task of GSCM to minimize all negative effects a product or service has on the environment (Rettab, 2008). (Sarkis, 2011), Defined GSCM as "integrating environmental concerns into the inter-organizational practices of SCM including reverse logistics."

2.8.2. Supply Chain Operational Reference (SCOR)

The Supply Chain Operation Reference model (SCOR) was used as a master guide to determine the main sub-processes in green supply chain. SCOR is a well-known model in the literature of supply chains developed by the Supply Chain Council. The main processes in this model are plan, source, make, deliver, and return. From the definitions of the "plan" process in the SCOR model, four main sub-processes are derived from the green supply chain literature, namely, inventory control and management, production and capacity management, green supplier management, and green marketing. In respect of the importance of the "return"

process in green supply chain, the process is extended to three sub-processes, namely, collect, recover, and dispose.

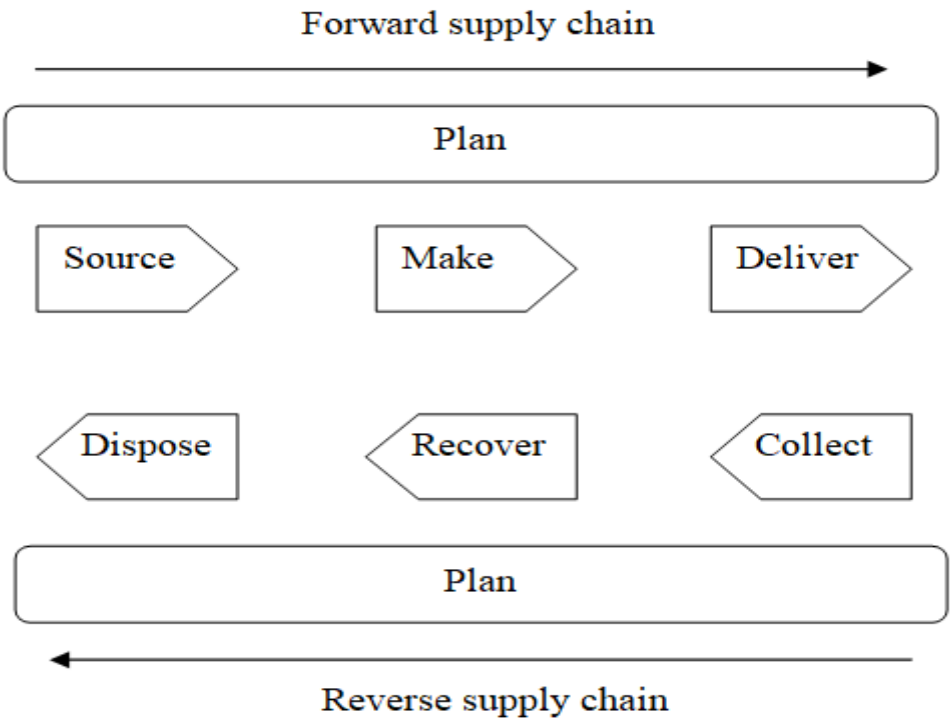

Figure 2.4: Sustainable supply chain processes: main categorization (Adopted from SCOR model (Council, 2008))

SCOR is a process reference model which combines the concepts of business process reengineering, benchmarking and best practices. Thus SCOR as a process reference model contains:

- Standard descriptions of management practices
- A framework of relationships among the standard processes
- Standard metrics to measure process performance
- Management practices that produce best in class performance
- Standard alignment to features and functionality.

2.8.3. SCOR Performance attributes and metrics

The performance section of SCOR consists of two types of elements; performance attributes and metrics. A performance attribute is a group of metrics used to express strategy. An attribute itself cannot be measured; it is used to set strategic directions. And metrics measure the ability of a supply chain to achieve these strategic attributes. SCOR level-1 metrics are strategic and high-level measures that cross multiple SCOR processes. Lower level metrics are associated with a narrower subset of processes.

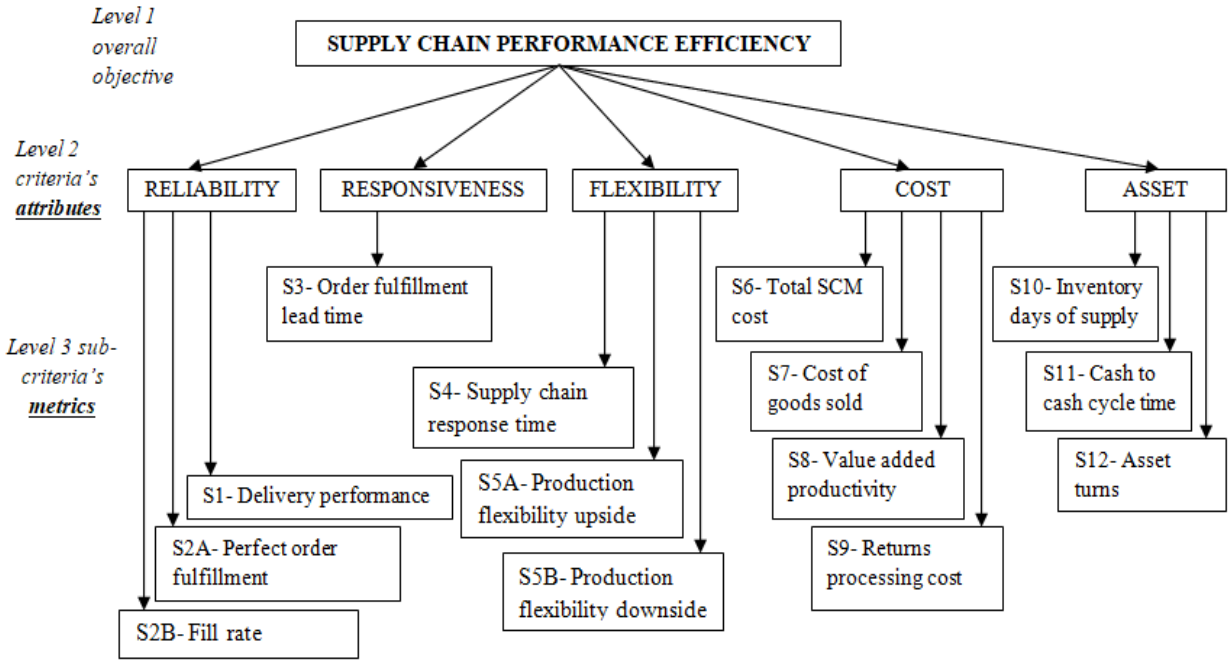

Figure 2.5: SCOR performance attributes and metrics (from (Kocaoglu B, 2013))

- Delivery performance: measures the quality of the company's performance to its Promised Order Delivery Date
- Perfect order fulfillment: defined as the right product, delivered to the right place, at the right time, in the right condition and packaging, in the right quantity, at the right cost, to the right customer. Another concept to consider as a potential alternative is the definition of replenishment
- Fill rates: can only be used when the product is shipped from stock to the customer. Fill rate represents the percentage of orders that can be shipped from stock within 24 hours of the order receipt. This shows how quickly your company can respond to

customer orders in the situation where your company has decided to produce in a make-to-stock environment

- Order fulfillment lead times: defined as the time from receipt of customer order to customer order receipt
- Supply chain response Time: The ability to react purposefully and within an appropriate time scale to significant events, opportunities or threats (especially from the external environment) to bring about or maintain competitive advantage in the marketplace
- Production flexibility upside: The number of days required to achieve an unplanned sustainable20% increase in production
- Production flexibility downside: The percentage order reduction sustainable at 30 days prior to delivery with no inventory or cost penalties
- Total supply chain Management costs: represents the sum of all costs your company incurs to run your integrated supply chain
- Value-added productivity: defined as the measurement of cost and productivity performance required to realize product revenue objectives. A higher number indicates a better use of resources in the supply chain transformation process

2.8.4. Green SCOR

The concept behind Green SCOR is fairly simple. Because the SCOR model already is a robust supply chain management tool, it is built upon the foundation of SCOR mode to include environmental elements. The goal was to create an analytical tool that provides a clear view of the connection between supply chain functions and environmental issues; thereby, improving organizational management of both (Cash, 2003).They investigated SCOR on environmental issues and combines best practices in environmental management into SCOR. (Qianhan X, 2010), Developed a Green SCOR model which was based on several industry cases in the Chinese automotive industry. In 2008, the Supply Chain Counsel itself released Green SCOR as a new module for SCOR version 9.0 for managing the environmental footprint in supply chain management (Wilkerson, 2008). Three activities in the area of waste disposal and 12 metrics have been added to the original SCOR model. These extensions, which are still valid

in version 10 of SCOR, lead only to a small fraction of environmental understanding in a holistic view on supply chain management.

The SCOR model release 10.0 investigated on its relationship to environmental issues. For this, all activities on SCOR level 3 have been investigated and split in activities which are independent of any resource activities and those, which are related to resource activities. Those activities, which are related to resource activities, are those activities which have to be considered when modeling a Green Supply Chain Management based on the SCOR model. The table below shows an overview of the result of the investigation.

Table 2-1: Resource-relevant activities in the SCOR (Schrödl H, 2013)

SCOR section	Resource-relevant activities
Plan	• Identify, Prioritize, and Aggregate Supply Chain Resources • Balance Supply Chain Resources with Supply Chain Requirements • Identify, Assess, and Aggregate Product Resources • Balance Product Resources with Product Requirements • Identify, Assess, and Aggregate Production Resources • Balance Production Resources with Production Requirements • Identify, Assess, and Aggregate Delivery Resources • Balance Delivery Resources with Delivery Requirements • Identify, Assess, and Aggregate Return Resources • Balance Return Resources with Return Requirements
Source	○ Identify Sources of Supply ○ Verify Product ○ Select Final Supplier(s) and Negotiate ○ Transfer Product ○ Receive Product
Make	• Finalize Product Engineering • Package

	• Produce and Test • Waste Disposal
Deliver	○ Enter Order, Commit Resources, and Launch Program ○ Pack Product ○ Route Shipments ○ Ship Product ○ Select Carriers and Rate Shipments ○ Install Product ○ Receive Product from Source or Make
Return	• Identify Defective Product Condition • Return Defective Product • Identify MRO Product Condition • Return MRO Product • Identify Excess Product Condition • Return Excess Product • Transfer Defective Product • Transfer MRO Product • Transfer Excess Product

The Plan processes cover the planning activities which are necessary to operate a supply chain. On level 3, planning consists of 20 activities as in Supply Chain Council. Ten activities are directly related to resource management. The Source processes describe the ordering (or scheduling) and receipt of goods and services. In SCOR, the source processes are divided into three sourcing strategies in relation to their production strategies: sourcing of a stocked product, sourcing of a make-to-order product, and sourcing of an engineer-to-order product. Due to the highest ratio of environmental issues in the activities, the activities for the engineer-to-order product are investigated. In this sourcing strategy, seven activities are defined on SCOR level 3. Five of the mare related to resource management. The Make processes cover all activities dealing with the conversion of materials. As already seen in the sourcing process, the production process is also subdivided into three different production strategies: make-to-

stock, make-to-order, and engineer-to-order. On SCOR level 3, there are eight activities in the make process. Four of them are directly related to resource management. The Delivery processes describe the activities associated with the creation, maintenance, and fulfillment of customer orders. In this delivery strategy, 15 activities are defined on SCOR level 3. Seven among them are directly related to resource management. The Return processes describe the activities associated with the reverse flow of goods back from the customer. On SCOR level 3, there are 27 activities in the return processes. 9 of them are directly related to resource management.

2.9. Conceptual framework

Based on overall review of related literatures, and particularly the work of (Ninlawan C, 2010) and (Chin TA, 2015), the model linking the relationship between GSCM practices, environmental collaboration, strategic approach and sustainability performance is depicted in Figure 2.6 below. The GSCM practices are conceptualized to include green procurement, green manufacturing, green distribution and green logistics. The organizational performance is investigated using the SCOR model with the greening context.

In this framework the GSCM practices (green procurement, green manufacturing, green distribution and green logistics) are supply chain processes which are designed individually to minimize or eliminate wastes from them. And the collaboration of environmental thinking leads to directly enhance both organizational and environmental performance.

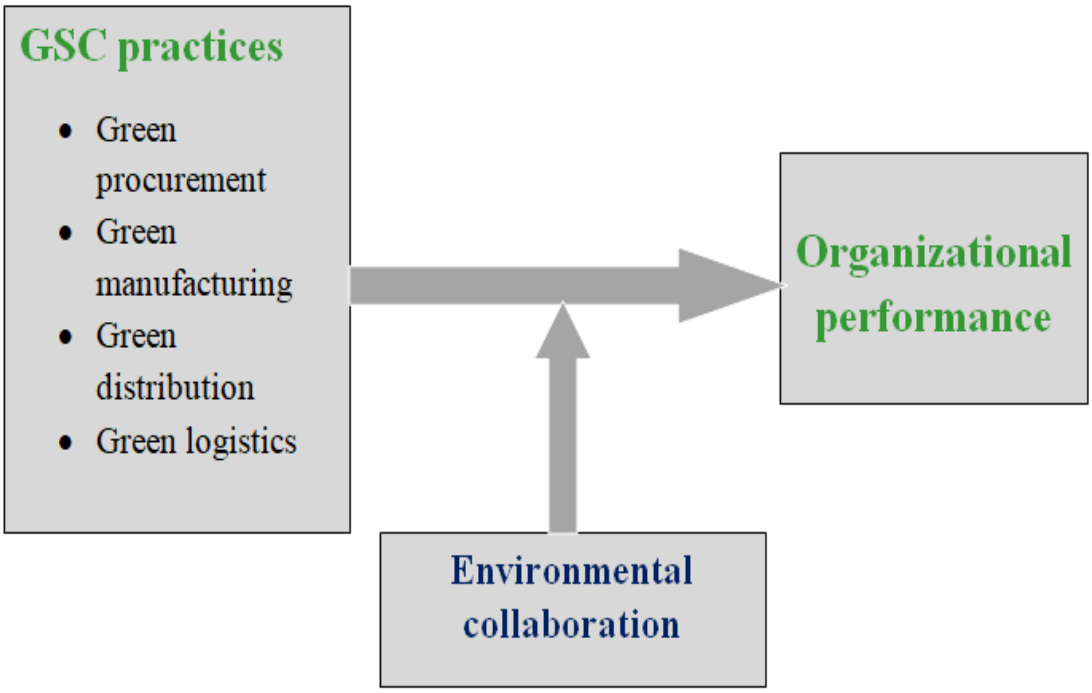

Figure 2.6: Conceptual framework (Chin TA, 2015)

CHAPTER THREE

3. METHODOLOGY

3.1. Research design & approach

Descriptive research design is used to investigate the company's performance and pin-point improvement directions. As such the research method makes it possible for the presentation of facts that concern the nature and status of the situation, aiming at casting light on current issues or problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method. And so, to achieve the objective of the study, a descriptive-research approach which constituted both qualitative and quantitative research approach were employed.

According to Fauzi A, 2018, the qualitative analysis or approach was employed to answer questions about the complex nature of an existing phenomenon, having the purpose of describing and understanding it from the view of points of the participants or target groups. This was particularly indispensable to interpret results about the structure and performance of tire manufacturing in HATMPLC under consideration. On the other hand, quantitative research is primarily focused on the numeric analysis of data (Shekhar P, 2019).

3.2. Data type

Both primary and secondary data were used for the study. Primarily data were those which were collected a fresh and for the first time and they are believed to be original in character (VO., 2017). Primary data are collected to provide information regarding a specific topic and secondary data are data previously collected and analyzed that includes documents analyzed.

This study used both primary and secondary data sources to address the research aims, purposes and questions. To clarify the fundamental SC structure and implementation and observe performance of the captioned company, models in the literature review and primary data collection tools were applied. Moreover, to the company's manufacturing process observation, semi-structured interview and document analysis were conducted, and secondary data were used in designing the green supply chain management.

3.2.1. Primary data source

In general the primary data sources are categorized as observation, survey method, experimentation, and unpublished written and recorded document. To this specific research purpose, HATMPLC's manufacturing plant was sources of primary data. And following that data acquisition guideline; semi-structured interview in face-to-face interview and observation in the production plant environment were conducted so as to dig out the overall performance, wastes and constraints of the company. Finally, unpublished document were employed to look into the performance and input utilization trend.

3.2.2. Secondary data source

Published and official report documents were used as data sources. More prominently, national and international reports and performance guidelines are used as supplementary data sources. Here, the employment of secondary data attributed particularly in providing standards and improvement approaches for tire production process, the overall performance, green the supply chain processes and acquiring technology know-how.

3.4. Target population and sample

3.4.1. The target population

In line with the objective of the study, the target of the research was to investigate the supply chain performance components using the SCOR tool, for this part the target population of the study was top management, line and operational management, supervisors and professional experts and experienced staff.

3.4.2. Sample size

Qualitative research experts argue that there is no straight forward answer to the question 'how many' and that sample size is contingent on a number of factors relating to methodological and practical issue. The number of people to interview depends on the data the researcher needs, available time and resource (Baker SE, 2012).

In this study for the key informant interview, the existing departments in the company were identified and listed as potential key informants that include purchase, finance, marketing, human resource and production departments. Following that, respondents believed to provide the required data are selected including all the executives and department managers.

A total of 8 respondents are selected; two from production department (the plant manager, production manager), two from marketing department (the marketing department manager and sales manager), one from purchase department, one from human resource, two from distribution center officers, all having work experience of more than 5 years in the company.

3.5. Data collection tools

In this study, key informant interview guide, document analysis and observation were used to collect data from the target population. The main tool in the data collection process was document analysis and the others are employed to collect supplementary data in order to support the data collected by document analysis.

3.5.1. Interviews

Face to face interview method is preferred due to its flexibility and ability to provide new ideas on the subject. Moreover, it enables to obtain in-depth information about participants' thought, beliefs, knowledge, reasoning, motivation, and feeling about the issue under study (CR., 2004). In order to get detail information from informants about the performance, SC structure and implementation of tire manufacturing in Horizon Addis Tire manufacturing PLC, the student researcher conducted interviews with 8 from the top and operational position by using non-probability purposive sampling technique. They were selected as they are individual who facilitate the realization of organization goal.

3.5.2. Document analysis

Document analysis is a systematic procedure for reviewing or evaluating documents both printed and electronic (computer based and internet transmitted) material. Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted in order to elicit meaning and gain understanding. Document analysis is often used in combination with other qualitative research methods as a means of triangulation (Bowen, 2009).

In this study as a main data collection instrument, it is used in gathering information from unpublished documents. Further it is employed to collect the required data from available documents (in the company’s annual reports and financial statement) about the performance of tire production and wastes existing in HATMPLC.

3.5.3. Observation

Observation helps to identify and guide relationships with informants, to learn how things are organized, to learn what constitutes appropriate question, how to ask them and which question may best help to answer the research questions (Kawulich, 2012). And this study involved a direct observation in the environment of HATMPLC's manufacturing plant in order to understand the overall tire production process and existing wastes.

3.6. Data analysis and presentation

This part covers approaches employed to analyze and present waste study, supply chain performance and green supply chain management design. The wastes in HATMPLC are discussed and presented both qualitatively and quantitatively as imported wastes and company generated wastes. The data collected in wastes as imported and company generated was quantified in money worth and environmental volume coverage and discussed in a descriptive approach.

3.6.1. Supply chain performance analysis

The performance measure framework utilized in this research is based on SCOR-model version 5. Furthermore, it concentrated the research scope to Level 1 performance attributes and metric specifically. The SCOR-model contains five basic management processes: Plan, Source, Make, Deliver, and Return (Fig 4). The model is hierarchical with three levels. Each process element in Level 1 can be decomposed to Level 2 process elements. Likewise, each Level 2 process element consists of Level 3 process elements. Level 1 metrics (shown in Table 2) are primary and high level measures that may contain multiple SCOR processes. Level 1 metrics do not necessarily relate to a SCOR Level 1 process (Plan, Source, Make, Deliver, and Return). However, it is important to note that the metrics are intended to be hierarchical as the process elements.

Table 3-1: SCOR performance attributes and metrics (Ikatrinasari Z, 2020)

No	Attributes	Definitions	Metrics
1	Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer	Delivery performance Fill rate Perfect order fulfillment
2	Responsiveness	The velocity at which a supply chain provides products to the customer	Order fulfillment lead time
3	Cost	The costs associated with operating the supply chain	Total supply chain management cost Value-added productivity cost Warranty/returns processing cost
4	Flexibility	The agility of a supply chain in responding to market place changes to gain or maintain competitive advantage	Supply chain response time Production flexibility upside Production flexibility downside
5	Asset	The effectiveness of an organization in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital	Inventory days of supply Cash-to-cash cycle time Asset turns

3.6.2. Green supply chain process design

The ultimate objective of green supply chain analysis is to identify often hidden environmental impacts and take appropriate steps to mitigate them. By using SCOR as an analysis tool, an organization can take a more complete view of the supply chain itself. This ability in turn allows possible identification of more environmental aspects and impacts. The Green SCOR elements integrated into SCOR will highlight best practices that can mitigate those impacts (Cash, 2003).

Best practice means finding and using the best way of working to achieve business objective. Applying best practice means learning from and through the experience of others. Most businesses have some operational issues that can be improved through the introduction of best practice method, including; quality management, purchase and order management, and supply chain management as a whole. It can be identified which operational area will benefit from best practice method by benchmarking, internal analysis or reviewing appropriate national and international standards (CCMM, 2021). And for this study, internal analyses were made to supply chain processes and identified operational areas that will benefit from best practices followed with the using best way of working or practice from other companies' experience.

Basically, in the designing of the green supply chain management for HATMPLC, best practices in GSCM are employed in order to collaborate the environmental thinking to the supply chain processes. In which those best practices are techniques or methodology that, through experience and research, has proven to reliably lead to a desired result (As, 2015).

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Introduction

As the main objective of this research is referred to the designing of green supply chain management in HATMPLC, so as to show the research in clear image, the researcher designed a conceptual framework considered to be appropriate and hence, based on the specific objectives stipulated, the results (findings), development (design) and discussions of the results, which are resulted from the applied data collection tools (document analysis and supplementary key informant interview and observation) are presented in this chapter.

4.2. Document analysis

4.2.1. Supply chain structure of HATMPLC

A supply chain structure of a company includes the supplier of raw materials and components that the company needs to manufacture and distribute its products to intermediate or final customers. Most of the suppliers of the HATMPLC are from abroad who supply all of the raw materials except the natural rubber (Bebeka rubber), which is from Jimma Ethiopia, and they are imported from more than 65 different companies, mainly from Malaysia, India, China, Indonesia, Egypt, and Europe, with different raw materials like carbon black (N-220, N-326, N-330, N-339, N-550, N-660), chemicals (accelerator, anti-oxidant, anti-ozonant, bonding agent, resin, vulcanizing agent, inhibitor, mold releasing agent, activator), rubber (natural, synthetic) and cords.

The production of horizon tire takes place in the plant of HATMPLC in Addis Ababa, Saris by which it produces in daily base for stock or an order receipt from customers. The supply chain structure of HATMPLC in Figure 4.1 below is detailed in SCOR thread diagram.

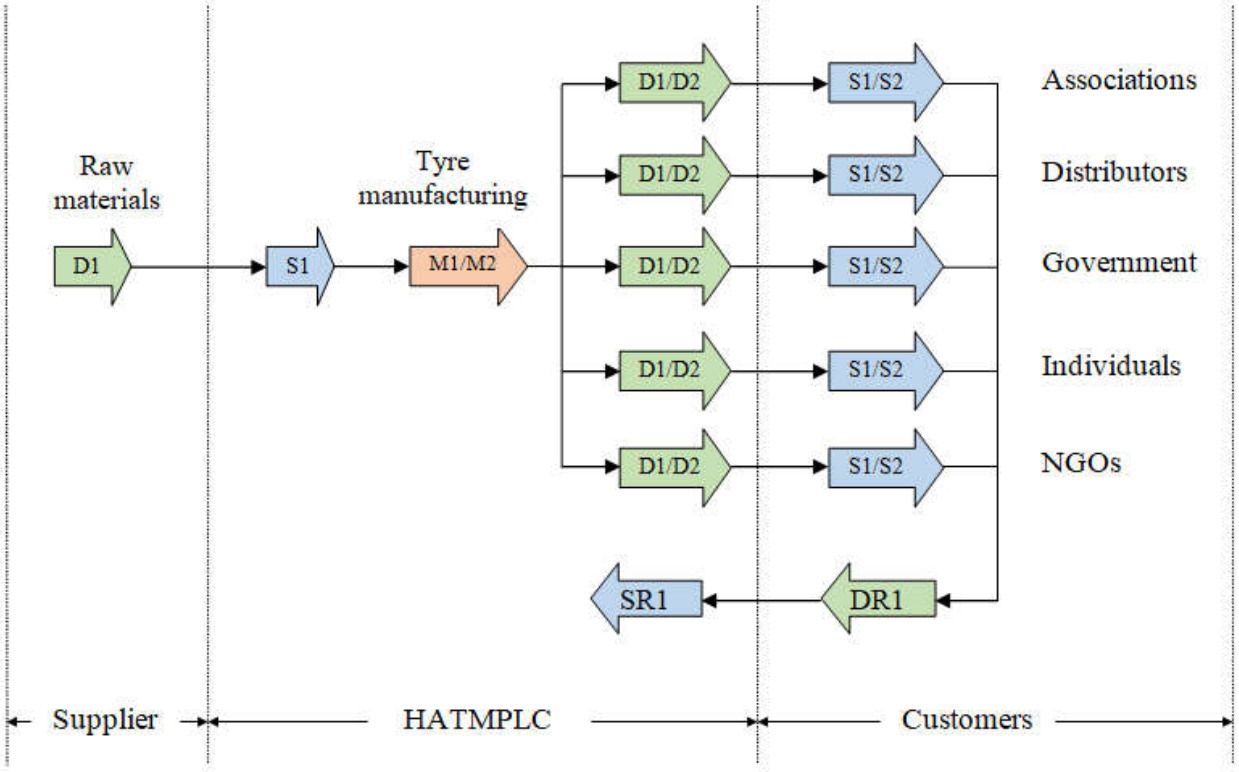

Figure 4.1: SCOR thread diagram for HATMPLC

Where, S1 = source stocked product

S2 = source make-to-order product

D1 = deliver stocked product

D2 = deliver make-to-order product

M1/M2 = make-to-stock and/or make-to-order

SR1 = source return defective product

DR1 = deliver return defective product

Figure 4.1 shows that, all raw material suppliers deliver requested type of material(D1), considered to be stocked, to be sourced by the company(S1) and the company produces tire either to stock (M1) or for an order receipt (M2) from customers (NGOs, distributors, associations, government or individuals) and delivers to them (D1/D2) then after those

customers sourcing stocked or ordered tire (S1/S2) from HATMPLC tires with defect will be returned (DR1) before the date of warranty to the company and it will be sourced (SR1).

4.2.1.1. Production

The company follows the production process flow and steps depicted in Figure 2.2. The production process time depends on the type of tire in the range of 20 minutes to 170 minutes excluding the cooling times of each batch. With this structure the company has produced 447,863 pieces in 2011 E.C and 489,514 pieces in 2012 E.C that is an average of 1550 pieces of tire a day, yet the company has a production capacity of 800,000 to 1,000,000.

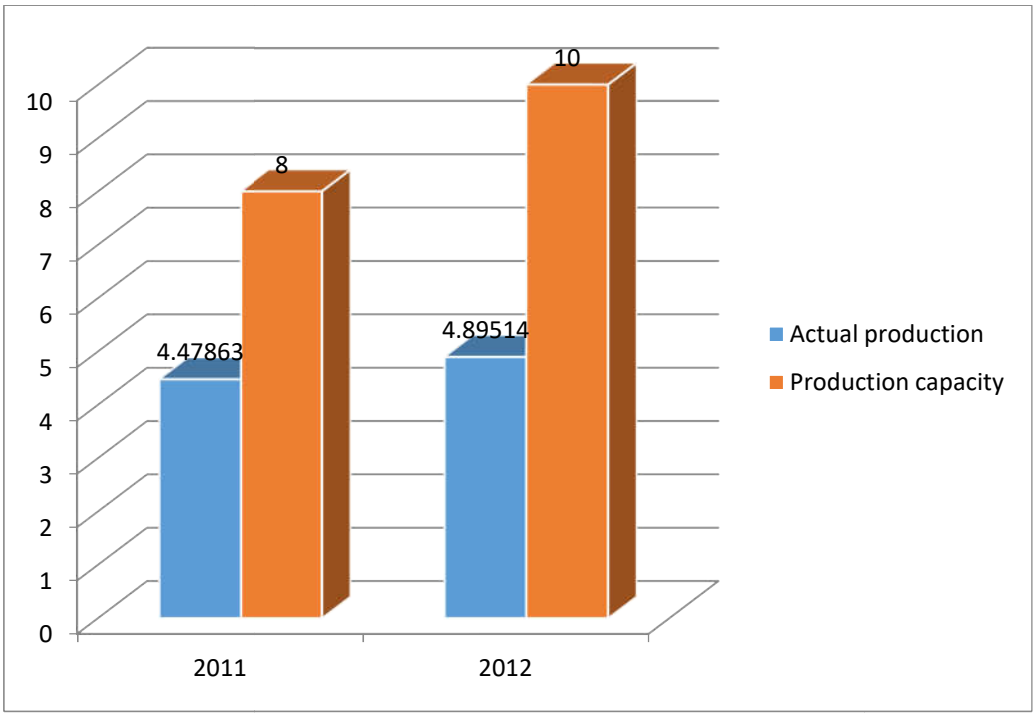

Figure 4.2: Actual production to capacity comparison

The company has made improvements to machineries and increased its employees from 777 to 800. Even though an improvement to the machineries is made and labor force is increased, HATMPLC decreased its actual production to capacity ratio.

Generally, the productions flow starts from production designer who plans in consideration with the information (report) from marketing department sales office for customer demand and quality, following that raw materials (chemicals, rubber and black carbon) move to the production area which starts in the compound mixing through to the tire finishing. The

finished tire goes to the company's warehouse located inside the production plant where the distribution to customers continues.

4.2.1.2. Distribution

The distribution of Horizon Addis Tire Manufacturing PLC has been targeting its product to distributors, associations, governmental and non-governmental organizations and end user individuals. Following this it can simply be expressed that the company has both direct and indirect channels of distribution. Customers listed above receive company's product directly from the manufacturing plant that is from the warehouse in the manufacturing plant site. All governmental and non-governmental organizations, associations and individuals are direct consumers of company's product, while distributors, who are retailers and wholesalers, distribute HATMPLC's products to end consumers. Figure 4.3 below shows the distribution channels involved in HATMPLC that the direct channel, which is zero-level channel, involves only the manufacturer (HATMPLC) and end consumers (government, NGO's, associations and individuals), and in the indirect distribution channel the manufacturer and distributors (wholesalers and retailers) are involved as in one-level and two-level distribution channels.

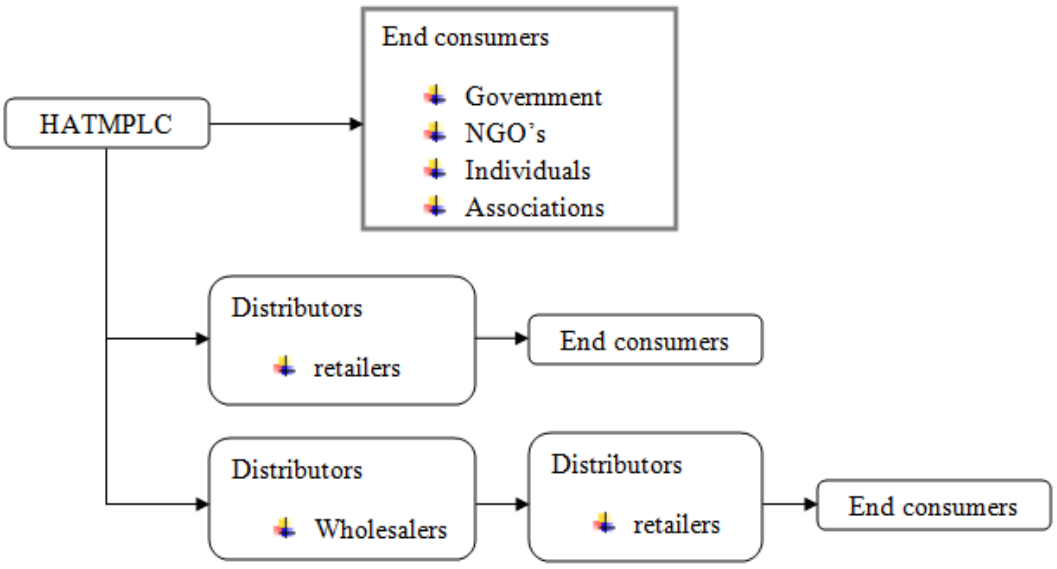

Figure 4.3: Distribution channel options of HATMPLC

Though the above groups of customers are customers of Horizon Addis tire manufacturing PLC, the sales report of marketing department depicts that they have different sales contribution to the company. The graph below in Figure 4.4 shows the sales contribution of customers of the company from 2008 E.C to 2012 E.C.

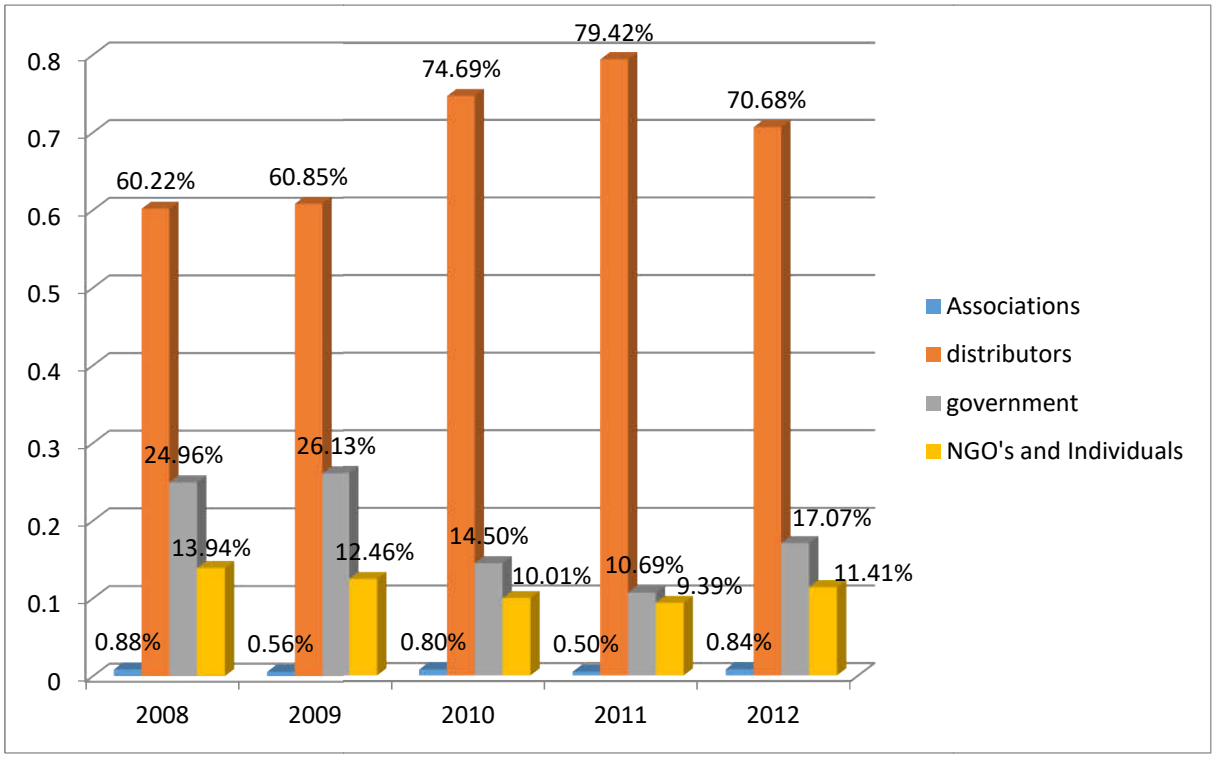

Figure 4.4: Sales contribution of customers

While associations, individuals and non-governmental organizations having lower record of sales contribution to the company, below 15%, distributors have highest record of sales contribution to the company with more than 60% of overall sales of the company each year.

4.2.2. Company production wastes

The internal wastes or failures starts from the raw material usage through to quality assurance of tires and these are classified as semi-finished product scraps and tire scraps as in the annual report of production department shows in Table 4 below. Semi-finished product scraps include those of input wastes which are compound wastage in mixer, return tread, bead wire, coated cord wastage, and tire scraps include three wheelers, passenger diagonal and radial, light truck diagonal and radial, industrial, grader, farm and floatation tire scraps.

Table 4-1: Wastes of company's production

Description	2011 E.C.		2012 E.C.	
	Upper limit (%)	Actual (%)	Upper limit (%)	Actual (%)
1. Internal Failure				
1.1 Semi Finished product Scrap				
Total semi product scrap	0.58	0.83	0.58	0.92
Total semi product scrap without radial	0.22	0.85	0.22	1.04
1.2 Tire Scrap				
Total tire scrap	0.70	0.81	0.70	0.69
Total tire scrap without radial production	0.27	0.62	0.27	0.54
1.3 Bladder Scrap	0.20	2.59	0.20	1.70
1.4 Flaps Scrap	0.01	0.07	0.01	0.22
Total Tire and semi product Scrap	0.29	0.82	0.29	0.81
Total semi product &tire scrap W/Out Radial	0.30	0.73	0.30	0.79
Defective	1.00	1.60	1.00	1.29

Source (Annual report of HATMPLC production department)

Starting from input usage in compound mixing carbon black, rubber (natural and synthetic), chemicals through to green tire wastes are included in semi product scraps having an actual percentage of 0.83 and 0.93 in 2011 and 2012 respectively from a plan to manage semi product scrap to a percentage of 0.58 in both years showing an increasing semi product scrap. But in case of tire scrap there is an improvement from 2011 to 2012 in addition to achieving their plan to manage upper limit of tire scrap percentage. The bladder scrap, as we see in the figure below, was planned to limit waste percentage in between 0 and 0.5 yet they actually recorded more than 2.5 percent in 2011 and though the scrap percent is minimized, for the quantity of production incremented in the later year, the quantity of bladder scrap is approximately the same. Reasonably discarded tires from quality checking room are those

listed as defective, the company's plan was to limit it to 1% but they recorded a defective tire percent of 1.6 and 1.29 in 2011 and 2012 respectively.

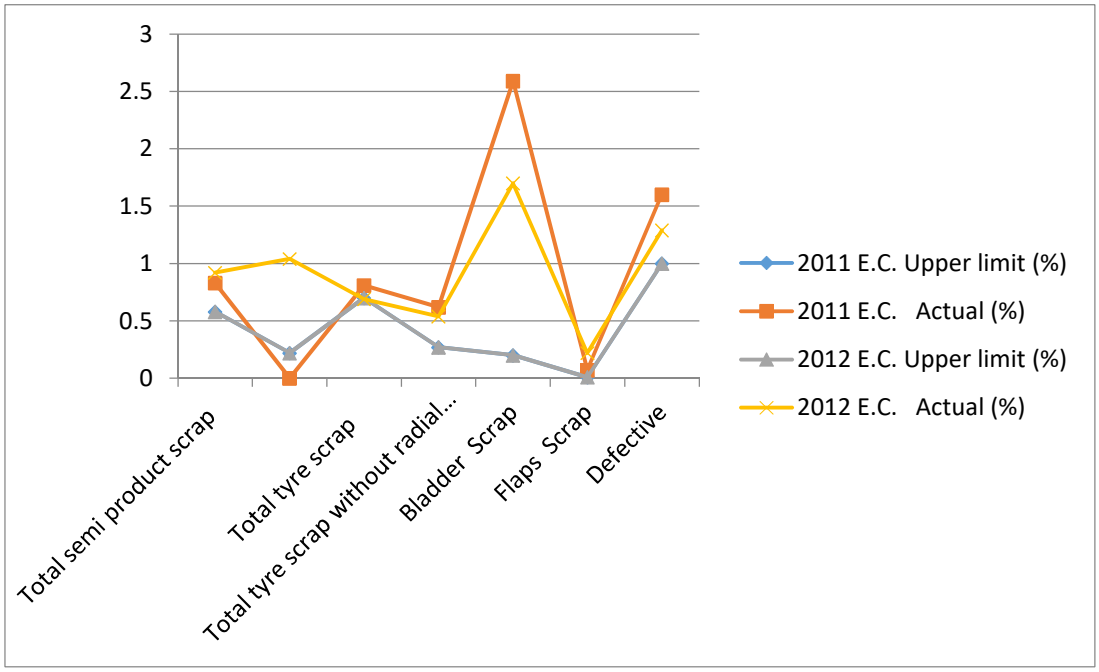

Figure 4.5: Planned to actual company waste comparison

With the production capacity of 800,000 and 1,000,000pcs, and actual production of 447,863pcs and 489,514pcs in those years the waste estimated is not small amount. If the actual production amounts worth 1,008,041,701 and 1,113,596,331 birr, the company's defect worth can be estimated as:-

1.6% of the actual production in 2011 is 7166pcs and 1.29% of actual production in 2012 is 6315pcs using this data

2011 defective worth = $\frac{7166*1,008,041,701}{447,863}$ = **16,129,099.4 birr**

2012 defective worth = $\frac{6315*1,113,596,331}{489,514}$ = **14,366,005.5 birr**

These values are resulted as estimation because of the tires costs vary in between 2,500 to 13,000 birr from the smaller tire to large tires. If only the defective result in those cost values in each year, scraps reported in the above table would worth much higher value for

HATMPLC. Minimizing company's waste result in an increase in turnover ratio, so minimizing is an improvement.

4.2.3 Supply chain performance of HATMPLC

This section contains the SCOR performance evaluation. From the performance metrics calculated in the Appendix-C, performance attributes; reliability, responsiveness, cost, flexibility and asset performances of HATMPLC are presented in tabular form and analyzed in descriptive approach.

4.2.3.1. Reliability

Table 4-2: Reliability of HATMPLC

Attributes	**Performance metrics**	**2011 E.C**	**2012 E.C**
Reliability	Delivery performance	0.53	0.6988
	Fill rate	0.56	0.766
	Perfect order fulfillment	0.53	0.6988

Customers order different variety and amount of tires depending on their status as they are distributors, governmental organizations, individuals, NGOs and Associations. Even though each customer order's different types of tires with different amount, customers order enters in a single order receipt/document. The fill rate 0.56 or 56% a year later increased to 0.766 or 76.6%, even though there is an increase in the order fill rate it is clear that the company is leaving money on the table by letting customers to go to other competitors. The case fill rate clarifies that from 100 orders entering by customers 56 of orders are filled in 2011 and 76.6 of orders in 2012.

An improvement direction for a perfect order is to maximize the percentage of POF, following this HATMPLC improved its POF percentage from 53% to 69.88%. Even though the percentage increased from 2011 E.C to 2012 E.C by 16.88%, the value tells that HATMPLC has failed to fulfill 47% and 30.12% of customers order in 2011 E.C and 2012 E.C respectively.

4.2.3.2. Responsiveness

Table 4-3: Responsiveness of HATMPLC

Attributes	**Performance metrics**	**2011 E.C**	**2012 E.C**
Responsiveness	Order fulfillment lead time	1.52	1.28

In general a company could never have constant order fulfillment lead time for every single order receipt, following that HATMPLC has an average of 1.52 days of OFLT in 2011 and an average of 1.28 days OFLT in 2012. The lower the lead time of order fulfillment the higher the level of customer satisfaction, so looking to the values in 2011 and 2012 anyone can tell that HATMPLC has a better level of responsiveness to the customers. Additionally, this performance metric has a direct relation to inventory, and HATMPLC has lower OFLT which made the company to have the level of inventory it has now. But in contrary, the result shows that the company has lower demand forecast which may lead to a dissatisfaction of customers followed by delayed delivery of other orders.

4.2.3.3. Cost

Table 4-4: Cost performance of HATMPLC

Attributes	**Performance metrics**	**2011 E.C**	**2012 E.C**
Cost	Total supply chain management cost	0.32	0.519
	Value-added productivity cost	1,010,799.75	1,050,120.75
	Warranty/returns processing cost	0.02	0.02

For total supply chain management cost is the result of materials purchase cost, finance cost and inventory cost, the increase in raw materials purchase increases SCM cost which leads to the final product cost on customers. The above result 0.32 in 2011 E.C and 0.519 in 2012 E.C is total SCM cost expressed as a ratio of total revenue. As in the report of HATMPLC's finance costs related to supply chain management increased from previous to the current and this maximized the total SCM cost. The purchase department manager replied that the increase in cost of tire is directly dependent on foreign currency exchange rate. So the less the total SCM cost the better the status of the company is.

The value-added productivity cost is part of a set of Staff Productivity measures that help companies assess the efficiency of their staff related to the process "plan for and align supply chain resources." The higher the figure the better it is. In general, rising added-value per employee is positively suggestive of the rising productivity. Following this, even if there is an increase in purchase per annum and labor or employee, HATMPLC has also gained more increase in the revenue. So the VAP cost of the HATMPLC is in an increasing status which shows that the company well added-value on employees productivity.

Repair, replacement or compensation for defective product of one's company is experienced in many companies by their own warranty term and period. This measure shows the product quality, strength and durability of a company. If a company has higher warranty cost, the company has less performance on product quality and customer satisfaction. As we see on the table above HATMPLC has a warranty to revenue ratio of 0.02 in 2011 and 2012 E.C. Generally, minimizing warranty cost is an improvement to company's performance.

4.2.3.4. Flexibility

Table 4-5: Flexibility performance of HATMPLC

Attributes	**Performance metrics**	**2011 E.C**	**2012 E.C**
Flexibility	Supply chain response time	93	93

The time consumption to purchase raw materials for tire production, take order from customer, produce the tire, and fulfill the order receipt is 93 days in case of HATMPLC. Most of the company's customers get their order from pre-produced inventory, so the time consumption is low, but the sourcing time is scheduled to 3 month of regular basis, even though it depends on the currency exchange rate and the outsourcing firm status. Minimizing response time gives the company higher flexibility.

4.2.3.5. Asset

Table 4-6: Asset management of HATMPLC

Attributes	Performance metrics	2011 E.C	2012 E.C
Asset	Inventory days of supply	22.60	16.82
	Cash-to-cash cycle time	70	34.6
	Asset turns	0.88	0.78

The days in inventory shows time to sell entire inventory in the company, in case of HATMPLC it is 22.60 days in 2011 E.C and 16.82 days in 2012 E.C as an average time between the purchase of the raw materials and the sale of the finished product to its customers. Every company works to minimize inventory days of supply for it means products of the company are sold at fast rate and the company is getting profit at fast rate. Likewise HATMPLC improved 6.22 days from 2011 to 2012.

The Cash-to-Cash cycle is the time between when a business pays its suppliers and when the business receives payment from its customers, it can indicate changes in the health of company's supply chain. Lower cycle times can symbolize a more profitable. HATMPLC has duration of 70 days in 2011 E.C and 34.6 days in 2012 E.C. As we can see from the result in the table above, there is a clear reduction in cash to cash cycle time implying company's profitability that means as shown in appendix of calculations accounts payables has increased from 155,190,749 to 417,756,274 in 2012 which is 62.85% increase in HATMPLC's debt. Unpaid debt for a company means cash on hand and having an advantage of investing for profit. In general, minimizing inventories and/or inventory days of supply is an improvement in lowering the cash to cash cycle time.

Asset turnover ratio (asset turns), the indicator of company's ability to turn its asset to revenue or sale, is an overall performance indicator any company. HATMPLC turned its asset to sales by a ratio of 0.88 in 2011 and 0.78 in 2012. This shows that HATMPLC has weak company resource management system for its turns ratio decreased from 2011. And generally a company can have double net sales of its asset or triple, yet with this level of management organization HATMPLC has ratio of less than one, showing that it should increase or sustain its improved level of asset turns ratio.

4.3. Observation

As it is observed (Appendix-A), before HATMPLC's production start the company faces certain waste (a waste not generated in the company). All inputs for the production are imported from different countries abroad which imply that all the packaging entering with products to the company are wastes for the company. Input suppliers are different companies from China, India, Egypt, Ukraine, Germany, UK, Slovakia, Australia, Switzerland, South-Korea, United states, Belgium, Czech Republic and other countries in Europe. With the quantity of input entering to the company there is a directly proportional amount of packaging waste accumulation, following that Egypt is higher package waste contributor into HATMPLC. In surrounding area coverage of waste package, the black carbon's package and plastic and wooden pallet covers more space for it is one of the main frequently used raw materials, which is imported from Alexandria, and oil container barrels are the next imported package wastes covering the surrounding space.

Table 4-7: Imported waste contribution level

No.	Imported wastes	Amount in m^3	Country most contribute
1	Carbon black package	80	Egypt
2	Pallets (plastic & wooden)	189	Egypt
3	Plastic ties	6	China
4	Safety stickers	18	China
5	Textile rollers	36	UAE
6	Oil containing barrels	140	South Korea

As shown in Table 4-7 Egypt has higher imported waste contribution than others, from a total of 469m^3 volume of package waste import 57.35% is contributed by Egypt.

Generally, from raw materials used for the production of tire rubber is basic and must be used kind of raw material like those of oil and carbon black, yet it is not listed in the Table 4-7 above as package containing product for it is packed with a light plastic that is not removed during the raw material usage. And, all the machineries including the compound mixer, milling, extruding and calendaring, and curing machines are electrical or non-fuel using.

4.4. Key informant interview

In the procurement process, as it is collected in semi-structured interview in Appendix-E, HATMPLC's procurement process goes under the direct supervision of purchasing department. The purchase department reviews the status of purchase request from either of initiators the production, store and marketing departments and orders the needed quantity and type of material from selected outsourcing company for each type of material, and follows the ordered material till it is received and finally pays for it as shown in the Figure 4.8 below. In formalizing the procurement type involved, HATMPLC has a direct procurement type for the company moves goods/materials into the manufacturing process which help the company in deriving external profit and continuous growth in revenue, and establish long-term collaborative supplier relationships.

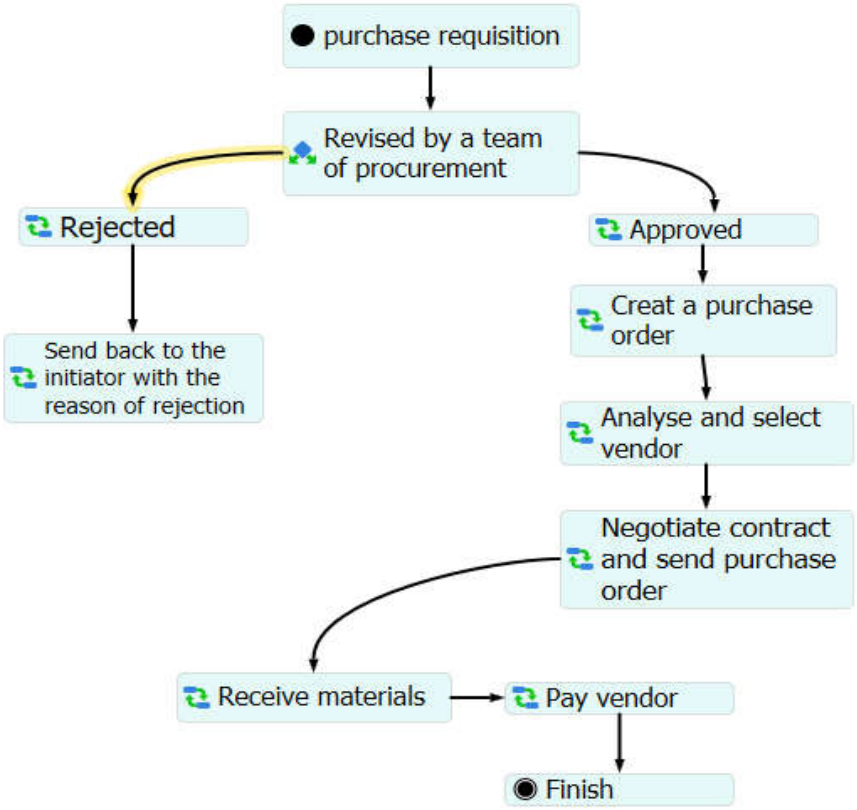

Figure 4.6: Procurement process flow of HATMPLC

The purchase department manager responded (Appendix-E) that, even if purchase requisition comes in any time randomly, the company by itself has a schedule of three month sourcing cycle time which depends on getting the foreign currency and its conversion rate. The company used to import its freight of raw materials using planes so as not to stop the production line; however, that could not be sustained due to the huge expenses involved.

In the production process, as to production department manager in Appendix-E, the production department has different streams of work that include production designer, maintenances, chemical analysts, production controllers and quality managers which are involved from compound mixing through to tire finish. Totally the production work proceeds in three shifts in twenty four hour of the day. And responded that, wastes generated in the company are either imported packaging wastes or company's production wastes and that the imported packaging wastes have equal waste contribution to the company's production wastes. The imported packaging wastes as in general include Plastic package waste, Plastic and wooden

pallets, Oil containers and Textile rollers, Appendix-A. HATMPLC has as much production waste as the imported package waste in quantity. As to the respondent from production department, in Appendix-E, there are wastes to be disposed and wastes to be sold in bid and from those semi-finished tire production wastes like compound wastages and coated cord wastages are of no use for the company or other firms.

In the return process, as to the sales department manager in Appendix-E, the reverse flow direction of HATMPLC is just through the warranty right of customers. The tire sold after checking standard and quality may face damage in time of use, if the tire sold from the company faces whatever reasonable damage in the one year period of the service, customers return the product with the receipt document of purchase. Even if this is the structure to return the product from customers, managers at distribution centers of HATMPLC in Teklehaimanot and Kality replied that there is no single tire returned throughout their occupation period from customers.

In consideration to environmental management status in HATMPLC, according to the company's informants in Appendix-E, the company considers an environmental management system and involved in it, and as it is reported HATMPLC is committed to work in compliance with ISO14001; 2015 to reach environmental goals that are both tangible and feasible showing that the company has fulfilled documents of Scope of the Environmental Management System setting out the type of operations HATMPLC's EMS will be applied to, Environmental Policy that demonstrate the company's commitment to any requirements or actions that will reduce its environmental impact, Environmental Objectives and plans for achieving them (who has ownership of each objective, how progress will be monitored, any specialized equipment or services required to achieve each objective and a timeline for achieving each objective) and others.

For the greenhouse gas emission context, there is no chemical reaction with a result of carbon dioxide because there is no combustion in the process, so that HATMPLC is not contributor to environmental disruption of the greenhouse gas carbon dioxide, that all the processes of tire manufacturing listed in Figure 2.2 does not involve combustion or chemical reaction resulting CO_2.

Also, the company uses Kaizen (Continuous Improvement) strategy where employees at all levels of a company work together proactively to achieve regular, incremental improvements to the manufacturing process. In a sense, it combines the collective talents within a company to create a powerful engine for improvement, which follows the PDCA (Plan Do Check Act) principle in the process for both the environmental management and the supply chain improvement. And the company has gained advantage by applying this strategy in product waste management, employee's effectiveness, productivity and quality even though it hasn't been reached to the extent the company needs to have.

Summary

To summarize the study discussion and result, with the application of tools for the study; the interview, documents review and observation, the SCOR thread and SCOR performance evaluator, generally the SCOR model has shown clear supply chain management view of HATMPLC. It is explained that the company has weakness to be improved and strength to be sustained.

From the SC structure of the company, it can be observed that most of raw material suppliers are from abroad and the tire production process takes place in the manufacturing plant around Addis Ababa Saris, working in three shifts with actual production capacity of 1550pcs in average per day. The company distributes its product for distributors, associations, governmental and non-governmental organizations, and individuals both by direct and indirect channels of distribution. And it has no return structure except that of the warranty path.

Existing wastes in the company are imported packaging wastes and company's production wastes, where Egypt contributing the highest volume portion of imported package waste in to the company. The company generated a production waste of 16,129,099.40 and 14,366,005.5 birr worth in 2011 and 2012 E.C respectively, just from tire scrap. Yet the company is committed to work in compliance with ISO 14001; 2015 to reach environmental goals.

Company's calculated SCOR performance metrics shows that reliability, flexibility and asset performance attributes requires an improvement while having a better value-added productivity metric and responsiveness attribute.

Generally, for HATMPLC has existed since 1972 G.C, even though it is named “Addis tire”, it has a supply chain structure and supply chain processes applied through to the present. So the design implemented below shows an improvement to the existing structure and process of the supply chain management, in consideration with the result from the study discussed above (weaknesses for the improvement and strengths for sustainability).

4.5. Green supply chain process design in HATMPLC

Beginning from the result, discussion and analysis in the earlier topics, supply chain processes are improved and developed in consideration with problems or weaknesses resulting from performance evaluation tool, waste study, environmental regulations and supply chain structure of the company using green SCOR design approach and best practices. Where, from the performance evaluation tool, the SCOR, in the reliability performance measure the fill rate and POF (which can be improved following the green improvement of the production process) and in the responsiveness performance measure the OFLT (which can be improved by improving the distribution process) are parameters that show the level of customer satisfaction. Where in the cost performance measure the total supply chain management costs (which can be improved following the improvement of distribution process), value added productivity cost (which can be improved by improving the production process) and the asset management performance measures inventory days of supply, cash-to-cash cycle time and asset turns (which can be improved following the improvement of procurement, production and distribution processes) shows the company’s performance on its own.

In general, best practices are employed for improving the existing supply chain management of the company while developments are made as proposition or recommendation for newer direction of supply chain process flow.

4.5.1. Green procurement design for HATMPLC

To start with, it is clear that the study report in the result and discussion topics of this thesis has exploited all possible weaknesses in the area where the study is applied. And the identification of possible environmental and operational aspects and impacts has highlighted to best practices in greening the supply chain of HATMPLC. Following that,

- ✓ Most of the suppliers of the company being from abroad have impacted in contributing equal amount of waste on HATMPLC as that of the production waste from the company.
- ✓ Having no basis for assessing progress on green procurement, are the highlighted from the green SCOR point of view in procurement.

The Direct procurement, HATMPLC has, involves the purchasing of goods, materials, and services directly associated with the production of tires. So, the purchasing team is expected to invest a lot of time and effort into developing and maintaining relationships with suppliers.

Quality of raw materials impacts the quality of the final product, and thus the organization's reputation and credibility along side with environmental management. The relationships with suppliers are usually long-term and collaborative in this process. However, the result shows that the company did not claim to address environmental issues consistently in the supplier selection and evaluation criteria. Rather, conventional factors such as cost, quality and time were dominant factors in the assessment of their suppliers, even though ISO 14001 is an internationally agreed standard that sets out the requirements for an environmental management system helping organizations to improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage.

Best practices

Procurement experts from OECD (Organization for Economic Co-operation and Development) and key partner countries mapped out best practices for green procurement, and validated the analytical framework (OECD, 2015).

- ➢ Setting a GP (Green procurement) legal and policy framework to assist buying entities in incorporating GP in their procurement procedures.
- ➢ Planning GP, including understanding market capacity and available technical solutions as well as assessing GP costs and benefits.
- ➢ Introducing environmental standards in the technical specifications, procurement selection and award criteria, as well as in contract performance clauses

- Professionalizing GP and increasing know-how and skills
- Raising awareness on GP solutions and their benefits with buyers, businesses and the civil society
- Monitoring the results of GP and providing a feedback loop into policy and regulation

HATMPLC has RMP (raw materials purchase) options reported as base materials and their equivalents from different countries and manufacturers as shown in the Appendix – B (lists of raw materials and related products). So having RMP options on hand and the best practices of OECD on green public procurement, HATMPLC can control the inflow of package waste import and improve its procurement process.

In setting up a GP legal and policy framework HATMPLC already in its best interest has collaborated the ISO 14001 and Kaizen for the environmental management so a proper implementation in procurement process and FDRE industrial environmental policy of waste import prohibition with additional consideration of eco-labeled products will enhance the analysis and selection of suppliers and manage package waste import. Eco-labels are marks placed on product packaging or in e-catalogs that can help consumers and institutional purchasers quickly and easily identify those products that meet specific environmental performance criteria and are therefore deemed “environmentally preferable”.

For the implementation of the above policies and environmental cases Ethiopian EPA should intervene in following up their accomplishments through annual green purchase reports. And HATMPLC itself should apply Kaizen principles accordingly in monitoring and controlling the green procurement for it is already existing approach.

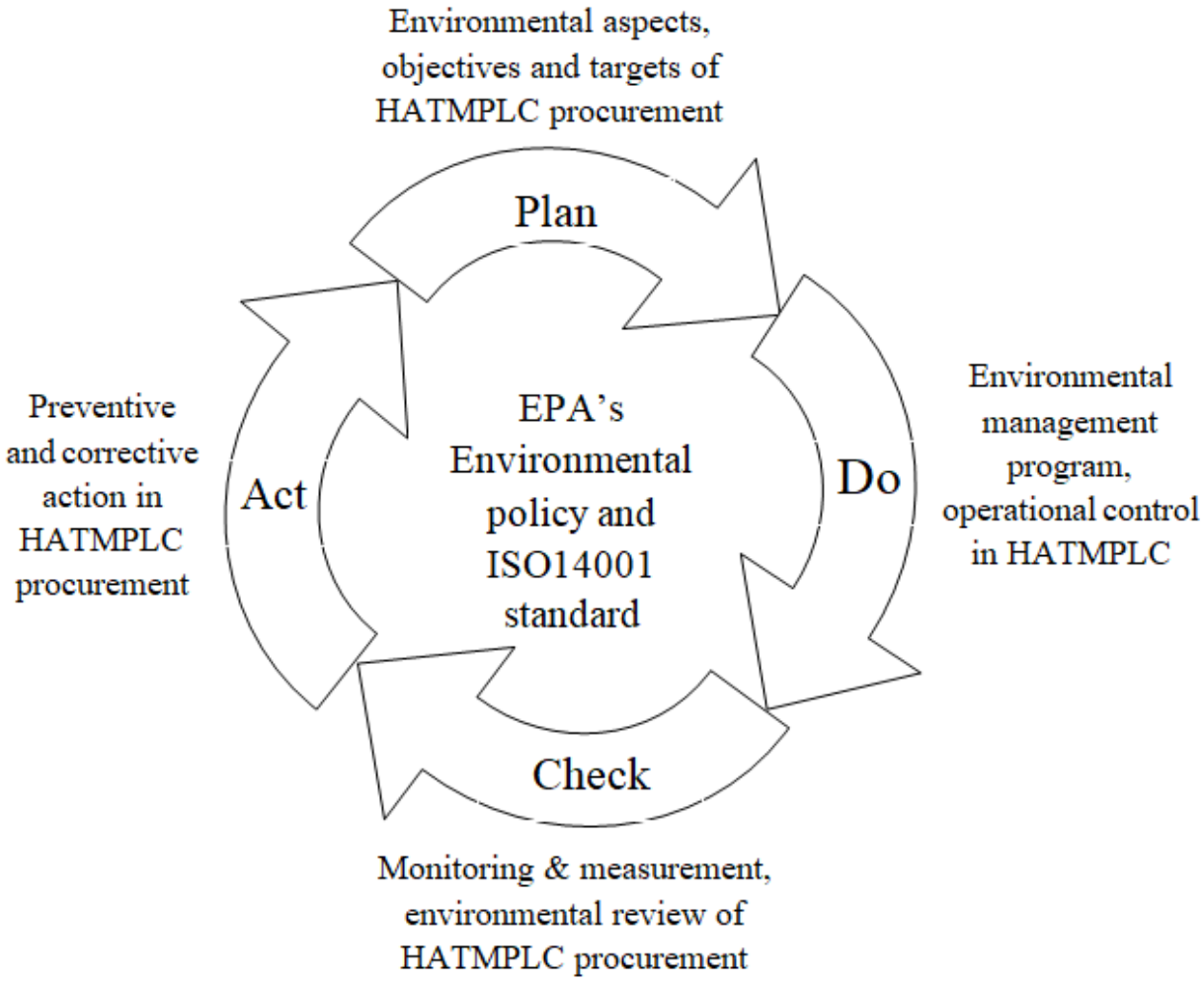

Figure 4.7: Green procurement for HATMPLC (Adopted from (Patel PM, 2015))

The figure demonstrates that the collaboration of federal EPA industrial policy, ISO14001 strategy, and the kaizen pillars for improvement in to greening the procurement process of HATMPLC. Through this final suppliers for all variety of raw materials will be selected and negotiated.

4.5.2. Green manufacturing design for HATMPLC

In manufacturing industries making the production process free of waste may cost perfection in each level of the process which is not possible. And yet because of minimizing company's waste result in an increase in turnover ratio or the conversion of company's resources to

revenue, an approach that minimizes production waste should be applied. As the waste study and performance evaluation result above shows, HATMPLC has waste involved from input usage through to quality assurance processes. The wastes involved in the tire production process of HATMPLC are

- ✓ Inventory wastes (input raw materials and/or WIP product scraps)
- ✓ Defects (Scraps)

Basically the tire production has standard procedure for materials use and every single variable involved in the process and work standardization will not be problem for creating wastes.

Best practice

Root Cause Analysis (RCA) is a method that is used to address a problem or non-conformance, in order to get to the "root cause" of the problem. It is used to correct or eliminate the cause, and prevent the problem from recurring. RCA is applied as a best practice in eliminating production wastes (greening the production) which leads to apply it in HATMPLC in order to minimize or eliminate raw material wastes (input wastes), WIP product scraps and defects in the company. The RCA follows the following steps in managing the existing problem;

Define the problem (or areas of improvement)

The very first step is to ‘specifically’ and ‘clearly’ define the waste existing in the form of the ‘problem definition’. Once outlined, the problem definition should be reviewed by stakeholders involved in the RCA process for its accuracy and viability.

Assemble as much data and inputs as possible.

Next, one should gather enough information/evidence around the problem statement to understand the waste comprehensively. Try to seek as much qualitative and quantitative data about the problem statement, as possible.

Locate the causes

With enough data available on hand, now each of the causes identified and try to pin-point the underlined/root cause behind the waste should be reviewed.

Find solutions

This step is about coming up with the resolution for the root cause identified above. The solution could be:

- **Corrective Solution:** A short term or stopgap measure to tackle the problem at hand. This solution addresses the 'direct' and 'evident' cause of the waste
- **Preventive Solution:** A more thought about and long term resolution that targets the 'root cause' and prevents it from re-occurring

Create actionable strategies (or plans) to implement the solution

With the solution defined, it's time to devise the plan to incorporate the solution, methodically. This step will involve identifying and recording:

- activities required to implement the solution
- resources needed for the activities
- schedule of activities
- users responsible for the activities
- any additional aspects around the solution's implementation

Monitor the solution and confirm if it works

Last and quite essential step in the RCA process is to regularly monitor the solution post its implementation and ensure it stays viable and doesn't let the root cause to re-occur.

The figure below shows the above RCA application procedures for HATMPLC production waste elimination/minimization or greening company's production management.

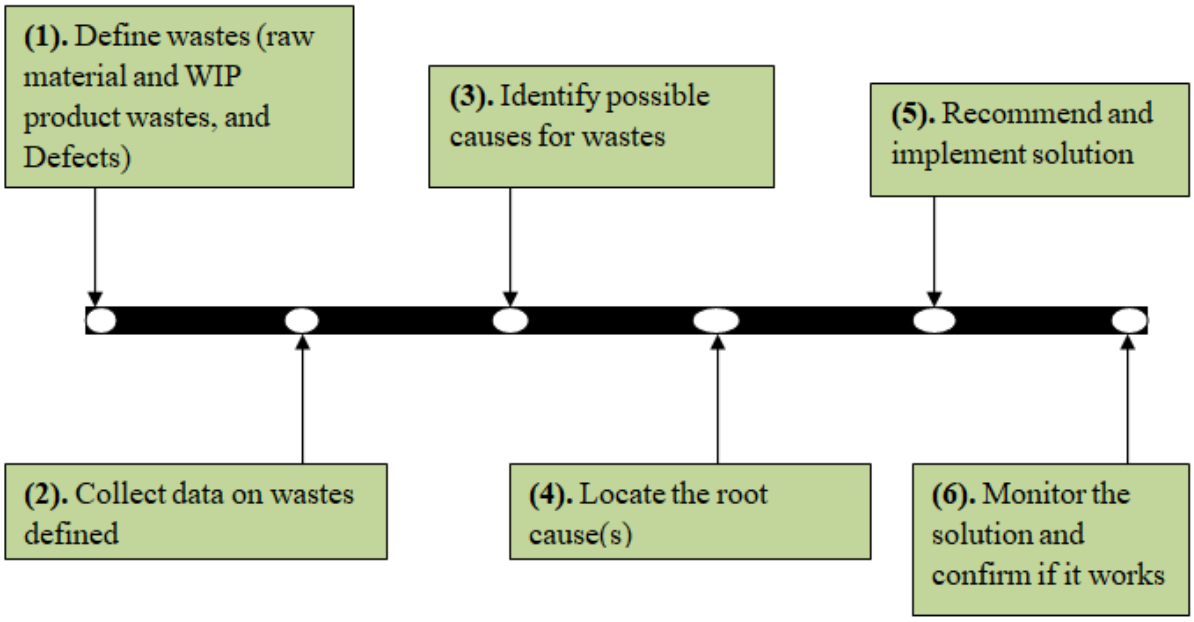

Figure 4.8: RCA application in greening production

4.5.3. Green distribution design for HATMPLC

Even though this process of a supply chain does not involve waste from company's product or packaging (as in case of HATMPLC), an improvement or proper selection of distribution management leads to a greener overall supply chain management. A distribution network affects inventory carrying cost (ICC), materials handling cost (MHC) and transportation costs (TC).

As we can see from Appendix C in the table, ICC is recorded 7,480,926 ETB, MHC of 58,962,559 ETB and 1,026,610 ETB of TC in 2012 E.C. Based on those records from HATMPLC, from distribution network design options listed in the literature review from (Chopra, 2003), the design that best optimizes the distribution network is selected in weight value. With the advantages of existing structure HATMPLC and status listed below weighted score is applied to select proper distribution network for an effective and greener supply chain contribution.

Company status,

- Location of the warehouse is the same location as the manufacturing plant
- More than 45 distribution centers of Horizon Addis tire all over Ethiopia
- A single product in product variety (Tire), even though those tires are catalogued as passenger car bias and radial tires, light truck radial and bias tires, truck and bus bias tires, farm tires, industrial tires, OTR tires, floatation tires and three wheeler tires
- Already has better performance in order fulfillment and productivity
- Although the sourcing period depends in the currency exchange rate and the regular schedule is three months (90 days), outbound response time of HATMPLC's supply chain is three days, which is best.

In consideration with the above profiles of HATMPLC, weights for criterions are made in accordance with the designer's consideration and rated in relation to the above qualitative descriptions.

Table 4-8: Weighted score to select distribution network design for HATMPLC

Purpose: To identify and select the weighted distribution network design for HATMPLC in accordance with the criterions													
Criteria	**Wei-ght**	**Manufacturer storage with direct shipping**		**In-transit merge**		**Distributor storage with package carrier delivery**		**Distributor storage with last mile delivery**		**Manufacturer / distributor storage with costumer pickup**		**Retail storage with customer pickup**	
		Rati-ng	**weigh ted score**	**Rati-ng**	**weigh ted score**	**Rati-ng**	**weigh ted score**	**Rati-ng**	**weigh ted score**	**Rati-ng**	**weigh ted score**	**Rati-ng**	**weigh ted score**
Materials handling cost	350	74%	**259**	68%	**238**	68%	**238**	65%	**227.5**	57%	**199.5**	48%	**168**
Inventory carrying cost	275	83%	**228.25**	75%	**206.25**	55%	**151.25**	55%	**151.25**	83%	**228.25**	48%	**132**
Transpor tation cost	175	48%	**84**	57%	**99.75**	75%	**131.25**	40%	**70**	78%	**136.5**	88%	**154**
Response time	125	65%	**81.25**	70%	**87.5**	78%	**97.5**	74%	**92.5**	68%	**85**	95%	**118.75**
Returnab ility	75	32%	**24**	32%	**24**	50%	**37.5**	54%	**40.5**	92%	**69**	84%	**63**
Total	1000		**676.5**		**655.5**		**655.5**		**581.75**		**718.25**		**635.75**

Rating: Excellent (100%-85%); Good (85%-75%); Satisfactory (75%-50%); mediocre (50%-25%); poor (25%-0%)

Manufacturer/distributor storage with customer pickup is the best fit in case of HATMPLC with total weight of 718.25 and it is selected as a network designed for the company. It has an advantage in minimizing total supply chain cost because total supply chain cost is the sum of supply chain related costs (MHC, ICC, TC, materials purchase cost and finance costs). And for more improvement in order visibility, customer experience and returnability the distribution network can be designed as a merged network of the distributor storage with package carrier delivery is structured. The figure below shows the merged network structure designed for HATMPLC.

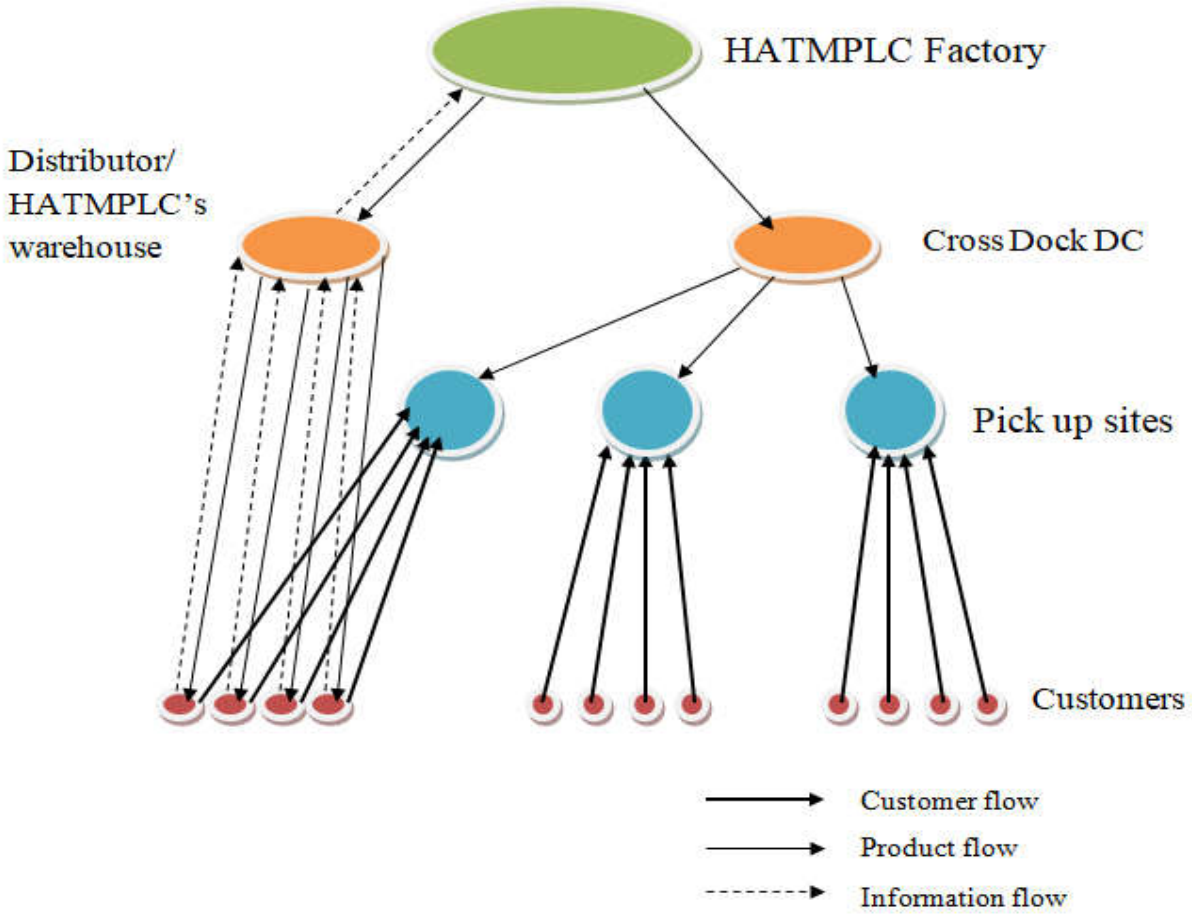

Figure 4.9: Distribution network for HATMPLC

In this case the cross dock DC and pick up sites are the factory warehouse itself and/or retailer which means there will be no other facility to be built. The existing facilities structure of the company has quite pleasant support to the above distribution network design.

The implementation of this design is simple for there will be no additional facility construction to facilitate the distribution in accordance with the design, in that HATMPLC's marketing management office, with help of Kaizen implementation steps, can implement it. And for further improvement and follow up Kaizen PDCA approach should be carried through the distribution.

4.5.4. Return design for HATMPLC

According to the discussion in the above section there is almost no reverse logistics path for HATMPLC, except that the warranty makes one. Even though there is return policy through warranty, there was no returned tire defect from customers throughout 2011 and 2012 E.C. Following this, RL or GL may not improve company's production waste but the natural environment and economy.

There are options of purposes in returning waste tires which involve latest green technologies, Pyrolysis, retreading and recycling for other materials.

- Pyrolysis is a green technology process by which waste tire is re-converted to carbon black (can be re-used in tire manufacturing, Shoe sole production and pigments), Pyrolysis oil (used in steel plant, Glass plant and Brick plant), steel wire and combustible gas (Pyro-gas). The process involve other cascaded process machines like steel wire drawing machine that separate steel wire and free the tire from it, tire shredding machine to put the steel free tire in to pieces and the obvious Pyrolysis machine plant.
- Retreading is a technological process in which a used tire's worn tread is removed and a new tread is positioned on the undamaged tire casing. It once was the only option considered as recycling for the purpose of fresh utilization of tires. In this process a tire worn-out its tread is considered as just the user had consumed its 50% value. In (Uriarte-Miranda ML, 2018), the implementation of RL has both environmental and economic benefits in the different areas of implementation. The economic benefits are

dependent on the degree of implementation in the process of transformation and distribution of companies. Retreaded tires can last 75.0% to 100.0% of the life of a new tire, based on the quality of the retreading process. The costs of retreaded tires are 30.0–50.0% less than the cost of a new tire. This makes it attractive to consumers, such as truck fleet operators who travel long distances and demand higher tire replacement rates.

So that, proper disposal option is not even an option in returning tire for there are greener technologies to recycle, remanufacture and re-use. It much valuable to see the brighter direction which is collecting disposed tires around the environment to put them back in to the supply chain. The figure below show the existing best practice in returning waste tires back in to the supply chain process. Even though it is the best practice that can be applied the "how?" and the "who?" are questions that should be answered in designing the reverse/green logistics process.

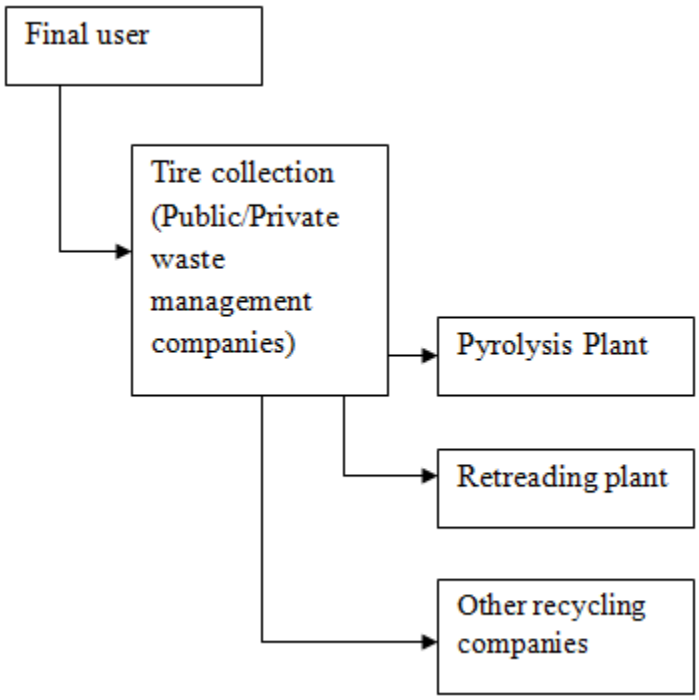

Figure 4.10: Best practice in tire return (GL)

The management of the RL structure can be performed by a third-party (public or private) company can perform the whole process of collection, classification, and re-manufacturing of the waste tire or the manufacturing company itself can extend its participation within the RL process assuming some responsibilities.

The following HATMPLC's background, existing structure and process designs made in the upper section supports in designing the return process of waste tire to a supply chain.

- Expertise in tire manufacturing
- Distributors have higher sales contribution
- No return experience other than the warranty return policy
- The distribution network is designed as a merged network of manufacturer/distributor storage with customer pickup and distributor storage with package carrier delivery which gives an increased returnability access for the product

Accordingly, it is effective to outsource the after collection of waste tire (Retreading, Pyrolysis and/or others) to 3PL. The figure below shows the developed return structure

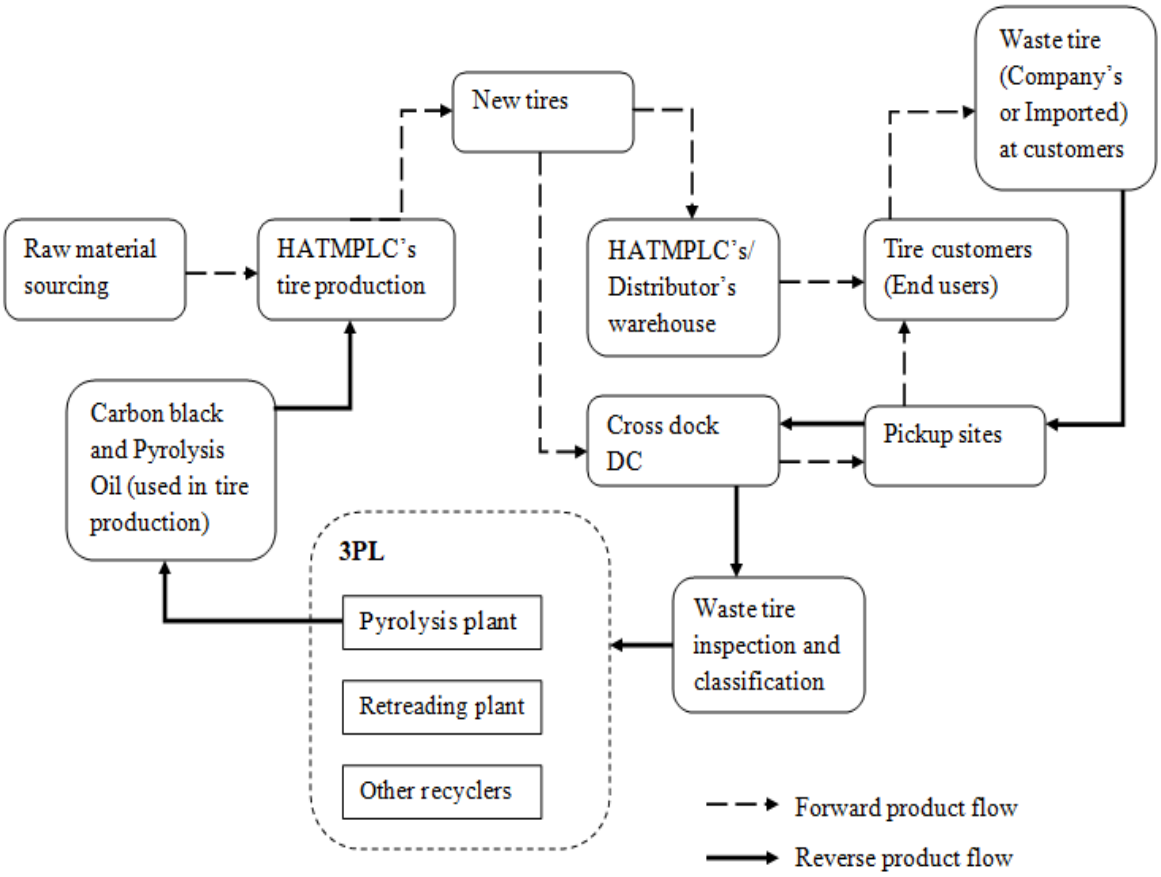

Figure 4.11: Reverse logistics design of tire (HATMPLC Manufacturer)

So the waste tires (company's tire or imported tire) after consumption can be delivered by consumers to pickup sites in advance. And then to the cross dock DC, which in our case is the HATMPLC's factory/warehouse, where the inspection and classification of waste tires is undertaken. Finally 3PL continues the left over process from here on.

To implement and monitor the return design, HATMPLC can set an isolated reverse logistics department to facilitate the promotion, collection, transportation, inspection/isolation and distribution to the 3PL. Managing to sustain this helps in terminating or minimizing both company's and natural environment's waste tire.

Generally, the overall supply chain structure of (Green supply chain management) waste minimization/elimination and performance improvement considered process design can be structured as follows,

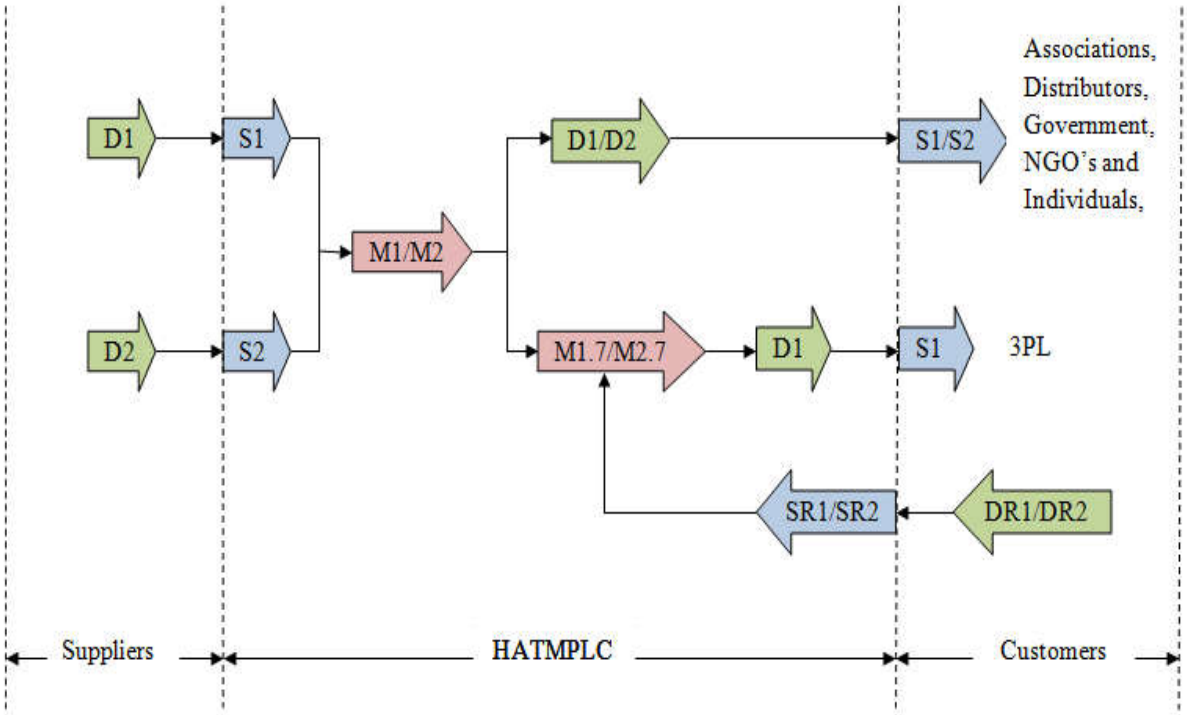

Figure 4.12: Developed SCOR thread diagram for HATMPLC SC structure

Where,

SR2 and DR2 = Return Maintenance, Repair & Overhaul, the return of products or assets to perform preventative maintenance, (end-of-life) overhaul or repairs due to breakage/aging with use.

M1.7 and M2.7 = Waste disposal

In the reverse logistics, the disposable wastes from the company's production and wastes collected from customers and sourced as disposable waste by the company will be delivered to 3PL in contract as discussed in section earlier.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The purpose of this thesis has been to design a green supply chain management model which specifically involves greener supply chain processes design by employing performance measurement tool and other research tools for studying wastes involved in the company hindering green supply chain. Hence, it was started by wondering how the overall supply chain structure of the company looked like, for it helps in exploiting spots or problematic stages which does not consider a greener approach. Then researcher continued to a little deep look into the company's production process for approving the loose input utilization and wondering the existence of wastes in other stages of production process. And finally, how the performance of the company, both cost performances and non-financial performances looked like for they support in giving an insight to overall company's strength and weaknesses.

To answer these highlighted curiosities of the research, it was deeply searched to all areas of the enquires through applying tools for the research and it was found that the supply chain structure lacks a reverse flow of product to integrate the supply chain to environmental management, a production waste of about 16,129,099.4 in 2011 E.C and 14,366,005.5 ETB worth in 2012 E.C just from tire defect, 55.9% and 48.9% of capacity utilization in 2011 E.C and 2012 E.C respectively and a package waste import into the company that is about equal amount to company's production waste.

The main factors contributing to these situations referred to the importing of almost all raw materials from abroad that led to the dependency in foreign currency, loose managing structure to take measures on existing weaknesses, the limited cooperation, involvement and support of the concerned stakeholders. Following this, it can be concluded that the above mentioned factors has contributed for the higher amount of both company's production waste and imported package wastes, no consideration of reverse product flow to integrate the supply chain to environmental management and no improvement in capacity utilization.

And to confront these weaknesses (higher amount of wastes, non-existence of reverse flow of product to integrate the supply chain to environmental management and unimproved capacity utilization) in the company's overall supply chain, green supply chain management design is made, specifically to the involved supply chain processes; the procurement process, production process, distribution process and the return process. In that, in consideration with environmental management and performance improvement directions, green SCOR approach is employed with its existing best practices.

In general, it can be concluded that the company HATMPLC has draw backs and unconstructed structural parts in its supply chain processes, and following that a green supply chain management design is structured. Implementing the designed supply chain management structure would result in improvement to the company's overall performance and leads the supply chain to a greener or waste free environment as a whole.

5.2. Recommendation

Away from the designed structure for mitigating the existing problems in the company, to minimize the import level of raw materials and waste, government intervention and involvement of concerned stakeholders is a path way. For the natural rubber production already exists in Ethiopia, enhancement of the rubber manufacturing (both natural and synthetic) by Ethiopian firms can minimize or terminate the rubber import from abroad. And a collaboration of government to build a Pyrolysis plant in the country and strengthen companies involved in rethreading would totally enhance both the environmental management and the economy of the country as a whole.

In sourcing raw materials, the company is suggested to make an in-depth study in predicting customer demand and plan inventories before five month or half a year, in consideration with materials shelf time, for it helps in choosing cost efficient transportation mode at the same time with large amount and variety of raw materials. In turn it helps to respond to regularly fluctuating foreign currency around the world.

The increase in customer demand increases the inventory for tire production and the tire itself, which in-turn leads to increase the production capacity utilization and the market share, so to

increase customer demand the company is recommended to enhance product promotion throughout the country and COMESA region as the company's objective.

Every country has an international relation to one another; in economic, political and technological aspects, so it is strongly recommended that intentional and non-intentional waste imports be considered in all economic, trade and technology of inter-organizational relations.

And finally, in order for achieving the set goals of production waste minimization the company is recommended to strictly apply the waste management approach the company intended to apply (Kaizen) in regular basis of each production batch. And further, it is strongly suggested that future studies include inter-organizational collaborations for sustainability and environmental management.

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Appendix- A Wastes

Imported package wastes




Plastic package waste


Plastic and wooden pallets

Oil containers

Textile rollers

Company wastes

Tire scrap

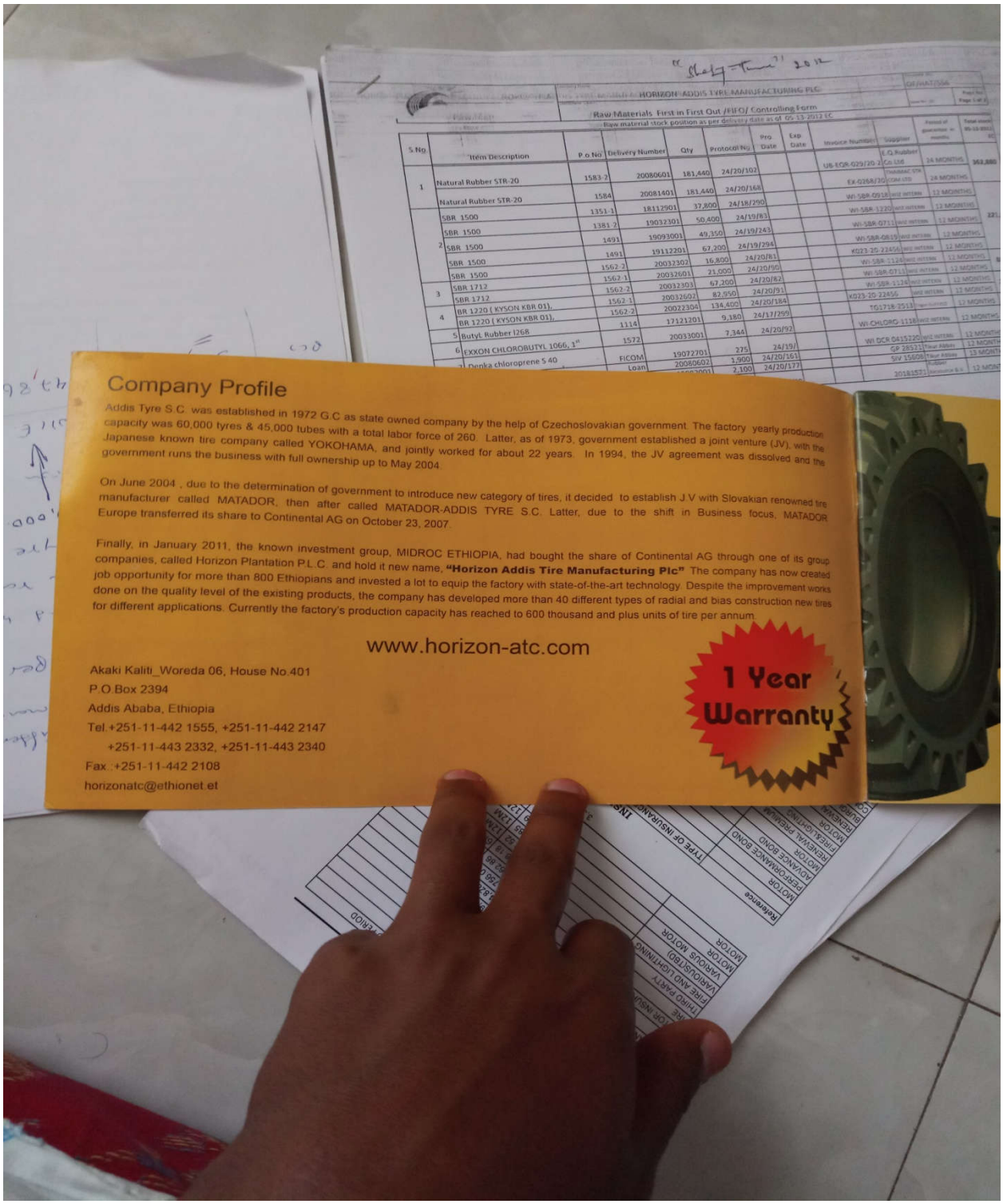
Semi-finished tire parts

Tire marking stamp

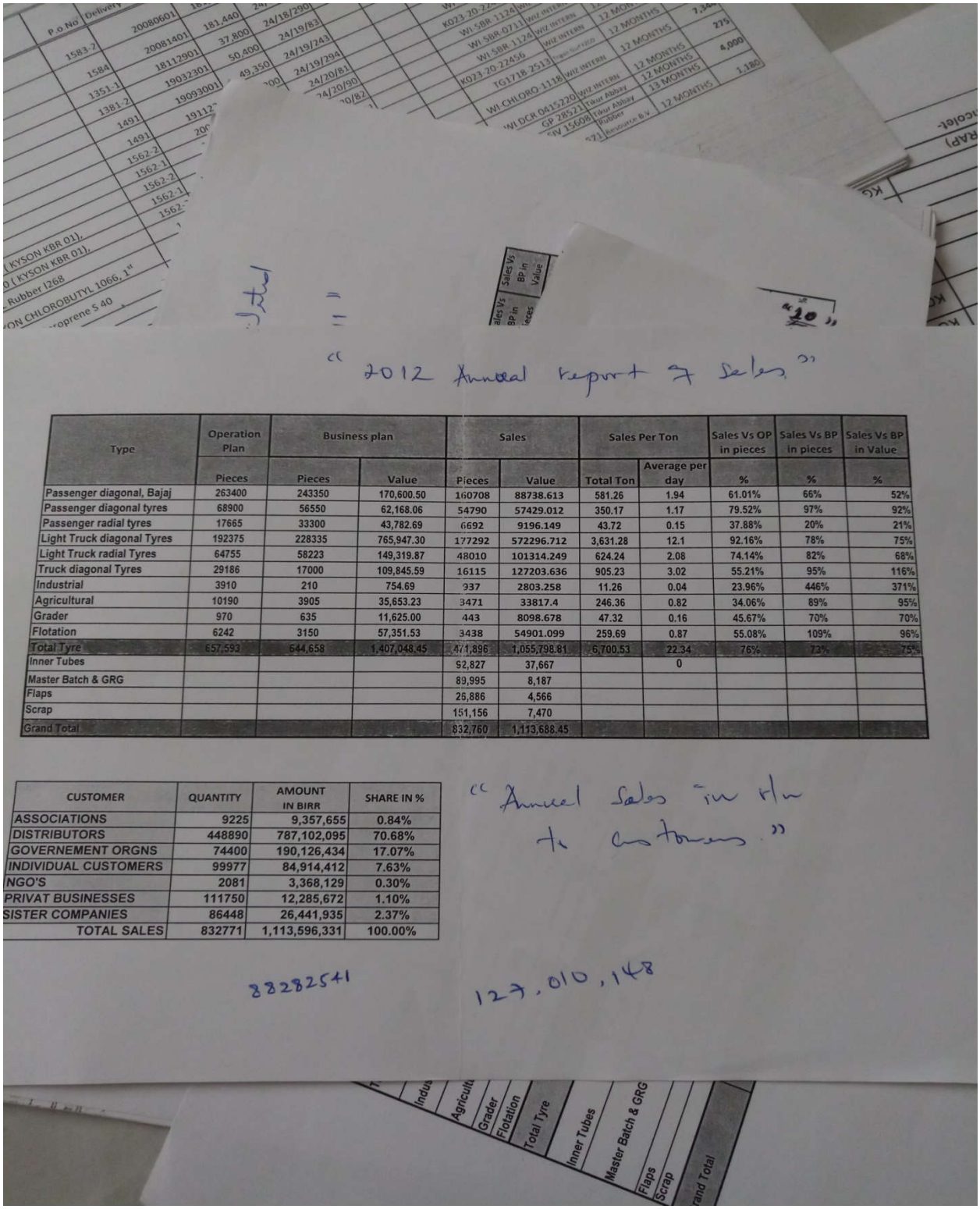
Steel cord from inputs

Failed machinery parts and appliances

Appendix - B Documentation samples



Company catalogue sample



"2012 Annual report of Sales"

Type	Operation Plan	Business plan		Sales		Sales Per Ton		Sales Vs OP in pieces	Sales Vs BP in pieces	Sales Vs BP in Value
	Pieces	Pieces	Value	Pieces	Value	Total Ton	Average per day	%	%	%
Passenger diagonal, Bajaj	263400	243350	170,600.50	160708	88738.613	581.26	1.94	61.01%	66%	52%
Passenger diagonal tyres	68900	56550	62,168.06	54790	57429.012	350.17	1.17	79.52%	97%	92%
Passenger radial tyres	17665	33300	43,782.69	6692	9196.149	43.72	0.15	37.88%	20%	21%
Light Truck diagonal Tyres	192375	228335	765,947.30	177292	572296.712	3,631.28	12.1	92.16%	78%	75%
Light Truck radial Tyres	64755	58223	149,319.87	48010	101314.249	624.24	2.08	74.14%	82%	68%
Truck diagonal Tyres	29186	17000	109,845.59	16115	127203.636	905.23	3.02	55.21%	95%	116%
Industrial	3910	210	754.69	937	2803.258	11.26	0.04	23.96%	446%	371%
Agricultural	10190	3905	35,653.23	3471	33817.4	246.36	0.82	34.06%	89%	95%
Grader	970	635	11,625.00	443	8098.678	47.32	0.16	45.67%	70%	70%
Flotation	6242	3150	57,351.53	3438	54901.099	259.69	0.87	55.08%	109%	96%
Total Tyre	657,593	644,658	1,407,048.45	471,896	1,055,798.81	6,700.53	22.34	76%	73%	75%
Inner Tubes				92,827	37,667		0			
Master Batch & GRG				89,995	8,187					
Flaps				25,886	4,566					
Scrap				151,156	7,470					
Grand Total				832,760	1,113,688.45					

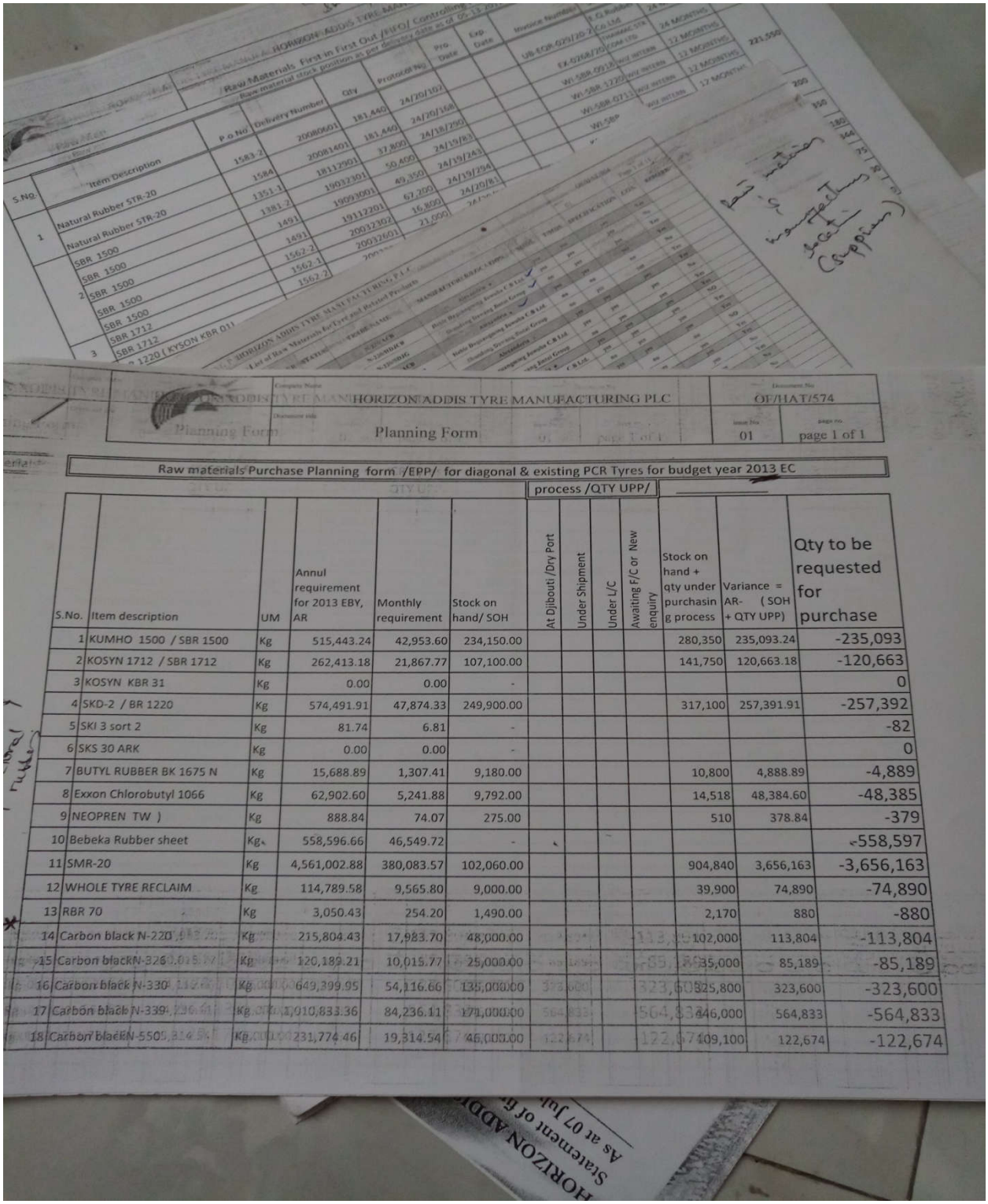
CUSTOMER	QUANTITY	AMOUNT IN BIRR	SHARE IN %
ASSOCIATIONS	9225	9,357,655	0.84%
DISTRIBUTORS	448890	787,102,095	70.68%
GOVERNEMENT ORGNS	74400	190,126,434	17.07%
INDIVIDUAL CUSTOMERS	99977	84,914,412	7.63%
NGO'S	2081	3,368,129	0.30%
PRIVAT BUSINESSES	111750	12,285,672	1.10%
SISTER COMPANIES	86448	26,441,935	2.37%
TOTAL SALES	832771	1,113,596,331	100.00%

"Annual Sales in Birr to customers"

88282541

127,010,148

Annual sales report sample



HORIZON ADDIS TYRE MANUFACTURING PLC

Planning Form

OT/HAT/574

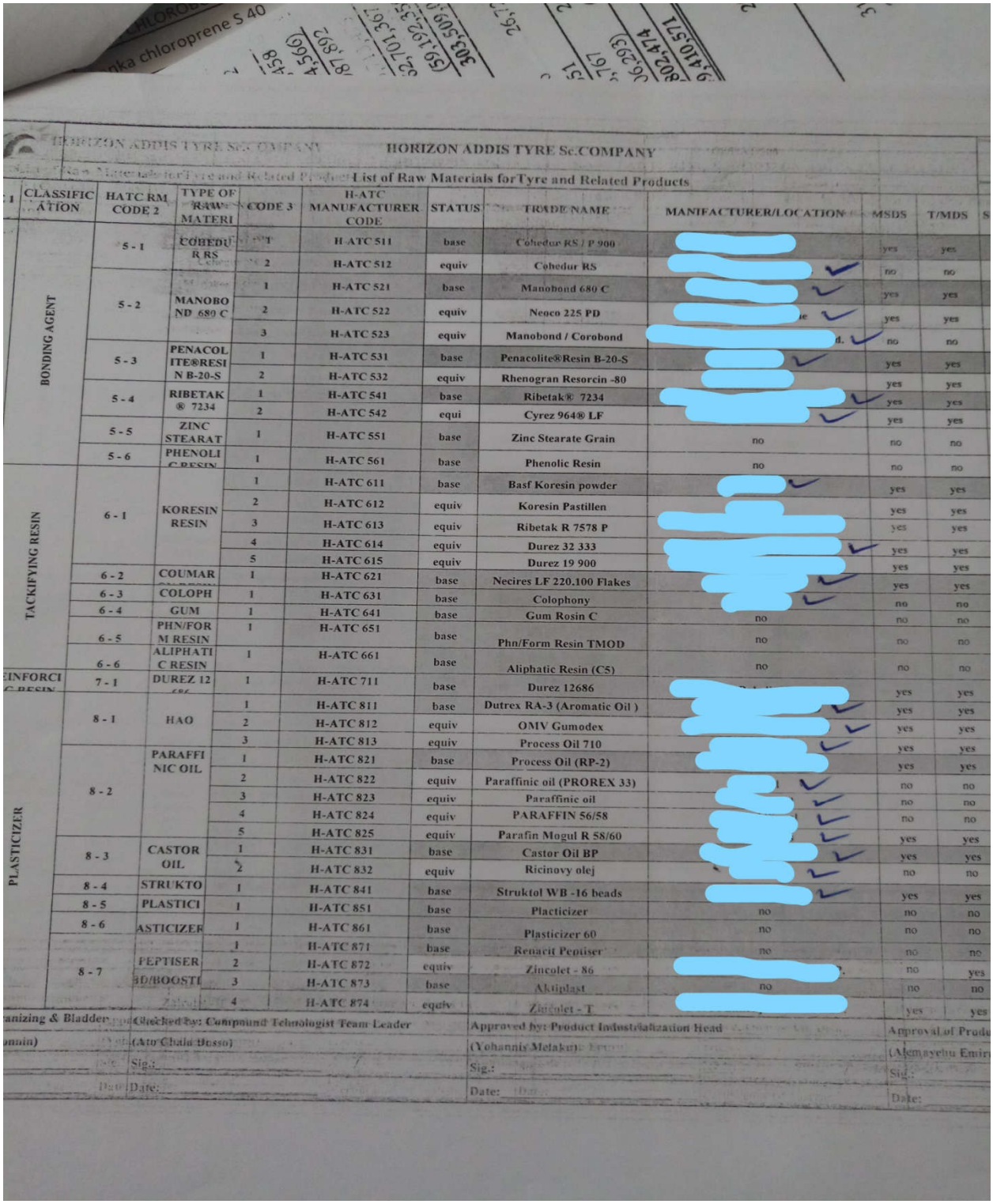
01

page 1 of 1

Raw materials Purchase Planning form /EPP/ for diagonal & existing PCR Tyres for budget year 2013 EC

S.No.	Item description	UM	Annul requirement for 2013 EBY, AR	Monthly requirement	Stock on hand/ SOH	process /QTY UPP/ At Djibouti /Dry Port	Under Shipment	Under L/C	Awaiting F/C or New enquiry	Stock on hand + qty under purchasing process	Variance = AR- (SOH + QTY UPP)	Qty to be requested for purchase
1	KUMHO 1500 / SBR 1500	Kg	515,443.24	42,953.60	234,150.00					280,350	235,093.24	-235,093
2	KOSYN 1712 / SBR 1712	Kg	262,413.18	21,867.77	107,100.00					141,750	120,663.18	-120,663
3	KOSYN KBR 31	Kg	0.00	0.00	-							0
4	SKD-2 / BR 1220	Kg	574,491.91	47,874.33	249,900.00					317,100	257,391.91	-257,392
5	SKI 3 sort 2	Kg	81.74	6.81	-							-82
6	SKS 30 ARK	Kg	0.00	0.00	-							0
7	BUTYL RUBBER BK 1675 N	Kg	15,688.89	1,307.41	9,180.00					10,800	4,888.89	-4,889
8	Exxon Chlorobutyl 1066	Kg	62,902.60	5,241.88	9,792.00					14,518	48,384.60	-48,385
9	NEOPREN TW)	Kg	888.84	74.07	275.00					510	378.84	-379
10	Bebeka Rubber sheet	Kg	558,596.66	46,549.72	-							-558,597
11	SMR-20	Kg	4,561,002.88	380,083.57	102,060.00					904,840	3,656,163	-3,656,163
12	WHOLE TYRE RECLAIM	Kg	114,789.58	9,565.80	9,000.00					39,900	74,890	-74,890
13	RBR 70	Kg	3,050.43	254.20	1,490.00					2,170	880	-880
14	Carbon black N-220	Kg	215,804.43	17,983.70	48,000.00					102,000	113,804	-113,804
15	Carbon blackN-326	Kg	120,189.21	10,015.77	25,000.00					35,000	85,189	-85,189
16	Carbon black N-330	Kg	649,399.95	54,116.66	135,000.00					325,800	323,600	-323,600
17	Carbon black N-339	Kg	1,010,833.36	84,236.11	171,000.00					446,000	564,833	-564,833
18	Carbon blaeN-550	Kg	231,774.46	19,314.54	46,000.00					109,100	122,674	-122,674

Raw material purchase plan sample



HORIZON ADDIS TYRE Sc.COMPANY

List of Raw Materials for Tyre and Related Products

	CLASSIFICATION	HATC RM CODE 2	TYPE OF RAW MATERI	CODE 3	H-ATC MANUFACTURER CODE	STATUS	TRADE NAME	MANUFACTURER/LOCATION	MSDS	T/MDS
	BONDING AGENT	5 - 1	COBEDU R RS	1	H-ATC 511	base	Cohedur RS / P 900		yes	yes
				2	H-ATC 512	equiv	Cohedur RS		no	no
		5 - 2	MANOBO ND 680 C	1	H-ATC 521	base	Manobond 680 C		yes	yes
				2	H-ATC 522	equiv	Neoco 225 PD		yes	yes
				3	H-ATC 523	equiv	Manobond / Corobond		no	no
		5 - 3	PENACOL ITE®RESI N B-20-S	1	H-ATC 531	base	Penacolite®Resin B-20-S		yes	yes
				2	H-ATC 532	equiv	Rhenogran Resorcin -80		yes	yes
		5 - 4	RIBETAK ® 7234	1	H-ATC 541	base	Ribetak® 7234		yes	yes
				2	H-ATC 542	equi	Cyrez 964® LF		yes	yes
		5 - 5	ZINC STEARAT	1	H-ATC 551	base	Zinc Stearate Grain	no	no	no
		5 - 6	PHENOLI C RESIN	1	H-ATC 561	base	Phenolic Resin	no	no	no
	TACKIFYING RESIN	6 - 1	KORESIN RESIN	1	H-ATC 611	base	Basf Koresin powder		yes	yes
				2	H-ATC 612	equiv	Koresin Pastillen		yes	yes
				3	H-ATC 613	equiv	Ribetak R 7578 P		yes	yes
				4	H-ATC 614	equiv	Durez 32 333		yes	yes
				5	H-ATC 615	equiv	Durez 19 900		yes	yes
		6 - 2	COUMAR	1	H-ATC 621	base	Necires LF 220.100 Flakes		yes	yes
		6 - 3	COLOPH	1	H-ATC 631	base	Colophony		no	no
		6 - 4	GUM	1	H-ATC 641	base	Gum Rosin C	no	no	no
		6 - 5	PHN/FOR M RESIN	1	H-ATC 651	base	Phn/Form Resin TMOD	no	no	no
		6 - 6	ALIPHATI C RESIN	1	H-ATC 661	base	Aliphatic Resin (C5)	no	no	no
	EINFORCI	7 - 1	DUREZ 12	1	H-ATC 711	base	Durez 12686		yes	yes
	PLASTICIZER	8 - 1	HAO	1	H-ATC 811	base	Dutrex RA-3 (Aromatic Oil)		yes	yes
				2	H-ATC 812	equiv	OMV Gumodex		yes	yes
				3	H-ATC 813	equiv	Process Oil 710		yes	yes
		8 - 2	PARAFFI NIC OIL	1	H-ATC 821	base	Process Oil (RP-2)		yes	yes
				2	H-ATC 822	equiv	Paraffinic oil (PROREX 33)		no	no
				3	H-ATC 823	equiv	Paraffinic oil		no	no
				4	H-ATC 824	equiv	PARAFFIN 56/58		no	no
				5	H-ATC 825	equiv	Parafin Mogul R 58/60		yes	yes
		8 - 3	CASTOR OIL	1	H-ATC 831	base	Castor Oil BP		yes	yes
				2	H-ATC 832	equiv	Ricinovy olej		no	no
		8 - 4	STRUKTO	1	H-ATC 841	base	Struktol WB -16 beads		yes	yes
		8 - 5	PLASTICI	1	H-ATC 851	base	Placticizer	no	no	no
		8 - 6	ASTICIZER	1	H-ATC 861	base	Plasticizer 60	no	no	no
		8 - 7	PEPTISER	1	H-ATC 871	base	Renacit Peptiser	no	no	no
				2	H-ATC 872	equiv	Zincolet - 86		no	yes
			3D/BOOSTI	3	H-ATC 873	base	Aktiplast	no	no	no
				4	H-ATC 874	equiv	Zincolet - T		yes	yes

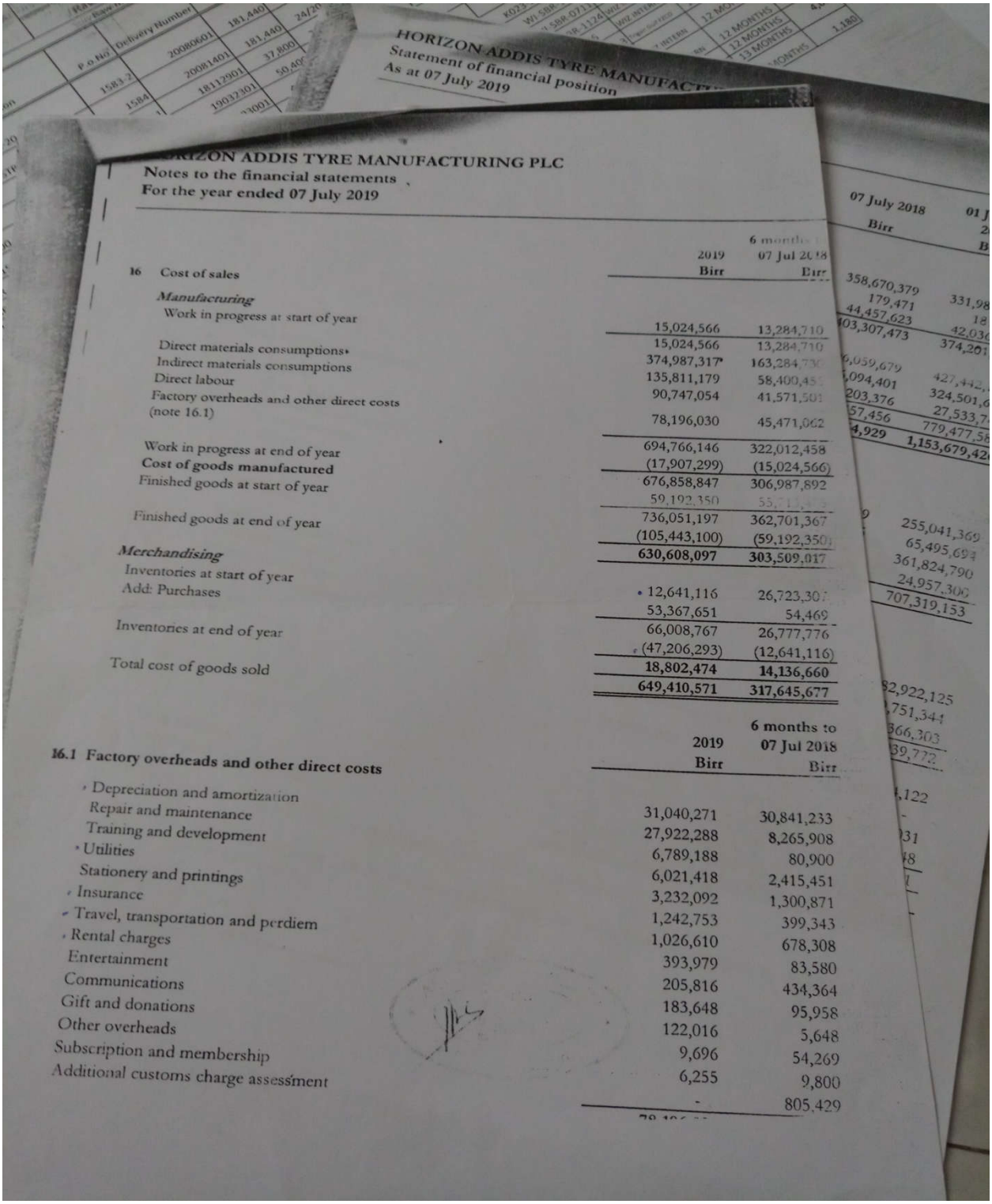
anizing & Bladder — Checked by: Compound Tehnologist Team Leader — Approved by: Product Industrialization Head — Approval of Produ

(Ato Chala Bosso) — (Yohannis Melaku) — (Alemayehu Emir

Sig.: — Sig.: — Sig.:

Date: — Date: — Date:

List of raw materials and related products sample



HORIZON ADDIS TYRE MANUFACTURING PLC
Statement of financial position
As at 07 July 2019

HORIZON ADDIS TYRE MANUFACTURING PLC
Notes to the financial statements
For the year ended 07 July 2019

16 Cost of sales	2019 Birr	6 months 07 Jul 2018 Birr
Manufacturing		
Work in progress at start of year	15,024,566	13,284,710
	15,024,566	13,284,710
Direct materials consumptions	374,987,317	163,284,730
Indirect materials consumptions	135,811,179	58,400,453
Direct labour	90,747,054	41,571,501
Factory overheads and other direct costs (note 16.1)	78,196,030	45,471,062
	694,766,146	322,012,458
Work in progress at end of year	(17,907,299)	(15,024,566)
Cost of goods manufactured	676,858,847	306,987,892
Finished goods at start of year	59,192,350	55,713,475
Finished goods at end of year	736,051,197	362,701,367
	(105,443,100)	(59,192,350)
Merchandising	**630,608,097**	**303,509,017**
Inventories at start of year	12,641,116	26,723,307
Add: Purchases	53,367,651	54,469
	66,008,767	26,777,776
Inventories at end of year	(47,206,293)	(12,641,116)
Total cost of goods sold	**18,802,474**	**14,136,660**
	649,410,571	**317,645,677**

16.1 Factory overheads and other direct costs	2019 Birr	6 months to 07 Jul 2018 Birr
Depreciation and amortization	31,040,271	30,841,233
Repair and maintenance	27,922,288	8,265,908
Training and development	6,789,188	80,900
Utilities	6,021,418	2,415,451
Stationery and printings	3,232,092	1,300,871
Insurance	1,242,753	399,343
Travel, transportation and perdiem	1,026,610	678,308
Rental charges	393,979	83,580
Entertainment	205,816	434,364
Communications	183,648	95,958
Gift and donations	122,016	5,648
Other overheads	9,696	54,269
Subscription and membership	6,255	9,800
Additional customs charge assessment	-	805,429

Financial statement sample

Appendix-C Calculations

Gathered performance data from company's annual reports (purchasing, finance, human resource, production)

Performance data	2011	2012
Accounts payable	155,190,749	417,756,274
Total cost of goods sold	317,645,677	649,410,571
Total asset	1,144,664,929	1,423,567,522
Total liabilities	398,287,764	559,850,141
Total gross annual sales	1,008,041,701	1,113,596,331
Total revenue	1,008,041,701	1,113,596,331
Total credit sales	494,954,646	531,725,175
Accounts receivable	306,094,401	367,953,821
Average inventories	19,682,211	29,923,704
Total cost of warranty	20,160,441	22,271,365
Annual material purchase	222,650,269	273,500,095
Production capacity	800,000pcs	1,000,000pcs
Actual production	447,863pcs	489,514pcs
Total employment (in FTEs)	777	800
Inventory carrying costs	4,920,552	7,480,926
Travel and transportation costs	678,308	1,026,610
Other materials handling costs	39,107,141	58,962,559
Number of orders delivered	282	361
Number of orders delivered in full and in time	215	304
Number of order received	407	435
Number of orders filled from stock	204	265
Number of orders filled in 24 hrs from stock	115	203
Actual lead time for all orders shipped(days)	431	463
Source cycle time(days)	90	90

Finance cost	57,051,336	238,028,441
Orders with faulty documentations	0	0
Orders with shipping damage	0	0
Order fulfillment lead time(days)	3	3

Performance Calculations

Delivery performance

$$\frac{Number\ of\ orders\ delivered\ on\ time\ and\ in\ full}{Total\ number\ of\ orders\ received} = \frac{215}{407} = \underline{\mathbf{0.53}} \quad (2011)$$

$$= \frac{304}{435} = \underline{\mathbf{0.6988}} \quad (2012)$$

Fill rate

$$\frac{number\ of\ orders\ filled\ from\ stock\ shipped\ with\ in\ 24hrs\ of\ order\ receipt}{total\ number\ of\ stock\ orders}$$

$$= \frac{115}{204} = \underline{\mathbf{0.56}} \quad (2011)$$

$$= \frac{203}{265} = \underline{\mathbf{0.766}} \quad (2012)$$

Order fulfillment lead time

$$\frac{sum\ actual\ lead\ times\ for\ all\ orders\ shipped}{total\ number\ of\ orders\ shipped} = \frac{431}{282} = \underline{\mathbf{1.52}} \quad (2011)$$

$$= \frac{463}{361} = \underline{\mathbf{1.28}} \quad (2012)$$

Perfect order fulfillment

$$\frac{total\ orders\ shipped\ ontime\ and\ in\ full - orders\ with\ faulty\ documentation - orders\ with\ shipping\ damage}{total\ number\ of\ orders\ received}$$

$$= \frac{215 - 0 - 0}{407} = \underline{\mathbf{0.53}} \quad (2011)$$

$$= \frac{304 - 0 - 0}{435} = \underline{\mathbf{0.6988}} \quad (2012)$$

Total supply chain management cost

$$\frac{sum\ of\ supply\ chain\ related\ costs}{total\ revenue} = \frac{222{,}650{,}269 + 4{,}920{,}552 + 57{,}051{,}336 + 39{,}107{,}141 + 678{,}308}{1{,}008{,}041{,}701}$$

$$= \underline{\mathbf{0.32}} \qquad (2011)$$

$$= \frac{273{,}500{,}095 + 7{,}480{,}926 + 238{,}028{,}441 + 58{,}962{,}559 + 1{,}026{,}610}{1{,}113{,}596{,}331}$$

$$= \underline{\mathbf{0.519}} \qquad (2012)$$

Value-added productivity cost

$$\frac{total\ gross\ annual\ sales - total\ annual\ material\ purchases}{total\ employment\ (in\ FTE)}$$

$$= \frac{1{,}008{,}041{,}701 - 222{,}650{,}296}{777} = \quad \underline{\mathbf{1{,}010{,}799.75}}$$

(2011)

$$= \frac{1{,}113{,}596{,}331 - 273{,}500{,}095}{800} = \quad \underline{\mathbf{1{,}050{,}120.75}}$$

(2012)

Warranty/return processing cost

$$\frac{total\ cost\ for\ warranty}{total\ revenue} = \frac{20{,}160{,}441}{1{,}008{,}041{,}701} = \underline{\mathbf{0.02}} \qquad (2011)$$

$$= \frac{22{,}271{,}365}{1{,}113{,}596{,}331} = \underline{\mathbf{0.02}} \qquad (2012)$$

Supply chain response time

Order fulfillment lead time + source cycle time

$$= (3 + 90) = \underline{\mathbf{93}} \qquad (2011/12)$$

Inventory days of supply

$$\frac{average\ inventory}{Cost\ of\ goods\ sold(COGs)/365} = \frac{19{,}682{,}211}{(317{,}645{,}677/365)} = \underline{\mathbf{22.60}} \qquad (2011)$$

$$= \frac{29,923,704}{(649,410,571/365)} = \underline{\mathbf{16.82}} \quad (2012)$$

Cash-to-cash cycle time

Inventory days of supply + days of sales outstanding – days of payables outstanding

= *Inventory days of supply* + $(\frac{accounts\ receivables}{total\ credit\ sales} - \frac{accounts\ payables}{COGs})$ x number of days

= 22.60 + $(\frac{306,094,401}{494,954,646} - \frac{155,190,749}{317,645,677})$ x 365 = **70**

(2011)

= 16.82 + $(\frac{367,953,821}{531,725,175} - \frac{417,756,274}{649,410,571})$ x 365 = **34.6**

(2012)

Asset turns

$$\frac{total\ gross\ annual\ sales}{total\ net\ asset} = \frac{1,008,041,701}{1,144,664,929} = \underline{\mathbf{0.88}} \quad (2011)$$

$$= \frac{1,113,596,331}{1,423,567,522} = \underline{\mathbf{0.78}} \quad (2012)$$

Appendix-D Key informant interview

HAWASSA UNIVERSITY

HAWASSA INSTITUTE OF TECHNOLOGY

FACULTY OF MANUFACTURING

DEPARTMENT OF INDUSTRIAL ENGINEERING

Masters program in Industrial engineering and logistics management

DESIGNING GREEN SUPPLY CHAIN MANAGEMENT SYSTEM FOR HORIZON ADDIS TIRE MANUFACTURING PLC

Interview Guide for managers, vice managers, department heads and logistic officers

Dear interviewee,

The purpose of this interview is to collect information and data on the study titled on designing green supply chain management system for Horizon Addis tire manufacturing PLC. Therefore, your cooperation in providing answers and explanations is valuable for the study. Since the success of this study depends upon your genuine responses, kindly provide objective and honest views and observations for all items included in this interview. And the data to be collected in this interview is only for the purpose of this thesis.

Part I. Interviewee Personal Information

1. Sex: Male _____ Female_____
2. Qualification (BA, BSc, MA, MSc, etc.); _____
3. Area of Specialization _____
4. Work position _____

Open-ended Questions

1. How is the product variety in HATMPLC?

   _____

   _____

   _____

2. What supplies do you get from abroad for the company's production and/or any other processes?

   _____

   _____

   _____

3. In what criterion do the HATMPLC purchase its raw materials?

   _____

   _____

   _____

4. How can you express the resource usage in your company and wastages through the stages from input usage, production and packaging processes?

   _____

   _____

   _____

5. What types of distribution channels has involved in HATMPLC?

   _____

   _____

   _____

6. Does HATMPLC have return policy?

   If yes, how does it work?

   _____

   _____

   If No, Why?

   _____

   _____

7. Does your company consider an environmental management system throughout its supply chain?

   If yes, explain how

   _____

   _____

   If No, why?

   _____

   _____

8. How is the company disposing wastes? And how can you describe their effects in the environment?

   _____

   _____

   _____

9. How do you explain about CO2 emission in HATMPLC's manufacturing process

   _____

   _____

   _____

10. How is the overall HATMPLC's performance in consideration with procurement, production, distribution and return?

    _____

    _____

    _____

Thanks for your participation!

Thank you very much for finding the time to participate in my interview. The results will be kept confidential and will only be used for this master thesis, as mentioned in the beginning.

Have a good day.

Appendix-E Key informant interview responses

1) How is the product variety in HATMPLC?
   - The company is tire manufacturing company, and for further check on the types of tires the company produce you can use the company's product catalogue (Production plant manager)
2) What supplies do you get from abroad for the company's production and/or any other processes?
   - Five or six years earlier the company had imported every single inputs from abroad and currently the natural rubber from Jimma is a country made product used in the manufacturing plant, even though all the natural rubber used in the plant is not country made.(Production plant manager, production manager, Purchase department head)
3) In what criterion do the HATMPLC purchase its raw materials?
   - Purchase requisition comes in any time randomly from inventory managers or the production department containing all the requirements of needed raw materials and even if requisition doesn't get to our department the company by itself has a schedule of three month sourcing cycle time which depends on getting the foreign currency and its conversion rate. So our department selects base or its equivalent in cost effective manner. (Purchase department manager)
4) How can you express the resource usage in your company and wastages through the stages from input usage, production and packaging processes?
   - The company uses Kaizen (Continuous Improvement) strategy for improvements to the manufacturing process and the company has gained advantage by applying this strategy in product waste management. A daily report of waste tyre or scrap and input product wastes enters to the production department. And reports fluctuate from day to day; it is hard to tell the waste management level without looking it in annual basis. (Production department manager, Production plant manager)
5) What types of distribution channels has involved in HATMPLC?
   - HATMPLC sales its product for distributors, associations, governmental and non-governmental organizations, and individuals. And we have distribution centers those

work by commission so products are delivered by their request. Order receipt enters every single day from those customers and the company tries to fulfill the need of them (Marketing department sales manager)

6) Does HATMPLC have return policy?

- Yes and No, we have already set conditions to returning product defects back in to the company that needs an approval of company's quality experts on what its cause is. But the company does not have other return policy to its waste tire. For the why not, why would the company add another burden while trying to increase its expertise and market place share? (Marketing department head, Sales manager, Production plant manager)

7) Does your company consider an environmental management system throughout its supply chain?

- Yes, the company applies the ISO 14001 regulations for environmental management and each process considers this regulation. (Production plant manager, Production department manager)

8) How is the company disposing wastes? And how can you describe their effects in the environment?

- Wastes generated from the company are sold in bids even though not all of the wastes are sold in bid. Because of different companies bid the waste variety for different purpose it would be not clear where wastes of the company might harm the natural environment. (Production manager, production plant manager)

9) How do you explain about CO2 emission in HATMPLC's manufacturing process

- In consideration with greenhouse gas emission, there is no chemical reaction with a result of carbon dioxide because there is no combustion in the process. The company has no environmental harm. (Production manager)

10) How is the overall HATMPLC's performance in consideration with procurement, production, distribution and return?

- A better performance won't just appear suddenly for such huge companies. When you see the history of HATMPLC, previously the company had lower production capacity, lower product demand and tire varieties, but through time the company is increasing its performance in every processes of its supply chain; there is no single tire returned

throughout the occupation period of more than 6 years, increased sales, capacity utilization and productivity, even though it hasn't been reached to the performance extent the company needs to have. (Production plant manager, Marketing department manager, sales manager, distribution center managers, production department manager)