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School of Mechanical & Industrial engineering

Developing a Product Quality Standard Framework for Local Midi Bus
Fabrication Sector: A Case of Ada Bus Assembling and Metal Engineering

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Declaration

I hereby declare that the work which is being presented in this thesis entitled **“Developing a Product Quality Standard Framework for local Midi Bus Fabrication Sector. A Case of: Ada Bus Assembling and Metal Engineering”** is original work of my own, has not been presented for a degree of any other university and all the resource of materials used for this thesis have been duly acknowledge

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ABSTRACT

Ensuring product quality standards based on national standards is the top priority of the automotive fabrication industry, as it plays a significant role in solving passengers' or users' needs and requests, which is the ultimate objective of all local midibus public transport fabricators' efforts. This study delves into the aspect of product quality standards related to national standards, considering its four dimensions to study the influence of product quality standards on passenger travel in the local midi bus fabrication sector. In Ethiopia, every year, hundreds of local developers are fabricating or building local midi buses, but the complaints of passengers and users have not been addressed. Local midi bus fabrication process quality standards, safety and comfort quality standards, anthropometry and ergonomics quality standards, and quality standards of engineering input are very serious among passengers and users. The authors did mention in their writings that passengers and users are making complaints about the local Midi bus being built in the area. The basis of the complaint is the lack of safety and comfort for the passengers and users, ergonomic and anthropometric quality standard problems, the poor quality standard of the materials used, and the poor quality standard of the fabrication process. This study attempts to fill the gap by focusing on the development of a model and then the extraction of a framework for product quality standards for local midi bus fabrication. The purpose of this study is to explore the current situation of safety and comfort, ergonomics and anthropometry, materials, and fabrication processes in the product quality standard between the automotive fabrication sectors related to the Ethiopian standard, identify the gap in property, attribute, and national technical committee, and develop a product quality standard framework. The specific objectives were to determine, analyze, and identify the existing practice of standard development, identify the reasons why the existing standard development team framework is not doing well, and develop a product quality standard framework for the local midi bus fabrication sector practice. This study adopted concepts of standard and standardization, passenger compliance, product standard development strategy, and product quality standard practice in the sector. An explanatory research design was used. The target population consisted of whole respondents from the local bus body construction company and the remaining respective members from the national-level institution, the electromechanical standard development group, who responded to conduct a SWOT analysis to identify the current state of the institution. The sample size was taken from all respondents in the company's case. Questionnaires, interviews, and observation were the data collection instruments. Supervisors served as expert judges to establish the validity of the instruments. The collected data was analyzed using descriptive analysis and SWOT analysis, as well as with the aid of IBM SPSS Statistics 27 software. The local bus fabrication, safety and comfort, fabrication process, ergonomics and anthropometry, and engineering materials had a significant positive influence on the product quality standard of a local midi bus. However, the components, materials, and fabrication process used in the fabrication of local midi buses do not guarantee local midi bus product quality standards to meet national standards. The Institute of National Standards should be responsible for providing national standards to the local midi bus fabrication company that has a lower product quality standard. Domestic midi bus factories can develop a national standard using the developed model and the extracted framework. They should regularly send their employees to refresher workshops so that they understand Ethiopian standards and improve their skills. This study will help the local Midi Bus Innovation and Ethiopian Standards Institute develop product quality standards by involving stakeholders. In this way, using national standards, the local midi bus will become competitive in the neighboring country. By using the national standard, it will fulfill the demands of the passengers and users of the local midi bus.

Keyword: Local Midi Bus, metal Fabrication Process, Standard, Product Standardization, Road Vehicle, Standard Development.

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List of Abbreviation

ES	Ethiopia standard
ESA	Ethiopia standard agency
IES	Institute of Ethiopia standard
ISO	international organization for standardization
KPI	key performance indicator
MIDI	Metal Institute Development Institute
	MTETRDC Manufacturing Technology and Engineering Industry Research And Development Center
SPSS	Statistical Package for the Social Science
SWOT	Strengths, Weakness, Opportunities and Threats
TC	Technical committee

CHAPTER ONE

1 INTRODUCTION TO RESEARCH JUSTIFICATION

1.1 Introduction

In the previous three decades, the automotive fabrication sector has seen unparalleled changes, including dramatic shifts in management styles, product and process technology, passenger expectations, supplier attitudes, and competitive conduct (de la Rosa et al., 2017). Slow and steady advances in fabrication processes may not ensure an organization's long-term profitability or survival in today's fast-changing industry (Ikome et al., 2022). As a result, firms must advance product quality standards at a faster rate than their competitors if they want to become or remain market leaders (Lone & Bhat, 2023).

In recent years, automotive fabrication industry owners have been gradually moving to the idea that product quality standards can be a profit-generating function rather than merely a cost center. When it comes to issues such as reliability, availability, safety, comfort, quality, and cost-effectiveness levels of plant and local midi buses there is no doubt that the cost of national standards can be high and often represent a significant portion of recurrent budgets (Megiso, 2017a).

Standard (2017) stated that a local midi bus's internal and external effectiveness is strongly influenced by the national standard role and impact on passenger seat areas such as product quality standards, passenger environment, and amount of travel in progress. Many researchers have also discussed the importance of product quality standard in the context of its role in keeping and improving availability, performance efficiency, and product quality standard (Society of Automotive Engineers of Japan, 2021).

Local midi bus fabrication evolves rapidly (Mteirdc, 2019a). To keep up with the changing systems and national standards that the product quality standard strategy needs to be prepared, developed, approved, and reviewed periodically to advance fabrication efficiency continuously to be competitive. The standardization of construction materials is one influential factor in this (ESI, 2016).

Any automotive fabrication industry by itself has its own set of challenges. The bus and midi bus fabricators probably face more hurdles. Since they are fabricating local midi buses that passengers or users travel, there is a lack of product quality standards in these industries. Therefore, manufacturers of vehicles for public transport face several significant challenges, including

stringent government and international regulations and complex standards that are difficult to build and maintain (Wang, 2020).

Ada Bus Assembling and Metal Engineering is a case company in this research. The company is in the automotive fabrication line of business. Local fabricated Buses and Midi Buses are products of Ada Bus Assembling and Metal Engineering.

The company's data indicates that the average product quality standard performance of the last three years has not benefited. The main reason that hinders the company from achieving its goal is that it does not work together with National Standard Institute based on product quality standards while building a local midi bus.

- Important local midi bus quality standards can be approved by the Ethiopian Standards Institute, but the automotive fabricator is not able to use and meet the product quality standards. The vital standards development team and technical committees do not include standards. Basic product quality standards and other standards that can be prepared developed, and approved by the institute or coordinated and controlled by the standards are the things that comprise national standards.
- User and passenger complaints may be caused by ergonomics and anthropometry, lack of safety and comfort, lack of quality of construction materials, or operational problems. This also includes issues related to midi-bus/kitikit product quality standards, inadequate quality assurance team, and absence of commitment of product quality assurance staff, with standards included by the technical committee to achieve vehicle standards.

This shows that the firm has an issue with product quality standards. Other defects may occur in addition to international and national standards that are not harmonized, particularly when the local midi bus fabrications are pushed beyond their local midi bus fabrications boundaries or due to operational faults. As a result, concerns with ergonomics and anthropometry, safety and comfort, fabrication process losses, and construction material quality standard become clear results. All of these results, among other critical performance criteria, have the potential to have a detrimental influence on passenger safety and comfort, ergonomics and anthropometry, user satisfaction, and national standards.

To guarantee that the local midi bus functions in the appropriate condition while fulfilling its fabrication targets at the lowest possible standardization, national standard management must make deliberate judgments about the Product quality standard objectives and strategies to be

followed as a result, to boost the company's competitiveness, this research solves the local midi bus national standard problem by developing a new national product quality standard management framework

1.2 Background of the Study

Developed by the local automotive fabrication sector, Midi Buses are changing the landscape of the transport industry at the national level. In addition to national public transport standards, it is necessary to unify the product quality standard related to the standard of local Midi Bus. the Automotive Fabrication Sector (fabricate Midi bus) and the Institute of Ethiopia Standard should also actively set and develop product quality standards by accepting these changes and gaps. In addition, the local midi bus building and Institute of Ethiopia Standard should be actively identified gaps and improved through the International Standards Organization (ISO). In particular, Ethiopia is a member country of the International Organization of Standards (ISO) and has been actively involved in the automotive fabrication sector, establishing and working with the capacity authorized by the government to adopt, preparing, develop and approve national standards that are suitable for the country (ISO - Members, n.d.).

Ethiopia deserves to be a competitive country in automotive assembly and fabrication. But according to the competitive manufacturing and fabrication industry capacity, the corresponding product quality standards are set to compete with advanced countries like Europe, USA and Japan which have a strong technological base on modern equipment. Since 2003, however, a strategic response system has been developed at the government level involving the Ministry of Commerce, Industry and Energy, Ministry of Transport and Resource Production. Local fabricates Midi Bus common transport Passengers in Ethiopia, for example, locally fabricated Midi Bus from Isuzu NPR buses, locally named 'Kitkit'

was given by the community. The Transport Authority has announced that it has started introducing buses that accommodate up to 24 passengers (Jilcha et al., 2020b). They also stand as a testament to Ethiopian mechanical genius. "Kitkit" midi bus is a local fabrication taxi/midi bus that operates a fixed route road vehicle in the country (Ohno, 2019).

A midi bus is a type of public transport bus that is smaller than a full single-decker bus but larger than a minibus. With the rapid development of industrialization and globalization, the fabrication and market of the midi bus are growing (Infrastructure & Diagnostic, 2008). A domestic Midi Bus has a capacity of 25 seats including the driver and is 8 meters to 11 meters long. In addition, in the

country, a midi bus has more seats than a minibus and is more fuel efficient than a full-size single-decker bus. Again, urbanization and emerging suburbs have created a demand for midi buses. And midi buses are easy to manage in road transport due to their small size (Mobility & Cities, 2002). The importance of local midi buses fabricator products from certified sustainable sources has increased over the past three decades across developing countries, paralleling the demand and concern for international product quality standards for global sustainability issues (Issues et al., 2020). The Local Automotive fabricator sector that fabricates midi buses has a problem of fabrication processes standard, ergonomic standard and anthropometry data, safety and comfort standard and low quality of engineering materials. So, the midi bus product quality standard is prepared, developed and approved by concusses within an authorized body, and the Midi Bus company must operate using the developed and approved standards as a criterion (Claude, 2018). The standardization of customized automotive fabrication is part of the government's measures to facilitate recent global trade developments, particularly in the motor road vehicle industry, which is considered a significant contributor to the country's economic, productivity, investments, technology transfer and exports among others(Society of Automotive Engineers of Japan, 2021). Local Automotive fabrication companies should focus on fabrication process standards, ergonomics and anthropometry data (Megiso, 2017b), safety and comfort (Jilcha et al., 2020b) for local midi bus building materials (Ohno, 2019).These indicators have been mentioned by different writers at different times and in different ways. However, they did not focus well on product quality standards, especially at national standards. Therefore, if the automotive fabricator focuses on the product quality standard, it can be competitive at the international and national level, can be reducing complaints by meeting the needs of the passengers, in addition, it can motivate the national standard institute for the preparation and development of the for local midi bus product quality standard.

It is important to develop a framework involving the local midi bus fabricator factory to help the local automotive fabrication factory, the Ethiopian Standards Institute and other relevant bodies to establish and approve the product quality standards. Therefore, settings standards for the midi bus fabricator sector especially for local fabricate of midi bus was a significant impact on economic and public transport sectors as well. This study was based on the concept of standard and standardization to assess and identify the local midi bus standard development gap of Ada Bus

Assembly and Metal Engineering Factory and the standards development conceptual framework involving the fabricator.

Most of the methods that have standardized other sectors on products that have completed product development in the past have extensive experience in product quality standards. Product quality standards are being applied in other sectors due to the importance of standards. In the same context, a type of ISO standard development 'top-down method' has been carried out in the past, which can first meet the regulations of the Minister of Road Vehicle Transport. However, despite early initiatives for ISO standard development and "a reference to ISO standards" for specific agendas in road vehicle regulations there is no initiative for the automotive fabricator (local Midi Bus) sector(Society of Automotive Engineers of Japan, 2021).

Finally, the main objective of this research is to assess and identify the relationship gap between the local Midi Bus fabricator and the Ethiopian Standard Institute and prepare the way how to set standards by developing a framework that helps to prepare, develop and approve the local midi bus product quality standard.

1.3 Statement of the Problem

In the past ten years, the “product quality standard” has become an increasingly important requirement segment of the local automotive fabrication sectors. Local midi buses are now more likely to engage in public transport arrangements (road vehicles) than in the past (Mteirdc, 2019). Research on the reasons for and consequences of this shift has focused on objective measures of ergonomics and anthropometry (Megiso, 2017),, safety and comfort (Jilcha et al., 2020), engineering materials, and fabrication processes (Tetteh et al., 2017). However, there has been little work exploring local midi buses’ subjective experiences of the development of product quality standards.

According to the literature, the local fabricated midi bus, especially the automotive fabrication sector of the local midi bus, has various product quality standard-related problems. Midi-bus passengers, locally known as 'kitkit', are experiencing discomfort, fatigue, stress, and health-related issues, especially long- and short-distance passengers (Jilcha et al., 2020a). Builders pay less attention to passenger ergonomics and anthropometry, safety and comfort, fabrication processes, and engineering materials (Ohno, 2019). As they do not provide adoptions for eco-motivation, requirements should be very low. The local midi bus differences in structure-related

passenger seat arrangement and passenger anthropometric measurements were observed (Addisu& Koricho, 2022).

The company's midi bus fabrication faces a persistent issue with product quality standards, despite passenger feedback. The company specializes in the fabrication of local midi buses, but it doesn't focus on safety, comfort, ergonomics, engineering materials and fabrication processes, or adherence to international and national standards. A comprehensive study is needed to understand why factory workers don't prioritize these standards and identify any international or national standards that may hinder their implementation. The research paper will use various methods to compare the company's product quality standards with those of the National Standard Institute, aiming to develop a framework for achieving national standards.

This research aims to better understand why the established national standard institute does not set product quality standards to develop for the automotive fabrication sector. In local Midi buses, qualitative and quantitative methods such as surveys, visits, and interviews were conducted to assess and identify the opinions of experts with long experience in the case company, and they should stay with those who are interested in issuing national standards and have repeatedly requested product quality standards.

1.4 Research Questions

- What is the existing practice of local midi bus product quality standard development for local midi bus?
- What are the reasons why the existing product quality standard development framework is not doing well?
- How to develop a product quality standard framework for the local midi bus product?

1.5 Objectives

1.5.1 General objectives

The general objective of this study is to assess the status of product quality standard local midi bus in Ada bus assembly and metal engineering through national standards and to develop a framework to assist in setting product quality standards.

1.5.2 Specific objectives

- To analyze the existing practice of standard development local Midi Bus fabrication
- To identify the reasons of why the existing standard development team framework is not doing well
- To develop a product quality standard framework for the local midi bus fabrication sector

1.6 Scope and limitation of the study

1.6.1 Scope of the Study

This study focused on the relationship between Ada Bus Assembly and the Metal Engineering sector related to product quality standards by the Institute of Ethiopia standards. The fabrication of local midi bus status in ergonomics standard and anthropometry data, safety and comfort standard, engineering materials standard, and fabrication process standard are the aspects considered in the Ethiopia standard. It's just a matter of focusing on the locally approved product quality standard and the local midi bus fabricator's community gives the name 'kitkit" use of the specification.

1.6.2 Limitation of the study

During the study, the researcher encountered some problems that could be limited. The main limitation of the Ethiopian Standard Institute was that it took time to find the director, department leaders, supervisors, and experts due to the restructuring and supervisor reform. Lack of experience in research related to the road vehicle, especially the automotive fabrication sector related to product quality standards and road vehicle fabrication sector and related practical research work has faced a challenge. In addition, regarding the research method, this study mainly uses questionnaires, interviews, discussions, and field and document surveys as primary and secondary data. Still, the researcher is limited to using other methods such as focus group discussions due to restructuring and reform. Therefore, the limitations of using different methods can affect the reliability and validity of the study. However, overcoming all the limitations, the researcher did his best to make the study successful and achieve the goal.

1.7 Significance of the study

Determining the importance of international automotive fabrication standards in the context of Ethiopian local midi bus building interest is not as easy because developed nations and developing nations, like Ethiopia, differ in fabrication technology processes and national standards.

To satisfy the international standard, many road vehicle standards ought to be implemented. The issue of local midi bus product quality standards and understanding of national norms is not the only thing dividing developed and developing countries; there is also a significant issue with developing countries' product quality standards. Countries like Ethiopia lack local midi bus product standards, despite the strong desire to develop new local midi bus product quality standards and learn the necessary national knowledge

In this study, the indicators that describe the standard of product quality, which are examined, selected, and divided into four categories, are related to international and national standards. In terms of developing, preparing, and approving the product quality standard of these indicators, it was necessary to identify the gaps in the existing framework and develop a new automotive fabrication product quality standard. This study aims to develop a model and extract a framework for these product quality indicators for the local midi bus fabrication sector to help them understand which method is more suitable and useful for them.

In particular, this study is useful for the automotive fabrication sector to determine which product quality standards should be prepared and developed. In the long term, the automotive manufacturing sector may consider indicators for product quality standards to evaluate the results of this research.

The study contributes to the ongoing research study on different fabrications used in the automotive fabrication industry to make it more competitive in terms of product quality standards. This research uses a developed framework by combining the generic quality model and national standards as well as the fabrication process. The research has motivated national standards to develop the product quality standard of the local midi fabrication which can be easily implemented in an existing system.

Also included in this study are domestic midi bus product quality standard indicators. The detailed description of the association and development from the national standard can be used as a starting point for further studies to determine the standard of product quality in the automotive fabrication industry and to plan a development pathway at the national standard.

1.8 Organization of the paper

The Organization of this study is classified into different chapters, as follows: Chapter One: Background and Introduction: This section provides a background of the topic researched during the study. The main idea of this chapter is to explain the background of the problem, the objectives and the contribution made by this research study.

Chapter Two: Literature Review: This chapter provided information about the main subjects of local Midi bus product quality standards to provide this practical suggestions and recommendations to upgrade the knowledge of national standard development in the automotive fabrication industry at the case company, Ada Bus Assembling and Metal Engineering Factory and drew research gaps that fill the gap in the body of knowledge for the research topic under investigation. In addition, this chapter provides a theoretical foundation with the formulation of some suggestions from the literature, which are the basis for the research methodology.

Chapter Three: Research Methodology: - This chapter provides the plan of the research. In other words, this section explains the research design, approaches, strategies and data collection methods. In this research, a case company and national standard institute study strategy are used to answer the research questions. Chapter 4: Data Analysis, Discussions and Interpretation. Chapter Five: Conclusions and Recommendations and Further Research Areas.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Introduction

The chapter provides a detailed analysis of the connection between the local midi bus product quality standard and national standards preparation, development, approval, and setting review. It covers various aspects of national standards and includes a discussion on important elements of known assessment frameworks related to the national standard and midi bus fabrication, their methodology, and their applicability to other automotive manufacturing industries. Additionally, the chapter highlights the importance of product quality standards in the preparation, development, approval, and setting of national standards for the local midi bus fabrication sector.

2.2 Standardization, Standard and Quality

2.2.1 Concept of Standardization

In the ISO/IEC definition of standardization, it can be seen that standardization is “the activity of establishing (provisions), with regard to actual or potential problems,” Thinking of standardization as an activity for ‘making provisions for problems’ actually emphasizes that it is a process in which solutions are identified and standards are established (Wang, 2020). Based on the concept of automotive fabrication, it is possible to identify, prepare, and develop the product standard.

National standard organizations have a significant role to play in improving the quality infrastructure of these relations. Not only stakeholders and manufacturing industry play this role, but also standard development experts in other organizations (e.g. industry associations, conformity assessment bodies and metrology institutes) can play an important role (Mulugeta, 2020). This concept shows that the automotive manufacturing sector must be involved in the national standardization process.

Product standard adaptation is the process and strategy of consistently producing and selling products or services (ISO, 2016). It involves ensuring that a product meets specific standards for product quality appearance in each market. Proponents of standardization strategies argue that companies can gain competitive advantages by combining price, quality, and reliability with products that are similar in design and functionality around the world (Standard, 2017b). The other article also say that consumers prefer this standardized product over product standardization. It is the process of bringing the product to market without making any changes. standard and

Standardization is a framework of agreement that all product quality standards in a manufacturing industry or firms must follow to ensure that processes related to service creation or performance are performed according to established guidelines (Filip et al., 2018). Therefore, it is beneficial for the automotive fabrication sector to follow the above-mentioned ideas.

2.2.2 Concept of Standard

A standard is a document established by consensus and approved by a recognized body that provides for common rules, guidelines, or characteristics for actions or their results and aims to achieve a higher level of performance in a context, according to the source of the article, Ingvarson, (2015). Standards are defined by ISO as documented agreements that provide technical specifications or other precise requirements that are consistently used as regulations, guidelines, or interpretations to ensure that materials, products, processes, and services are fit for their intended purpose (Loukakou, 2012). However, it was understood from the users of the vehicle that the construction of local midi buses is not being done accordingly. Therefore, it would be important for the domestic automotive fabrication sector to manufacture using national standards.

A standard is generally an agreement on a technology, method, or format for an application. National standards, also known as national standards, are controlled by one of several governing bodies that exist to promote their development and ensure their standards (Standards et al., 2020). A standard is defined as a scale or measure used for comparison. It can also be defined as the satisfaction that an individual or group considers important and strives to achieve. Process standards are requirements for the way products are made, while product standards are specifications for product characteristics (Wang, 2020). Therefore, like other factory products (basic steel, automotive assembly components), vehicles manufactured in the country need to be separated into mandatory and compulsory ones and prepared at the national level.

It can be understood from this definition that a standard is not only used for standardization but also as a "guideline" i.e. required for capacity building of automotive fabrication. The concepts of standards indicate that the preparation of standards and the development of standards are important tools to ensure the effectiveness and control of the process. Since standards define the criteria needed to assess process capability and product quality acceptability, a government agency is required to ensure that a given task, product quality, or process capability conforms to standards set for required purpose(Society of Automotive Engineers of Japan, 2021). Following this, a governmental institution has been established and started working in countries, especially in

developing country, such as Ethiopia through the Council of Ministers (Ethiopian Standards, 2013).

Standards can be classified as international standards and national standards as well as standards of a specific industry and company standards (*National Standards Bodies in Developing Countries*, 2023). At the same level, standards can be defined as the qualities and characteristics that products and services should have. Therefore, standards can be applied to all products regardless. Accordingly, some standards can be applied to different products, while others are different and still more. In general, automotive fabrication factories take their product description to the institute for standardization.

2.2.3 Concepts of Quality

Quality is measure to which a set of natural characteristics of an object fulfills requirements ES (ESI, 2016). For automotive fabrication sector, the quality of a product or service depends on an exchange between two persons, one supplying the product or service and the other receiving the product or service. The supplier and the consumer can have diverse views on what quality is and this may lead to confusions and disputes. In that sense, quality can be understood as “the conformance with customers’ requirements or fitness for purpose”. However, if compatible products are found to be unsuitable for use, they are considered substandard products. In this case, if the specification does not receive the approved standard from the agency/institute, the fabricator has produced his own specification and could not fully consider the consumer's request. This brings to say that; the customer is king. Quality is not absolute but relative. A product might be of worthy quality for national, but of poor quality for national else (*National Standards Bodies in Developing Countries*, 2023). In order to meet the demands of passengers, the automotive fabrication sector needs to manufacture their products according to standards of product quality. In order to meet the demands of passengers, the automotive fabrication sector needs to manufacture their products according to standards of product quality.

2.3 Local Midi Bus Features

The most important of the four markets is the generic product, which includes services. The fabrication industry's product or service must be desired by the customer and satisfy that need when the customer buys and uses the local Midi Bus. The product quality standard varies from type to type. Visible products and tangible goods or materials, these properties will have product quality standards that must be met. Invisible, intangible services will also have service quality

standards. According to the idea raised above, it means that local Midi Bus (kitikit) product standard should be prepared and developed nationally (Ohno, 2019). The local midi bus should meet the passenger demand, which should include criteria like ergonomics and anthropometrics, safety and comfort, materials, and the fabrication process.

However, the product quality standard means that it is capable of meeting the needs of passengers or when something is correcting, but this is not enough. Since it is competition, quality should be measured by the characteristics of products and services that are similar to other competitors. In particular, the strategy chosen by indigenous companies to compete in the business sector in which they are engaged is called differentiation. If it is the same product, it is expected that the quality standard of the local product will be better than other competitors of the imported product. Therefore the national standard setting to the automotive fabrication is essential.

Whether a company's product quality standard is low or high has its own distinct disadvantages. If a company promotes aggressively with a lower-than-expected product, tries to sell at a lower price, and no matter how much market distribution is maximized, profits will be made before one company uses another because of profits. Local branding and environmental goals, as well as three market associations, namely price promotion distribution, need to ensure that the company's product quality is effective and satisfactory in order to attract customers. In this way, it is important to understand that the company's competitive strategy must be considered before determining the characteristics of local Midi Bus.

2.4 Passenger Complaints on Local Midi Buses

When a product is manufactured, it must follow the standards, be verified by an authorized body according to international or national product standards, and receive a certification for the product (Wang, 2020). Accordingly, local midi bus factories have standardized or adjusted product quality standards internationally or nationally. And they deserve to be protected and mobilized to the national standard. In this standardization and adaptation situation, when an organization becomes international, local midi-bus passengers may complain about organizations as agents of product quality standards, and a theoretical analysis of internationalization should be done first (Ngoc et al., 2017). Based on this point, the national standard institute needs to develop the product quality standard for local midi bus fabrication sectors.

Jilcha et al(2020b) found that the locally built Isuzu NPR (Kitkit) buses have many complaints from passengers about the design of the air conditioner, among which the design is not compatible

with safety and health from ergonomic considerations. Passengers are experiencing comfort, safety, fatigue, stress, and health-related issues with the frame material and size of these Isuzu NPR buses, locally named 'Kitkit. Therefore, this study believes that it shows that standardizing the local midi bus product quality standard is not well done.

Megiso (2017b) evaluated the passenger ergonomics of locally modified city buses in Addis Ababa, Ethiopia, as stated in the conclusion of the article, and found that the elderly, children, the disabled, and major segments of the population were disadvantaged in the study. Passengers with limited mobility are also dissatisfied with this sector of public transport. In order to avoid these problems, it is proposed that there should be a national standard of practice for the fabrication and approval of the local midi bus, which will help all sections of society to use it equally without discrimination. Based on the suggestion presented at the conclusion of the study, it was not well explained that the product quality standard of midi buses fabricator for the country should be prepared, develop and approved as well as awareness given to the fabricator's understanding and put into operation.

According to a study conducted by (Tetteh et al., 2017), Ergonomic Analysis of Passenger Environment of Local Buses in India privately converted midi bus transports providing Intercity Commuter Transport Services, one of the most cited concerns in personal midi bus transport is that rubber neck manufacturers give travelers less ergonomics, safety and comfort. Also, the absence of all-round transport body structure and the training code supported to control the business has led things to go wrong. Among the primary aspects evaluated are the passage and exit of the carriage, the directness of the view to the seats, the dimensions of the seats and the dispersion of the seats. However, author argues that it is possible to reduce the cost if they use the quality standard of the fabrication standard, the quality standard of the seat construction material, and the standard development professional of the experts.

In Ethiopia, Addis Ababa, improved midi buses are providing public transportation services for cross-distance passengers. According to this study, one of the main complaints of passengers in locally fabricate midi bus is the poor quality of fabrication process (specially welding and fitting bolt), the lack of the passenger's safety, the poor quality standard of the material used for the passenger's support, the narrowness of the seat arrangement and the lack of adjustment(Claude, 2018). This study believes that not working on local product quality standard, the lack of product

quality standard developed specifically for local midi bus has made busy builders poor in terms of passenger ergonomics and anthropometry, safety and comfort, as well as building materials.

This research believes that public transportation and local midi bus fabricator have a significant role in the Ethiopian economy. Because they are extremely important, they should be standardized by Ethiopian standard. Even if their status is not good, it does not mean that they can continue their work. The problem with these types of midi bus was lack comfort and safety of the driver as well as passengers and this conscious increase passenger complains. The passenger need comfort, safety, reliability, quality of materials, suitable operation service. Local midi bus has a significant positive effect on the passenger's satisfaction and negative complaints.

Generally, the local midi bus passenger's needs and complain described above, basically the entire local midi bus fabricators not consider that the Ethiopia standard. This paper believes that the product quality standards development for local midi bus fill the gap and satisfy passengers as well as fabricated a competitive local midi bus.

2.5 Strategy Application of Standard Development for Local Midi Bus

To define strategic local Midi Bus product quality standard development need to understand the concept of the term “strategy” itself. This in turn is harmonized by another two concepts that are also interesting to analyze “tactics” and “plan”. Although everyone believes they recognize what “strategy” means, they do not always know how to define it properly. Pace and Faules (1994) admits that “The concept of strategy is a term that is often ambiguously, and sometimes confusingly defined. The term strategy as part of the concept of “strategic thinking” could be regarded as a way of combining the goals to be achieved in the long term with the decisions to be made in advance, expecting future situations and possible threats from the environment.

There are differences in strategy applied to local Midi Bus product quality standard development and strategy applied to other areas of life, such as the military context. The resources available to act in the field of local Midi Bus product quality standard development are based on the establishment of road vehicles standard development team and technical committee, not on physical interaction as in the case of war. This will force the local Midi Bus fabricator or national standard institution exercising strategic local Midi Bus product quality standard development to constantly be consensus its relationships with its stakeholders to ensure that the state of those relationships conforms to its strategic goals, and to check that the messages produced have been appropriately received and decoded(Jena & Behera, 2010).

In this sense, tactics can consider as tactical tools of road vehicles product standard development all of the accepted techniques and means: road vehicle product standard team, technical committee, events, informative relations with the standard development team, engineering material manufacturing industry, preparation of a local Midi Bus product standard development identity manual, etc. Finally, the technical standard refers to all the operational decisions resulting from the tactics.

2.6 International and National Standards Organization

It is important to ensure effective planning, operation and control of processes including conditions, requirements, parameters, product quality preparation, product standardization (Wang, 2020). In international and national standards that are deliberately designed to meet requirements, a governmental body is necessary to monitor various aspects of the process or product and to ensure that the product meets the standards (Ministry of Urban Development Government of India, 2013). These standards are important to ensure interchangeability, security and understanding between different departments while minimizing differences and alternatives.

Although international and national standards are very useful, they have several limitations. Usually, with support and aid from abroad, the whole body is dispersed and the product is assembled in the country to easily hit the local market (Engineering & Vidyalaya, 2014). Therefore, it is important to see that both Fabricators and passengers are listed in the specification of products that they think the company can fulfill. Their details are not carefully read to avoid their mistakes. Foreign vehicle requirements should not be negotiated for domestic production. Imported vehicles cannot be standardized for local ergonomic and anthropometry. Passengers think or want to use a standard Midi Bus. In contrast, they reject substandard work. The wide spread of road vehicle standards makes changing standards long and expensive for fabricators and automakers, making it difficult for them to respond quickly to customer demand. But setting and dreaming up product quality standards makes them subject to continuous monitoring and the only standards that work effectively. Approve on product quality standards are routinely conducted by a government agency/institute to ensure that process results meet national or international standards (Standards et al., 2020).

The Regulatory Standards Organizations are formed at the behest and in support of the regulators. These organizations are responsible for the development and maintenance of the underlying technical standards that provide shape and form to the regulations; the standards enable the

conformity assessment of the product and its parameters leading to verification that the product (or service or process) complies with the respective regulations.

The regulators, Standards making bodies (IEC, Cenelec, UL, CSA, VDE, VCCI, etc.), OEMs, factories (or contract manufacturers), component suppliers, third-party testing laboratories, a creditor, third party notified bodies, auditors, technical professional organizations (TIA, IEEE, EIA, etc.), technical and marketing publications – all these entities have contributed in creating thriving ecosystem that provides a mechanism and oversees launch of safe products globally (ISO, 2016).

2.7 Practice of Product Quality Standard in Different Sectors

In any company, product quality standards are crucial for ensuring high-quality products and supporting the overall strategy of the manufacturing industry. National Standards enable firms to manage their fabrication process standards, create lists of input materials and components, propose and develop standards, and approve and implement national standards to benefit shareholders and customers. These standards help the fabrication industry achieve optimal performance in all aspects of the process in a continuous manner.

2.7.1 Product Quality Standard and Automotive Assembling Sector

Product Quality Standard has been in the automotive assembling industries for decades, known as road vehicle standard (ESI, 2016). Product quality standards in automotive assembly practice mean optimizing assembly processes, broadly production and manufacturing; it is the act of increasing productivity within the minimal national standard while being flexible while being consistent for improved quality. In the automotive assembling industry, the Product Quality Standard is a mechanism for continuous production improvement at the simplest minimum standard for security maximization. Product Quality Standard in the automotive assembling industry is reaching the height of assembling efficiency by doing things better, faster, and cheaper (Siwec& Pacana, 2021). Product Quality Standard is the unification of firms' entire standards, such as procurement, manufacturing, and after-sales service, as an end-to-end system. It has been the purpose of the product quality standard to boost production efficiency, develop quality standards, and meet passenger demand. The product quality standard approach is like a typical production system combined with passengers' orientation and the necessity of continuous improvement (Pacana & Czerwińska, 2020).

2.7.2 Product Quality Standards and The Public Transport Sector

Product Quality Standards have become increasingly important not just in the automotive assembling industry, but also in other Public Transport service industries. This is a relatively new concept for many Public Transport industries, but it has led to significant improvements in various aspects, such as fabrications (Ngoc et al., 2017). National Standards are designed to create exceptional Product Quality Standards systems with strong technical and social components in Public Transport industries. However, local midi bus Standards in the Public Transport service industry are not always clearly defined, and can be influenced by the variability of national standard development and delivery (Lone & Bhat, 2023).

As a passenger, it's important to know that Product Quality Standards are in place in the transport service industry. These standards are created through collaboration with technical committees, stakeholders, and social aspects to ensure outstanding national standards are met. However, it's important to note that standards in the Public Transport industry can be influenced by the level of variety of offerings and variability of national standards. It's crucial to do the research and choose a company that prioritizes quality and safety

Product Quality Standards are the maximization of value that prepares, develops, approves, and sets national standards over strong leadership and the implementation of value-added local midi bus standards by maintaining industry best practices. And enables sustained delivery of high-quality, cost-effective public transport services and capabilities that deliver exceptional passenger value. Product Quality Standards are a strategic competitive advantage that influences the effectiveness of operations in creating and sustaining customer satisfaction and reliability (Siwiec & Pacana, 2021).

Product Quality Standards are the processes of enhancing post-sales services (Lone & Bhat, 2023). As a user of Public Transport services, it is important to note that there are National standards in place to ensure that all processes involved in service delivery are properly synchronized. In addition to this, it is also imperative that firms handling Public Transport services adhere to Product Quality Standards, which goes beyond operational effectiveness. These standards also take into consideration ergonomics and anthropometry, safety and comfort, building material, and fabrication process associated with the service groups, with the aim of achieving outstanding performance and ultimately, passenger satisfaction (Asimeng, 2021). It is important for all

stakeholders in the Public Transport sector to prioritize these setting standards for the benefit of all.

2.7.3 Product Quality Standard and the Basic Metal and Engineering

Basic metals and engineering industries play an important role in the industrialization process of a country. Product quality standards in the Basic Metal and Engineering sector cannot, therefore, separate it from hazard. So, because of these intrinsic risks, and specific recent incidents in global automotive assembling and fabrication operations, stakeholders stress for firms in the industry to perform becomes intense(Engineering & Vidyalaya, 2014).

Product quality standards play a crucial role in sustainability efforts. When products meet certain quality standards, they tend to last longer and perform better, leading to an increase in the development of product quality standards and local midi bus public transport. Additionally, high-quality products often require less national standard and standardization, which can save energy and resources(Lone & Bhat, 2023). By setting and enforcing strict product quality standards, industries can promote sustainable practices and reduce their passengers' complaints. Ultimately, these efforts lead to a healthier local midi bus public transport for all passengers or users.

2.8 National standard institute and Technical Committee for Product Quality Standards

2.8.1 National Standard Institute

Ethiopian Standards Institute (ESI) started its activities in 1970 and became fully operational in 1972 as an autonomous institution. The purpose to establish the institution was to determine the quality of agriculture and industrial products. It is also intended to promote and expand standardization and quality control activities in the national economy. To benefit the people and protect customers, the automotive sector and manufacturing products were expected to meet the required national standards. Similarly, export commodities also were expected to meet internationally recognized standards (ESI, 2016).Ethiopia was expected to achieve this by developing national standards and adopting international standards(Temesgen, 2021).The institute was established as a national standards body in February 2010 by the Council of Ministers Regulation No. 193/2010. The institute is an autonomous federal government institute and currently reports to the Ministry of Trade.

2.8.2 Technical Committee and National Product Quality Standards

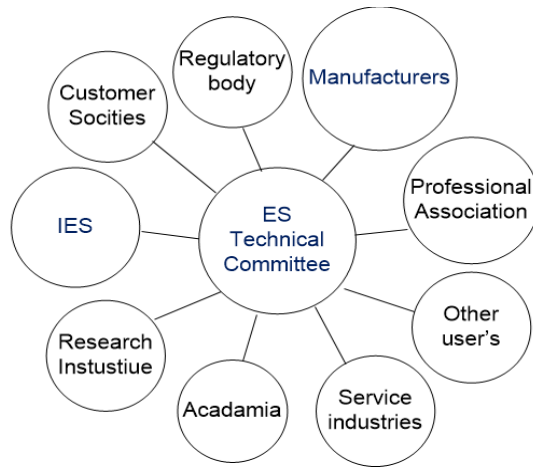
According to (BSI & ISO, 2016) the Technical Committees (TCs) play a crucial role in standardization. They are groups responsible for developing and drafting standards, which are then ratified by National Standards Organizations. While anyone interested in the draft standard can participate, only representatives of National Standardization Bodies have the right to vote in the Technical Committee. These committees comprise experts in a specific field, representing national committees, industry, professional associations, government, trade unions, and other stakeholders. As stakeholders, national standard institute can send experts to TCs as observers with the right to participate in debates.

The primary purpose of the Committee is to assist the Board in fulfilling its oversight responsibilities on specific technical matters that go beyond the scope or expertise of non-technical Board members. Technical committees for standardization facilitate cooperation among legal entities and individuals interested in organizing and performing work on international, regional, and national standardization in particular areas of activity and fixed objects of standardization.

ISO has put together groups of experts that represent every sector imaginable from soaps to spacecraft, MP3 to coffee. In fact, there are more than 250 technical committees. Firms can find out what they do here. ISO members can choose whether they want to be part of a particular TC, and their level of involvement. If Factories are interested in getting involved, contact the national standards body. The national standards body is the ISO member and represents ISO in the country. Contact details can be found in the list of national members. Companies and individuals are not eligible to join ISO as members(Klochkov et al., 2017)

Organizational standardization has many useful functions. Some of these are providing product quality standards for decision, achieving cooperation and action towards goals, instructing and changing and providing feedback to National Standards. Moreover, organizational standardization can be divided into formal and informal standardization(Wang, 2020).

The Technical Standards Committee (TSC) was to create and maintain automotive manufacturing and local Midi Bus technical standards and to evaluate and pre-approve new and existing products for use in domestic Midi Bus product quality and construction standards. But now the IES is placed in the working framework as shown in (Figure 2.1).



Source : Temesgen(2021)

Figure 2. 1 The involvement stakeholder national standard framework

In particular, it focuses on the study of the actions of the stakeholders, the behavior and participation of the technical committee bodies and stakeholders in the development of national standards, academia, service industry, research institute, IES, customer associations, regulatory bodies. To put the whole system into practice, it includes manufacturing, trade unions and other linkages. The automotive industry is being worked on to extract product quality standard information through existing entities such as manufacturers and service industry, transportation engineering, manufacturing engineering (Temesgen, 2021). In particular, the framework in which the automotive fabrication sector participates is seen as limited.

2.8.3 Consensus for National Standards

Consensus standards are recommendations or operating practices that are created by a group of experts that do not, by them, have the ability to be enforced, unless adopted by a regulatory body. The principle of consensus involves the tendency of the individual to follow the lead of the group or peers (Mhatre et al., 2017). Three elements crucial to the functioning of consensus are (1) common acceptance of laws, rules, and norms, (2) attachment to the institutions which promulgate and apply the laws and rules, and (3) a widespread sense of identity or unity, which discloses to individuals who experience it, those features in respect to Consensus enables a group to share power - everyone who is fundamentally affected by a decision can work together to find solutions that meet everyone's needs. It's about working with each other rather than for or against each other (Coenen et al., 2017). Whenever there's disagreement, there's no consensus: consensus means

everyone is on the same page. When you're talking about all the people in the world, it's hard to find a consensus on anything. There are just too many opinions. However, in a smaller group, reaching a consensus is possible. Consensus is a general agreement on a decision made by the majority of those involved. For example, the problem may be as simple as friends trying to decide which restaurant has multiple options to choose from or complex as decisions on distributed systems (Kamdem et al., 2022).

In consensus decision making participants voice their concerns during the discussion so that their ideas can be included. In the end, however, they often decide to accept the best effort of the group rather than create factions or an "us against them" mentality (Claude, 2018).

2.8.4 Shaping expert consensus

International standards bodies have two key features that make them valuable in addressing automotive manufacturing policy issues (ILO, 2021). Firstly, they prioritize expertise, considering standards to be authoritative and reflective of specialist opinions. Secondly, intervention aimed at influencing a standard must be supported by technical reasoning in accordance with the requirements of international standards bodies (Brown et al., 2021).

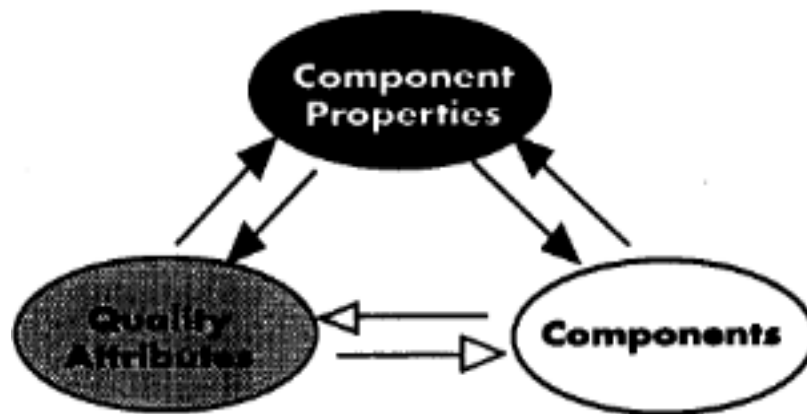
The focus on experts in institutions can greatly impact the involvement of individual automotive fabricators. While other methods of global governance, such as national standard development (Timo et al., 2019) Experts, only provide draft proposal, experts in standards organizations have the ability to influence standards that can have real governing power globally (Wang, 2020). National regulation or legislation, on the other hand, offers limited opportunities for expert engagement. Some worry that public engagement may hinder policy efforts on topics like local midi bus safety and comfort, ergonomic and anthropometry, building material and fabrication process. For an automotive fabricator seeking to maximize their global regulatory impact, international standards bodies offer an effective way to engage (ES (Ethiopian Standards), 2016). Similarly, automotive fabricator organizations that prioritize expert governance may find that international standards bodies have more influence and legitimacy than closed self-regulatory efforts.

Second, standards bodies and their processes are designed to facilitate the arrival of consensus on what should and should not be within a standard (Issues et al., 2020). This consensus-achieving experience is useful when addressing questions surrounding automotive fabrication sectors like local midi bus fabrication that may face initial disagreement (ISO, 2016). Although achieving

consensus can take time, it is important to note that the definition of consensus in these organizations does not imply unanimity, and in practice, it can often be achieved through small changes to facilitate compromise (Claude, 2018). This institutional capacity to resolve expert disagreements based on technical argument stands in contrast to legislation or regulation that will impose an approach after accounting for limited expert testimony or filings. The capacity to resolve expert disagreement is important for local midi buses, where it will help resolve otherwise controversial questions of what local midi bus fabrication are mature enough to include in standards.

2.9 Dromey's Generic Quality Model

Al-Obthani & Ameen, (2018) quality model was created for many product sectors, not just software development. It acknowledges that each automotive fabrication product's quality is evaluated differently, and that a more dynamic idea for modeling the fabrication process is required to be comprehensive enough to apply to various automotive fabrication link national standard technical committee scopes (Sulistiani et al., 2018). Figure 2.2 below, however, illustrates the model's quality attributes.



Source :Dromey, (2011) Generic Quality Model

Figure 2.2 Generic Quality Model

Rapid automotive fabrication sector expansion for the Quality Model Application, a platform for integrated product and process application. The quality model is extremely intricate, continually changing, and capable of updating the automobile fabrication industry swiftly. The International

Automotive Task Force (IATF) developed ISO/TS 16949 to establish common practices and procedures throughout the automotive industry. The required quality characteristics of ISO/TS 16949 and ISO/TC road vehicles are ergonomics and anthropometry, safety and comfort, component/materials and fabrication process, and efficiency. Recently, quality models have been introduced with the goal of assessing these characteristics (Ngoc et al., 2017). This results in standard models for all bus features that are of appropriate traditional automobile manufacturing product quality. A model for conceptual product quality standards has been created (Dromey, 2011)

2.10 Indicators for Measuring Product Quality Standard of Local Midi Bus
Passenger comfort and safety (Jilcha et al., 2020a), ergonomics and anthropometry (Megiso, 2017a), and Engineering material (Addisu & Koricho, 2022) unfulfilled needs in the fabrication process have been written about local Midi Buses at different times. This paper believes that the SWOT (Strengths, Weaknesses, Opportunities and Threats) technique is widely used in many other manufacturing industry areas (Namugenyi et al., 2019). It can be used to relate product quality standards with fabrication process quality standards, ergonomics quality standards and anthropometry data, safety and comfort quality standards, and engineering materials quality standards. The SWOT technique was used to identify gaps between the industry product and process. So it is convenient to identify gaps in the product quality standard development in the fabrication of the local Midi Bus 'Kitikit'. Therefore, to identify the gap, an attempt was made by dividing the indicators using SWOT (Strengths, Weaknesses, Opportunities and Threats) techniques.

2.10.1 Ergonomics and Anthropometry related local midi bus quality standard

Anthropometrics is the study of human body measurements and movements, while ergonomics is a scientific discipline that focuses on designing products and environments to fit the individuals who use them. Ergonomics relies on anthropometric data to determine a product's optimal size, shape, and form, making it more user-friendly. With the help of ergonomists, fabricators can identify which user characteristics to consider during the design process (Jena & Behera, 2010). When designing products, systems, or processes, it's important to consider a combination of ergonomics and anthropometrics to ensure product quality standards are met. Factors such as comfort, functionality, and user-friendly systems should be considered to emphasize the

interaction between the user and the road vehicle being built. Experience in this area is crucial for successful product development (Engineering & Vidyalaya, 2014). To avoid travel-related injuries, anthropometric measurements are utilized to analyze how workers interact with various elements such as tasks, tools, machines, road vehicles, and safety gear, specifically passenger seats and work equipment. These measurements are combined with product quality standards to determine the level of protection needed to prevent hazardous exposures, whether chronic or acute. It has been confirmed that collaboration between the authorized body and the manufacturer is necessary for this process.

Using ergonomic standards and anthropometric data is crucial in designing products that meet the ergonomic needs of passengers. This refers to the relationship between people and the products they use. Designers and fabricators must always keep in mind the importance of utilizing ergonomic standards and anthropometry data to ensure high-quality standards for the intended passengers of the product.

2.10.2 Comfort and Safety related local midi bus quality standard

The article suggests measuring whole-body vibration on buses and comparing it to ISO comfort and safety criteria and health guidelines (Megiso, 2017b). Due to the vibration between the engine and the chassis, it is suggested that the driver and passenger in the middle row seat will be exposed to unnecessary nerves. The quality standard local Midi Bus has a wheelbase specification that is typically used for city transport and public services, the article says. It states that many international and national standards, such as road vehicle standards, are used to assess vibration, human health, and safety effects.

According to Indian research and statistics, the ever-increasing environmental sensitivity of society's demand for mobility is a major challenge for traffic policymakers and transport corporations, including private fleet operators. However, the article explains that the focus is not on the safety and comfort of the fabricators but on the passengers getting a vehicle and going. Consequently, it can be understood that it is very important for light and heavy passenger vehicle fabricators and bus bodybuilders to adapt to the ecologically motivated requirements, which will make it more and more important to include basic safety and comfort minimum requirements in the public transport vehicle (Infrastructure & Diagnostic, 2008). The technical standing committee looked at the areas of problems and stated that the overall exercise has standardized the important aspects of the construction of the bus body, considering the minimum requirements of passenger

safety and comfort. Improper fitting and bolting, not locking of the bolts, and not rusting of the vertical and supporting pillars should be given importance in terms of safety and comfort.

Nowadays, road vehicle fabricated standards and transportation service standards have received much attention due to their clear relationship with passenger satisfaction and passenger retention. Therefore, it is important to provide the road vehicle to the user after the product quality standard has been measured by an authorized body, and the development of the standard of transportation service is a key issue that determines the existence of local Midi Bus companies.

2.10.3 Fabrication process and Material related local midi bus quality standard

The key raw materials are now steel, for instance in the industries which produce collective transport vehicles (buses and trains) and agricultural vehicles (harvesters and tractors). With a view to reducing the weight of such vehicles, plants are engaging in designing structural components using modern steel forms that allow for the implementation of more thinning materials (thinner sheets) and frameworks with welded joints of various metals (Mteirdc, 2019b). In order to develop high strength, easy to soften and high levels of ductility and toughness, this industry needs steel mills.

Like the chassis, the body of a midi bus must be made of sheet metal of the appropriate thickness and manufacturing quality. As they run along an assembly line parallel to the assembly line of the chassis, the various steel parts are welded or welded together. The intercity bus should be fitted in such a way that it does not cause any physical injury to the passenger and does not cause any discomfort. Based on this, it is necessary to prepare as well as development the product quality standard of the local product and make it work for the manufacturer. The steel panels are assembled together to form the bottom, sides and top of the body. Then the doors should be attached to the body according to the requirements to fit and fit the passenger. If the inputs used to manufacture these domestic medium-sized buses are produced locally at the required product quality standard, they will avoid imported inputs.

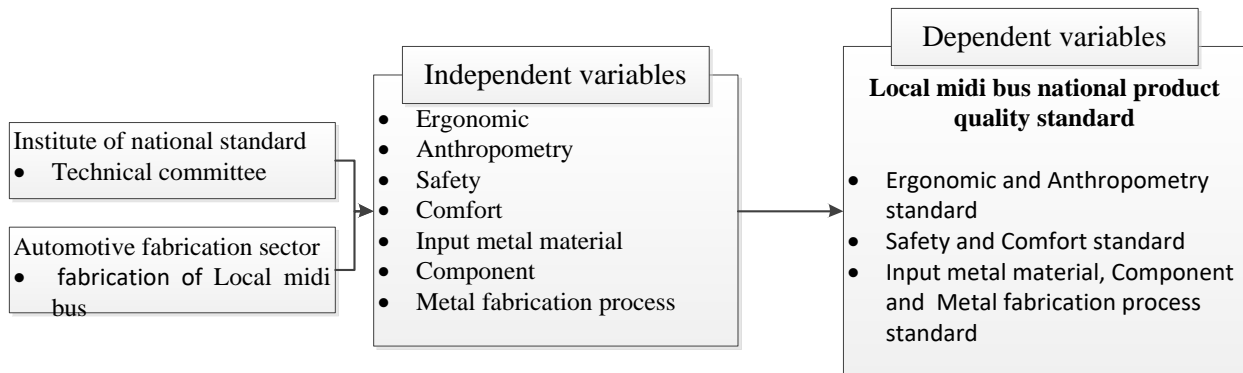
The body is cleaned with soap and water, and then treated with phosphate to prevent rust. A coat of primer is sprayed on the body and baked in a large oven, while a coat of paint is sprayed in the same manner and baked to dry. This technology is used to make the color uniform and if done according to the standard, it gives beauty to the vehicle and the passenger and protects the local bus body from rusting (Issues et al., 2020). Windows is installed in the body. Interior parts such

as the instrument panel and seats are installed. External parts such as door handles and lights are installed here; local manufacturers produce the item as a requirement for the vehicle, saving foreign currency.

2.11 Conceptual Framework

In the diagrammatic view of the conceptual framework, the independent variables are ergonomics and anthropometry, safety and comfort, components, as well as material and fabrication processes. The dependent variable is the local midi bus product quality standard, which, according to the diagram, depends on the vehicle design and fabrication (international and national standards), the education and skills possessed by the technicians in the automotive fabrication industry, and the passengers' needs or tastes.

A conceptual framework is a representation of the relationship that paper expects to see between basic material manufacture, automotive fabricators, the institute of national standard technical committee variables, or the characteristics, properties, attributes, and national technical committee variables that you want to study. Conceptual frameworks can be developed or visual and are generally developed based on a literature review of existing studies assessments, and they were extracted from the developed model about local midi buses.



Source: own source

Figure 2.3: Conceptual Framework.

The intervening variables include stakeholders such as fabricators, the fabricators, the ministry of industry, research institutes, and centers. ministry of transport, the government of Ethiopia, and regulatory agencies such as the National Standard Body, IES, and the Motor Vehicle Inspection

Unit. Secondly, the road standard development department depends on how the vehicle was designed and fabricated, the materials used based on national standards in the manufacture, the experience and skills used by the local midi bus structure and body building technicians in the automotive fabrication industry, and the passengers’ preferences or tastes based on bus structure safety and comfort needs and passengers travel.

2.12 Gaps from existing literature

In order to obtain sufficient information on the topic, many articles are reviewed from various sources, among which journal articles, Ethiopian Standard Institute articles, reports and unpublished Master's these are the main ones. During the literature survey, recent documents related to locally built midi buses ‘kitikit’ are collected from various sources and then each document is critically analyzed to order to filter gaps below.

- ❖ Kassu Jilcha. 2019, this papers deal Safety and Health Suitability of Locally Built Isuzu NPR (Kitkit) Buses with Ergonomic Consideration but not product quality standard perspective.
- ❖ Teshome Dengiso Megiso, 2017, this papers this paper see the deal Passengers ergonomics evaluation of locally modified intercity buses but not integrate product quality standard. Addis Ababa, Ethiopia
- ❖ Emmanuel Theodore Asimeng 2021 Bus rapid transit implementation with the inclusion of incumbent paratransit operators in African cities: lessons from Accra
- ❖ Local built bus related product quality standard or Midi Bus approach in institute of Ethiopia standard is not explored and not much has been found in automotive industry.
- ❖ A major gap in many studies related locally fabricated road vehicle is that they do not clearly show the impact of obtaining national quality standard approval and certification on the competitive market set of automotive manufacturing, especially domestic Midi Bus road vehicle sector. They fail to know the real cause of the change.

Table 2 Research Gaps

Authors	Title of the articles	Finding
Sophia Teteha (2017)	'Ergonomics Evaluation of Locally Made Vehicle Passenger Seats in Traro Vehicles in Accra, Ghana	did not match passenger anthropometric and seat dimensions were observed with locally manufactured passenger seats

Megiso, 2017	Passengers Ergonomics Evaluation of Locally Modified Intercity Buses Addis Ababa, Ethiopia	ergonomics such as safety, comfort, ease of use, productivity and aesthetics for the passengers.
Kassu Jilcha. (2019)	Safety and Health Suitability of Locally Built Isuzu NPR (Kitkit) Buses with Ergonomic Consideration	anthropometric data, Comfort and safety , health related problem (fatigue, stress, ergonomically problem
	Developing a Product Quality Standard Framework for the Local Midi Bus Fabrication Sector.	Developing a framework for Setting National standard

2.13 Summary of the Literature Review

Many studies related to product quality standard development practices in international competition have been conducted in the country, for example, there is experience in agriculture, textiles, health sector, and chemical industries. But competitiveness isn't just about building a midi bus, it's important to know the factors involved. Rather, it requires the use of a product quality standard to meet the required mid-buses standard requirement or service to meet the healthy and sustainable global customer or passenger requirements. Although in developing countries such as Ethiopia, the lack of road vehicle standard development management practices and organizational performance in relation to product quality standard is not enough. In addition to this, the challenges can be seen in the quality standard of Midi Bus road vehicle construction. The inability to prepare, develop and implement product quality standards has had an impact on the development of the road vehicle construction sector in Ethiopia. The vehicle being built with the current innovation process is insignificant for global competitiveness. As a result, the domestic road vehicle fabrication sector in many developing countries is operating using traditional and outdated technology and fabrication process techniques.

CHAPTER THREE

3 RESEARCH METHODOLOGY

3.1 Research Design

The purpose of this research is to develop quality standards for local midi buses in Ethiopia's automotive fabrication sector. The study uses both qualitative and quantitative methods and a combination of primary and secondary sources to identify problem areas related to ergonomics, safety, comfort, materials, and fabrication processes. The research design is both explanatory and descriptive, beginning with a description of the automotive fabrication industry's influence on product quality standards. The study area, data sources, and sampling methods are explained in the section.

3.2 Method of the Study

To carry out the objective of study, the following methods were used.

1. Identifying the problems:

The idea was born based on the complaints raised by passengers and users about the local Midi buses and the fact that automotive manufacturers have repeatedly requested the research center have their products prepared, developed, and approved. Based on these basic ideas from Ada Bus Assembly and Metal Engineering, as well as from the Ethiopian Standards Institute, and looking at related article information that is known from time to time, it became the starting point of the problem.

2. literature reviews:

Collecting literature reviews is the foundation of any research. To continue the study, it is important to collect significant information about the problem of the bus or local Midi Bus, which is related to setting the product quality standard. A collection of different literary works contributes to the consideration and understanding of the research problem studied.

Based on this, the literature review related to the local midi bus fabrication product quality standard, concept standard and standardization, ergonomics and anthropometry, safety and comfort, local midi bus building components and materials and fabrication standard, national standard development and technical committee, and application. To get adequate information about the research topic, a total of 72 pieces of literature were identified from journal articles,

conference proceedings, books, and unpublished master theses. 62 were from the 2015–2023 publication years, and 10 were from the 2007–2014 publication years.

3. Selecting the most complained local Midi Bus 'Kitikit' for the study

It is better to select one Midi Bus that works in one country because it will be very difficult to study every Midi Bus that is made in Ethiopia since it will be very expensive and time-consuming. There are several points for producing a critical local Midi Bus that meets product quality standards. The reason for choosing a local Midi Bus is the proximity of the company where data is collected, taking into consideration the institution's practice and examining written related articles and records, as well as interviewing managers and supervisors and their expertise. Complete versions of intermediate buses were evaluated based on customer or passenger demand, fabricators' experience with the product quality standard of the fabrication process, ergonomics and anthropometry, safety and comfort, engineering material standards, and staff perceptions of the national standard.

1. Collect the relevant information of flow and materials:

To conduct the study, obtaining clear information and collecting information about the standard (Ergonomic and anthropometry, safety and comfort, engineering material and fabrication processes, national standard) used for midi bus production in the country, preparation of related product quality standards, and understanding the development and flow from the beginning to the end, Ethiopian standard The work was carried out because the institute needed to explore.

2. Study the process flow of the selected local Midi Bus fabrication:

Studying the setting of the national standard workflow of the selected local Midi bus fabrication strengthens the understanding of how each procedure is performed from the start to the endpoint. Also, it helps us understand the operations, materials, and product quality standards that were used in every step.

3. Describe the type of product quality standards the sector use:

Based on the information collected, to understand the situation by visiting the factory to observe the product quality standard used. Local Midi Bus fabrication factory visits and discussion with the operation manager and quality control and inspection section expert allows for an understanding of the international or national standards used in the local Midi Bus fabrication

including material quality standards. It also helps to understand the activities required to move a Midi Bus building from raw materials to customers or passengers.

The main data gathered for the current product quality standard is all the operations carried out for the product of the selected to support local Midi Bus. Every step of activities was assessed and identified as preparation and development of product quality standards.

4. Identify the main problems and then develop the existing structure that can be made in the process.

Identifying the main problem and the local Midi Bus standard development process of the country, developing the standard development framework used for vehicles at the national standard, and using it to create a competitive domestic midi bus and reduce passenger complaints assess and Identifying the problems and passenger complaints in the process of midi bus construction at every standard and in every area concerning on product quality standards was analyzed.

5. Reforming the existing standards development structure.

Based on the identified improvement ideas, it is important to reform the standard development structure that benefits the local midi bus fabrication to make it accessible and useful to all involved in the sector.

3.3 The study area

In studies, population refers to the entire group of individuals or persons (subjects or events) with common characteristics that the researcher is interested in. The population of the study is determined based on a random and purposive sampling system. Random sampling was used for the case company to assess the product quality standard for all the elements, and purposive sampling was used because it is necessary to focus in-depth on the national standard developed and approved by the Ethiopian Standards Institute Electromechanical Standards Development Team. The information was collected from selected local Midi bus fabrication sectors and the Ethiopian Standard Institute in Addis Ababa. Local Midi Bus fabrication companies were selected as case companies due to their closeness to the research work, the number and professional composition of employees, the year of establishment, the fact that local Midi Buses are still being fabricated, and the identification of local bus types and Midi Bus fabrication sectors.

3.4 Method of Data Collection

The process of data collection is an essential activity that enables the study to be successful. It was used to highlight the approaches that can be used to conduct this research using different methods. Both primary and secondary data collection methods were used in this paper.

3.5 Data sources

1. Primary Data Sources

In research, population refers to the general population (cases or events) that have common characteristics that the researcher is looking for. The random data was collected from the local Midi Bus Fabrication Sector in Addis Ababa City; on the other hand, the purposive sample was from the Institute of Ethiopia Standard, Electromechanical Standard Development Team. The reason why the automotive fabrication factory was chosen was that it is currently in operation and still provides passenger transport services, and it was a product related to the study. In addition, there are seven teams in the structure of the Ethiopian Standard Institute for product development in various sectors. In this case, the related standard development team was an electromechanical standard development team that deals with road vehicle standard development. It is prepared to evaluate the current situation of the company or institution and the factors related to the development of the national standard for local Midi buses and are approved by the institution for use by the user. A variety of primary data collection methods were used.

2. Direct Physical Observation

In order to realize and collect some relevant information, physical observation of the local Midi Bus developer and facility was done as it provides sufficient opportunity for the study. The observation was because it helps to assess the well-made local Midi Bus and stage development unit and find better ways to complete tasks. In addition, direct observation is critical to identifying the type of standards they use to understand the current situation. It is necessary to visit the company directly to observe and record the different fabrication process areas of the company, the standard of the fabrication process, the different characteristics of the products, the standard of the types of machines, the production units, the flow of information and the flow of materials, the standard of product, the numbers and types of machines, their quality standard, between work stations. Local Midi Bus specification, fabrication process standard and capacity, raw materials quality standard, the company's finished Midi Bus helps to identify standard preparation and development gap.

3.6 Sampling Technique

Some different automotive fabrications and assemblies are found in Addis Ababa, Ethiopia. This study was conducted at the Ada bus assembly and metal engineering factory. The sampling technique was the whole sampling because there were small numbers of employees in Ada Bus Assembling and Metal Engineering Factory. The total number of workers currently beginning at the feeder of raw materials is case company 26 and from institute 14 total of 40.

1. Questionnaire

The questionnaire was designed to have both close-ended and open-ended questions. It is also useful to analyze the qualitative and quantitative data to determine the respondent's opinion on the research topic. The questionnaire has two parts. The first section contains general questions for the entire questionnaire. The second section contains questions specifically designed for respondents on the product quality standard of local Midi Bus fabrication.

2. Interview

This study needs more resources to address information to institute and Case Company of experts, standard development expert, work stations, and departments to whom this issue may concern. Therefore, formal and informal interview was prepared for the production manager of each section, operation heads, quality control and inspection section and also for some of the expertise.

3. Secondary Data Collection Method

In order to achieve the objective of the study, the case company and Institute of Ethiopian Standards previous research works, literature reviews, articles, proclamation, web-site of ISO and IES, catalogue and technical committees' manuals related to road vehicle standard information and many other important documents were reviewed. Ada Bus Assembling and Metal Engineering Factory and institute of Ethiopia standard data and related web sites were also used for the secondary data collection. Those mentioned documents are the product quality standard development teams and composition of members, the company's product quality standard approval and the way it is accessible to the user, the annual product plan and related issues are explored.

4. Product Selection Methodology

This paper is about product quality standard development of local Midi Bus through Ethiopia standard. Ada Bus Assembling and Metal Engineering in Addis Ababa Akaki kality Sub City W 05 back to Wuhalimat. In order to conduct the study, it's better to select a local Midi Bus kitikit which is been fabricate by Ada Midi Bus assembling and Metal Engineering factory, because it is

very hard to concentrate on every Midi Bus because of the product kinds due to source and time constraint There are different points to make out critical product. By watching the company records and interviewing managers, supervisors the data was gathered which is important for selection of the product

3.7 Data Analysis

The data was analysed using SWOT and IBM SPSS statistics 27. Using SWOT techniques strength and weakness of the case company and opportunities and threats from institute of Ethiopia standard side was analyzed. In addition, Data analysis is a method of putting facts and figures to solve the research problem. It is vital to finding the answers to the research objectives. For research quality to be ensured, the study used both quantitative and qualitative methods of data analyses. After all data was gathered, the researcher carried out a data-cleaning procedure requiring the detection of missing responses to increase the accuracy of the responses. The exhaustiveness, coding and accumulation of missing data were checked and edited. The data were categorized, encoded and entered into the research machine using the Social Sciences Statistical Package (IBM SPSS statistics 27). The interview data was thematically represented using themes that complemented the questionnaires. The questionnaire data were analyzed using descriptive.

3.8 Ethical consideration

Ethical clearance obtained from the manufacturing technology engineering industry, research and development center, and Official letters written from the manufacturing technology engineering industry and research, and development center, to the respective institute Ethiopia Standard and Ada Bus Assembling and Metal Engineering. Since the purpose of the study explained to the research subjects, they also informed that the information provided by the research subjects kept confidential and that their identity disclosed in connection with the information. Informed consent secured from each participant. For product quality standard assessment findings, picture/photo, feedback given to all the standards institutes and manufacturing industries involved in the study. It planned to provide a copy of the result to the relevant level institution, research manufacturing industries, Ministries and centers, and the privacy of the respondents and their responses in the report are not included in the analysis at the individual level.

3.9 Reliability and Validity Tests

3.9.1 Reliability Tests

This part help to testing the research questions previously, the survey measures used examined for the reliability and validity by using SPSS and the inter-item reliability consistency (alpha) was used to measure its reliability. Consequently, the reliability of each questionnaire was calculated by Cronbach 's and the results of Cronbach 's alpha for the questionnaires based on each perceptive is as shown below.

Table 3-1 Cranach's alpha result for each Local midi bus product quality standard measurement measure

Local midi bus product quality standard measurement		Reliability statistics
	Cronbach's Alpha	N of items
Safety and comfort	0.984	8
Ergonomic and anthropometry	0.936	4
Engineering materials	0.947	4
Fabrication process	0.990	5

Cronbach's alpha value is a —commonly used threshold for acceptable reliability and thus, is considered acceptable as Table 3.2 shows, all alpha scores for each waste minimization measures were in the acceptable range from 0.936 to 0.990.

3.9.2 Validity Tests

In the discussion held around the development framework, which was attended by the standard development team leader, experts, product quality standard department members, operation managers and technical experts, the main discussion was confirmed by the time limit.

The points raised during the discussion were the relevance of the way to prepare and develop product quality standard using the developed framework; the feasibility of a framework has the content of being able to connect the institution and the case company to the framework. As discussed in the discussion, the framework is useful and practical as it addresses the communication gaps and problems between the Ethiopian Standards Institute and the Case Company (automotive factories sector). It is recommended that it be included in the checklist in the relationship between the institutions and the case company, as it requires minor improvements in the work process.

Checklists can be the source of the updated scope and include relevant technical committees as well as member composition review and automotive fabrication order to help use Ethiopia standard. In addition to this intensive training, standards development team experts at all levels as well as departmental standard development team staff and machine operators can help implement the automotive manufacturing process effectively and efficiently.

Research Framework

Figure 3.1 describes the overall research methodology and steps to be followed in this study. It begins by building the theoretical framework and ends with conclusions and recommendations.

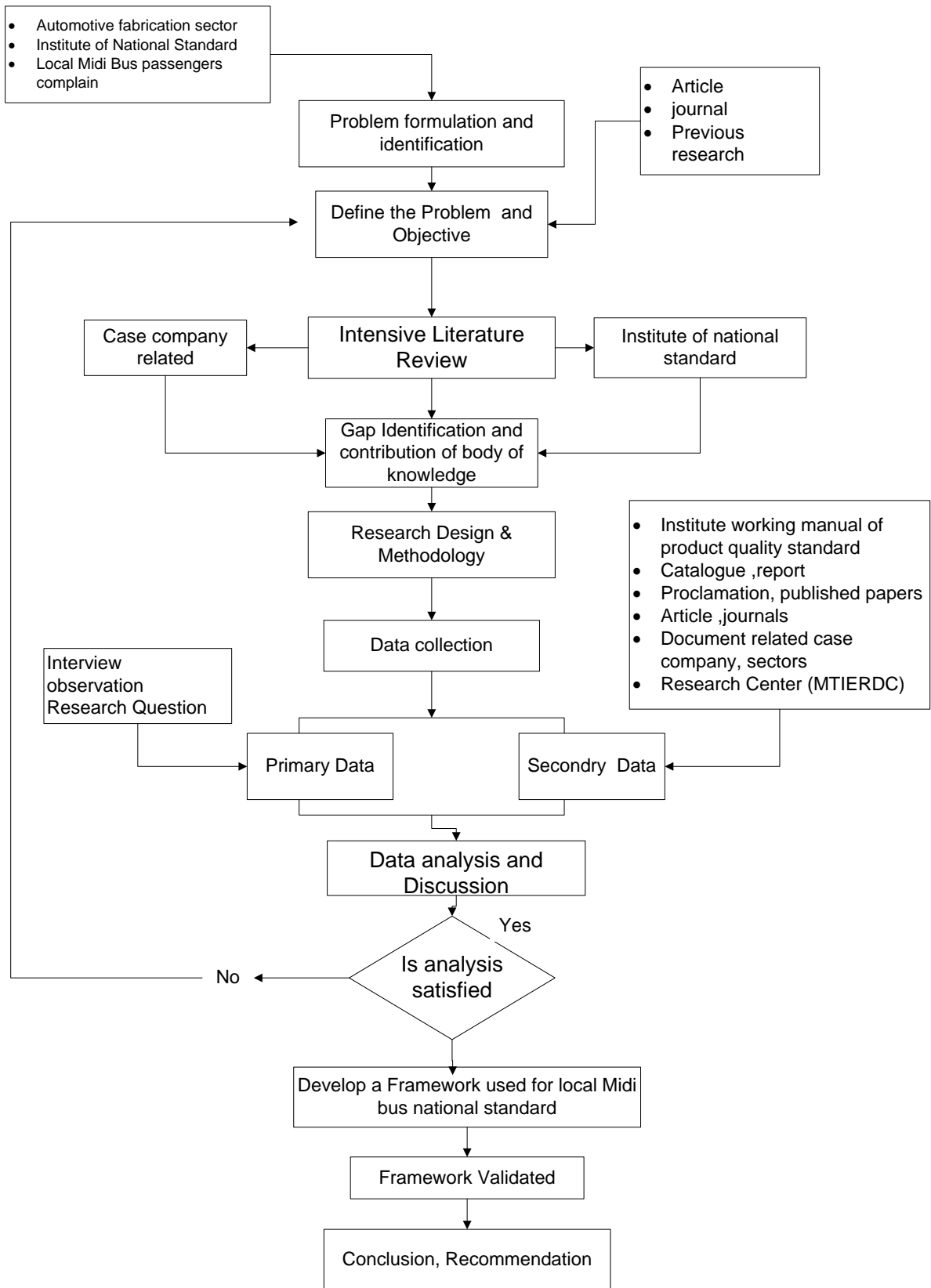


Figure 3-1: Research Process Flow

CHAPTER FOUR

4 DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter of the study deals with displaying and interpreting the data obtained from questionnaires, interviews, and different secondary sources. The data is analyzed using different statistical tools, including tabular and textual forms. Also, the raw data from the institute and the automotive fabrication sector are presented.

4.2 Background Information of the Respondents

The researcher designed questionnaires to assess the specifications used by the workers related to Ethiopian standards to build a minibus road vehicle in their work area. Employees' background characteristics were measured in terms of gender, category of employee, educational level, and working experience. The questionnaires were distributed to 26 Ada bus assembly and metal engineering shop floor workers at Midi Bus Builders, and all 26 questionnaires were returned.

Table 4.1: Response rate of questionnaire for fabrication process of each section

Sections	No. distributed	No. returned	% response
Cutting and bending section	4	4	100%
Welding section	10	9	100%
Assembling section	7	10	100%
Panting section	3	2	100%
Testing section	2	2	100%
Total	25	26	100%

Source: respondents result

As can be observed from Table 4.1, the response rate of the questionnaire for the five sections cutting and bending section, welding section, welding section, painting section, and inspection and testing section is the same: 100%. So the total response rate is 100%, which is a very good response rate, so it is representative.

4.2.1 Respondents Gender

According to Table 4.2, the majority of workers in bus fabrication companies in Ethiopia are male (84.6%). While there are some female workers, their number is small (15.4%). Conducting a study on women could shed light on the relationship between gender differences and organizational success, particularly in terms of product quality standards.

Table 4.2: Gender of Respondent

		Gender			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	22	84.6	84.6	84.6
	female	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

4.2.2 Working Experience of Respondents

The study sought to establish the duration the respondents had been working in the bus vehicle structure building company. Results of the descriptive analysis presented in Table 4.3 revealed that 16(61.5%) of the respondents had been working for between 6-10 years, with 4 (15.4%) for between 11-15 years, while 4(15.4%) for less than 5 years and the least 2(7.7%) for more than 15 years. The findings indicated that most of the respondents had worked in the bus road vehicle fabrication company for more than 6 years. This implies that the respondent had enough experience to give relevant information on the relationship between bus vehicle product quality standard of a local midi bus fabrication process.

Table 4.3 Working Experience of Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
<5year	4	15.4	15.4	15.4
6-10years	16	61.5	61.5	76.9
11-15years	4	15.4	15.4	92.3
>15year	2	7.7	7.7	100.0
Total	26	100.0	100.0	

4.2.3 Job Category of Respondents

Results on the job category of respondents as presented in Table 4.4 reveal that the majority (18 (69.2%)) of them were technicians, with 6 (23.1%) supervisors and 2 (7.7%) managers. This implies that various categories, disciplines, and statuses of employees work in the automotive fabrication sector in Ethiopia.

Table 4.4 Job Category of Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Technicians	18	69.2	69.2	69.2
Supervisors	6	23.1	23.1	92.3
Operation Managers	2	7.7	7.7	100.0
Total	26	100.0	100.0	

4.2.4 Highest Level of Education Attained

From the analysis of respondents' level of education shown in Table 4.5, 7 (26.9%) of the respondents were certificate holders, with 4 (15.5%) having diploma of education, with 4 (15.38%) having Degree, secondary and undergraduate education, while 9 (34.6%) and 2 (7.7%) Primary and secondary education.

Table 4.5 Highest Level of education attained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	2	7.7	7.7	7.7
	Secondary	9	34.6	34.6	42.3
	Certificate	7	26.9	26.9	69.2
	Diploma	4	15.4	15.4	84.6
	Degree	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

It can be concluded that the employees had the relevant education necessary to proactively participate in issues regarding the relationship between local bus road vehicle product quality standards of a local midi bus. The result indicates that most of the employees of the Midi-bus building are qualified with high school diplomas and certificates, while the rest are diploma and a degree graduates. That is why the Manufacturing Technology Engineering and Research and Development Center are focusing on training for the preparation and development of product quality standards. Training is a catalyst for a deeper understanding of mechanisms and control systems that enable workers to be imaginative, inventive and able to take teamwork measures, preparation and development of product quality standards.

4.3 Product Quality Standard of local midi bus status analysis

4.3.1 Influences of Safety and comfort on the product quality standard of local midi bus

In order to arrive at the objective, it's better to dig out factors that influence local midi bus builder product quality standard. 8 questions were distributed to respondents to examine general information about the Safety and comfort that influences the product quality standard of local midi bus.

The main concept on the first question was to identify if Ergonomic and anthropometry that influences of the product quality standard of local Midi Bus. The questionnaire has discussed four Ergonomic and anthropometry related question which presented in Table 4. 6. The analysis result show that the average answer for influence of Safety and comfort questions is 11.5% strongly disagrees, 53.4% disagree, 11.5% moderately agree, agree 15.4%, 7.7 strongly agree. Total percentage of positive answer which is the addition of agree and strongly agree is 23.1%.and total percentage of negative answer which is the addition of strongly disagree and disagree is 64.9 %. The result of the analysis show that Safety and comfort standard has highly influence on product quality standard of local midi bus of case company.

Table 4. 6 Safety and comfort that influences standard of local midi bus

List of items	SA	A	MA	D	SD
Local midi bus company has Safety and comfort standard criteria.	3 (11.5%)	2 (7.7%)	3 (11.5%)	9 (34.6%)	9 (34.6%)
Your company has methods that are used to analyze Safety and comfort standard.	3 (11.5%)	3 (11.5%)	1 (3.8%)	9 (34.6%)	8 (30.8%)
There is a good relationship/linkage on institute of Ethiopian standard.	4 (15.4%)	1 (3.8%)	1 (3.8%)	14 (53.8%)	9 (34.6%)
You able to use Ethiopian standard the Safety and comfort fabrication process of local midi bus	3 (11.5%)	3 (11.5%)	5 (19.2%)	12 (46.2%)	4 (15.4%)
There are different causes for low Safety and comfort in your company.	0	3 (11.5%)	5 (19.2%)	8 (30.8%)	9 (34.6%)

Immediate superior support you by Safety and comfort that are used for the fabrication process.	3 (11.5%)	0	5 (19.2%)	10 (38.5%)	8 (30.8%)
There should be an Ethiopian standard for safety and comfort to perform tasks in the quality department.	3 (11.5%)	0	4 (15.4%)	11 (42.3%)	8 (30.8%)
There is a possible solution to apply the safety and comfort of the selected product.	4 (15.4%)	2 (7.7%)	4 (15.4%)	12 (46.2%)	4 (15.4%)

KEY: SA=strongly agree; A=Agree; MA=moderately agree; D=Disagree and SD=strongly disagree

The main concept in the first question concerns the identification of the presence of safety and comfort that affects the product quality standard of local Midi Bus products. The majority of the questionnaires presented are highly disagreeable and disagreeable, which shows that case company and institute of Ethiopia standard together needs to work on safety and comfort standard, and that the case company needs awareness to understand safety and comfort related to product quality standard on local Midi Bus.

4.3.2 Influences of Ergonomic and anthropometry on the product quality standard of local midi bus

In order to arrive at the objective, it's better to dig out factors that influence local Midi Bus builder product quality standards. Four questions were distributed to respondents to examine general information about ergonomics and anthropometry that affect the product quality standard of the local midi bus.

The main concept of the first question was to identify if ergonomics and anthropometry influence the product quality standard of the local Midi Bus. The questionnaire has discussed four ergonomic and anthropometry-related questions, which are presented in Table 4. 7. The analysis results show that the average answer for the influence of ergonomic and anthropometry questions is 15.4% strongly disagree, 46.2% disagree, 19.2% moderately agree, 11.5% agree, and 7.7% strongly agree. The total percentage of positive answers, which is the addition of agree and strongly agree, is 19.2%, and the total percentage of negative answers, which is the addition of strongly disagree and disagree, is 61.6%. The result of the analysis shows that ergonomics and anthropometry have a

highly significant influence on the product quality standard of the local midi bus of the case company.

Table 4.7 Ergonomic and anthropometry concerns that have impact on standard of local midi bus

List of items	SA	A	MA	D	SD
Mostly there is Ergonomic and anthropometry specification on your Company.	2 (7.7%)	2 (7.7%)	14 (53.8%)	3 (11.5%)	5 (19.2%)
There are major Ergonomic and anthropometry problems that occur on the local midi bus.	3 (11.5%)	3 (11.5%)	10 (38.5%)	3 (11.5%)	7 (26.9%)
There are different defects that are observable exceedingly on production process and indicate the problems of Ergonomic and anthropometry	2 (7.7%)	3 (11.5%)	10 (38.5%)	6 (23.1%)	5 (19.2%)
There is Ergonomic and anthropometry problem or defect occurring repeatedly (frequently) on local midi bus.	2 (7.7%)	4 (15.4%)	12 (46.2%)	4 (15.4%)	4 (15.4%)

KEY: SA= strongly agree; A=Agree; MA=moderately agree; D=Disagree and SD=strongly disagree

The main concept in the second question concerns the identification of the presence of Ergonomic and anthropometry that affects the product quality standard of local Midi Bus products. The majority of the questionnaires presented are highly disagreeable and disagreeable, which shows that case company and institute of Ethiopia standard together needs to work on Ergonomic and anthropometry, and that the case company needs awareness to understand Ergonomic and anthropometry related to product quality standard on local Midi Bus.

4.3.3 Influences of Engineering Material on the product quality standard of local midi bus

In order to arrive at the objective, it's better to dig out factors that influence local Midi Bus builder product quality standard. Four questions were distributed to respondents to examine general information about the Engineering material that effect the product quality standard of local midi bus

The main concept on the first question was to identify if engineering material that influences of the product quality standard of local Midi Bus. The questionnaire has discussed four Engineering material related questions which presented in Table 4.8. The analysis result show that the average answer for influence of engineering material questions is 15.5% strongly disagree, 42.3% disagree, 19.2% moderate, agree 11.5% and 7.7 %strongly agree. Total percentage of positive answer which is the addition of agree and strongly agree is 19.2%. And total percentage of negative answer which is the addition of strongly disagree and disagree is 57.8 %. The result of the analysis show that engineering material has highly influence on product quality standard of local midi bus of case company.

Table 4. 8 Engineering material that influences standard of local midi bus

List of items	SA	A	MA	D	SD
There is no much difference in the use of standard stainless steel to that of mild steel in local bus body building	2 (7.7%)	4 (15.4%)	14 (53.8%)	1 (3.8%)	5 (19.2%)
Fasteners, hand rails and hand holds and guarding of step wells are more often than not made of standard stainless steel.	3 (11.3%)	3 (11.3%)	10 (38.8%)	3 (11.3%)	7 (26.9%)
In most cases bus vehicle body is built by body builders as per the requirements of the public transport /institutions or customer desire and specifications.	1 (3.8%)	3 (11.5%)	3 (11.5%)	14 (53.8%)	5 (19.2%)
Bus vehicle body is painted as per the requirements of the customer/passenger.	1 (3.8%)	2 (7.7%)	2 (7.7%)	17 (65.4%)	4 (15.4%)

KEY: SA= strongly agree; A=Agree; MA=moderately agree; D=Disagree and SD=strongly disagree

Future research is needed to see the exact effects of engineering materials. However, from Table 4.8, the majority of respondents said that the question of the application of engineering materials affects the product quality level of the local midi bus.

4.3.4 Influences of Fabrication process the product quality standard of local midi bus

The main concept on this question was to identify if Fabrication process that influences of the product quality standard of local Midi Bus.

Fabrication process of local midi bus by combining typically standardized parts using one or more individual processes. For example, steel fabrication is the production of metal structures using a variety of processes such as cutting, bending, welding and assembling. In order to arrive at the objective, it's better to dig out factors that influence local Midi Bus builder product quality standard. Four questions were distributed to respondents to examine general information about the Fabrication process that effect the product quality standard of local midi bus

The main concept on this question was to identify if Fabrication process that influences of the product quality standard of local Midi Bus. The questionnaire has discussed five Fabrication process related question which presented in Table 4.9. The analysis result show that the average answer for influence of Fabrication process questions is 26.9% strongly disagree, 26.9% disagrees, 15.4% moderate, agree26.9% and 3.8% strongly agree. Total percentage of positive answer which is the addition of agree and strongly agree is 30.8% and total percentage of negative answer which is the addition of strongly disagree and disagree is 53.8%. The result of the analysis show that Fabrication process has highly influence on product quality standard of local midi bus of case company.

Table 4.9 Fabrication process that influences standard of local midi bus

List of items	SA	A	MA	D	SD
your organization uses standard welding to join type local midi bus body mild steel metal sheets and steel structures	2 (7.7%)	4 (15.4%)	4 (15.4%)	11 (42.3%)	5 (19.2%)
local midi bus in your organization are fabricated and can readily fulfill the Ethiopian standard	2 (7.7%)	3 (11.5%)	2 (7.7%)	14 (53.8%)	5 (19.2%)
This organization takes a keen interest in technical skills and knowledge in electronic component sensitivity.	3 (11.5%)	1 (3.8%)	5 (19.2%)	12 (46.2%)	5 (19.2%)
The fabrication process of bus assembly is usually based on the body assembly finished by painting. In the multi	2 (7.7%)	3 (11.5%)	3 (11.5%)	13 (50.0%)	5 (19.2%)

station flow production line					
Fabrication is the process of constructing products by combining typically standardized parts using one or more individual processes.	2 (7.7%)	4 (15.4%)	4 (15.4%)	12 (46.2%)	4 (15.4%)

KEY: SA= strongly agree; A=Agree; MA=moderately agree; D=Disagree and SD=strongly disagree

The majority of the questionnaires presented are highly disagreeable and disagreeable, which shows that case company and institute of Ethiopia standard together needs to work on Ergonomic and anthropometry, and that the case company needs awareness to understand Ergonomic and anthropometry related to product quality standard on local Midi Bus.

4.4 Qualitative result

To better understand and analyze the Ethiopian standard development process, this paper interviewed various individuals involved, including the national standards development manager, standard experts, and employees from different departments. The interviews were performed multiple times to collect relevant information and cross-checked to ensure the reliability of the responses. This paper believes that this study needs more resources to provide information to all the people, stations, and departments that are concerned about this issue, especially the Ada bus assembly and Metal Engineering factories. By gathering more data and insights through these interviews, this paper hopes to make informed recommendations for improving the standard development process in Ethiopia's manufacturing industries, including the automotive fabrication sector.

Factory manager: involves how upper management guides the organization and how the organization leads in the community. They did not emphasize national standards for local midi bus product quality.

Human Resource Focus: Outlining the importance of human resources, around 40 employees work round the clock to ensure the base of designing highest standards in quality due to precise and undeviating guidance given through the human resources. According to him the key aspect of its success is its skilled and motivated workforce backed by a superior image of the company. With

the focus on achieving further sustainable development, the company has implemented several initiatives within the past few years including projects focused on employee skills development, local and international training and identifying the gaps to be competitive in HR. The approach to training and skill development except national product quality standards and has enhanced employee motivation and engagement with the company, where the company gains a long-term achievement in HR sustainability which enhances employee productivity. However, Human Resources explained the company did not use product quality standards in corporate with the national standard institute. In monitoring the production quality standard of the Midi Bus road vehicle, ensuring that it meets the required standards

The researcher found that there is a lack of written documents and organization at the Ethiopian Standard Institute regarding the local Midi Bus road vehicle product quality standards. The institute is not responsible for carrier product quality standard training, awareness creation, periodic discussion, local road vehicle product quality standard strategies, and knowledge dissemination. When asked about what needs to be done to set the standard of the local road vehicle, most employees and managers agreed about the importance of adapting road vehicle standards development, providing training, building knowledge, creating awareness, and exchanging experiences. However, they also expressed concerns about the lack of training provided to local road vehicle builders and the need for clearer instructions and perspectives for the work.

Human Resource Focus: Outlining the importance of human resources, around 52 employees work round the clock to ensure the base of designing highest standards in quality due to precise and undeviating guidance given through the human resources. According to him the key aspect of its success is its skilled and motivated workforce backed by a superior image of the company. With the focus on achieving further sustainable development, the company has implemented several initiatives within the past few years including projects focused on employee skills development, local and international training and identifying the gaps to be competitive in HR. The approach to training and skill development except national product quality standards and has enhanced employee motivation and engagement with the company, where the company gains a long-term achievement in HR sustainability which enhances employee productivity. However, Human

Resources explained the company did not use product quality standards in corporate with the national standard institute

Local Midi Bus Fabrication Process Management: The Company did not adhere to national standards regarding product quality, specifically in regards to ergonomics, anthropometry, safety and comfort, engineering materials and components, and fabrication processes. National standards recognize that there is always room for improvement in product quality, even when no errors occur. Competitors are always striving to make their products better, so it is important for companies to use product quality standards to avoid falling behind. Companies should aim to receive no complaints from customers, not just keep them to a minimum. This requires adopting a new approach to product quality standards, such as ensuring that each customer is satisfied with their public transport (de la Rosa et al., 2017).

Table 4.10 interview responses related to fabrication of local Midi Bus product quality standard

Question items for interview	Yes (%)	No (%)
Is there a series of preparation and development that can be used to approve and set the national standard performance of local built midi buses?	14.28%	85.72%
Do you know factors that help institute of Ethiopia standard to develop quality standard of local midi bus road vehicle?	79.34%	20.66%
Does institute has good local midi bus road vehicle standard development team in Ethiopia standard?	-	100%
Does the Ethiopian Standards Institute has a local midi bus road vehicle standards development team and workplace	-	100%
Do you have some local midi bus road vehicle standard development mechanisms that used to develop local road vehicle standard development?	71.43%	28.57%

4.5 Field observation data analysis

Observation of the Ada Bus Assembling and Metal Fabrication factory showed that the owner and managers of the company are more concerned with profit and minimization of cost than optimization of the local midi bus product quality standard. Also, there are no written documents,

product specification manuals, training manuals, periodic assessments of local midi bus standard performance, or the national standard product quality standard they use.

4.5.1 Local Midi Bus Fabrication Process influence

During the factory visit, the researcher observed that the midi bus in the factory uses different materials. The frame or chassis uses secondary materials that are not cracked, bent, or broken, as verified by an internal expert. But it was found necessary to do it based on national product quality standards. Parts and accessories must not be installed on the Midi Bus frame or chassis in a commercial environment except as specified by the local Midi Bus factory. But the fabrication of the frame or chassis, including all other processes, takes place in a designated place, just like any other fabrication or assembly. Researchers observed that the quality of the local Midi bus is affected due to the lack of national product quality standards in the fabrication process.



Figure 4.1 Local midi bus fabrication processes from factory survey

For Ada Midi bus manufacturing automotive assembly operations, only arc welding was used, using the most common welding methods. During factory observation welding of the midi bus structure and body construction process, resistance metal inert gas (MIG) welding, plasma arc welding (PAW), and tungsten inert gas (TIG) welding were not used for bus construction.

4.5.2 Local Midi Bus fabrication influence on Comfort and Safety standard

The passageway seat is generally considered the average seat by factory standards and has been complained about by passengers. However, the lack of registration with the standards of the Ethiopian Institute is a gap. Because it was easy to get in and out of, and if the footrest was adjusted more than other seats during the factory inspection, passenger complaints would be reduced. However, during the construction process, metal bolts and assembly inconveniences were noticed. The window seat is often considered the worst seat because it's difficult to get in and out of, and one can't see out the window. In terms of comfort and safety, door frames, seat frames, bolt and nut installation, and welding work are not adjusted, and not using the qualifications of the Ethiopian Standard Institute was seen as a limitation.



Figure 4.2 Local Midi Bus Comfort and Safety from factory survey

But Local Midi Bus/Litkit: a long- Long distance bus with room for comfort and safety to maintain factory standards as much as possible. It has been seen that the lack of practice to build the system using it and not working together with the Ethiopian Standard Institute to produce the standard has highlighted the problem.

In the ergonomics standard, anthropometric data, taking into account the differences between the characteristics of the passenger's body, capabilities, and physical limitations, is used to construct passenger and driver seating positions, equipment, safety devices, and personal protection. The experts said that they did not have an understanding of the standard of product quality.

4.5.3 Cutting and bending machine workstation

Operation of the line begins with the worker shaping and bending the supplied Midi Bus building material to prepare it for the next job. It has a cutting saw and sheet metal cutting shearing machine, a power hack saw machine, and an auxiliary measuring tool. There are four workers in the cutting and bending workplace; two of them work on the machine, namely the cutting machine and the metal cutting shearing machine, to set up the machine with parts, and the other two operate the machine. This preparation of material will prepare the desired length according to the requirements given to them by the supervisor. The cutting and bending operations are completed in the factory's work shop and transported to the construction site. It is understood that the experts in this work department do not have national standard knowledge in terms of product quality compared to the requirements given to them by the supervisor.

4.5.4 Midi Bus fabrication work station Welding process influence on standard

In the welding process, metal material uses the materials provided from the cutting and bending section to build the road vehicle structure, and the welding work is performed at the designated location.



Figure 4.3welding process and machine (Field survey)

As shown in Figure 4.10, when the employee works on welding prepared building materials on irregular floors, no effort is made to prevent defects in the product quality standard of the midi bus road vehicle being built, even if the workplace is in a sitting or standing position. This has a negative impact not only on the worker's lack of comfort but also on the product quality standard of the midi bus vehicle structure, especially the standard of comfort and safety for the passenger. The expert explained that all the welding work is done by arc welding, and the researcher observed this. However, the use of arc welding for vehicle body construction has affected the product quality standard performance of the local mid bus fabrication.



Figure 4.4 Welding process (Field survey)

Another welder can be seen sitting on the roof of a vehicle, as shown in Figure 4.2. It is difficult for the operator to carry out his work and receive the electrode needed for welding. The appearance of the welding process has a negative impact on the product quality of the vehicle as well as its performance.

4.5.5 Midi Bus assembling workstation influence product quality standard

The factory has fabricated a single Midi Bus assembly as shown in Figure 4.12 there is a single work location per bus or midi bus vehicle. Once the midi bus road vehicle is placed in a designated location, the rest of the vehicle construction work would be done there



Figure 4.5 Midi Bus Assembling work station (Field survey)

It is difficult to carry out an inspection of the completed work done on a vehicle. For example, once the vehicle structure was finished, the welding quality had to be checked to the specified quality standard and transferred to the next midi bus body job or the next job. It was seen that the next job was done immediately without any quality inspection or testing being done. This has a

negative impact on the product quality standard of the midi bus road vehicle as a whole, and particularly on the performance of the midi bus road vehicle.

4.5.6 Painting Process Influence Standard of Local Midi Bus

Before the vehicle body is painted, the vehicle is prepared for painting. As shown in the picture, the body of the candle is received individually and placed on the ground. In figure 4.13, it is observed that the product quality is affected by painting, welding, and the fabrication process.



Figure 4.6 Midi Bus Assembling work station (Field survey)

4.6 Effect of the existing practice on development local Midi Bus product quality standard

The objective of the study was to investigate how current practices in standard development and workflow frameworks affect the quality standards of the local Midi Bus product. The local Midi Bus is designed to provide public transportation services in Ethiopia. The study found that the automotive fabrication sector of the local Midi Bus has a weak connection with the Ethiopian Standard Institute in terms of product quality standards development and approval. This is due to the composition of the technical team, which has not been revised and lacks a relevant technical committee. The Electromechanical Standard Development Team of the Ethiopian Standards

Institute follows the institute's current structure and offers services for vehicle product quality standards with the previous technical committee composition and revised or unrevised scope.

4.7 Result and Discussion

This section explains how to use the modeling framework to develop a model that supports the current product quality standard development process for local MIDI bus fabrication and identifies issues with the current framework. It also relates to and examines the impact of local midi buses on ergonomics, safety, comfort, input materials, and manufacturing processes. Develop a model and framework in combination with the identified issues and the production quality standards of local midi buses.

4.7.1 Existing framework of product quality Standard Development

From the collected data, observation, and interviews, as shown in Figure 4.1, the existing framework includes seven technical committees, stakeholders, the Metal Industry Development Institute as role of intermediaries for preparing standard request proposals, and the Ethiopian Institute of Standards.

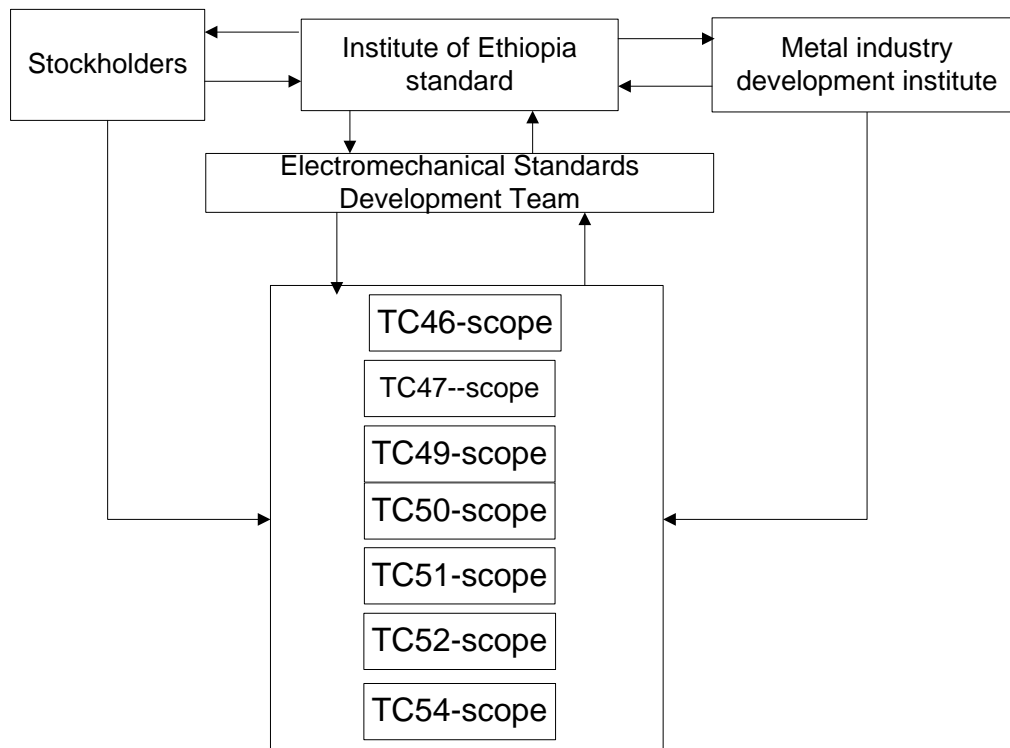


Figure 4.7 the existing framework

Figure 4.11 Existing framework of product quality Standard Development and Scope of technical committee

List Technical Committee	Designation	Scope
Mechanical system and components	TC46	Standardization of Mechanical system and components which lay down Characteristics and design of screw threads, fastener, stud, nuts, rolling bear, plain bearing and including their technical requirements
Mechanical system and components	TC47	Standardization of methods for mechanical testing, including the verification and Calibration of equipment that are used to determine the properties of metallic materials.
Mechanical testing of metals	TC49	Standardization of Hand-held assembly tools, electric tools and pneumatic tools; all machine tools for the working of metal, wood and plastics, operating by removal of material or by pressure
Manufacturing engineering	TC50	Standardization of Tractors, machines, systems, implements an their equipment used in agriculture and forestry.
Tractors, machinery for agriculture and forestry and mechanical handling equipment	TC51	The standard covers standardization in the field of:-Cast, wrought and cold-formed steel, including technical delivery conditions for steel; all types of cast iron and all types of pig iron; Ferroalloys and other alloying additives used in iron-and steel making;-Iron ores, including terminology, methods of sampling, preparation of samples, moisture determination, size determination, chemical analysis and physical testing; - Protective and decorative metallic and non-metallic coatings (excluding paints and other organic coatings) applied by electrolysis, fusion, vacuum or chemical means, mechanical deposition, ion plating, and the testing and Inspection methods for such coatings.
Ferrous metals	TC52	Standardization in the field of: Light metals and their alloys (i.e. aluminum magnesium, titanium and their alloys).
Non-ferrous metals	TC54	The standard covers standardization of all questions concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of moped, motor cycles, motor vehicles, trailers, semi-trailers, light trailers, Combination vehicles, articulated vehicles and their equipment

Source: institute of Ethiopia standard

The first objective of the study was to investigate how the practices in standard development workflow frameworks affect the fabrication quality standards of midi buses in the country. Local midi buses are based on public transport or public service operations to support road transport in Ethiopia. The study indicated that there is a weak relationship between the production quality level of the domestic midi bus sector (automotive factory) and the preparation, development, and certification of the Ethiopian Standard Institute. Preparation of product quality standards according

to standards development experts, sets of materials and components, sets of quality-carrying characteristics, do not attach when stating damage due to the inability to set product quality standards due to identification of quality-carrying characteristics: set of production process and production process quality-carrier related to the production of intermediate bus products. A set of features also made an impact by not being designed separately. As can be seen in Figure 4.1, the Ethiopian Standards Institute has supported local midi buses that are not included in ISO/TC related to road vehicles and did not encourage the fabricator to do the work.

4.7.2 Identify the reasons of why the existing standard development framework is not doing well

The second objective is to determine why the current standards development framework is not effective in establishing local Midi bus product quality standards. According to data from the Institute of Ethiopia Standards, there is an Electro-Mechanical Standard Development Team responsible for ensuring the quality of local Midi buses through the Institute. The institute's information reveals that the team consists of seven technical committees with a total of 40 members. However, none of the participants could discuss the product quality standard of local Midi buses on behalf of the automotive factory sector, which prevented them from working on the standard, according to the information obtained from the fabricator and the institute. In addition, data from the case company based on the questions, interviews, and observation of the factories showed that the factories did not ask for and use the product quality standards regarding local Midi buses, while on the other hand, the data obtained from the institute shows that the institute does not have the experience of developing, approving, and informing the product quality standards of local Midi buses.

According to the data obtained from the institute, the scope of each technical committee has remained unchanged since the existing framework was in operation during the establishment of the institute in 1972, which prevented the fabricator Midi Bus from participating as a representative. In addition to this, the document survey of the company's case shows that there is a lack of awareness as to the impact that local midi buses have no knowledge of setting product quality standards and no technical committee representative at the national authority level.

The data from the Institute, from a fabricator and related literature review, shows that, since the establishment of the institute, the local midi bus fabricator has been made by matching the scope of each technical committee and lack of experience in product quality standards. The results of the

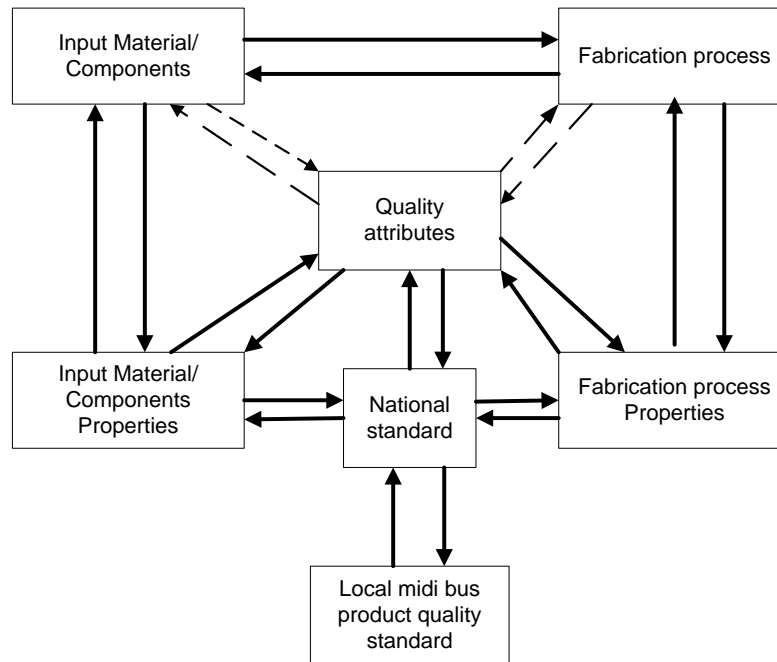
company's survey showed that there is a lack of awareness in the area of setting product quality standards and approving midi buses product quality standards. The data from both sides is clear as to why the existing standard development framework is not doing well. The institute's document analysis shows that most of the members of the technical committee are assemblers, businesses, importers, and exporters of road vehicles. This indicates that, due to the absence of representatives from the automotive factory sector, it was not possible to prepare and approve product quality standards.

4.7.3 Framework for a Model of local midi bus Product Quality Standard

The approach to formulating a model and developing a framework for local midi bus product quality is to first identify a small set of high-level quality attributes and then, in a top-down fashion, decompose these attributes into sets of subordinate attributes. The local midi bus product evaluation standard, ISO/TS 16949, and ISO/road vehicle are typical of this approach. In this case, it decomposes fabrication processes into four attributes: analyzability, stability, testability, and modifiability. While this provides some indication of what local midi bus fabrication processes are about, the technical processes are still very vague and of little assistance in building quality into local midi buses. Seeking even further direct decomposition of such vague attributes is not the best way forward. Instead, it is better to employ a model that places only a single level (a set of quality-carrying properties) between the high-level quality attributes and the components of a product linked to national standards. Fabricators, like local minibuses, will show that such an approach is both simpler and much more powerful. It allows them to approach the task of building a model for local midi bus product quality in a systematic and structured way by proceeding from the intangible to the tangible. This is a practical strategy for dealing with concepts as elusive and complex as product quality standards.

Elsewhere, we have described a generic model along these lines that supports building quality into products and processes (Pacana & Czerwińska, 2020). Using this general model as a starting point, in conjunction with the national standard, a related technical committee and product quality standard model was developed as a model consisting of six main entities, namely: a set of material/components, a set of quality-carrying properties of components, a set of high-level quality attributes, a set of developed national standards, a set of fabrication processes, and a set of quality-carrying properties of the fabrication process. There are at most twenty-two binary relations among

these entities. The following diagram illustrates the potential relationships that must be considered when building local midi bus product quality standards into designs.



A model has been created by merging fabrication processes, national standard, and Dromey's generic quality model.

Figur4.8 Propose local midi bus product quality standard model

From two important perspectives: Firstly, build quality from the bottom up. That is, for each component, we can identify which quality-carrying properties are important to satisfy and which high-level quality attributes each of these properties impacts. In defining this perspective, the quality-carrying properties serve as the intermediaries that link entities to high-level quality attributes. It is also possible to employ this model to look at building local midi bus product quality standards from the top down. That is, for each high-level product quality standard attribute, the automotive fabrication sector can identify which quality-carrying properties imply that attribute and which product entities possess particular quality-carrying properties. Applying this scheme, we can define the scope of the task of building each high-level quality attribute into automotive fabrication products. In adapting this model to local midi buses, fabricators will replace the terms component and fabrication with structural form, and it will focus on the four primary constructive directed relations that may be used to assist in building product quality standards in local midi buses. The first two of these relationships are:

- structural form \rightleftarrows quality carrying property relation
- quality-carrying property \rightleftarrows quality attribute relation

Together, these two relationships allow us to view the task of building high-level quality attributes together with national standards into local midi buses from the bottom up by ensuring that particular product properties are satisfied. This perspective is most useful to those (that is, the local midi bus fabricators) with the responsibility of implementing product quality standards for local midi buses. In fact, a local midi bus fabrication process standard can be usefully structured along these lines. The other two relationships that are useful are:

- quality attribute \iff quality- carrying property relation
- quality-carrying property \iff quality attribute relation

These two relationships allow us to view the task of building high-level quality attributes into local midi buses from the top-down by identifying which properties need to be satisfied for each structural form in order to build in a given high-level quality attribute. This perspective is most useful to designers and builders who have the responsibility for specifying and factoring high-level quality attributes into the design and fabrication of local midi buses. Only when the company has access to both perspectives is it's in a position to understand what must be done to build quality into local midi buses. This bottom-up, hop-down model can provide the concrete advice that is so vitally important to implementing the process of building product quality standards into local midi buses.

In formulating a model for local midi bus product quality standards based upon the generic framework we have just sketched, we will exploit the property that local midi bus fabrication processes are constructed only using structural forms (that is, the local midi bus passengers reduce complaints about components and materials of the implementation parts and fabrication process).

1. **Component and materials Standardization**

Standardizing components means using the same part in multiple products. This is closely related to product variety. Some examples of standardized materials are sheet metals, metal profiles, rods, and plates, and standardized components are tires, batteries, bearings, motors, light bulbs, resistors, and fasteners. Component standardization happens within a single company, like with the Quad-4 engines at General Motors, and across multiple companies, like with Timken roller bearings at Ford, General Motors, and Chrysler. This paper likes to call these cases internal standardization and external standardization, respectively. In the case of internal standardization, the components

may be designed and manufactured by the company or provided by suppliers. In the case of external standardization, the components are usually designed and manufactured by suppliers.

2. Structural Forms for Processes and Data

To be entirely accurate, it is necessary to focus on the structural forms (components, materials, and fabrication processes) for a particular local midi bus. The reason for this is because we find differences, like the assignment being an expression in C Transfer C to TC but a statement in national standards. Even with this difference, it is possible to adopt a component or material of scope in TC where assignments are only used in statements. Putting these sorts of difficulties aside, a common set of structural forms for processes within the imperative paradigm, listed in order from the highest-level structures to the lowest-level structures (increasing technical committee (TC) order), is given below. The set of structural forms for data (which are ranked below "expressions") within the imperative paradigm are also ranked from the highest to the lowest structural level (again in increasing numerical order) and are also listed.

3. Quality-Carrying Properties of Local Midi Bus

In broadest terms, the properties associated with structural forms that impact the product quality of local midi buses involve two fundamental things: components and materials and fabrication processes. The component/material properties this research will use cover characteristics that impinge on the specification-independent minimum requirements for component/materials, irrespective of the problem being solved (that is, poor component/material criteria rather than strong formally proved component/material criteria) (Dromey, 2011). The fabrication process properties cover characteristics associated with both high- and low-level design, and the extent to which the local midi bus's functionality at all levels is specified, described, characterized, and documented. It is therefore convenient to divide the quality-carrying properties associated with the structural forms of local midi bus buildings into four basic categories. In order of precedence (for classification purposes), these categories are:

- fabrication processes properties (minimal generic requirements for Fabrication processes)
- structural properties (low-level, internal external design issues)
- component/input material properties (high-level, internal external design issues)
- descriptive properties (various forms of specification documentation)

The next step, which is probably the most difficult and open to question, is to identify a set of properties that adequately cover these four categories. In presenting a set of properties that do what is required it does not pretend that this is the only or the best set of properties for a particular application. What it does however claim is that a model of this form provides a very useful way to tackle the problem of local midi bus product quality standard systematically and constructively. Over time, we may expect with experience of application that a more refined and accurate set of properties will emerge. Its criteria for selecting and defining these properties has been based on the requirements that they form an orthogonal (no overlapping), consistent, and complete set. Quality defects that are discovered that do not result from a violation of any of these properties will provide the constructive force needed to refine the property model and definitions of the properties. It may, for example, be appropriate to have a set of properties that focus much more interlobular issues. With this model there may be occasions where one must make the choice of classifying a defect as for instance either a fabrication process problem or perhaps an internal and external local midi bus problem. In this case the precedence (which owner has arbitrarily chosen) suggests the problem should be too classified as a fabrication processes problem. The precedence rule is fabrication processes problems before structural, before assembling and joining, before descriptive problems. Builders reasoning in choosing this order are based on passenger's perception of their relative impact on the utility of local midi buses.

Automotive fabricators and Standard development institute should not be discouraged by this situation as this sort of framework is used over and over again in science to build any good and useful empirical model. What this research proposes is a framework for climbing the ladder of local midi bus product quality and thrust research' foot only on the first rung-the task remains to climb to the top of the ladder, they will list a set of properties that may be associated with structural forms and then provide definitions for each of these properties. Only by examining the definitions of each in detail will it be possible to judge how successful they have been in characterizing the quality-carrying properties of the structural forms of fabrication of local midi buses. Some quality-carrying properties are much harder to define and characterize than other properties. To assist with the definition process, they will use a variety of devices including both positive and negative examples. For example, take the property structured which can apply to a number of structural forms. They can at least partially define the property structured in an indirect way by identifying deviations from being structured. When a deviation from being "structured" occurs it results in a

product quality standard defect. they claim that a structural form must be structured in order not to contribute negatively to the quality of a local midi bus product. Exhibiting any of the deviations such as being “unstructured” or ill-structured prevents a given structural form from having the property of being “structured”. The “definitions” they will use are always corrigible and open to refinement and improvement. They do however provide a basis for developing a useful constructive model of local midi bus product quality standard.

There are a number of defects associated with structural forms that are ergonomic and anthropometry, safety and comfort, input material or components-specific. For example, expressions in C may have side-effects whereas expressions in Pascal do not permit side-effects. they identify the impact of each product defect on the, high-level quality attributes of the ISO-9126 local midi bus Product Evaluation standard in each case. In the quality impact specification, the intent is that the greatest impact is upon the first listed quality attribute and then successively lesser impacts are on the other listed quality attributes. These decisions are empirical.

The order, and hence precedence, of sub properties, within a category has been chosen based on a judgment of the relative impact of a sub property on its parent property. This is purely an empirical heuristic decision. However, it is not hard to justify to most people that a violation of a computability property is likely to have a much more significant impact on fabrication processes than violation of a consistency property.

4. Fabrication process Properties

Fabrication process properties fall broadly into fabrication type that deal with Cutting, folding, casting, forging, machining, shearing, punching, stamping, and welding(Addisu & Koricho, 2022). The particular national and international technical committees’ fabricators have selected have been chosen in such a way that any violation of one of these fabrication types could potentially mean that under some circumstances at least, the local midi bus may not exhibit its intended functionality. For example, if the structure of a local midi bus of internal seat arrangement and joining process indicates that under some circumstances there is a risk that it may not terminate then this risk threatens correctness and hence functionality and is therefore a product quality standard defect. By contrast an interior part of local midi bus may be classified as progressive if upon examining its structure we find that for all paths through the interior part of local midi bus there is evidence of progress towards termination and it is not possible to by-pass the termination point. These characteristics are a weak installation of the formal requirements for a proof of

termination. The fabrication process type properties automotive fabrication sectors will use are therefore:

- TC46. suitable technical committee Result obeys laws of Mechanical system and components, etc.
- TC47 suitable technical committee Result obeys laws of Mechanical system and components, etc.
- Tc49 suitable technical committee Result obeys laws of Mechanical system and components, etc.
- TC50 suitable technical committee Result obeys laws of Manufacturing engineering
- TC51 suitable technical committee Result obeys laws of Tractors, machinery for agriculture and forestry and mechanical handling equipment
- TC52 suitable technical committee Result obeys laws of Ferrous metals
- TC54 suitable technical committee Result obeys laws of Mechanical system and components, etc.
- ISO/TC22 suitable technical committee Result obeys laws of Road vehicles
- ISO/TC35 suitable technical committee Result obeys laws of Paints and varnishes, etc.
- ISO/TC44 suitable technical committee Result obeys laws of Welding and allied processes
- ISO/TC159. suitable technical committee Result obeys laws of ergonomics/human factors

Each of these technical committee which has composed from stakeholders, manufacturing industries to chairman, members and secretary precedence will now be defined and discussed in more detail in see Appendix 2

A. High-Level Quality Attributes of Local Midi Bus

When discussing the quality of fabrication, it is often evaluated based on high-level attributes such as functionality, reliability, build ability, and maintainability. However, selecting these high-level quality attributes can be challenging because they should be complete, compatible, and non-overlapping. Unfortunately, this is difficult to achieve in fabrication because each high-level quality attribute is dependent on several low-level quality-carrying product characteristics that impact multiple high-level quality attributes. For instance, redundancy in fabrication affects efficiency, jointing process, weld ability, manufacturability, build ability, and maintainability, while correctness properties affect reliability and functionality. There is not much that fabrication

sectors and national standard institutes can do about this overlap problem. Instead, they should clarify the links between low-level quality-carrying product characteristics and high-level quality attributes. Moreover, they should ensure that the high-level quality attributes they choose adequately describe the high-level needs that sectors and institutes as well as automotive fabrication factories together have for fabrication.

The national standard for local midi bus evaluation, which is based on six quality attributes (functionality, reliability, usability, efficiency, maintainability, and operability), is widely accepted and recognized by the national standard technical committee. This standard is linked to the international and national standards for automotive manufacturing and has gained significant popularity. Therefore, there is a serious solution in this standard, as it does emphasize the importance of standards related to ergonomics and anthropometrics, safety and comfort, building materials, and fabrication processes. National standard institutes believe that reusability is a crucial high-level quality attribute of the fabrication of local midi buses that deserves the same recognition as other high-level attributes in ISO-road vehicles due to its impact on productivity and product quality standards.

If the ISO 9126 Quality Model (ISO 1991) is to be accepted by fabrication sectors and national standard institutes, they must clarify the definition of "reusability" and include it in the model. A structural form can be considered reusable if it uses standard local midi bus features, has no vehicle dependencies, and executes a single, well-defined, encapsulated, and precisely specified function that can be fully adjusted during performance testing. Additionally, the performance testing and data structures associated with a reusable module should have parameterized lower and upper bounds for all ranges. No variable should be assigned to a technical committee or any other fixed constant, and all constants used should be declared. Although some may argue that the fabrication process and functionality already cover reusability, it is a unique subset of modularity, structurally, and descriptive properties that deserve separate recognition. Furthermore, recognizing reuse as a high-level quality attribute will prompt those responsible for local midi bus development to construct reusable local midi buses more attentively.

Constructive Theorem: If each of the quality-carrying properties associated with a particular structural form is satisfied when that particular structural form is used in a automotive fabrication sector, then that structural form will contribute no quality defect to the local midi bus.

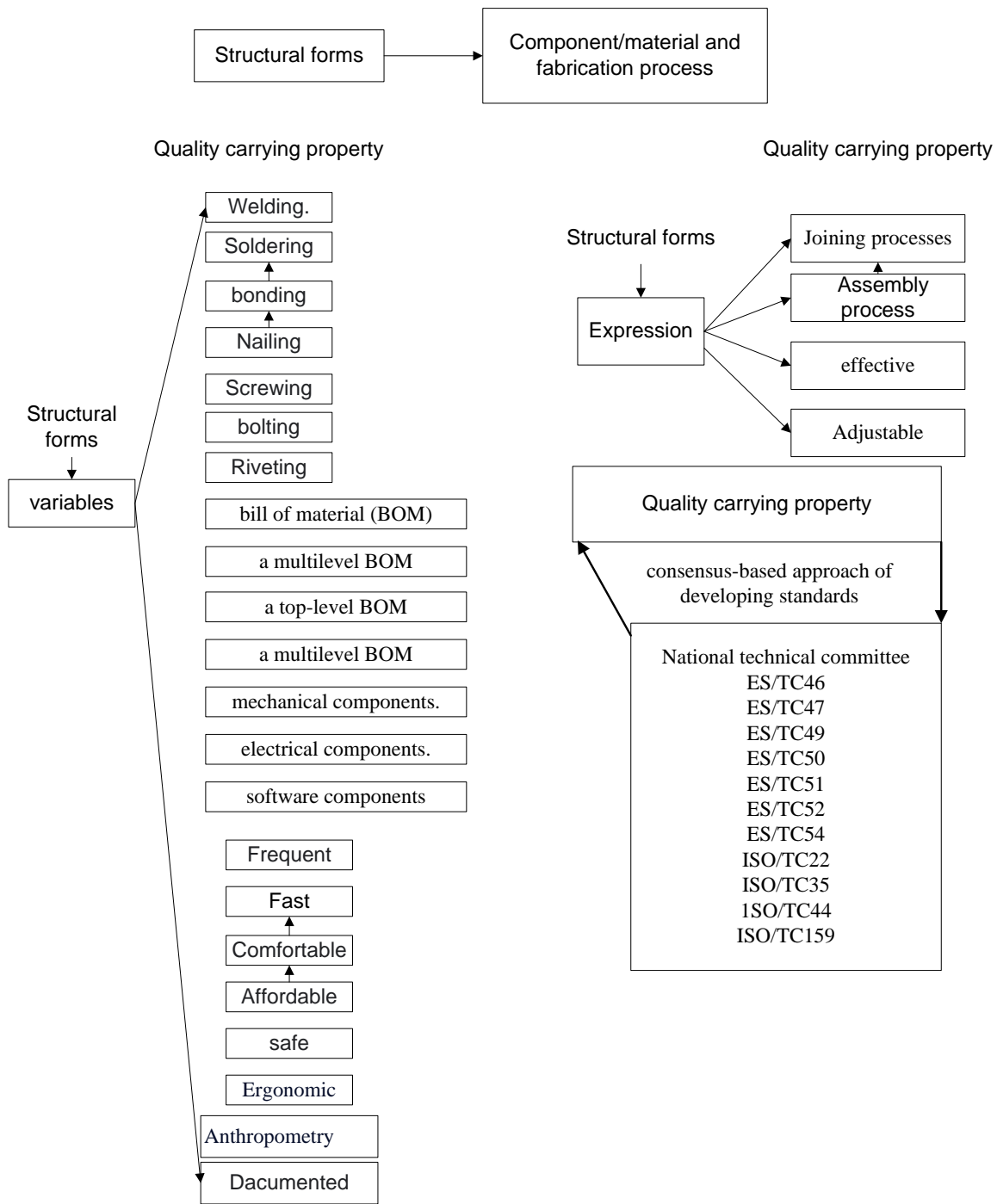


Figure.4.9 quality –carrying properties of variables, expressions and related technical committee

Table 4.12 Developed framework of Electromechanical Standard Development team

List Technical Committee	Designation	Scope
Road vehicles	ISO/TC22	All questions of standardization concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of the following types of road vehicles and their equipment as defined in the relevant items of Article 1 of the convention on Road Traffic, Vienna in 1968 concluded under the auspices of the United Nations
Paints and varnishes	ISO/TC 35	Standardization in the field of paints, varnishes and related products, including raw materials
Welding and allied processes	ISO/44	Standardization of welding, by all processes, as well as allied processes; these standards include terminology, definitions and the symbolic representation of welds on drawings, apparatus and equipment for welding, raw materials (gas, parent and filler metals) welding processes and rules, methods of test and control, calculations and design of welded assemblies, welders' qualifications, as well as safety and health
Ergonomics	ISO/159	Standardization in the field of ergonomics/human factors, in particular, general ergonomics principles, anthropometry and biomechanics, ergonomics of human system interaction and ergonomics of the physical environment, addressing human characteristics and performance, and methods for specifying, designing and evaluating products, systems, services, environments and facilities
Mechanical system and components	TC46	Standardization of Mechanical system and components which lay down Characteristics and design of screw threads,

		fastener, stud, nuts, rolling bear, plain bearing and including their technical requirements
Mechanical system and components	TC47	Standardization of methods for mechanical testing, including the verification and Calibration of equipment that are used to determine the properties of metallic materials.
Mechanical testing of metals	TC49	Standardization of Hand-held assembly tools, electric tools and pneumatic tools; all machine tools for the working of metal, wood and plastics, operating by removal of material or by pressure
Manufacturing engineering	TC50	Standardization of Tractors, machines, systems, implements an their equipment used in agriculture and forestry.
Tractors, machinery for agriculture and forestry and mechanical handling equipment	TC51	The standard covers standardization in the field of:-Cast, wrought and cold-formed steel, including technical delivery conditions for steel; all types of cast iron and all types of pig iron; Ferroalloys and other alloying additives used in iron-and steel making;-Iron ores, including terminology, methods of sampling, preparation of samples, moisture determination, size determination, chemical analysis and physical testing; -Protective and decorative metallic and non-metallic coatings (excluding paints and other organic coatings) applied by electrolysis, fusion, vacuum or chemical means, mechanical deposition, ion plating, and the testing and Inspection methods for such coatings.
Ferrous metals	TC52	Standardization in the field of: Light metals and their alloys (i.e. aluminum magnesium, titanium and their alloys).
Non-ferrous metals	TC54	The standard covers standardization of all questions concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of moped, motor cycles, motor vehicles, trailers, semi-trailers, light trailers, Combination vehicles, articulated vehicles and their equipment

Source: Adapted From (ISO & ESI ,2016)

the basic characteristic of structural forms is that they possess, or alternatively, they may each be assigned a set of quality carrying properties. The form-property model can facilitate building product quality standard into local midi bus, detecting and classifying quality defects in local midi bus and the creation of a framework that is refinable and understandable at a number of levels. A focus on quality defects also makes a positive, if indirect, contribution to building product quality standard into local midi bus by telling us what not to do. In considering local midi bus the two principal categories of structural forms are:

- National Standard Technical Committee \Rightarrow that describe draft product quality standard proposal processes
- discussion based on principle censuses \Rightarrow that agreed opinion develop national product quality standard

Based on the above mentioned gap in the existing standards process flow, an attempt was made to reconcile the threats and weaknesses between the existing standards development team, the technical committee and the revised framework. It can be clearly seen that the improved framework of the Standard Development Team has shown significant improvements by incorporating various technical committees and the case company as well as related departments.

4.8 Summary of the result

The study found that there are gaps in the use of product quality standards in the field of midi bus factories in the country and a lack of a framework to develop product quality standards in the Ethiopian Standard Institute. The study also attempted to link the gaps in the domestic midi bus fabrication sector with the national standard institute, the Manufacturing Technology Engineering Industry Research and Development Center. According to the results of the study, the product quality standard of local midi bus fabrication is not good; the case company does not have a representative in a technical committee and is not involved in product quality standard preparation, development, and approval related to local midi bus safety and comfort standards, ergonomic and anthropometry standards, engineering materials, and components. The study tries to identify that there is no way for the automotive fabrication sector to adapt to the product quality standard framework used for local minibus fabrication.

The existing standard does not appear to have drawn considerably from the framework originally proposed, and while the product quality standard can provide high-level guidance, it does not go nearly far enough to support building quality into automotive fabrication. However, the new development framework overtakes the problem. The existing framework must be recognized in any attempt to build a quality model because the local midi bus does not directly manifest quality attributes. Instead, it exhibits product characteristics that imply or contribute to quality attributes and other characteristics (product and process defects) that detract from the quality attributes of a product. Existing framework models of product quality fail to deal with the local midi bus product and process characteristics side of the problem adequately, and they also fail to make direct links between quality attributes and corresponding product characteristics.

The newly developed framework addresses these two issues. The study focused on the primary local midi bus product, the product quality standard, or its implementation. However, the developed framework in the paper was equally well applied to other components of product quality, such as requirements specifications and user interfaces. In addition to solving the complaints of the passengers and filling the gap, the paper also developed a product quality standard framework for a way of paper and a quality carrying requirements specification.

4.9 The proposed way of product quality standard framework

The proposed way of develop product quality standard of local midi bus framework is differing from the existing standard development team that it includes the auxiliary vehicle standard development team and an additional four technical committees as well as include the automotive fabrication sectors and the local input manufacture as members.

❖ Target Groups

Standards play an important role for every stakeholder in the research community. While there may be significant differences between countries in this respect, it is always important to consider the following groups of stakeholders:

- Policymakers/government organizations
- Research institute and centers
- Ministry of Trade and Industries
- Ministry of Transport
- Researchers
- NGOs

- Suppliers
- Metal Manufacturing industry
- Automotive Fabrication Sector
- Road vehicle Standard Development Team
- Metrology Institute and Conformity Assessment Bodies
- Technical Committees ISO/22, ISO/35, ISO/44 and ISO/159 How to communicate
- Intermediate organizations/center

These include sector associations, research platforms, and clusters. Often they facilitate groups creation and composition as well as idea generation and they are willing to provide information to their members or associates

Once the framework is built, it is important that maintain it. One of the main issues will be the availability of a contact at NSB. Consider the following methods of promoting the engagement of standardization and automotive fabrication sector:

✓ **Creating a dedicated framework**

This can be a low-cost way to reach a potentially wide audience. Make sure the target group will be able to find it by using relevant keywords, such as “standardization”, “local midi bus”, “automotive fabrication”.

✓ **Organizing dedicated events**

These can be very useful for communicating to a wide range of target groups. Such events could be conferences or seminars. It is important to clearly identify the topic of the event, the target audience, the aims as well as the information to be presented and the focus given to the specific interests of the audience.

With these kinds of events, the way in which NSBs contact the potential audience and advertise the event to attract attendees is crucial. Holding face to- face meetings or creating a forum/platform which is useful as a way to provide detailed information to specific stakeholders (e.g. policymakers, research contacts at a university, industries Automotive Fabrication Sector) and to obtain a high level of feedback.

✓ **Integrating technical committees with researchers**

This is simple because of the reason that NSBs are using their existing committee contacts. Often, technical committees are not aware of the benefits of integrating standardization and local midi

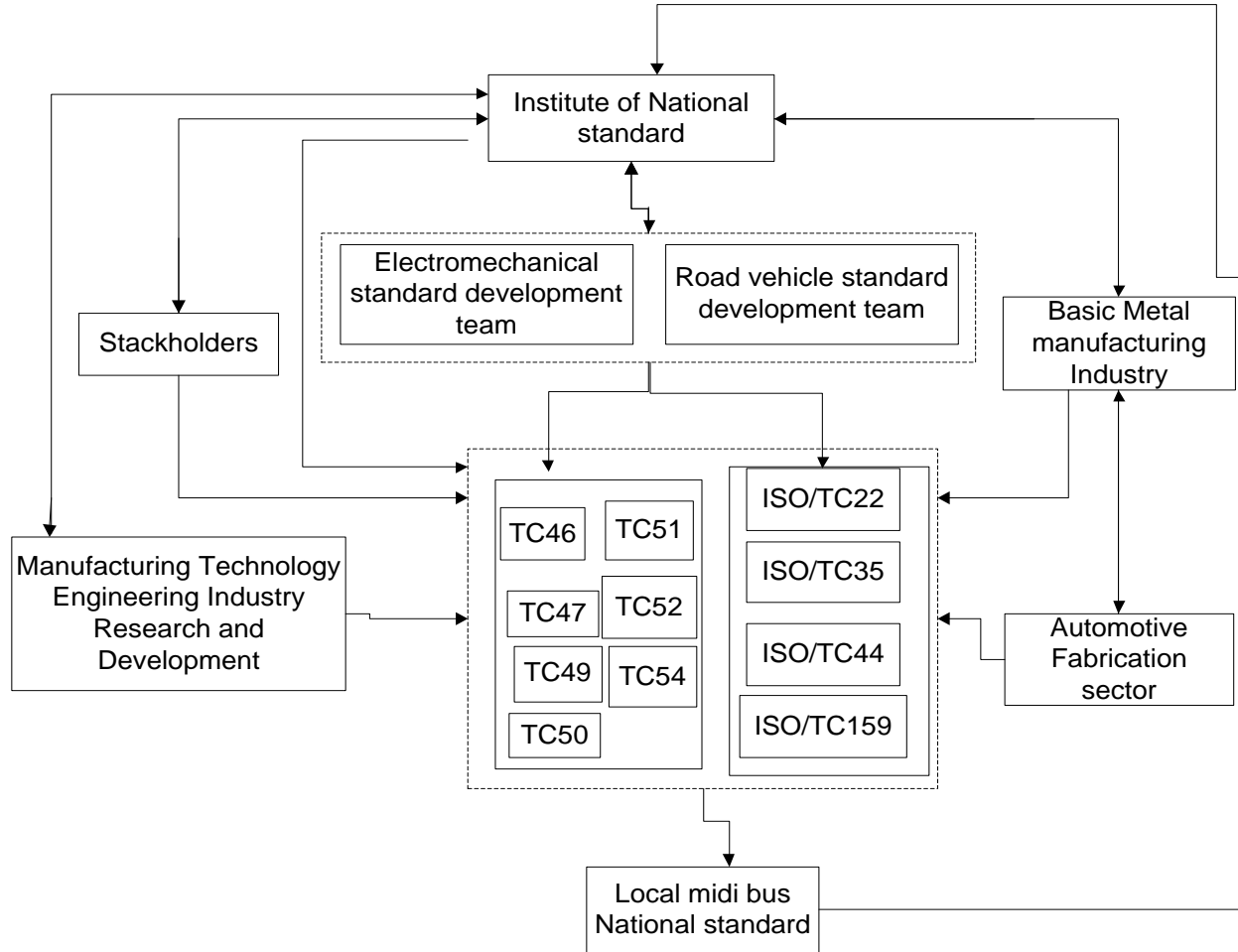
bus fabrication. The same is true for local midi bus fabrications, and they will not understand the way standards are developed and the content that standards have and their benefits for local midi bus and automotive fabrication. Hence, develop improved mechanisms to facilitate and encourage the automotive fabrication Industry to participate in standardization and establish effective mechanisms to support standardization experts to contribute standards-related knowledge to relevant automotive fabrication projects.

✓ **Raising awareness**

Increased awareness of local midi standards, standardization processes, and the benefits standardization brings to local midi bus and car manufacturers, including related government agencies and the metalworking industry. This encourages local stakeholders such as midi buses and car manufacturers to consider the role of standards and standardization in their research projects. This can be done in various ways. Distributing brochures and flyers – These can be used for general purposes as well as for specific audiences and events. Due to the limited amount of information published, it is important to carefully select key topics to publish. Presentations at external events, communicating information to identify target groups and act as the first point of contact for further discussion.

✓ **Combine with the country automotive fabrication development program**

National Standardization Organizations need to reach out to the local midi bus and car manufacturers, including government departments and research agencies, in their country by going beyond simply providing an expert service to local midi bus and car manufacturers, projects. They need to ensure that the catalytic role of standards can be maximized to help overcome the market barriers to the adoption of new technology-based products and services. Designing a policy or strategy that will help to link the country's automotive fabrication development programs and standardization activities is a base line.



A model was created in Figure 4.10 combining fabrication processes, national standards and generic quality model. This framework was derived from the above model in order to be able to develop local midi bus product quality standards.

Figure 4.10. Proposed product quality standard framework

4.10 Existing and developed framework Result Comparison

Significant gains in the quality of local midi buses will not take place until there is a comprehensive model of local midi buses' product quality available. Several different models of local midi buses' product quality have been proposed (Al-Obthani& Ameen, 2018; Sulistiani et al., 2018). While these models offer interesting insights into various aspects of local midi bus quality they have not been strong enough to stimulate significant gains in the quality of local midi bus or to gain wide acceptance.

Most recently the international standard ISO Road Vehicle Technical Committee combined with automotive Product quality standard combined product quality model Evaluation Characteristics has been put forward as a high-level framework for characterizing interrelated to local midi bus product quality standards (Anttila& Jussila, 2017). This product quality standard appears to have drawn considerably on the model originally proposed by the existing model framework. While this product quality standard can provide high-level guidance it does not go nearly far enough to support building quality standards into automotive fabrication sectors for local midi bus.

What must be recognized in any attempt to build a product quality standard model is that local midi bus does not directly manifest product quality standard attributes. Instead, it exhibits product characteristics that imply or contribute to quality attributes and develops product National standards and other characteristics (product defects) that detract from the quality attributes of a product. Existing models and national technical committee of automotive sectors to local midi bus quality standards fail to deal with the product characteristics side of the problem adequately and they also fail to make the direct links between quality attributes, fabrication process, corresponding product characteristics and technical committee of national product quality standard development. Firms need to address these four issues. The firm's focus will be on the primary local midi bus product quality standard, the ergonomic and anthropometric, safety and comfort, engineering materials and fabrication process or national product quality standard implementation. However, the framework we will provide may be equally well applied to other components/materials of automotive fabrication products such as requirements technical committee scopes and passengers or user compliance. As the explanation of standard development staff members, to solve this

complaint, the sectors and institutes together with stakeholders will also apply the national technical committee of a product quality standard model for automotive fabrication sectors related to a local midi bus specification. Experts suggest there is a national standard for road vehicles related to automotive assembly, but no national practical knowledge about local midi buses related to product quality standards. The greatest challenge in proposing any model for local midi bus product quality standards is to find a framework that can accommodate this knowledge in a way that is constructive, refine able, and intellectually manageable. The prime requirement of any such model is that it makes clear and direct links between national standards relative automotive technical committee, high-level quality attributes, explicit product characteristics, fabrication process and product standards at all levels. Beyond this, the model must provide:

- systematic guidance for building quality into the local midi bus
- a means to systematically identify /classify local midi bus characteristics and product quality standard defects,
- a means to systematically identify /classify local midi bus characteristics and develop product quality standards
- a structure that is understandable at a number of levels, refine able and adaptable, and
- a technical committee scope that is aligned with product quality standards of local midi bus products

CHAPTER FIVE

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The study sought to establish the relationship between the local midi bus fabrication process and materials and components (by assessing and identifying the properties, attributes, and national standard technical committee) and national product quality standards of ergonomics and anthropometry, safety, and comfort. From the findings of the study, it shows that local midi bus vehicles were not manufactured using national standards. In order to make the bus manufacturer and the institute work closely together using the proposed product quality framework, the composition of the seven technical committees' needs to be reviewed and improved so that they can be members of the process. The National Standards Institute has a close relationship with the automotive industry regarding product quality standards and ensures local midi buses have a thorough understanding of the product quality standards expected from national standards and automotive manufacturing. The National Standards Institute has to engage strategic planning technical committees related to automotive fabrication and the local Midi buses that use the National Standard. In this section, the research findings are summarized as per each research objective.

The thesis has achieved its goal by identifying the gaps between properties, attributes, and the national standard technical committee in Ethiopian standards and the case company's product quality standards, especially those related to safety and comfort, ergonomics and anthropometry, materials and fabrication process standards, and assessing a product quality standard framework model that involves the local midi bus fabrication sector and adds road vehicle standard development with TC and representatives of automotive sectors. The added road vehicle standard development team, representative of the automotive fabrication sector, and technical committee will help the existing TC more efficiently prepare, develop, approve, and set national standards for the local midi bus fabrication sector.

5.2 Recommendation

Based on the findings of the study, the researcher would like to recommend the following major recommendations to the case company and Institute of Ethiopia standard.

- The automotive fabrication sector and the Institute of Ethiopia Standard should develop policy guidelines for local midi bus national standards application. They should monitor bus construction factories and importers to improve quality.
- The Institute should focus on local fabrication standards requirements, encouraging manufacturers to use advanced materials like stainless steel, ergonomics, and anthropometry, as well as the fabrication process, for improved product quality standards.
- A policy guideline should be developed to invoke a bus body structure recall due to improved vehicle standards. Local bus fabrication companies should access locally manufactured components and periodically send employees to workshops for competence and skill upgrades. Expert committees should be convened to represent various bus-related bodies.

5.3 Future scope of the Research

This study focused on the relationship between local midi bus product quality standards related to ergonomics and anthropometry, safety and comfort, and the material and fabrication processes of local midi bus quality standards through national standards. Future studies should focus on the relationship between vehicle design and materials and the product quality of public transport and use experiments to determine the product quality standard of the local midi buses. Future studies should focus on other types of metal fabrication products in order to compare their product quality standards to international and national standards. In addition, other areas of further research to be considered can be recommended in the following future research areas:

- • Future studies can use the two quality carry cost-related automotive fabrication system data's (project components or input materials) to realize the relationship between passengers 'wants and technical requirements to improve public transport service delivery.
- • Future studies can use the national product quality standard to improve the local automotive fabrication of local buildings.

Future research can take into account other automotive fabrication products and trucks fabrication with a conceptual model integrated approach

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Appendix 1



Addis Ababa University
Addis Ababa Institute of Technology (AAiT)
School of Mechanical and Industrial Engineering (SMIE)
Industrial Engineering

Dear Sir/Madam,

I am a student in Addis Ababa University and currently conducting a research entitled, “**Develop a Product Quality Standard Framework for Local Midi Bus Fabrication Sector:** a case of Ada Bus Assembling and Metal Engineering” for partial fulfillment of the award of Master degree in Industrial Engineering Stream. This questioner is prepared to assess **Ada Bus Assembling and Metal Engineering Sector**. your input is very important to the research hence you are kindly requested to fill these questionnaires to achieve the grand objective of the study. This study is for academic purpose and your response will be kept highly confidential and used only for this research.

I thank you very much in advance for participating in this survey providing your though full feedback.

Tesfaye Gemechu

Mob: 0911385245

Email; tgemehu149@gmail.com

Appendix II

Questioners FOR ADA BUS ASSEMBLING AND METAL ENGINEERING

I. Personal information

1. Age group, 18-30 , 31-40 C, 41-50 D, Above 50
2. Sex: Male Female
3. Academic qualification: 1-12 Grade Diploma Degree
 Master's degree PHD & above
4. Year of service at ADA bus factory
 1 Year 1-5 r 6-10Year 11 & above

II. Please insert a tick (√) where you think is appropriate in the space

KEY: SA=strongly agree; A=Agree; MA=moderately agree; D=Disagree and SD=strongly disagree

Safety and comfort product quality standard of local midi bus					
List of items	SA	A	MA	D	SD
Local midi Bus Company has Safety and comfort standard criteria.					
Your company has methods that are used to analyze Safety and comfort standard.					
There is a good relationship/linkage on institute of Ethiopian standard.					
You able to use Ethiopian standard the Safety and comfort fabrication process of local midi bus					
There are different causes for low Safety and comfort in your company.					
Immediate superior support you by Safety and comfort that are used for the fabrication process.					
There should be an Ethiopian standard for safety and comfort to perform tasks in the quality department.					
There is a possible solution to apply the safety and comfort of the selected product.					
Ergonomic and anthropometry product quality standard of local midi bus					
	SA	A	MA	D	SD

Mostly there is Ergonomic and anthropometry specification on your Company.					
There are major Ergonomic and anthropometry problems that occur on the local midi bus.					
There are different defects that are observable exceedingly on production process and indicate the problems of Ergonomic and anthropometry					
There is Ergonomic and anthropometry problem or defect occurring repeatedly (frequently) on local midi bus.					
Mostly there is Ergonomic and anthropometry specification on your Company.					
Engineering material product quality standard of local midi bus					
	SA	A	MA	D	SD
There is no much difference in the use of standard stainless steel to that of mild steel in local bus body building					
Fasteners, hand rails and hand holds and guarding of step wells are more often than not made of standard stainless steel.					
In most cases bus vehicle body is built by body builders as per the requirements of the public transport /institutions or customer desire and specifications.					
Bus vehicle body is painted as per the requirements of the customer/passenger.					
Fabrication process that influences standard of local midi bus					
	SA	A	MA	D	SD

your organization uses standard welding to join type local midi bus body mild steel metal sheets and steel structures					
local midi bus in your organization are fabricated and can readily fulfill the Ethiopian standard					
This organization takes a keen interest in technical skills and knowledge in electronic component sensitivity.					
The fabrication process of bus assembly is usually based on the body assembly finished by painting. In the multi station flow production line					
Fabrication is the process of constructing products by combining typically standardized parts using one or more individual processes.					

Appendix III

INTERVIEW FOR ADA BUS ASSEMBLING AND METAL ENGINEERING

1. Does your factory have a nationally approved product quality standard for the medium bus body you build??
 No () Yes ()
 If Yes, please explain
2. How does the product quality standard enforce the standards of local bus body building while in factory?
 (a) is it during or (b) after tail end Please explain

3. What is the disadvantage of not using bus body construction standards? Please explain

4. How does product quality level ensure correct / quality / appropriate use? Building materials? Please explain
5. How is product quality standard utilizing the use of proper engineering designs? Please explain

6. Please explain your factory's interest in product quality standard certification in terms of quality agreement

7. Who designs the bus body in your factory? Is the product quality standard institute or your factory? Please explain

8. What are the factors that prevent you from using the bus body construction product quality standards that you build in your factory?

.....

9. What are your future plans/expectations to improve the quality level of bus body building in your factory?

.....

APPENDIX IV: INTERVIEW FOR ETHIOPIAN STANDARD INSTITUTE (ESI)

10. Does your organization have product quality standard for local mid bus vehicle body building?

No () Yes ()

If Yes, please explain

11. How does the product quality standard enforce the standards of local bus body building while in industry?

(a) is it during or (b) after tail end Please explain

.....

12. What are the penalties meted out in case of failure to observe bus body building standards? Please explain

.....

13. How does product quality standard enforce the use of correct / quality / ideal use of engineering? Materials? Please explain

14. How does product quality standard enforce the use of proper engineering drawing designs? Please explain

.....

15. What guarantees does product quality standard provide to interested parties in terms of certification in view of standards conformance? Please explain

.....

.....

16. Who develops local bus body design drawings? Is it product quality standard institute or the manufacturer? Please explain

.....

17. What are the challenges faced in the maintenance of standards for local bus body building?

.....

18. What are the future plans / prospects for the improvement of school bus body building?

.....

Appendix IV

Mechanical system and components

This technical committee (TC46) is Composition of a chairperson, a secretary and nine members as shown in table 4.2. Out of the eleven members, there are two road vehicle manufacturing industry representatives, the Ethiopian Metals Industry Development Institute Chairperson and Ethiopian Standards Agency Member and Secretary. The remaining seven members are stockholders. On the other hand, during document analysis and interviews, it was understood that five of the eleven members are reformed institutions, and they are one chairman, one member and secretary, and the remaining three members. The chairman of the Ethiopian Metal Industry Development Institute has been upgraded from an institute to a research center, and a member and secretary of the Ethiopian Standards Agency has been upgraded from an agency to an institution. Technical committee (TC46) Mechanical system and components has a Scope of Standardization of Mechanical system and components which lay down Characteristics and design of screw threads, fastener, stud, and nuts, rolling bear, plain bearing and including their technical requirements. As the Mechanical System and Components Technical Committee, the non-inclusion of the local Midi Bus fabricator has affected the product quality standard, so that it does not use the standards included in the scope.

Technical Committee (TC46) Mechanical Systems and Components have scope for standardizing mechanical systems. However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. From the survey of the document, it is still narrow in scope: the wheel threads, fasteners, studs and nuts, rolling vehicles, field bearing and their technical requirements, features and design are detailed in the document. A representative of the Technical Committee of Mechanical Systems and Components said that the local Midi Bus fabrication factory was not included in the membership, which affected a product quality standard and also did not benefit that included in the scope.

Scope: Standardization of Mechanical system and components which lay down Characteristics and design of screw threads, fastener, stud, nuts, rolling bear, plain bearing and including their technical requirements. (*Source: institute of Ethiopia standard*)

Table-1 TC 46 Mechanical system and components

S.No	Composition TC 46	Status
1	Ethiopian Metals Industry Development Institute	Chairperson
2	Bishoftu Automotive Industrial Engineering	Member
3	Addis Ababa University -Institute of Technology- school of Mechanical and Industrial Engineering	Member
4	Akaki Basic Metals Industry	Member
5	STEEL RMI	Member
6	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
7	Mesfin Industrial Engineering PLC	Member
8	Kality Metal Products Factory	Member
9	Ethiopian Conformity Assessment Enterprise	Member
10	Ethiopian Society of Mechanical Engineers	Member
11	Ethiopian Standards Agency	Member and Secretary

Mechanical testing of metals

This technical committee (TC47) is Composition of a chairperson, a secretary and nine members as shown in table 4.3. Out of the ten members, there is one road vehicle manufacturing industry representative, METEC-Quality Management Center Chairperson and Ethiopian Standards Agency Member and Secretary. The remaining seven members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of ten members, three members are reformed institutions, namely one chairman, one member, one member and a secretary, and the remaining seven members are stakeholders. The Chairman of METEC - Quality Management Center has changed the responsibility from METEC, Ethio-Engineering Group and the member and secretary of the Ethiopian Standards Agency have been reformed from an agency to an institution.

Technical committee (TC47) Mechanical testing of metals has a Scope Standardization of methods for mechanical testing, including the verification and Calibration of equipment that is used to determine the properties of metallic materials. However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee of Mechanical testing team said that the local midi bus fabrication factory was not included in the membership, which affected the product quality standards and also did not benefit that included in the scope

Scope: Standardization of methods for mechanical testing, including the verification and Calibration of equipment that are used to determine the properties of metallic materials. (*Source: institute of Ethiopia standard*)

Table-2 TC 47 Mechanical testing of metals

S.No	Composition TC 47	Status
1	METEC-Quality Management Center	Chairperson
2	Addis Ababa University -Institute of Technology-School of Mechanical and Industrial Engineering	Member
3	Mesfin Industrial Engineering PLC	Member
4	Akaki Basic Metals Industry	Member
5	Ethiopian Society of Mechanical Engineers	Member
6	Ethiopia Conformity Assessment Enterprise	Member
7	Ethiopian Metals and Industry Development Institute	Member
8	National Metrology Institute	Member
9	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
10	Ethiopian Standards Agency	Member and Secretary

(*Source: institute of Ethiopia standard*).

Manufacturing engineering

This technical committee (TC 49) is Composition of a chairperson, a secretary and nine members as shown in table 4.4. Out of the eleven members, there are two road vehicle manufacturing industry representatives, the Ministry of Trade and Industry Chairperson and the Ethiopian Standards Agency Member and Secretary. The remaining six members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of eleven members, three members are reformed institutions, namely one chairman, one member, one member and a secretary, and the remaining eight members are stakeholders. The Chairman of the Ministry of Trade and Industry has reformed into Ministry Trades, the members of the Ethiopian Metal Industry Development Institute reformed into the research center and the member and secretary of the Ethiopian Standards Agency have been reformed from an agency to an institution. Technical committee (TC49) manufacturing engineering has a Scope Standardization of Hand-held assembly tools, electric tools and pneumatic tools; all machine tools for the working of metal, wood and plastics, operating by removal of material or by pressure. However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee (TC49) of Manufacturing Engineering said that the local midi bus fabrication factory was not

included in the membership, which affected the product quality standards and also did not benefit that included in the scope.

Scope: Standardization of Hand-held assembly tools, electric tools and pneumatic tools; all machine tools for the working of metal, wood and plastics, operating by removal of material or by pressure. (*Source: institute of Ethiopia standard*)

Table-3 TC 49 Manufacturing engineering

S.No	Composition TC 49	Status
1	Ministry of Trade and Industry	Chairperson
2	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
3	METEC- Akaki Basic Metals Industry	Member
4	Ethiopian Manufacturing Industry Association	Member
5	Ethiopian Society of Mechanical Engineers	Member
6	Bishoftu Automotive Industrial Engineering	Member
7	Mesfin Industrial Engineering P.L.C.	Member
8	Ethiopian Conformity Assessment Enterprise	Member
9	STEEL RMI	Member
10	Kality Metal Product Factory	Member
11	Ethiopian Standards Agency	Member and Secretary

(*Source: institute of Ethiopia standard*)

Tractors, machinery for agriculture and forestry and mechanical handling equipment

This technical committee (TC 50) is Composition of a chairperson, secretary and thirteen members as shown in table 4.5. Out of the fifteen members, there is one road vehicle manufacturing industry representative, the Ministry of Agriculture Chairperson and Ethiopia Standards Agency Member and Secretary. The remaining twelve members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of fifteen members, three members are reformed institutions, namely two members, one member and a secretary, and the remaining twelve members are stakeholders. Adama Agricultural Equipment has reformed into representatives to the Ethio-engineering group, the members of the Ethiopian Metal Industry Development Institute reformed into the research center and the member and secretary of the Ethiopian Standards Agency have been reformed from an agency to an institution. Technical committee (TC50) Tractors, machinery for agriculture and forestry and mechanical handling equipment have a Scope Standardization of Tractors, machines, systems, implements and

their equipment used in agriculture and forestry. However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee (TC50) of Tractors, machinery for the agriculture and forestry and mechanical handling equipment said that the local midi bus fabrication factory was not included in the membership, which affected the product quality standards and also did not benefit that, was included in the scope

Scope: Standardization of Tractors, machines, systems, implements and their equipment used in agriculture and forestry. (*Source: institute of Ethiopia standard*)

Table-4 TC 50 Tractors, machinery for agriculture and forestry and mechanical handling equipment

S.No	Composition TC 50	Status
1	Ministry of Agriculture	Chairperson
2	Federal Cooperative Institute	Member
3	Ethiopian Conformity assessment enterprise	Member
4	Ethiopian Agricultural business Corporation	Member
5	Addis Ababa University -Institute of Technology-school of Mechanical and Industrial Engineering	Member
6	Giz-Ethiopian	Member
7	Ethiopian Agricultural Research Institute	Member
8	Agricultural Transformation Agency	Member
9	Ethiopian Society of Mechanical Engineers	Member
10	Agricultural Equipment's and Technical Service Enterprise	Member
11	Ethiopian Metals Industry Development Institute	Member
12	Adama Agricultural Equipment Industry	Member
13	Gedeb Engineering PLC	Member
14	Ministry of Water and Energy	Member
15	Ethiopian Standards Institute	Member and Secretary

(*Source: institute of Ethiopia standard*).

Ferrous metals

This technical committee (TC51) is Composition of a chairperson, a secretary and seven members as shown in table 4.5. Out of the nine members, there is one road vehicle manufacturing industry

representative, the Ethiopian Metals Industry Development Institute Chairperson and Ethiopian Standards Agency Member and Secretary. The remaining six members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of nine members, two members are reformed institutions, namely one chairman, one member, one member and a secretary, and the remaining seven members are stakeholders. The Chairman of the Ethiopia Metals Industry Development Institute has reformed a research center and the member and secretary of the Ethiopian Standards Agency have been reformed from an agency to an institution. Technical committee(TC51) Ferrous metals have a Scope the standard covers standardization in the field of:-Cast, wrought and cold-formed steel, including technical delivery conditions for steel; all types of cast iron and all types of pig iron; Ferroalloys and other alloying additives used in iron and steel making;-Iron ores, including terminology, methods of sampling, preparation of samples, moisture determination, size determination, chemical analysis and physical testing; -Protective and decorative metallic and non-metallic coatings (excluding paints and other organic coatings) applied by electrolysis, fusion, vacuum or chemical means, mechanical deposition, ion plating, and the testing and Inspection methods for such coatings. However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee (TC5I) of ferrous metals said that the local midi bus fabrication factory was not included in the membership, which affected on the product quality standards and also did not benefit that included in the scope

Scope: The standard covers standardization in the field of:-Cast, wrought and cold-formed steel, including technical delivery conditions for steel; all types of cast iron and all types of pig iron; Ferroalloys and other alloying additives used in iron-and steel making;-Iron ores, including terminology, methods of sampling, preparation of samples, moisture determination, size determination, chemical analysis and physical testing; -Protective and decorative metallic and non-metallic coatings (excluding paints and other organic coatings) applied by electrolysis, fusion, vacuum or chemical means, mechanical deposition, ion plating, and the testing and Inspection methods for such coatings. (*Source: institute of Ethiopia standard*)

Table -5TC 51 Ferrous metal

S.No	Composition TC 51	Status
1	Ethiopian Metals Industry Development Institute	Chairperson
2	Ethiopian Conformity Assessment enterprise	Member

3	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
4	Ethiopian Society of Mechanical Engineers	Member
5	Addis Ababa University -Institute of Technology-School of Mechanical and Industrial Engineering	Member
6	Akaki Basic metals industry	Member
7	Kality Metal Products Factory	Member
8	Steel RMI	Member
9	Ethiopian Standards Agency	Member and Secretary

(Source: institute of Ethiopia standard)

Non-ferrous metals

This technical committee (TC52) is Composition of a chairperson, secretary and nine members as shown in table 4.6. Out of the eleven members, there are one road vehicle manufacturing industry representatives, Akaki Basic Metals Industry Chairperson and Ethiopian Standards Agency Member and Secretary. The remaining eight members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of eleven members, three members are reformed institutions, namely one chairman, one member, one member and secretary, and the remaining eight members are stakeholders. The Chairman of Akaki Basic Metals Industry represent to Ethio engineering group, Ethiopian Metals Industry Development Institute reform to research center and the member and secretary of the Ethiopian Standards Agency have been reform from an agency to an institution.

Technical committee (TC52) Non-ferrous metals have Scope standardization in the field of: Light metals and their alloys (i.e. aluminum magnesium, titanium and their alloys). However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee (TC52) of Non-ferrous metals

Said that the local midi bus fabrication factory was not included in the membership, which had a negative impact on the product quality standards and also did not benefit that included in the scope

Scope: standardization in the field of: Light metals and their alloys (i.e. aluminum magnesium, titanium and their alloys). (Source institute of Ethiopia standard)

Table -6TC 51Non-ferrous metals

S.No	Composition TC 52	Status
1	Akaki Basic Metals Industry	Chairperson
2	Ministry of Mines Petroleum	Member
3	Ethiopian Conformity Assessment enterprise	Member
4	Ethiopian Society of Mechanical Engineers	Member
5	Addis Abeba University -Institute of Technology- School of Mechanical Engineering	Member
6	Aluminum Works PLC / B&C or Enter Africa	Member
7	Ethiopian Metals Industry Development Institute	Member
8	Kality Metal Product Factory	Member
9	Steel RMI	Member
10	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
11	Ethiopian Standards Agency	Member and Secretary

(Source: institute of Ethiopia standard)

Road vehicles and industrial trucks

This technical committee (TC54) is Composition of a chairperson, secretary and nine members as shown in table 4.7. Out of the sixteen members, there are two road vehicle manufacturing industry representatives and the other five representatives of enterprise, Federal Transport Authority Chairperson and Ethiopian Standards Agency Member and Secretary. The remaining seven members are stockholders.

On the other hand, through document analysis and interviews, it was understood that out of sixteen members, two members are reformed institutions, namely one member, one member and secretary, and the remaining members are stakeholders. The Bishoftu Automotive Industrial Engineering represent to Ethno engineering group, the member and secretary of the Ethiopian Standards Agency have been reform from an agency to an institution.

Technical committee Road vehicles and industrial trucks have Scope standardization in the field of: Light metals and their alloys (i.e. aluminum magnesium, titanium and their alloys). However, it has been prepared since the establishment of the institution and it was understood through an interview with the officials that it has never been revised or amended. A representative of the Technical Committee (TC54) of Road vehicles and industrial trucks Said that the local midi bus fabrication factory was not included in the membership, which had a negative impact on the product quality standards and also did not benefit that included in the scope

Scope: The standard covers standardization of all questions concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of moped, motor cycles, motor vehicles, trailers, semi-trailers, light trailers, Combination vehicles, articulated vehicles and their equipment (*Source: institute of Ethiopia standard*).

Table-7 Road vehicles and industrial trucks

S.No	Composition TC 54	Status
1	Federal Transport Authority	Chairperson
2	AA Transport Authority	Member
3	AA.Road Traffic Management Agency	Member
4	Addis Ababa Transport Bureau	Member
5	Addis Ababa Science and Technology University	Member
6	Automotive Manufacturing Company of Ethiopia (AMCE)	Member
7	Bishoftu Automotive industrial Engineering	Member
8	Anbesa City Bus Enterprise	Member
9	Ethiopian Roads Authority	Member
10	Sheger Mass Transport Service Enterprise	Member
11	Mesfin Industrial Engineering P.L.C.	Member
12	Lifan motors Automotive company	Member
13	Marathon MOTORS Engineering	Member
14	Belay AB Motors	Member
15	Nyala Motors	Member
16	Ethiopian Standards Agency	Member and Secretary

(*Source: institute of Ethiopia standard*)