



ADDIS ABABA UNIVERSITY
ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF MECHANICAL & INDUSTRIAL ENGINEERING

**Development of Service Quality Indicator for Ethiopian Freight
Railways**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa University
in Partial Fulfillment of the Requirements for the Degree of Masters of Science
in Mechanical Engineering (Railway Engineering stream)**

BY

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ABSTRACT

In this study I try to develop the specific item of the rail freight transportation of quality indicator model which help to monitor, control and improve their service and competitiveness. Indicator of quality for any service organization is the decisive factor to create the difference and obtain competitive advantage. The purpose of the study is making a model for rail freight quality indicator may give the true picture about the short comings in Railway freight service.

The current article is to give a partial overview about experts/ specialist, importer/ exporter and Freight transportation organization (company) survey results. This survey, conducted in the form of a questionnaire, asked respondents to assign priority levels to forty four items considered to be important in maintaining the quality of transportation services. The questionnaire for survey was prepared after thorough deep Preliminary literature study. To this end, based on the result of the survey, I carried out a factor analysis and attempt to reduce the number of variables. The data obtained from the respondents are entered in the software SPSS sheet for calculating the descriptive statistics. The study is based on empirical research.

Moreover the questionnaire-based survey proved that the following items are regarded as most important for freight transportation. Those determinants are identified are Safety of cargoes during transportation, Regularity of cargo arrival, Just-in-time delivery, Security of carriages, Proper maintenance of the cargos, Availability of cargo handling equipment at loading points.

The findings are useful and applicable to most of railway country and the research findings may be applicable for a new constriction of Ethiopian freight railways. Those important quality indicators have emerged as an important framework in Ethiopia rail freight transportation management. This framework can help define, monitor and manage high quality freight transportation opportunities.

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LIST OF ACRONYMS

VTPI	Victoria Transport Policy Institute
UIC	International Union of Railways
QI	Quality Indicator
CTU	Code of Practice for Packing of Cargo Transport Units
KMO	Kaiser-Meyer-Olkin
MBL	Minimum Break Load
MSL	Maximum Securing Load
LC	Lashing Capacity according to EN 12195 (used for road transport)
STF	Standard Tension Force = Pre-tension
F_{CARGO}	Force on the dunnage bag caused by the cargo [t]
m	mass of cargo [t]
a_h	Horizontal acceleration, expressed in g that acts on the cargo sideways or in forward or backward directions
a_v	Vertical acceleration that acts on the cargo, expressed in g
μ	Coefficient of friction for the contact area between the cargo and the surface or between different packages
bp	Package width for tipping sideways, or alternatively the length of the cargo for forward or backward
hp	package height [m] The load on the dunnage bag is determined of the movement (sliding or tipping) and the mode of transport that gives the largest force on the dunnage bag from the cargo

CHAPTER ONE

1. PROBLEM AND ITS APPROCH

1.1 Introduction

Today freight transport covers great importance in the field of the transportation system and in general in the economic system. It represents one of the most important elements in the national economy development process. [7]

The movement of freight is vital to the Ethiopian economy. Whether it is raw materials for manufacturing, fuel for electricity generation or transports of consumer goods the population of Ethiopian relies on freight transport for a high standard of living and economic prosperity.

So, Rail freight has a series of advantages on freight transportation including being high capable, low cost, high efficient, low carbon, free of climate and geographical conditions comparatively. Therefore, it takes the traditional advantage in the long distance and medium distance transport of bulk commodities.

With increased use of rail freight transport it is especially important to identify and evaluate quality indicators of this mode of transport.

Key indicators include. [6]

- Freight transportation;
- Cargo handling services (loading, unloading, transshipment operations in warehouses);
- Cargo storage (warehousing) services;
- Preparation for transport services;(sufficient, clean freight rolling stock in a timely manner)
- The rolling stock leasing services
- Freight forwarding services;
- Other services.

Freight transportation is the main type of services that supplemented by other services (loading, unloading, forwarding, etc.). Additional services may include marketing, commercial, insurance and information services.

Quality Indicators have emerged as an important framework in freight transportation management. This framework can help define and manage high quality freight transportation

opportunities. Indicators of quality are also implicit in the management framework of levels of service that has conventionally been used in field of transportation management. This quality indicator describes how these complimentary frameworks can be integrated to manage freight transportation in right manner.

Various literature sources define indicators as tools to “simplify measure and communicate trends and events.” [1] or as “quantitative measures that can illustrate and communicate complex phenomena simply, including trends and progress over time.” [2] Indicators reflect society's values and goals and become key drivers of change. They help to measure and understand directions of progress. [3]

Other literature sources similarly define indicators as statistics designed to allow significant trends to be monitored. [4] In this paper on developing quality indicators for Ethiopian freight transports that is “indicators are things we measure to evaluate progress towards goals and objectives”. They may have several functions, such as helping to identify trends, predict problems, assess options, set performance targets, and to evaluate a particular jurisdiction or organization [4]. This implies that an indicator should be clearly and unambiguously defined, be measurable in qualitative or quantitative terms. [9]

Currently, with growing negative impacts originating from transport activities, decision makers are becoming more aware of the necessity to implement solutions that promote the achievement of sustainable transport systems. Therefore, the development of indicators for measurement and assessment of transport activities may play an important role in the decision- and policy-making process. As suggested by [5], indicators linked to transport activities should be balanced, reflecting a combination of economic, social and environmental objectives and can be applied at several levels.

1.2 Statement of the Problem

Rail freight has a series of advantages on freight transportation including being high capable, low cost, high efficient, low carbon, free of climate and geographical conditions comparatively. Therefore, it takes the traditional advantage in the long distance and medium distance transport of bulk commodities. At the same time, the railway network is massive. Its infrastructure network, information network and operation network cover all over the country.

The share of the new railway of the corridor traffic could easily be up to 75% of foreign trade which will be incorporated in the second phase of the ten year plan period [8].

Figure shows the national railway network.

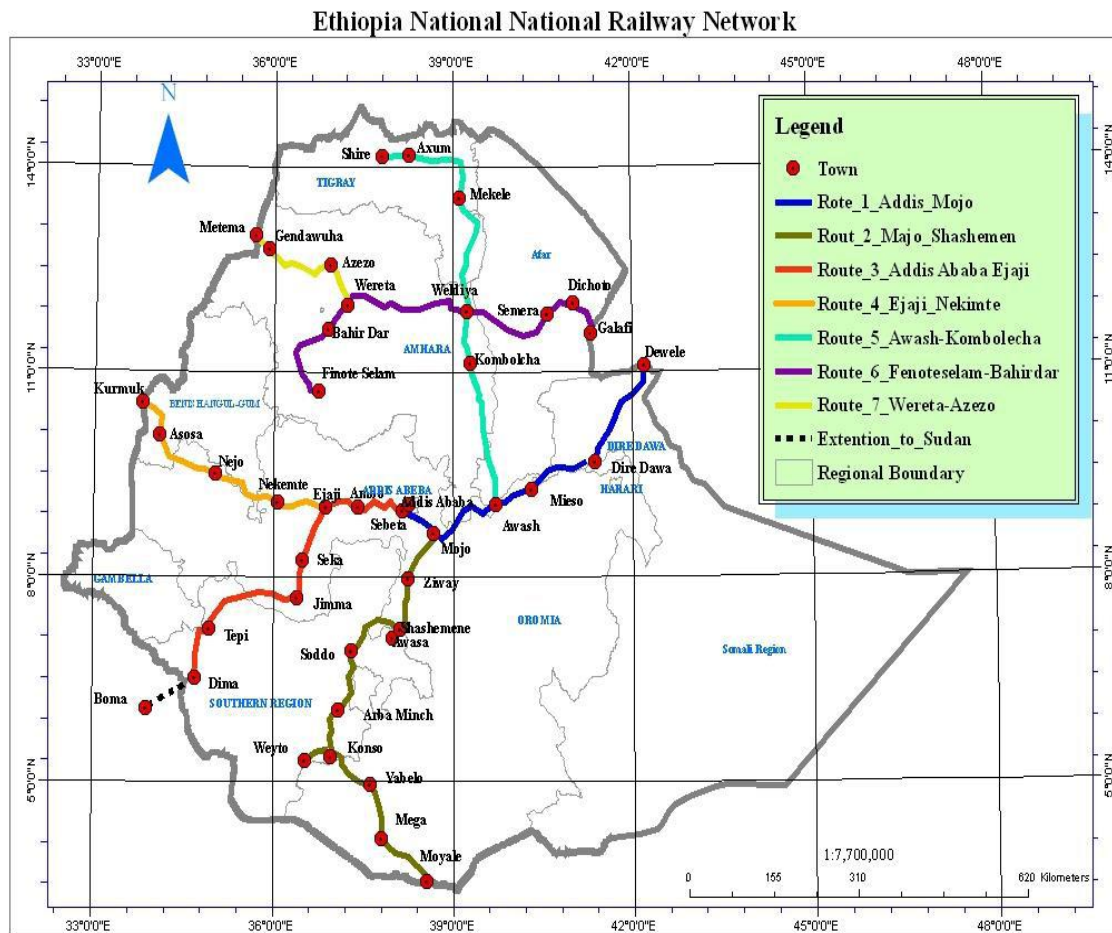


Figure 1: Ethiopian National Railway Network (ERC, 2010)[8]

About 95% of the Ethiopian cargo movements are transported through road freight transport services. In order to cater for the growing demand of freight transport in the movement of export, import and domestic cargo [16], it presupposes the availability of quality indicator for freight transportation.

In fact freight transportation has a lot of benefits for society life but they still faced by the problem. The Service quality level of freight transportation in our country is still low. At present, freight transportation operation is still colored with low level united compulsory service quality standards (quality indicator) and there has not been any organizational study about quality indicator for rail freight transportation in Ethiopia So, this reality leads to the need to develop

quality indicator in order to monitoring, controlling and improve their service and competitiveness of the provided services.

There are many complaints from the customers about freight transportation services. It shows that people have big expectation on freight transportation but the service has not fulfilled their needs yet.

Generally, there are no quality indicator with fully recorded (that is relevant data) so the user can't identify easily those provided service and therefore, first of all, it is necessary to identify and indicate main quality indicators on freight transportation.

1.2.1 Research Questions

- What are the service quality indicators that have significant influences to rail freight transportations in Ethiopia?
- What are the investigated quality indicators for freight transportation of railway on international level?
- How to evaluate the important quality indicator parameter?
- How to develop service quality indicator for Ethiopian freight railway?

1.3 Objective of the study

1.3.1 General Objective

The general objective of the study is to develop quality indicator model for Ethiopian freight railways which help to monitor, control and improve their service and competitiveness.

1.3.2 Specific Objective

- To assess main service quality indicator for Ethiopian freight railways.
- To investigate quality indicators for freight transportation of railway on international level
- To evaluate the important quality indicator parameter.
- To develop service quality indicator for Ethiopian freight railway

1.4 Significance of the study

Implementing the quality indicator for rail freight transportation would allow for:

- Evolutional tool (model) for the currently constructing the Ethiopia freight railways.

- Improving the operational efficiency
- Delivering goods in proper time
- Reefing the transport sector management system
- Increasing the transport facility handling capacity
- Improving the transport safety rate
- Satisfying a need of national economy and improving the quality and accessibility of transport service

1.5 Limitation

There are some limitations associated with this study that need to be discussed. Firstly, the results obtained from this study cannot be generalized because the freight importer/ exporter sampling size were small even though I selected by in terms of what type of goods import and export that relate to my question. Also, the issue of respondent perceptions could be questioned because the sample size consisted of respondents that come from different organization that may differ.

1.6 Outline of the study

The thesis is structured in six chapters. Chapter 1 introduces the study by describing the background, statement of the problem, objective and significance of the study. The second chapter covers literature review dealing with quality measurement, quality indicator national and international rail freight transportation and also frames work of transportation facility.

The methodological framework of the study is described in Chapter 3. The chapter begins with further detail the methods employed for carrying out the study.

Chapter 4 presents the details of the results obtained through analysis of the information and data collected through the methodology described in chapter 3 and discusses these results.

Chapter 5 presents the model development that is based on the finding of the research.

Chapter 6 presents the conclusions and recommendation drawn from the study.

CHAPTER TWO

2. RELATED LITRATURE REVIEW

2.1 Introduction

In this paper is to analyze that to identify and indicate main quality indicator for freight railways, investigate quality indicators on international level, evaluate the important quality indicator parameter and develop quality indicator model for freight railways. This would help them to monitor, control, and improve their service and competitiveness. It can also be used as an evaluation tool (model) for the currently constructing the Ethiopia freight railways.

Today freight transport covers great importance in the field of the transportation system and in general in the economic system. It represents one of the most important elements in the national economy development process. The movement of freight is vital to the Ethiopian economy. Whether it is raw materials for manufacturing, fuel for electricity generation or transports of consumer goods the population of Ethiopian relies on freight transport for a high standard of living and economic prosperity.

Thus, it is needed to develop an indicator for quality of rail freight transportation In fact freight transportation has a lot of benefits for society life but they still faced by the problem. For example Service quality level of Road transportation in our country is still low compared to other transportation modes like Air transport. At present, road operation is still colored with low level united compulsory service quality standards(quality indicator), for all road transport companies in the country so, This reality leads to the need to develop quality indicator in order to improve delay, train capacity, transportation quality(Proper maintenance of the cargos and security of carriage).

Moreover it does not exist as a standardized method (quality indicator) to compare the service assessment on freight in the Ethiopia context. This indicator should be an innovative key that allows evaluating holistically the quality provided by the freight corridors and the quality of freight shipments perceived by the shippers. Unless it is very difficult to improve the quality of freight transport, so as a whole it affects the socioeconomic of the country. Many of services

offered fail to attract customers. These conditions result in decreasing the quality of services and insufficient road operation.

Based on the facts, Ethiopia road transports have no relevant data on services. There are many complaints from the customers about freight transportation services. It shows that people have big expectation on road transportation but the service has not fulfilled their needs yet.

As a result of globalization, the consumer market and subsequently the transport market is expanding more and more. The necessity to connect longer distances in a shortest time possible has become the most important requirement and criterion for customers mainly due to the augmented need for product exchange and increased mobility of persons. Transport services have their specific features which make them different from material products. Such specific characteristics of transport services affect directly the possible evaluation of the quality of work performed by individual transport staff as well as the possible evaluation of the quality of services by the consumer.

In order to be able to determine the level of quality of transport services and set adequately the basic and the most important criteria improving, from the point of view of customers, the quality of services, it is necessary to define specific qualities of transport services as well as problematic issues connected with the provision of transport services.

Defining of such qualities and problematic issues will enable to determine the basic objectives which should result in the increased customer satisfaction with a transport service.

2.2 The Role of Indicators

Various literature sources define indicators as tools to “simplify measure and communicate trends and events” [1] or as “quantitative measures that can illustrate and communicate complex phenomena simply, including trends and progress over time” [2]. Indicators reflect society's values and goals and become key drivers of change. They help to measure and understand directions of progress [3]. Other literature sources similarly define indicators as statistics designed to allow significant trends to be monitored [4]. In this paper on developing quality indicators for Ethiopian freight transports that is “indicators are things we measure to evaluate progress towards goals and objectives”. They may have several functions, such as helping to identify trends, predict problems, assess options, set performance targets, and to evaluate a particular jurisdiction or organization [4].

Currently, with growing negative impacts originating from transport activities, decision makers are becoming more aware of the necessity to implement solutions that promote the achievement of sustainable transport systems. Therefore, the development of indicators for measurement and assessment of transport activities may play an important role in the decision- and policy-making process. As suggested by [5], indicators linked to transport activities should be balanced, reflecting a combination of economic, social and environmental objectives and can be applied at several levels.

2.3 Quality Measurement for freight railways In International level

“According to the International Union of Railways (UIC), a quality measurement basically entails a comparison between the current state of play as regards compliance with agreed quality criteria and the situation that should ideally pertain. It enables the quality of the service, product and end result to be appraised and quality-enhancement measures to be designed and introduced. [6]

A quality measurement is structured and documented as follows: criteria, measurement points, responsibility, frequency, statistical records and evaluation, measurement tools.[ibid]

2.3.1 Quality Criteria for Transport Indicators

In the report of Canadian Victoria Transport Policy Institute (VTPI) prepared by [5] the best practices for selecting indicators to measure transportation performance take

Into the account the following criteria:

- *Comprehensiveness* – indicators should reflect various economic, social and environmental impacts, and various transport activities (such as both personal and freight transport)
- *Data quality* – data collection practices should reflect high standards to ensure that information is accurate and consistent
- *Comparability* – data collection should be standardized so the results are suitable for comparison between various jurisdictions, times and groups. Indicators should be clearly defined.

- *Easiness to understand* – indicators must be useful to decision makers and understandable to the general public.
- *Accessibility and Transparency* – indicators (and the data they are based on) and Analysis details should be available to all stakeholders
- *Cost effectiveness* – indicators should be cost effective to collect. The decision making worth of the indicators must outweigh the cost of collecting them.
- *Net Effects* - indicators should differentiate between net (total) impacts and shifts of impacts to different locations and times.
- *Performance targets* – indicators should be suitable for establishing usable performance targets.

Table 1: Quality Criteria for Transport Indicators[5]

Potential indicator of quality	Criteria for good indicators of quality							
	<i>Comprehensiveness</i>	<i>Data quality</i>	<i>Comparability</i>	<i>Easiness to understand</i>	<i>Accessibility and Transparency</i>	<i>Cost effectiveness</i>	<i>Net Effects</i>	<i>Performance targets</i>
Quality indicator 1								
Quality indicator 2								
Quality indicator 3								
Quality indicator 4.....								

2.3.2 Rail freight transportation quality measurement Points

Quality measurement for railway transport is generally split into three phases:

1. Logistics prior to departure (terminal-railway interface):
 - Provision of wagons;
 - Handover of train;
 - Handover of documentation.
2. Rail journey (railway-railway interface):
 - Departure from departure railway station;
 - Changes of locomotives and crew;
 - Border crossings;
 - Arrival to destination station.

3. Logistics (railway-terminal interface):

- Time at which the train is handed over or made available for unloading

Measurement should be concentrated at spots, which are either known or hidden weak points. For customers the vital factor is the train arrival on time. Punctuality is expressed in terms of compliance with final loading and availability deadlines, which are defined as follows:

Final loading deadline: latest possible deadline by which the operator must have finished loading the train.

Availability deadline: point in time by which the train must be positioned at the unloading crane in the arrival terminal, ready for the first container to be taken off. Any forms required should also be available at this stage. If so dictated by circumstances, an alternative definition of the final loading deadline or availability deadline may be agreed upon provided it is clearly stated and allows customers' needs to be met. [6]

2.4 Quality Indicators for Freight Railways in International level

“With increased use of rail freight transport it is especially important to identify and evaluate quality indicators of this mode of transport. Key indicators include:

- Freight transportation;
- Cargo handling services (loading, unloading, transshipment operations in warehouses);
- Cargo storage (warehousing) services;

- Preparation for transport services;(;(sufficient, clean freight rolling stock in a timely manner)
- The rolling stock leasing services
- Freight forwarding services;
- Other services.

Freight transportation is the main type of services that supplemented by other services (loading, unloading, forwarding, etc.). Additional services may include marketing, commercial, insurance and information services.

Basic requirements, which are identified by users of services, are:

- Reliability of carriages (delivery of goods without damaging or otherwise affected them);
- Minimum delivery time (duration of carriage);
- Regularity of delivery;
- Just-in-time delivery;
- Security of carriages;
- Safety cargo delivery;
- Convenience during acceptance and issuance of goods;
- Presence of additional services;
- Presence of different levels of transport services;
- Adapting to customer needs (service flexibility);
- Adequate supply of documentary;
- Proper maintenance of the cargo;
- Delivery of the cargo from door to door;
- Acceptable (proportional) price of services;
- Performance of customs formalities;
- Access to reliable information about rates, conditions of carriage and the location of the cargo;
- Availability of necessary handling units (pallets, containers, wagons, etc.);
- Availability of cargo handling equipment at loading points;
- Avoiding of intermediate transshipment operations;
- The functional relevance of the means of conveyance;

- Specialized transportation option;
- Environmental protection.

Quality of transport services can be defined as the quantification of one or more services to customers, which compose their quality, description of characteristics. The quality of carriages assessment summarized the characteristics that determine their suitability to meet shippers' and consignees needs executing appropriate carriages.

In order to properly determine the quality of services it is necessary to evaluate these groups of indicators:

a) Indicators of timely implementation of carriage. This group of indicators, depending on their characteristics, can be divided into the following *indicators*:

1. ***Freight transportation in term.*** These indicators describe transportation of the goods for which date of arrival is pre-determined:
 - The average deviation from the cargo arrival pre-determined date;
 - The average exceed of the pre-determined date;
 - Maximum exceed of the pre-determined date;
 - The maximum allowable deviation from the pre-determined date;
 - Number of deviations from the pre-determined date of arrival of cargo;
 - Number of timely completed carriages.
2. ***Regularity of cargo arrival.*** These parameters describe the properties of the carriages, which resulting by receipt of cargo within the stipulated time frame:
 - Average number of cargo receipts within the time frame;
 - Minimum number of cargo receipts within the time frame;
 - The average time between receipts of cargoes;
 - The maximum time between the receipts of cargoes;
 - The minimum time between the receipts of cargoes;
 - Number of deviations from the regularity of the receipt of cargoes;
 - Number of received cargoes on pre-determined (agreed) regularity.
3. ***Speed of freight carriage.*** These parameters describe the properties of the carriages, which resulting by the duration of cargo transportation process or cargo movement speed:
 - Agreed duration of freight transportation (timeframe);

- Average duration of freight transportation (timeframe);
- The maximum allowable duration of freight transportation (timeframe);
- The maximum deviation from the average duration of freight transportation (timeframe);
- The percent of cargo arrivals in excess of agreed transportation time (timeframe);
- The average deviation from the agreed transportation time (timeframe);
- Average speed of freight transportation;
- The locomotive/car daily mileage;
- Number of cargo arrivals in agreed time.

b) Safety of cargoes during transportation. This group of indicators, depending on their characteristics, can be divided into the following *indicators*:

1. without losses. These indicators reflect property of transportation service to maintain steady mass of the cargo in the beginning and the end of the carriage or decreased mass depending on natural or specified cargo losses. These indicators are more suitable for perishable, bulk and break bulk cargoes. These indicators may include:

- Loss norms;
- Comparative losses of the cargoes;
- Average losses of the cargoes;
- Value of losses of the cargoes;
- Number of cargoes delivered without losses;
- Cargo quality reduction factor during transportation.

2. without damages. Freight transportation without damages means that during the carriage of goods the preservation and suitability to use them according to the purposes after their transportation is ensured. These indicators are very important for the transportation of various household appliances and other devices. These indicators may include:

- Part of the cargoes delivered without damages;
- The average losses due to cargo damage;
- Comparative costs due to cargo damage.

3. *without losses.* Freight transportation without losses describe property of transportation service to save the number of packages of the cargo in the beginning and the end of transportation process. These indicators may include:

- Comparative costs for the lost cargo;
- Percent of cargo losses during transportation;
- The average losses due to cargo disappearance.

4. *without contaminations.* These indicators describe the property of transportation service to maintain cleanliness of the cargo according to established standards and requirements. These indicators may include:

- Factor of contamination of the cargo during transportation (ratio between contaminated cargo and the total quantity of cargo transported);
- Part of the cargo which the consignee has not accepted due to the contamination during transportation;
- Percentage of allowable extraneous impurities of the cargo;
- Part of extraneous impurities.

c) *Economic indicators.* Estimating the quality of freight transport is necessary to take into account economic indicators that describe the costs associated with full-transport process or through individual work during cargo delivery. Economic indicators set in freight efficiency can be:

- Comparative costs associated with the carriage of goods by different modes of transport;
- Comparative total costs of freight delivery;
- Handling and warehousing costs;
- Percentage of transportation costs inside production costs.

The evaluation of the indicators mentioned above must be performed on a basis of regular quality audit. Taking into account the results of the surveys it is possible to determine the gaps in the railway transportation services quality system.”[Ibid]

2.5 Quality Indicators for Freight transportation in national level

“The freight transport system has a great role in the development of Export and Import goods in our country. So by creating reliable and safe transportation system we can distribute and export the goods in low cost and short time.

However, the freight transportation system still lack of progress and fast service giving causes to slower the development of sector; then the consignee, consigner, motor carrier, warehouse need uniformly give the service to the sectors,

So, In order to speed up the transportation system and management time we must increase the trip of freight good transportation development, port delay time, cost incurred, demurrage delay of vehicle, loading and unloading, checkup time and supervision system.” [7]

Those quality indicators are:

- Reduce Port delay time
- Increase trip (delivery time)
- Reduce Cost incurred
- Demurrage delay of vehicle
- Demurrage delay of loading
- Demurrage delay of unloading
- Checkup time
- Supervision system

2.6 Prevent cargo damage from unnecessary frictional movement

The magnitude of the vertical friction forces between a cargo item and the stowage ground depends on the mass of the item and a specific friction factor μ , which may be obtained from the Appendix 2.

Friction force $F_f = \mu \cdot C_z \cdot m \cdot g$ [kN], with mass of cargo [tone] and **$g = 9.81$ [m/s²]**.

The coefficients presented in Appendix 2 are applicable for static friction between different surface materials. These figures may be used for cargoes secured by blocking or by friction lashings. For cargoes secured by direct securing, a dynamic friction coefficient should be used with 75% of the applicable static friction coefficient, because the necessary elongation of the lashings for attaining the desired restraint forces will go along with a little movement of the cargo. The friction force cannot be increased by providing a greater contact area. As friction

factors may be diminished, if the contact area is contaminated by sand, dust, traces of water, oil, grease, ice or snow, good cleaning of the stowage surface of a CTU before packing is important.

2.6.1 Friction factors

Different material contacts have different friction factors. The table below shows recommended values for the friction factors. The values are valid provided that both contact surfaces are “swept clean” and free from any impurities. The values are valid for the static friction. In case of direct lashings, where the cargo has to move little before the elongation of the lashings provides the desired restraint force, the dynamic friction applies, which is to be taken as 70% of the static friction.

2.6.2 Resistivity of transverse battens

The attainable resistance forces F of an arrangement of battens may be determined by the formula:

$$F = n w^2 h \frac{1}{28l}$$

n = number of battens

w = thickness of battens [cm]

h = height of battens [cm]

L =free length of battens [m]

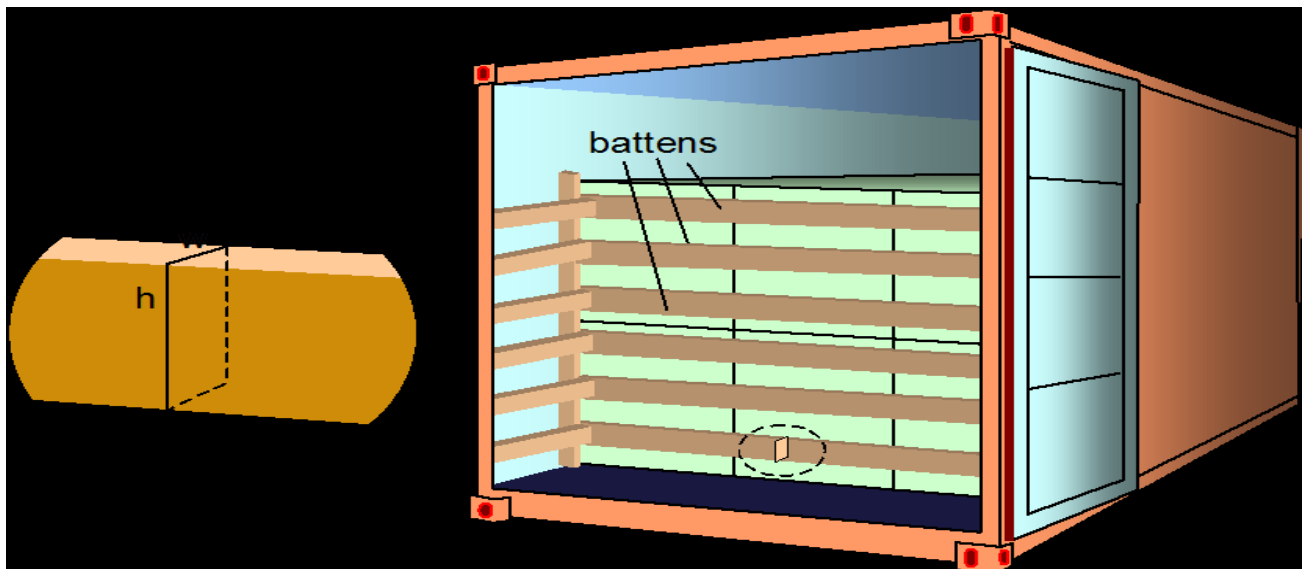


Figure 2: Transverse battens in an ISO container. [13]

2.6.3 Resistivity of longitudinal battens

A concentrated load should be bedded on two longitudinal beams placed at a distance s without further contact of the package to the bottom of the container in between. The necessary length t_1 of those beams for satisfying transverse strength requirements should be determined by:

$$t_1 \geq 0.18.m.(2.3-s) \quad [m]$$

t_1 =length of longitudinal beams for
satisfying transverse strength
requirements [m]
 m =mass of package [t]
 s = distance (mid to mid) of
longitudinal beams [m]

In the calculation above the distance s should not be entered with more than 1.6m

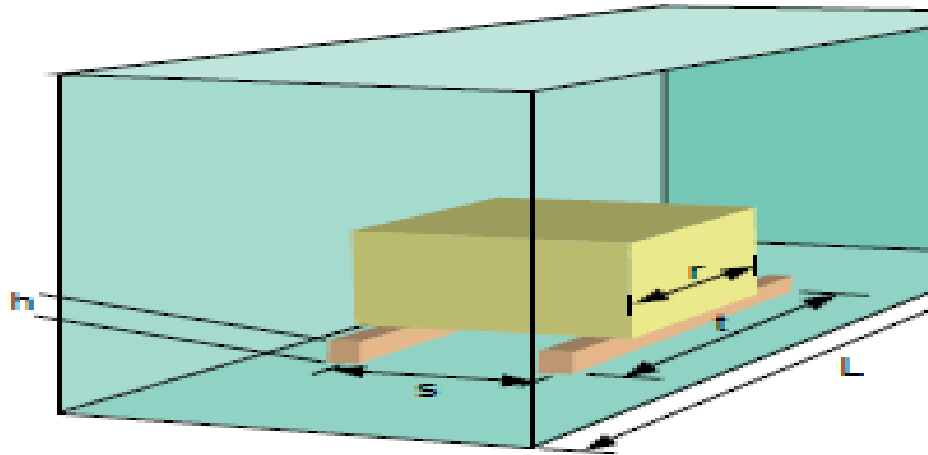


Figure 3: bedding beams for concentrated loads in an ISO container[13]

2.6.4 Permissible concentrated loads on flat racks

Bedding arrangements for concentrated loads on flat racks or platforms should be designed in consultation with the CTU operator of the flat rack or platform. [If no specific advice is available the provisions described in this section should be applied. If the package is placed with its entire foot print over the length r on the flat rack or platform, the permissible load m is:

$$m = \frac{p.l}{2.(l-r)} [t]$$

Note: m must not exceed P in this formula

M= mass of package [t]

P= payload (maximum gross mass – tare mass) [t]

L= length of platform / flatrack container
r= between mid-point of corner fittings [m]

l_{rm} = length of package footprint or bridging distance [m]

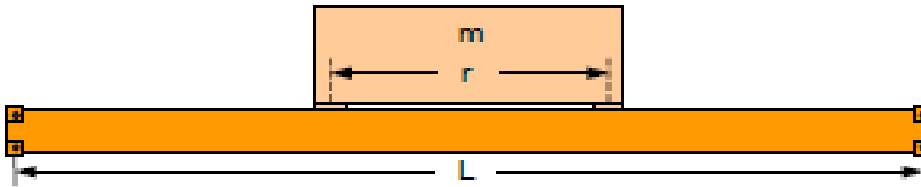


Figure 4: Concentrated loads on an ISO platform container[13]

2.6.5 Longitudinal position of the centre of gravity

The longitudinal position of the centre of gravity within the inner length of a loaded container is at the distance d from the front, obtained by the formula:

d= distance of common centre of gravity from the front of stowage area [m]

$$d = \frac{T \cdot 0.5 \cdot L + \sum(m \cdot d)}{T + \sum m}$$

T= tare mass of the CTU.) [t]

L= length of stowage area (inner length) [m]

m_n = mass of the individual packages or overpack [t]

d_n = distance of centre of gravity of mass from front of stowage area [m]

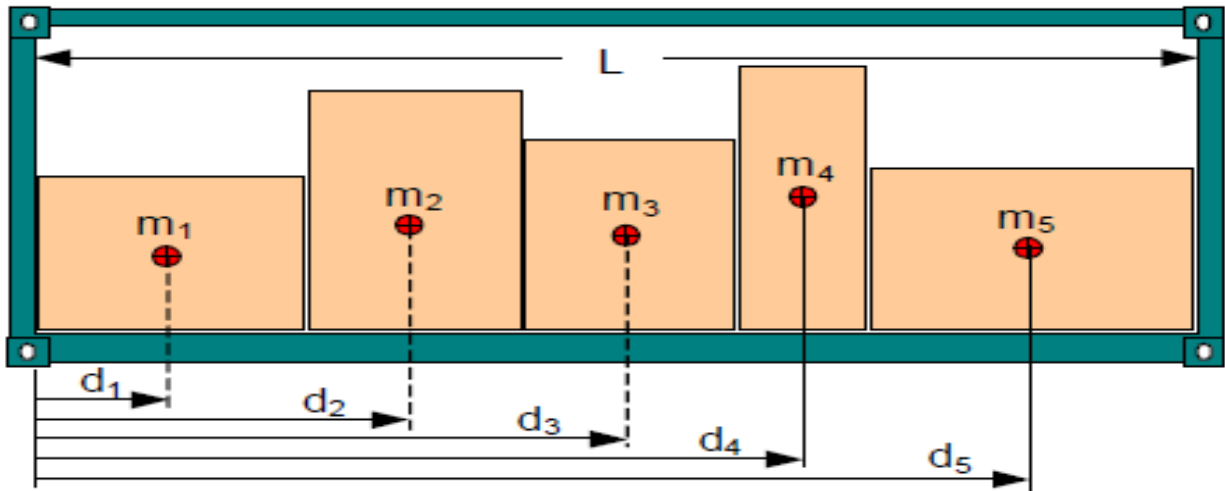


Figure 5: Determination of longitudinal centre of gravity [13]

2.6.6 Cargo securing with dun- nags bags

Accelerations in different directions during transport may cause movements of cargo, either sliding or tipping. Dunn age bags, or air bags, used as blocking device may be able to prevent these movements.

The size and strength of the dun age bag are to be adjusted to the cargo weight so that the permissible lashing capacity of the dun age bag, without risk of breaking it, is larger than the force the cargo needs to be supported with:

$$F_{DUNNAGE\ BAG} \geq F_{CARGO}$$

Force on dun age bag from cargo (F_{CARGO}), the maximum force, with which rigid cargo may impact a dun age bag, depends on the cargo's mass, size and friction against the surface and the dimensioning accelerations according to the formulas below.

$$F_{CARGO} = m \cdot g \cdot (a_h - \mu_{static} \cdot 0.75 \cdot a_v) \text{ ----- Sliding}$$

$$F_{CARGO} = m \cdot g \cdot (a_h - b_p/h_p \cdot a_v) \text{ [kN]----- Tipping}$$

F_{CARGO} = force on the dun age bag caused by the cargo [t]

m = mass of cargo [t]

a_h = Horizontal acceleration, expressed in g that acts on the cargo sideways or in forward or backward directions

a_v = Vertical acceleration that acts on the cargo, expressed in g

μ = Coefficient of friction for the contact area between the cargo and the surface or between different packages

b_p = Package width for tipping sideways, or alternatively the length of the cargo for tipping forward or backward

h_p = package height [m] The load on the dunnage bag is determined of the movement (sliding or tipping) and the mode of transport that gives the largest force on the dunnage bag from the cargo.

2.7 Prevention of damage to the cargo from falling

2.6.1 Cargo Securing Methods

Goods shall be prevented from sliding and tipping in forward, backward and sideways directions by locking, blocking, lashing or a combination of these methods.

2.7.1.1 Blocking and Bracing

Blocking means that the cargo is stowed against fixed blocking structures and fixtures on the CTU. Clumps, wedges, dunnage, stanchions, inflatable dunnage bags and other devices which are supported directly or indirectly by fixed blocking structures are also considered as blocking.

Blocking is primarily a method to prevent the cargo from sliding, but if the blocking reaches high enough, it also prevents tipping. Blocking is the primary method for cargo securing and should be used as far as possible.

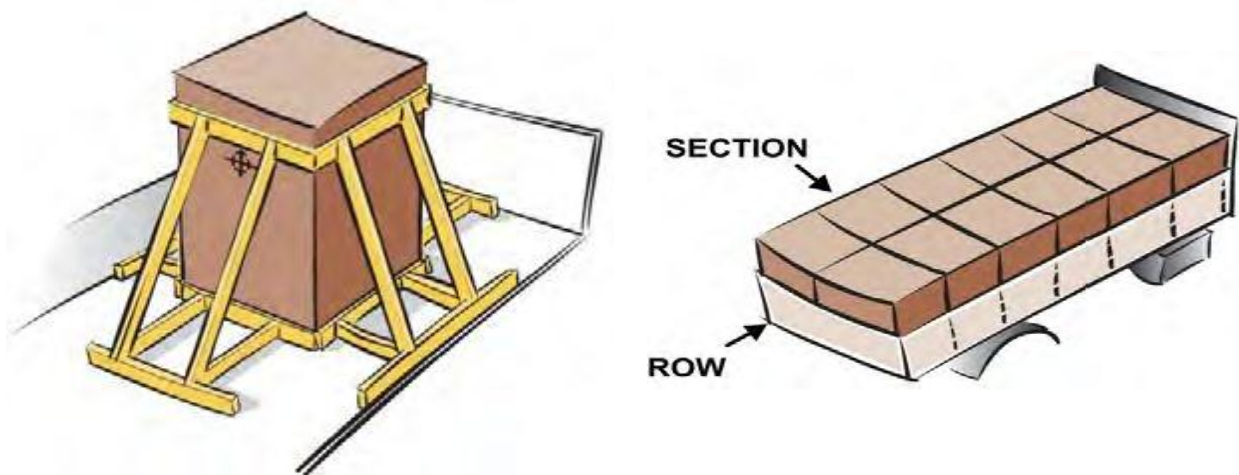


Figure 6: Blocking and Bracing [13]

The sum of void spaces in any direction should not exceed 15 cm. However, between dense rigid cargo items, such as steel, concrete or stone, the void spaces should be further minimized, as far as possible.

2.7.1.2 Top-over lashing

When using the tables for top-over lashing the angle between the lashing and the platform bed is of great importance. The tables are valid for an angle between 75° - 90° . If the angle is between 30° - 75° twice the number of lashings are needed (alternatively the table values are halved). If the angle is less than 30° , another cargo securing method should be used.

Top-over lashings preventing tipping forward and backward has to be placed symmetrically on the cargo.

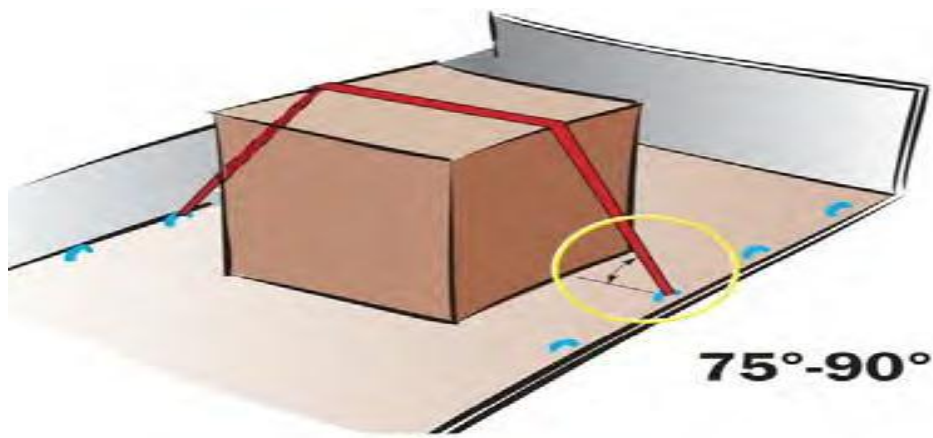


Figure 7: Top-over lashing [13]

2.7.1.3 Half loop lashing

A pair of half loop lashings prevents cargo from sliding and tipping sideways. Minimum one pair of half loop lashings per section should be used.

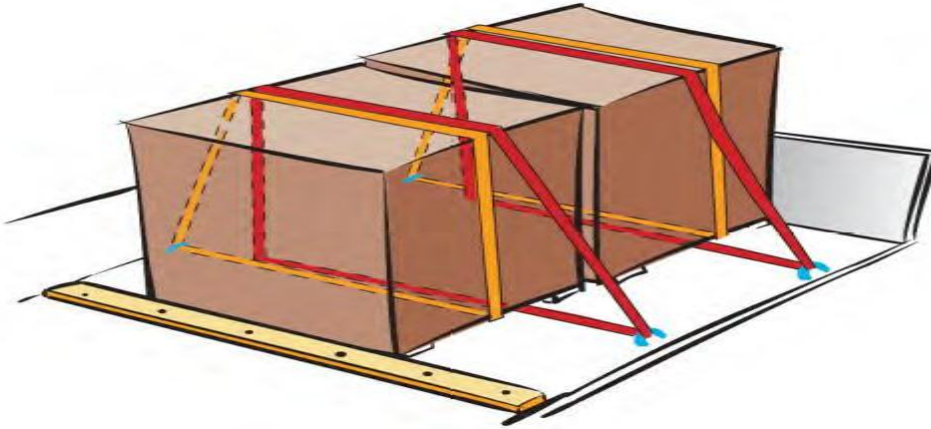


Figure 8: for tipping half the MSL value is to be used for design purposes[13]

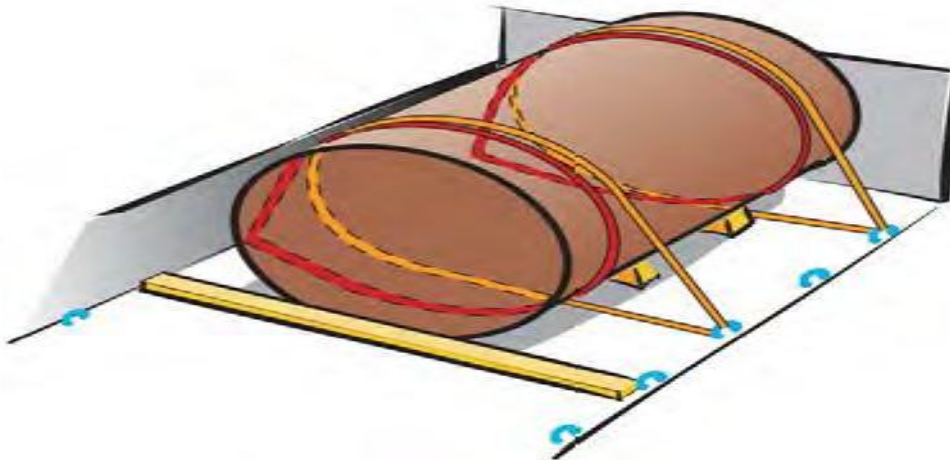


Figure 9: when long cargo units are secured with half loop lashings, at least two pairs should be used to prevent the cargo from twisting[13]

2.7.1.4 Straight lashing

The tables are valid for an angle of 30 - 60° between the lashing and the platform bed. Sideways and lengthways the lashing angle should also lie between 30 - 60°. If the cargo unit is blocked forward and backward and the lashings are placed with an angle of 90° towards the longitudinal axle, the cargo mass in the tables may be doubled.

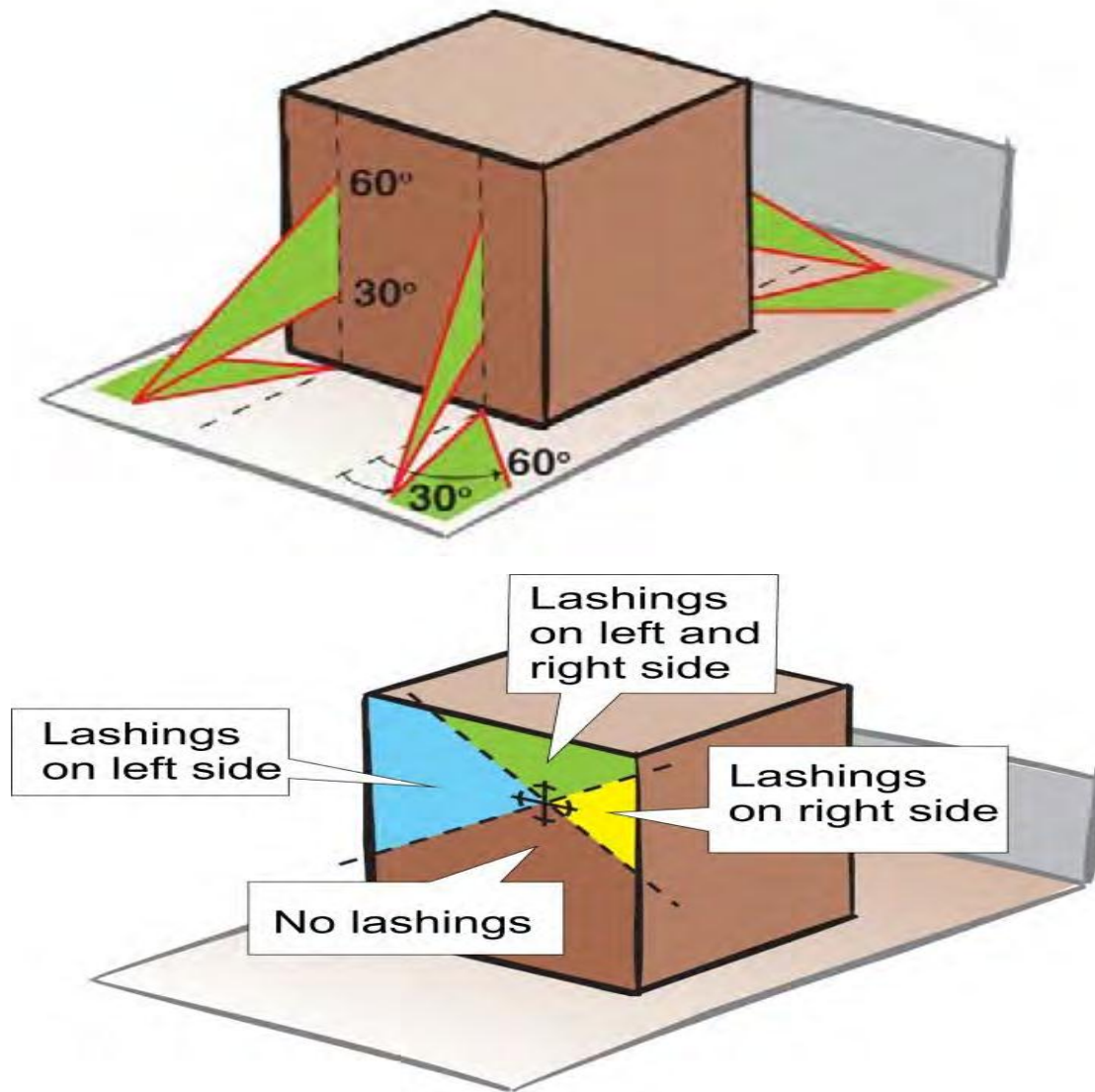


Figure 10: the allowable areas for fixing the lashings on the cargo unit are bounded by straight lines (one for each side), drawn through the centre of gravity in an angle of 45° .

When the lashings are fixed above the centre of gravity, the unit may also have to be blocked in the bottom to prevent sliding [13]

2.7.1.5 Spring lashing

A spring lashing is used to prevent cargo from sliding and tipping forward or backward. The angle between the lashing and the platform bed should be maximum 45° . There are a number of ways to apply spring lashings, as illustrated below.

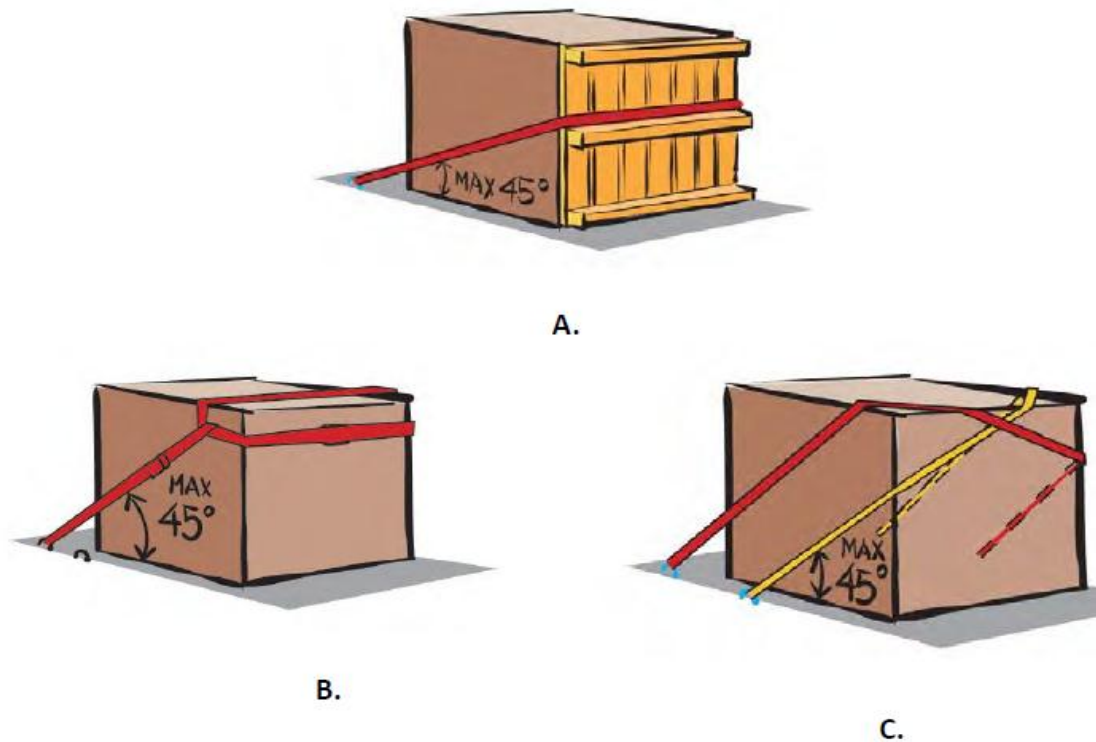


Figure 11: Spring lashing [13]

Observe:

- Alternative A is not fully effective for tipping avoidance.
- Alternative C has two parts per side and thus secures twice the cargo mass given in the lashing tables. If the spring lashing doesn't act on the top of the cargo the mass prevented from tipping is decreased. E.g. if the spring lashing acts at half the cargo height, it secures half the cargo mass given in the tipping tables.

For cargo units with the centre of gravity above their half height, the table values for tipping should be halved.

To prevent tipping, the spring lashing needs to be dimensioned for the mass of the outer section only.

2.7.2 BASIC CARGO SECURING REQUIREMENTS

2.7.2.1 Non-rigid goods

If the goods are not rigid in form (bags, bales etc.) more lashings than prescribed in this quick lashing guide may be needed.

2.7.2.2 Rolling units If rolling units aren't blocked, chocks with a height of at least $\frac{1}{3}$ of the radius, and shall be used.

If the unit is secured by lashings ensuring that the unit cannot roll over the chocks, the chock height need not to be greater than 20 cm.

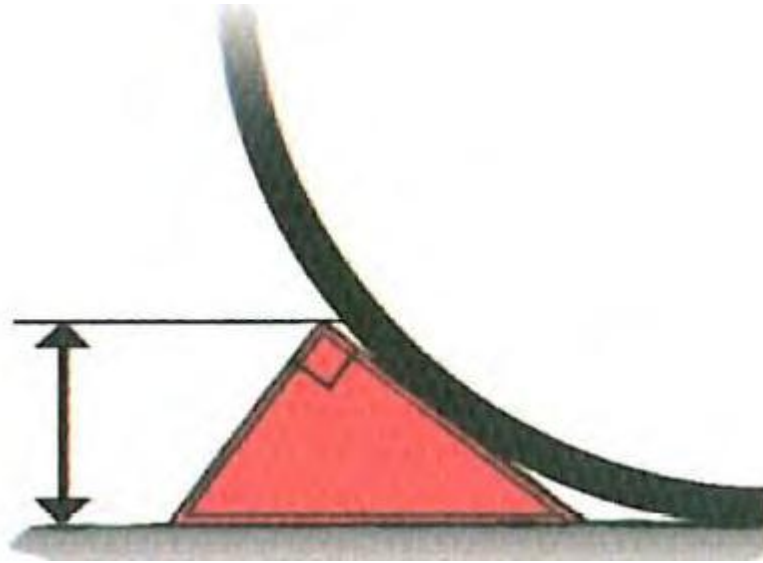


Figure 12: the chock height[13]

2.7.2.3 Bottom blocking

Bottom blocking preventing cargo from sliding must have a height of at least 5 cm, if the cargo isn't prevented from climbing over the blocking by suitable lashings.

2.7.2.4 Supporting edge beam In some cases fewer lashings are needed than the number of sections that are to be secured. Since each unit has to be secured, the lashing effect may in these cases be spread out by supporting edge beams. For each end section one lashing shall be used as well as at least one lashing per every other section.

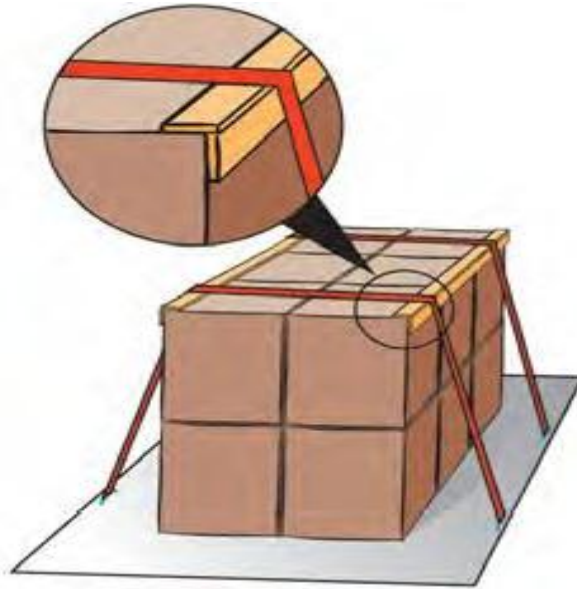


Figure 13: these edge beams can be manufactured profiles or deals (minimum 25x100 mm) nailed together [13]

2.7.2.5 Blocking against the doors

When the door end of a CTU is designed to provide a defined wall resistance (e.g. the doors of a general cargo container) the doors may be considered as a strong cargo space boundary and used for cargo securing, provided the cargo is stowed to avoid impact loads to the door end and to prevent the cargo from falling out when the doors are opened.

2.7.3 Cargo Securing Equipment

2.7.3.1 Labeling

Cargo securing equipment may be labeled with one or more of the following quantities:

MBL = Minimum Break Load

MSL = Maximum Securing Load

LC = Lashing Capacity according to EN 12195 (used for road transport)

STF = Standard Tension Force = Pre-tension

The unit **daN**, where $1 \text{ daN} = 1 \text{ kg}$, is sometimes used to indicate the LC and STF for cargo securing equipment. MBL and MSL are usually stated in **kg** or **tons**.

2.7.3.2 Maximum Securing Load, MSL

- During sea transport the cargo securing arrangements are designed with respect to the **MSL** in the equipment.

- If labeling of MSL is missing MSL is primarily taken as LC when dimensioning according to the tables in this Quick Lashing Guide.
- Alternatively the MSL for different types of equipment is calculated from the minimum break load, **MBL**, according to the table below.

Equipment	MSL
Web lashing, re-usable	50% of MBL
Web lashing, single use	75 % *) of MBL
Chain lashing (class 8), speed lash, turnbuckle	50% of MBL
Wire, new	80% of MBL
Wire, used	30% of MBL
Steel strapping	70% of MBL
Tag washer	50% of MBL
Air bag	50% of MBL

Table 2: Maximum 9% elongation at MSL [13]

If labeling of the pre-tension force is missing 10% of MBL, although not more than 1,000 kg, may be used as pre-tension when dimensioning according to the tables in this Quick Lashing Guide.

2.7.3.3 Lashing eyes

The lashing eyes should have at least the same strength in MSL as the lashings. For a half loop lashing the lashing eye should have at least the strength of $1.4 \times \text{MSL}$ of the lashing if both ends of the lashing are fixed to the same eye.

2.7.3.4 CONVERSION FACTORS FOR OTHER TYPES OF LASHING EQUIPMENT

For lashing equipment with MSL and pre-tension other than those shown in tables in this quick lashing guide, the table values shall be multiplied by a conversion factor corresponding to the actual lashing method and type of equipment, see the table below. All values used should be taken in **daN**, where $1 \text{ daN} \approx 1 \text{ kg}$.

Lashing method		Webbing	Chain	Steel strapping	Wire
Top-over lashing		Pre-tension*/400	Pre-tension*/1,000	Pre-tension*/240	Pre-tension*/1,000
Half loop lashing		MSL*/2,000 MSL*/5,000 MSL*/1,700 MSL*/9,100			
Spring lashing					
Straight lashing					

Table 3: pre tension & MSL are the values for the lashing equipment intended to be used[13]

2.8 Sterilization and maintenance of sanitation

2.8.1 Pests, Insects animals etc. that can cause contamination

2.8.1.1 Soil

Soil can contain spores, seed and eggs of one or more invasive alien species, and therefore should not be carried on or in the CTU internationally. Soil can be found at floor level in the internal corrugations of the side wall, in the internal angles of the corner posts and externally in the corner fitting apertures and body, fork pocket openings and on the upper surfaces of the cross rail bottom flanges.



Figure 14: Mud in corner fitting [13]



Figure 15: Mud in fork pocket [13]

Re-contamination of the CTU will generally result from positioning the CTU on mud, or a soft surface. Care should be taken to prevent the CTU from scraping across the ground surface.

Soil can also enter the CTU on the feet of persons, on the wheels of handling equipment and on the packages or goods themselves.

Soil should be swept out and bagged for incineration or washed out using a high pressure spray.

2.8.1.2 Plants/ plant parts/debris and seeds

Plants can grow on rail containers if residual seed has been allowed to germinate with or without contaminating soil. Other plant matter found on shipping containers includes leaves and other plant parts. Leaves can harbor spores and bacteria that can harm crops at the destination



Figure 16: cargo debris [13]

2.8.1.3 Moths



Figure 17: Asian gipsy moth [13]

2.8.1.4 Snails and slugs



Figure 18: Giant African snail [13]

2.8.1.5 Ants

Some ant species are considered pests, and because of the adaptive nature of ant colonies, eliminating the entire colony is nearly impossible. Pest management is therefore a matter of controlling local populations, instead of eliminating an entire colony, and most attempts at control are temporary solutions.



Figure 19: Pharaoh[13]



Figure 20: Carpenter ant nest[13]

2.8.2 Contaminant Treatment

The contaminant treatment method should be that most effective for the contamination present. Consideration should be given to containment and treatment of pests that have a potential for spread. In some cases the National Plant Protection Officer (NPPO) may request the specimen be collected for identification purposes.

If a CTU is found to have a minor re-contamination, cleaning can be effected using one of the following methods:

- Sweeping out or vacuum cleaning the container and applying an absorbent powder if required.
- Using low pressure water washes
- Scraping

If a live animal or insect is found which can be swept or washed out then this should be done. Bodies of animals should be disposed of safely by bagging and incineration. If the animal is considered as too dangerous to remove, then close the CTU's doors and inform the CTU supplier.

Operators may have contracts with pest control organizations and these may be employed to remove serious re-contamination.

If any plants or animals shown in the above are found within the CTU then the NPPO should be informed.

2.9 Availability of cargo handling equipment at loading point

A lot of terminal or port cargo handling equipment is provided to facilitate movement of the cargo to and from the ship's side and the transit shed, warehouse, barge, railway wagon or road vehicle. These include two-wheeled hand barrows and four-wheeled trucks either manually or mechanically propelled, and mechanically or electrically propelled tractors for hauling four wheeled trailers. Ro-ro trailers are moved by tug-masters or ro-ro tractors. There are also belt conveyors mechanically or electrically operated, or rollers, all perhaps extending from the quayside to the transit shed, warehouse, railway wagon or road vehicle. Containers are loaded and unloaded by means of the quayside container cranes, i.e. container gantries also called shiptainers.

2.9.1 Bulk Cargo Handling Equipment

So far as dry bulk cargoes are concerned, handling facilities may be in the form of power-propelled conveyor belts, usually fed at the landward end by a hopper (a very large container on legs) or grabs, which may be magnetic for handling ores, fixed to a high capacity travelling crane or travelling gantries. These gantries move not only parallel to the quay, but also run back for considerable distances, and so cover a large stacking area, and are able to plumb the ship's hold. These two types of equipment are suitable for handling coal and ores. In the case of bulk sugar or when the grab is also used, the sugar would be discharged into a hopper, feeding by gravity a railway wagon or road vehicle below. Elevators (US) or silos are normally associated with grain. They may be operated by pneumatic suction which sucks the grain out of the ship's hold.

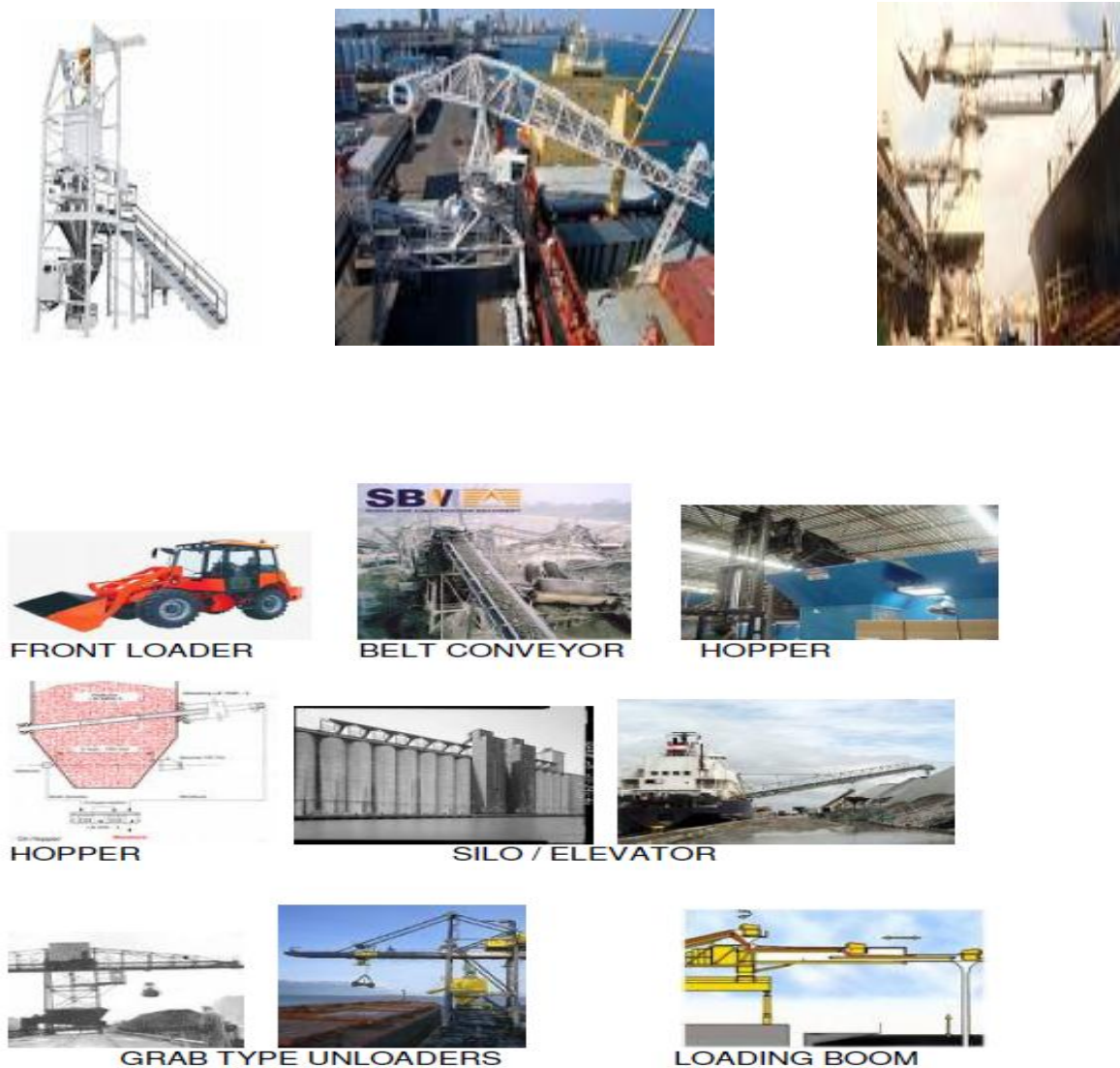


Figure 21: bulk cargo handling equipment [29]

2.9.2 Liquid Cargo Handling Equipment

The movement of liquid bulk cargo, crude oil and derivatives, from the tanker is undertaken by means of pipelines connected to the shore-based storage tanks.

Pumping equipment is provided in the tanker storage plant or refinery ashore, but not on the quayside. In view of the dangerous nature of such cargo, it is common practice to build the special berths a small distance from the main dock system on the seaward side. Oil cargo is discharged from the ship's tanks, via the cargo piping system to the main ship's manifold usually situated amidships, on either port or starboard side. From there by means of shore-based loading arms oil is transferred to the shore manifold and is then distributed to shore-based storage tanks

on the oil terminal. The loading arm hose must be flanged oil-tight to the ship's manifold so that oil spills can be avoided.



Figure 22: liquid cargo handling equipment [29]

2.9.3 General Cargo Handling Equipment

With regard to general cargo (goods, merchandise, commodities), also referred to as break bulk cargo, almost 90 percent of all such cargo in most liner cargo trades today is containerized. Meanwhile the system of Dockers handling cargo will continue, but doubtless every effort will be made to expand the already extensive use of various types of mechanized cargo-handling equipment. General cargo is handled by cranes on the quay, floating cranes or by the ship's own cargo gear (deck cranes, derricks, etc.). Attached to such lifting gear is a shackle which links the crane or derrick with the form of cargo-handling equipment being used. For most lifts a hook is used. There are numerous types of tools or loose gear that can be attached to the shipboard or shore-based lifting gear. They include the sling or strop, which is probably the most common form of loose gear. Such equipment, generally made of rope, is ideal for hoisting strong packages, such as wooden cases or bagged cargo, which is not likely to sag or be damaged when raised. Similarly, snottier or canvas slings are suitable for bagged cargo. Chain slings, however, are used for heavy slender cargoes, such as timber or steel rails. Can or barrel hooks are suitable

for hoisting barrels or drums. Cargo nets are suitable for mail bags and similar cargoes that are not liable to be crushed when hoisted. Heavy lifting beams are suitable for heavy and long articles such as locomotives, boilers or railway passenger coaches. Cargo trays and pallets, the latter being wooden or of steel construction, are ideal for cargo of moderate dimensions, which can be conveniently stacked, such as cartons, bags, or small wooden crates or cases.

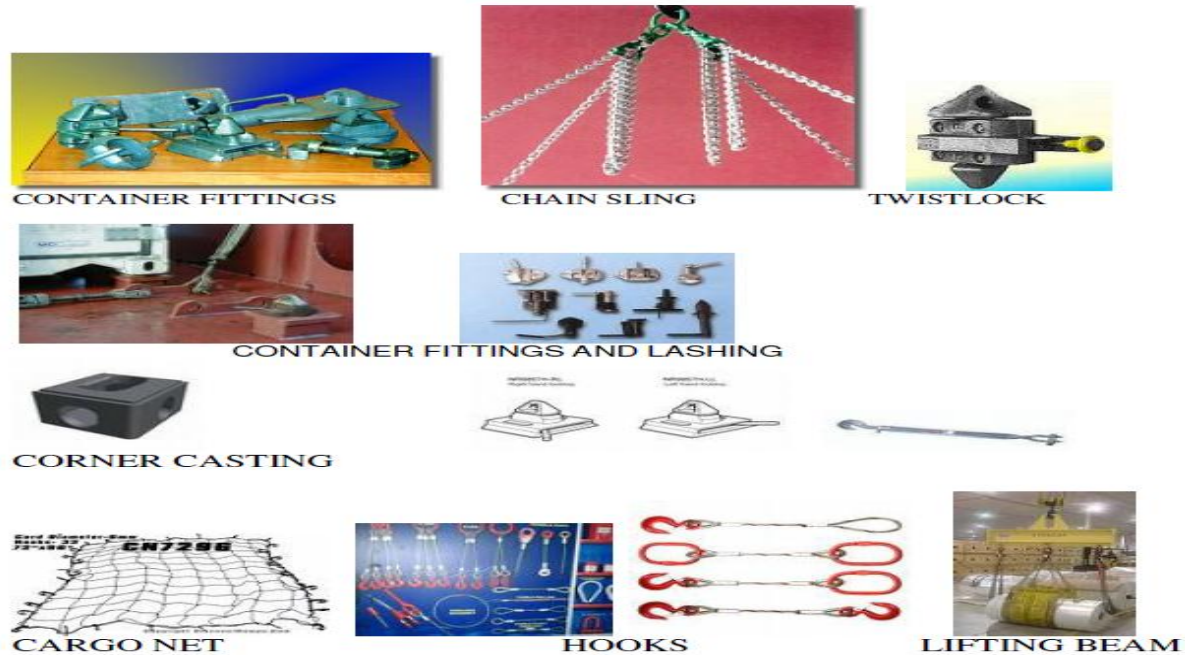


Figure 23: general cargo handling equipment[29]

CHAPTER THREE

3. METHODOLOGY OF THE STUDY

3.1 Research Methodology

As the research was exploratory in nature, qualitative methods were deemed more appropriate [8] and the multiple-case study was selected as the primary methodology.

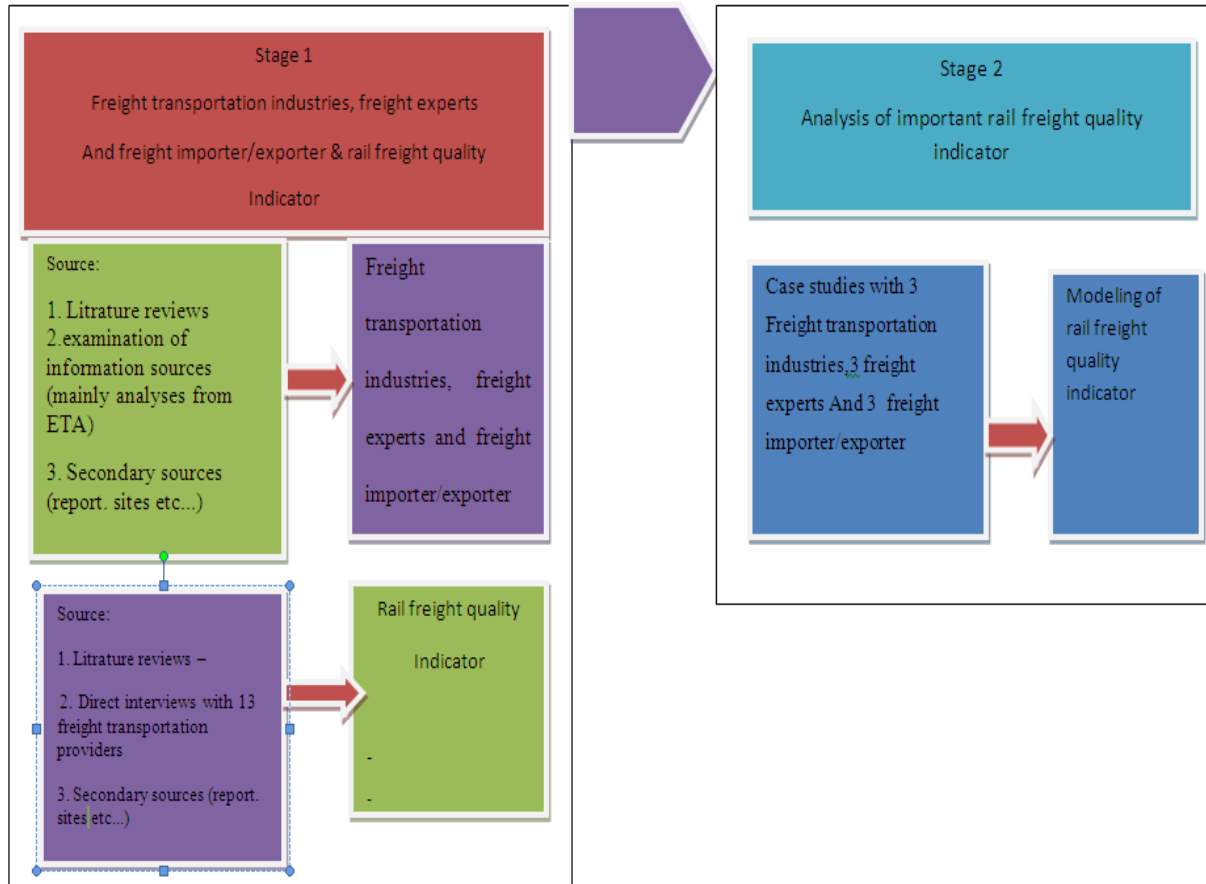


Figure 24 research methodology

In stage of preliminary, the distinctive features of the freight transportation sector in Ethiopia were analyzed. The methodology adopted within this phase was primarily literature review and the examination of information sources (mainly analyses from ETA, the main Ethiopian body for freight transportation studies). At the same time, an in-depth analysis on Freight Transportation Company, Freight Importer/exporter companies and Freight Experts (specialist) currently

available for freight transportation was conducted, including 13 interviews with freight transportation providers regarding the quality indicator offered.

Subsequently, nine case studies were carried out in companies involved in freight transportation activities and other sectors (e.g. metal importer, flower exporter). The motor carrier industry is the industry investigated in this research. This industry is chosen for two reasons. First, because of its importance, it generates the gross domestic product and hauls approximately high freight volume (source: Ethiopian transport authority 2004). Secondly, it is chosen because its performance. The major performance is over other modes of transportation including:

1. The number of motor carrier (vehicles), the uplifting capacity, the service life of the vehicles.
2. personnel management such as:
 - number of employ(Labor productivity)
 - number of branch office within the country
 - number of branch office out of the country
3. Service equipment.
 - No. of Toyota vehicles, it is important for the field work
 - No. of moveable Auto shop(for maintain purpose)
4. Motor carrier movement follow up and monitoring
 - derivers daily log book filed by control of the car
5. Operational performance
 - From Addis Ababa –Djibouti port trip round
Per month more than 5 trip round
Per month from 4-4.9 trip round
Per month from 3-3.49 tri round
 - Average freight ton km per month and per year
6. Fleet management support technology
 - GPS(global positioning system) and OBC(on board computer)

GPS (global positioning system), benefits:

- Speed control
- Real time information

- Hatch brake(incidental)
- Emergency button
- Fuel consumption
- Engine on/off
- Distance coverage
- Idle transmission
- Time event
- Past history...etc.(source: Ethiopian transport authority)

Those selected companies are:

Tans Ethiopia PLC and Tikur Abay Transport Private Limited Company (Tat Plc).The other one is simply select the Ethiopian railways but it is not in operation to get some information that's way included.

The other providers were selected in order to include the most relevant in terms of what type of goods import and export. A.A Administration Housing development project Office, Ethiopian Horticulture Producer Exporters Association (EHPEA) and Ethiopian Shipping Lines & Logistics Service Enterprise (ESLSE) and also some experts(specialists) for freight transportation are Ethiopian revenue and customs authority, Ethiopian transport authority(2) and Ethiopian Maritime Affairs Authority (EMAA). The collected data were then analyzed through empirical phase.

3.2 Data collection

This paragraph will outline the methods that were used to achieve the objectives and Specific objectives and the primary research designed, implemented and analyzed [12]. Therefore, the secondary research will be discussed first, followed by the primary research.

3.2.1 Secondary data collection

The secondary data is data which is collected to support the primary data and as comparison to other studies. The secondary data in this research are obtained from the institution or organizations associated with the research object such as books and proceeding about the quality indicator for rail freight transport. Other sources were articles and websites.

Every research project should include secondary research because secondary data gives on overview of what has been researched before in the same subject area, which will not only help

to choose a research topic and place the research in context, but is also crucial for the decision on research design for the own research [13]; [14].

3.2.2 Primary data collection

The primary data is data which are collected in the field based on the existing and reality condition. This data were conducted by questionnaire survey. The initial idea was to use structured interviews as research methodology to form a picture of the situation in:

Freight transportation organization (company) such as:

- Tans Ethiopia PLC
- Tikur Abay Transport Private Limited Company (Tat Plc)
- Ethiopian railways

Freight Importer/Exporter

- A.A Administration Housing development project Office
- Ethiopian Horticulture Producer Exporters Association (EHPEA)
- Ethiopian Shipping Lines & Logistics Service Enterprise (ESLSE)

Freight Experts (specialist):

- Ethiopian revenue and customs authority
- Ethiopian transport authority
- Ethiopian Maritime Affairs Authority (EMAA)

When the literature review was done and the research questions were better focused and defined, it has been decided, however, to change the initially planned research method of structured interviews for the following reason.

- The essential constraint was time. This was very difficult to address all organization within a short time period.

When the above-mentioned reasons were taken into account, it was decided to use self-administered questionnaires for the primary research. The initial plan was to use structured interviews to enable comparison and in fact, a questionnaire is not much different from a structured interview. The disadvantage of a questionnaire is however, that it is not possible to clarify the questions when they are not well understood or to press for a clear answer when the respondent has the tendency to give a short or ambiguous answer on an important subject. An

advantage of the questionnaire is that it can be sending to as much respondents as possible and therefore gives the opportunity to compare the results from several freight transportation organizations in a country.

3.2.2.1 Description of the questionnaires

The questionnaires consisted of forty four questions in eighteen categories: questions related to the important of quality indicator for freight transportation.

The Safety of cargoes during transportation dimension is measured in statements 1 to 3, *Speed of freight carriage*(duration of carriage) dimension is measured in statements 4 to 6, Regularity of cargo arrival dimension is measured in statements 7 to 11, Just-in-time delivery dimension is measured in statements 12 to 14, Security of carriages dimension is measured in statements 15 to 16, Proper maintenance of the cargos dimension is measured in statements 17 to 22, Comparative total costs of freight delivery dimension is measured in statements 23 to 24, Access to reliable information about dimension is measured in statements 25 to 27, Presence of different levels of transport services dimension is measured in statements 28 to 31, Adapting to customer needs dimension is measured in statements 32, supply of documentary dimension is measured in statements 33 to 34, Delivery of the cargo dimension is measured in statements 35, price of services dimension is measured in statements 36, Performance of customs formalities dimension is measured in statements 37 to 39, handling units dimension is measured in statements 40, cargo handling equipment dimension is measured in statements 41, Handling and warehousing costs dimension is measured in statements 42 to 43 while the Environmental protection dimension is measured in statement 44.

All the questions close-ended questions. Because of being closed- ended in nature the results of the questions are easy to compare, tabulate and analyze easier. Closed questions offer efficiencies to researchers. They are certainly easier to analyze and are usually quicker to administer and ask. Thus, they are often used in large samples and in self-completion interviews. The consistency in the response categories allows trends to be tracked over time if the same questions are used.

In the questions we used 5-point Likert-scale where the respondents are asked to select the most appropriate number that corresponds to extent to which they agree with a statement. The scales in our survey questions is 1 to 5 with “1” denoting “strongly disagree” and “5” denoting

“strongly agree”. The original scale of Likert-type scale was developed by Rensis Likert. He reported very satisfactory reliability data for the scales.

These statements were developed by [6] was used as the main guide for our structured questionnaire where data was collected accurately on the Freight transportation organization (company), Importer/Exporter and Experts (specialist): but we have however rephrased the statements to be Ethiopian context relevant so as to maintain validity. I have employed some statements to measure these dimension.

The selected organizations received the questionnaire in English language so that the respondents could answer in the language they were most comfortable with. Both cover letters and questionnaires contained the same information, Please see Appendix 1 for information on the structured questioner.

3.2.2.1.1 Testing of the questionnaire:

The questionnaire is tested to identify whether the questionnaire is able to capture the required data as expected by the researcher. The test was conducted mainly to find out whether my questionnaire was easily-understandable as well as whether there were any vague and confusing questions in the questionnaire. Five students were approached to answer the questionnaire in the presence of the researcher. All the respondents reported that they had no difficulty in answering the questions. However, we received one general comment from two students that some of the questions were a bit wordy and long. Accordingly, the authors made necessary changes.

3.3 Data Analysis Method

We are carrying out a quantitative research and this will involve some quantitative analyses with the use of statistical tools (descriptive). There are several software packages for the analysis of quantitative data some of which are broader in scope and user friendly like the SPSS. SPSS may obviously not be the best but its user friendly nature and the mastery we have of SPSS automatically makes it better for us. There may be spreadsheet packages that are better than the SPSS but SPSS is widely in use now also.

We have unanimously agreed to use the SPSS package for the analysis of our data. We use descriptive statistics mainly involving the mean, standard deviation, minimum and maximum in the data analysis. The mean simply put is the average of the sum of all values [25] which is representative of a distribution with several discrete or continuous variables that cannot be

employed wholly. Standard deviation seeks to measure the average amount of variability in a set of scores [Ibid] between values and measures.

The Objective of this study is to assess and evaluate the quality indicator attributes that have significant influences on situation of freight transportation towards rail transportation. Questionnaire is the most common tool to investigate the aim. The data that were collected will be analyzed using statistical method. This is:

- Software Statistical Package for Social Sciences 15 (SPSS 15) which provides the descriptive statistics.

3.4 Methodology of Reliability, validity and representativeness

Concerns regarding validity and reliability are particularly important for case-based research [23] [24]. The first issue in research design quality i.e. reliability of a method is related to the consistency of the results obtained from it. In the case of a questionnaire, the questions should obtain the same answer from a person each time it is asked.

To assure this, the questions should be simple and clearly worded [12]; [14]. To ensure the reliability of the results, test the question before distributing by giving five questionionier to the respondent randomly so the result was constant that means it is reliable.

Where needed, certain concepts (such as what is meant with centralization or open and closed offices) were explained to ensure that there could be no mistake to what was meant. Most questions were closed.

Secondly External validity reflects how accurately the results represent the phenomenon studied, establishing the generalizability of the results [24]. In this study, the generalizability was enhanced, as recommended by [24] by including multiple case studies representing different players on freight transportation. The validity of a research instrument indicates if it measures what it is supposed to measure [24] and if the collected information really reflects the phenomenon that is studied [15]. Finally, the representativeness of a research's results indicates to what extent these results can be generalized [12], by asking if the data and the research methods, together with conclusions derived from data analysis, are broader in their application than the sample of respondents studied [10].

CHAPTER FOUR

4. DATA COLLECTION, PRESENTATION AND ANALYSIS

This chapter is designed in a way that leads easily to the points that we wish to make regarding my research questions and objectives of study and that are best aligned with the methodological choices discussed earlier in the study. This means that, we will discuss how data was collected, what sample we took, the way the questionnaire was designed, the measurement of variables, coding of data.

The international quality indicator for freight transportation [6] was used as the main guide for our structured questionnaire where data was collected accurately on the Freight transportation organization (company), Importer/Exporter and Experts (specialist): This guide provided information on the following research purposes; to test the applicability of the international quality indicator for freight transportation.

4.1 The Questionnaire

I used the international quality indicator for rail freight transportation eighteen dimensions [Safety of cargoes during transportation, Duration of carriage (*Speed of freight carriage*), *Regularity of cargo arrival*, Just-in-time delivery , Security of carriages, Proper maintenance of the cargos , Comparative total costs of freight delivery , Access to reliable information about Presence of different levels of transport services, Adapting to customer needs, Supply of documentary, Delivery of the cargo, Price of services, Performance of customs formalities Handling units, Cargo handling equipment, Handling and warehousing costs and Environmental protection] which are subdivided into forty four statements, which were to select the important quality indicator for rail freight in my case.

The questionnaires consisted of forty four questions in one categories: questions related to the important of quality indicator for freight transportation. Please see Appendix 1 for information on the structured questioner.

4.2 Administering of questionnaires

As mentioned earlier in this study, we are using a convenience sampling technique. It was a little challenging experience but it was fun all the same. I had 90 questionnaires to administer and it

took us above two month to administer these 90 questionnaires but unfortunately I only received 73 questionnaires that were complete.

4.3 Measurement technique

Both the identified and important quality indicator for freight transportation measured using a Likert 5-point scale [1- strongly disagree, 2- disagree, 3- somewhat agree, 4- agree and 5- strongly agree].

4.4 Coding of quality indicator

The quality indicator dimensions/items are main variables used in this study and we coded these dimensions/items in order to ease our analysis of data collected. Here is the coding of the variables for analysis.

Quality indicator Dimensions/Items

Safety of cargoes during transportation (S_A)

S_{A1} delivery of goods without damaging

S_{A2} Delivery of goods without contaminating

S_{A3} Delivery of goods without losing

Duration of carriage (*Speed of freight carriage*) (D_B)

D_{B1} Agreed duration of freight transportation (timeframe);

D_{B2} Average duration of freight transportation (timeframe);

D_{B3} The maximum allowable duration of freight transportation (timeframe);

Regularity of cargo arrival; (R_C)

R_{C1} Average number of cargo receipts within the time frame;

R_{C2} Minimum number of cargo receipts within the time frame;

R_{C3} The average time between receipts of cargoes;

R_{C4} The maximum time between the receipts of cargoes;

R_{C5} The minimum time between the receipts of cargoes;

Just-in-time delivery (J_D)

J_{D1} The average deviation from the cargo arrival pre-determined date;

J_{D2} The average exceed of the pre-determined date;

J_{D3} Maximum exceed of the pre-determined date;

Security of carriages; (S_E)

S_{E1} Anti theft measure

S_{E2} Anti pilferage measure

Proper maintenance of cargos (P_F)

P_{F1} Prevention of water leakage damage to cargo

P_{F2} Prevention of rusting and dewing

P_{F3} Prevention of unpleasant smell,

P_{F4} Sterilization and maintenances of sanitation

P_{F5} Prevention of dangerous from unnecessary friction movement,

P_{F6} Prevention of damage to cargo from falling

Comparative total costs of freight delivery (C_G)

C_{G1} Total costs of freight delivery by rail

C_{G2} Total costs of freight delivery by track

Access to reliable information about (A_H)

A_{H1} rates of the cargo

A_{H2} Conditions of carriage and

A_{H3} The location of the cargo;

Presence of different levels of transport services; (P_I)

P_{I1} Truck Parking Spaces in Freight Terminals

P_{I2} Provision of Loading Platform

P_{I3} Permitting Change of Destinations

P_{I4} Labeling of Wagons

Adapting to customer needs; (A_K)

A_{K1} Service flexibility (Permitting Change of Destinations)

Supply of documentary; (S_M)

S_{M1} Adequate supply of documentary

S_{M2} Additional logistic/documentary supply (veterinary certificates, etc)

Delivery of cargo (D_L)

D_{L1} Delivery of the cargo from door to door

Price of services (P_P)

P_{P1} Acceptable (proportional) price of services

Performance of customs formalities; (P_o)

P_{o1} Clearance of Loaded Wagons

P_{o2} Providing Timely Information

P_{o3} Using Discretionary Powers for Customer Benefit

Handling units (H_Q)

H_{Q1} Availability of necessary handling units (pallets, containers, wagons, etc.)

Cargo handling equipment: (C_R)

C_{R1} Availability of cargo handling equipment at loading points:

Handling and warehousing costs (H_S)

H_{S1} Handling cost

H_{S2} Warehousing cost

Environmental protection (E_W)

E_{W1} Environmental protection

Respondents were to provide answers on their expectations the 5-point Likert scale 1- strongly disagree, 2- disagree, 3- somewhat agree, 4- agree and 5- strongly agree.

4.5 Recoding of quality indicator

S_A - Average score = $(S_{A1}+S_{A2}+S_{A3})/3$

D_B - Average core = $(D_{B1}+D_{B2}+D_{B3})/3$

R_C - Average score = $(R_C+R_C+R_C+R_C+R_C)/5$

J_D - Average score = $(J_{D1}+J_{D2}+J_{D3})/3$

S_E - Average score = $(S_{E1}+S_{E2})/2$

P_F - Average score = $(P_{F1}+P_{F2} + P_{F3} + P_{F4} + P_{F5} + P_{F6})/6$

C_G - Average score = $(C_{G1}+C_{G2})/2$

A_H - Average score = $(A_{H1}+A_{H2}+A_{H3})/3$

P_I - Average score = $(P_I+P_I+P_I+P_I)/4$

A_K - Average score = A_{K1}

S_M - Average score = $(S_{M1}+S_{M2})/2$

D_L - Average score = D_{L1}

P_P - Average score = P_{P1}

P_o - Average core = $(P_{o1}+P_{o2}+P_{o3})/3$

H_Q - Average score = H_{Q1}

C_R - Average score = C_{R1}

H_S - Average score = $(H_{S1} + H_{S2})/2$

E_W - Average score = E_{W1}

OIQI- Overall Quality Indicator = $(S_A + D_B + R_C + J_D + S_E + P_F + C_G + A_H + P_I + A_K + S_M + D_L + P_P + P_o + H_Q + C_R + H_S + E_W)/18$

4.6 EMPIRICAL RESULTS AND ANALYSIS

The objective of the analysis of primary data collected from survey as presented in the previous chapter is to answer our research questions which include finding out the important quality indicator for rail freight. This will enable us attain the objectives of our study which are mainly describing empirical phenomena which are the important quality indicator.

4.6.1 Frequency results

Frequency analysis is a descriptive statistical method that shows the number of occurrences of each response chosen by the respondents for forty four attributes.

Table 4 Reliability Coefficient (Cronbach's alphas)

Dimension	Number of items	Corrected Item-Total Correlation	Cronbach alpha if item deleted	Items/attributes
Safety of cargoes during transportation (S_A)	3	.148	.849	S_{A1}
		.063	.850	S_{A2}
		.265	.847	S_{A3}
Duration of carriage (<i>Speed of freight carriage</i>) (D_B)	3	.081	.852	D_{B1}
		-.044	.854	D_{B2}
		-.038	.855	D_{B3}
Regularity of cargo arrival; (R_C)	5	.055	.851	R_{C1}

		-.039	.851	R_{C2}
		.048	.851	R_{C3}
		.048	.851	R_{C4}
		.015	.852	R_{C5}
Just-in-time delivery (J_D)	3	.062	.850	J_{D1}
		-.209	.855	J_{D2}
		-.050	.852	J_{D3}
Security of carriages; (S_E)	2	.284	.847	S_{E1}
		.191	.848	S_{E2}
Proper maintenance of cargos (P_F)	6	-.038	.852	P_{F1}
		.147	.849	P_{F2}
		.018	.851	P_{F3}
		.095	.850	P_{F4}
		.177	.848	P_{F5}
		.199	.849	P_{F6}
Comparative total costs of freight delivery (C_G)	2	.887	.831	C_{G1}
		.845	.832	C_{G2}
Access to reliable information about (A_H)	3	.863	.833	A_{H1}
		.862	.831	A_{H2}
		.788	.834	A_{H3}
Presence of different levels of transport services; (P_I)	4	.825	.833	P_{I1}
		.851	.832	P_{I2}
		.889	.832	P_{I3}
		.837	.832	P_{I4}
Adapting to customer needs; (A_K)	1	.871	.832	A_{K1}

Supply of documentary; (S_M)	2	.839	.832	S_{M1}
		.832	.833	S_{M2}
Delivery of cargo (D_L)	1	.823	.833	D_{L1}
Price of services (P_P)	1	-.047	.856	P_{P1}
Performance of customs formalities; (P_o)	3	.185	.849	P_{o1}
		.084	.851	P_{o2}
		-.026	.855	P_{o3}
Handling units (H_Q)	1	.159	.851	H_{Q1}
Cargo handling equipment: (C_R)	1	-.209	.855	C_{R1}
Handling and warehousing costs (H_S)	2	.101	.853	H_{S1}
		.101	.853	H_{S2}
Environmental protection (E_W)	1	.159	.851	E_{W1}

4.6.2 Reliability Coefficient

The internal consistency of the quality indicator model items was assessed by computing the total reliability scale. The total reliability scale for the study is 0.849. This reliability value for our study is substantial considering the fact that the highest reliability that can be obtained is 1.0 and this is an indication that the items of the forty four dimensions of quality indicator model are accepted for analysis.

Cronbach's alpha simply provides you with an overall reliability coefficient for a set of variables [26] (e.g., quality indicator).

Table 5 above shows, the value that Cronbach's alpha would be if that particular item was deleted from the scale. We can see that removal of any quality indicators, except quality indicators >0.849, would result in a lower Cronbach's alpha. Therefore, we would not want to remove these quality indicators. Removal of quality indicators >0.849 would lead to a small improvement in Cronbach's alpha, and we can also see that the "Corrected Item-Total

Correlation" value was low for these items. This might lead us to consider whether we should remove these items.

4.6.3 Factor analysis

There is universal agreement that factor analysis is appropriate when sample size is above 50, for my case 73 sample size so it is acceptable. Kaisen (1974) recommend 0.5 as minimum (barely accepted), values between 0.7-0.8 acceptable, and values above 0.9 are superb.

Factor analysis is used mostly for data reduction reasons and is performed by examining the pattern of correlations between the observed measures [27].

Typically it is accepted [19], [20] that there are two types of factor analysis: exploratory and confirmatory. The primary objectives of an exploratory factor analysis are to determine the number of common factors influencing a set of measures and to evaluate the strength of the relationship between each factor and each observed measure. [28].

The KMO's test measures strength of the relationship among variables and varies between 0 and 1 and a value of 0 shows that the sum of partial correlations is large relative to the sum of correlations meaning factor analysis is likely to be irrelevant while a value close to 1, shows that patterns of correlations are relatively compact and factor analysis yield distinct and reliable factors (Field, 2005). For my case, the value is 0.826, which indicates that factor analysis is relevant for my study.

This analysis is based on the common factor model, which proposes that each observed response (44items of quality indicator model) is influenced by underlying common factors. This factor is defined as the natural affinity of an item for a group [21]. The strength of the link between each factor and each measure varies in that a factor could influence some dimensions more than others [19].Score below 0.45 indicate a weak loading and are therefore of little or no significance. Factor loadings are the weights and correlations between each variable and the factor.

The higher the load, the more important it is in defining the factor's dimensionality. A negative value indicates an inverse impact on the factor.

Table 5 Factor Analysis (Extraction Method: Principal Component Analysis.)

Item	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
S_{A1}		.688											
S_{A2}		.796											
S_{A3}													
D_{B1}													.562
D_{B2}													
D_{B3}													
R_{C1}				-.551									
R_{C2}													
R_{C3}												.821	
R_{C4}									.517		.815		
R_{C5}											.792		
J_{D1}		.690											
J_{D2}													
J_{D3}													
S_{E1}													
S_{E2}													
P_{F1}						-.503	.886						
P_{F2}							.769						
P_{F3}													
P_{F4}		.622											
P_{F5}		.748											
P_{F6}													
C_{G1}	.984												
C_{G2}	.949												
A_{H1}	.959												

A_{H2}	.966												
A_{H3}	.881												
P_{I1}	.935												
P_{I2}	.953												
P_{I3}	.978												
P_{I4}	.951												
A_{K1}	.959												
S_{M1}	.955												
S_{M2}	.945												
D_{L1}	.936												
P_{P1}									.651				
P_{o1}													
P_{o2}									.849				
P_{o3}								.527					
H_{Q1}				- .752									
C_{R1}													
H_{S1}			.695										
H_{S2}			.695										
E_{W1}				- .752									

a. 13 components extracted

Table 6 shows the factor loadings for each item in relation to the various factors. These values in the table show the weight and correlation each item has to a factor or component. All values below 0.45 are cut off from this table because they are not significant for analysis. From table 6, it can be realized that items from different dimensions are regrouped under the same factor. This factor analysis proves that the model is not a good measure of a quality indicator of freight transportation because we get similar items fall under the same factor showing that they measure the same thing. Those are, the Performance of customs, Delivery of the cargo (D_L), Access to reliable information about (A_H) Presence of different levels of transport services; (P_I), Adapting

to customer needs; (A_K) Supply of documentary; (S_M), Comparative total costs of freight delivery (C_G) and Handling and warehousing costs (H_S) dimensions fall under the same factor.

Table 6 Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.199	27.725	27.725	12.199	27.725	27.725
2	3.743	8.508	36.232	3.743	8.508	36.232
3	2.847	6.471	42.703	2.847	6.471	42.703
4	2.658	6.042	48.745	2.658	6.042	48.745
5	1.917	4.357	53.102	1.917	4.357	53.102
6	1.882	4.277	57.379	1.882	4.277	57.379
7	1.714	3.895	61.274	1.714	3.895	61.274
8	1.572	3.574	64.848	1.572	3.574	64.848
9	1.468	3.337	68.185	1.468	3.337	68.185
10	1.351	3.071	71.256	1.351	3.071	71.256
11	1.341	3.048	74.304	1.341	3.048	74.304
12	1.180	2.682	76.987	1.180	2.682	76.987
13	1.044	2.374	79.360	1.044	2.374	79.360
14	.986	2.240	81.601			
15	.957	2.176	83.776			
16	.891	2.024	85.800			
17	.777	1.766	87.566			
18	.682	1.550	89.116			
19	.627	1.425	90.541			
20	.555	1.262	91.803			
21	.541	1.230	93.033			
22	.470	1.068	94.100			
23	.414	.940	95.040			
24	.394	.894	95.935			
25	.320	.727	96.662			
26	.278	.632	97.294			
27	.233	.529	97.823			
28	.183	.415	98.238			
29	.176	.400	98.638			
30	.172	.390	99.028			
31	.118	.268	99.296			
32	.108	.245	99.541			
33	.071	.160	99.701			
34	.046	.105	99.806			
35	.034	.077	99.883			

36	.022	.049	99.932			
37	.014	.031	99.963			
38	.007	.016	99.979			
39	.005	.012	99.991			
40	.003	.006	99.997			
41	.001	.003	100.000			
42	.000	.000	100.000			
43	1.29E-016	2.93E-016	100.000			
44	-2.87E-016	-6.52E-016	100.000			

Extraction Method: Principal Component Analysis.

Total Variance Explained

Table 6, denotes how much of the total data fit into thirteen factors and this is carried using variance. The above item shows all the factors extractable from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factor and the previous factors. Notice that the first factor accounts for 27.725 % of the variance, the second 8.508 %, the third 6.471 %, the fourth 6.042%, the fifth 4.357%, the sixth 4.277%, the seventh 3.895%, the eighth 3.574, the ninth 3.337%, the tenth 3.071%, the eleventh 3.048%, the twelfth 2.682 % and the thirteenth 2.374%. All the remaining factors are not significant. The total variance percentage accumulated in the thirteen factors is 79.360% and the factor 1 carries 27.725% of data indicating that most of the data fits into that factor. The other twelve factors carry below 10% each and show relatively low fit of data in the factors.

Scree Plot

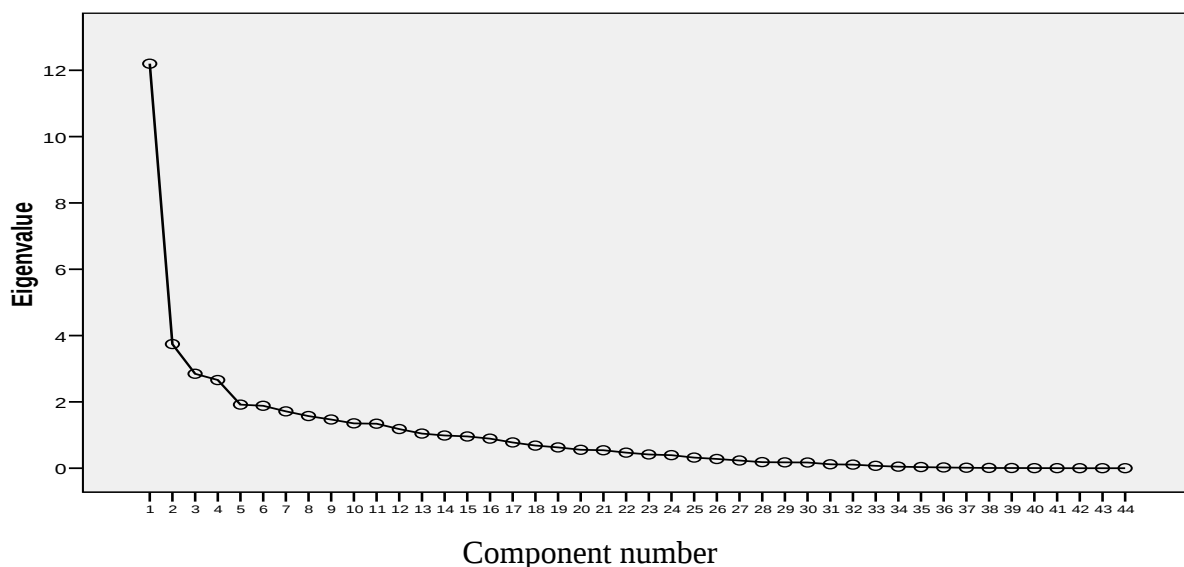


Figure 25: Scree plot

Scree Plot

The scree plot is a graph of the eigenvalues against all the factors. The graph is useful for determining how many factors to retain. The point of interest is where the curve starts to flatten. It can be seen that the curve begins to flatten between factors 13 and 14. Note also that Factor 14 has an eigenvalue of less than 1, so only thirteen factors have been retained.

Table 7 Commonalities

	Initial	Extraction
S_A1	1.000	.847
S_A2	1.000	.810
S_A3	1.000	.663
D_B1	1.000	.674
D_B2	1.000	.516
D_B3	1.000	.717
R_C1	1.000	.701
R_C2	1.000	.748
R_C3	1.000	.623
R_C4	1.000	.745
R_C5	1.000	.790
J_D1	1.000	.766
J_D2	1.000	.654
J_D3	1.000	.821
S_E1	1.000	.664
S_E2	1.000	.565
P_F1	1.000	.853
P_F2	1.000	.773
P_F3	1.000	.592
P_F4	1.000	.712
P_F5	1.000	.807
P_F6	1.000	.678
C_G1	1.000	.974
C_G2	1.000	.920
A_H1	1.000	.943
A_H2	1.000	.945
A_H3	1.000	.810
P_I1	1.000	.897
P_I2	1.000	.925
P_I3	1.000	.962
P_I4	1.000	.932
A_K1	1.000	.939
S_M1	1.000	.943

S_M2	1.000	.926
D_L1	1.000	.910
P_P1	1.000	.644
P_o1	1.000	.524
P_o2	1.000	.810
P_o3	1.000	.686
H_Q1	1.000	.950
C_R1	1.000	.671
H_S1	1.000	.971
H_S2	1.000	.971
E_W1	1.000	.950

Communalities

From Table 7, it can be seen that the output is a table of communalities which shows how much of the variance in the variables has been accounted for by the extracted factors. For instance over 90% of the variance in *fifteen items* is accounted for, over 80% of the variance in *eight items* is accounted for, over 70% of the variance in *eight items* is accounted for, over 60% of the variance in *nine items* is accounted for while over

50% of the variance in four *items* is accounted for.

Table 8 Descriptive statistics for the eighteen dimensions

Dimensions	N	Minimum	Maximum	Mean	Std. Deviation
S_A	3	4.48	4.77	4.6069	.14574
D_B	3	3.74	3.96	3.8173	.12279
R_C	5	4.50	4.82	4.6622	.13832
J_D	3	4.48	4.62	4.5356	.07478
S_E	2	4.63	4.66	4.6438	.01937
P_F	6	4.53	4.82	4.6491	.12474
C_G	2	3.88	3.93	3.9041	.03875
A_H	3	3.85	3.93	3.8904	.04110
P_I	4	3.88	3.96	3.9212	.03425
A_K	1	3.90	3.90	3.9041	.
S_M	2	3.88	3.89	3.8836	.00969
D_L	1	3.88	3.88	3.8767	.
P_P	1	2.97	2.97	2.9726	.
P_o	3	3.58	3.95	3.7991	.19679
H_Q	1	3.77	3.77	3.7671	.
C_R	1	4.58	4.58	4.5753	.
H_S	2	3.41	3.41	3.4110	.00000
E_W	1	3.77	3.77	3.7671	.
Valid N (listwise)	1				

From Table 9, it can be seen that standard deviation scores are fairly consistent for all eighteen dimensions and suggested a wide range of opinion on quality of indicator for freight transportation among the respondents surveyed.

4.6.4 Description of dimensions

Safety of cargoes during transportation (S_A)

Safety of cargoes during transportation has an average score of 4.6069 and the minimum and maximum are 4.48 and 4.77 respectively.

Duration of carriage (*Speed of freight carriage*) (D_B)

Cargo movement speed has an average score of 3.9041 and the minimum and maximum are 3.74 and 3.96 respectively.

Regularity of cargo arrival; (R_C)

Regularity of cargo arrival has an average score of 4.6622 and the minimum and maximum are 4.50 and 4.82 respectively.

Just-in-time delivery (J_D)

Just-in-time delivery has an average score of 4.5356 and the minimum and maximum are 4.48 and 4.62 respectively.

Security of carriages; (S_E)

Security of carriages has an average score of 4.6438 and the minimum and maximum are 4.63 and 4.66 respectively.

Proper maintenance of the cargos (P_F)

Proper maintenance of the cargos has an average score of 4.6491 and the minimum and maximum are 4.53 and 4.82 respectively.

Comparative total costs of freight delivery (C_G)

Comparative total costs of freight delivery have an average score of 3.6050 and the minimum and maximum are 3.88 and 3.93 respectively.

Access to reliable information about (A_H)

Access to reliable information about has an average score of 3.8904 and the minimum and maximum are 3.85 and 3.93 respectively.

Presence of different levels of transport services; (P_I)

Presence of different levels of transport services has an average score of 3.9212 and the minimum and maximum are 3.88 and 3.96 respectively.

Adapting to customer needs; (A_K)

Adapting to customer needs has an average score of 3.9041 and the minimum and maximum are 3.90 and 3.90 respectively.

Supply of documentary; (S_M)

Supply of documentary has an average score of 3.8836 and the minimum and maximum are 3.88 and 3.7 respectively.

Delivery of the cargo (D_L)

Delivery of the cargo has an average score of 3.8767 and the minimum and maximum are 3.88 and 3.88 respectively.

Price of services (P_P)

Price of services has an average score of 2.9726 and the minimum and maximum are 2.97 and 2.97 respectively.

Performance of customs formalities; (P_o)

Performance of customs formalities has an average score of 3.7991 and the minimum and maximum are 3.58 and 3.95 respectively.

Handling units (H_Q)

Handling units has an average score of 3.7671 and the minimum and maximum are 3.77 and 3.77 respectively.

Cargo handling equipment: (C_R)

Cargo handling equipment has an average score of 4.5753 and the minimum and maximum are 4.58 and 4.58 respectively.

Handling and warehousing costs (H_S)

Handling and warehousing costs has an average score of 3.4110 and the minimum and maximum are 3.41 and 3.41 respectively.

Environmental protection (E_W) Environmental protection has an average score of 3.7671 and the minimum and maximum are 3.77 and 3.77 respectively. The standard deviation is 0.19679 indicating the spread of gaps away from the mean.

5.7 Discussion

I have examined the important quality indicator of rail freight transportation in the respondents of experts/ specialist, importer/ exporter and Freight transportation organization (company). Those are Safety of cargoes during transportation, Regularity of cargo arrival, Just-in-time

delivery, Security of carriages, Proper maintenance of the cargos and Availability of cargo handling equipment at loading points.

Safety of cargoes during transportation, we found that the respondents' overall expectation on a scale of 1 to 5 is 4.6069

This is high and implies that the indicator should be implemented. Looking at the individual dimensions we realize that respondents expect a lot from the delivery of goods without losing, delivery of goods without contaminating and delivery of goods without damaging dimensions.

In the case of Regularity of cargo arrival, Just-in-time delivery, Security of carriages, Proper maintenance of the cargos and Availability of cargo handling equipment at loading points, I found that the respondents' overall expectation on a scale of 1 to 5 are 4.6622, 4.5356, 4.6438, 4.6491 and 4.5753. Those are high and implies that the indicators should be implemented. Looking at the individual dimensions we realize that respondents expect a lot from each dimensions. The rapid developed economy promotes cargo transport demand so, Rail freight transportation have to pay a lot of attention to the quality indicators to their success.

In summary from the descriptive statistic analysis or from results obtained, it is seen that the most important quality indicators are (>4.5) for (importer/exporter), Experts/ specialists and Freight transportation Organization Company. Other indicators are not so important for the above mentioned group of respondents.

CHAPTER FIVE

5. MODEL DEVELOPMENT

Research has focused on identifying potential indicators of quality for rail freight transportation activities. This research has been aimed at determining variables important to customers in defining the quality indicator of the freight transportation based on the most important quality indicators we can:

- Monitoring of indicator variables to determine whether existing conditions meet standards of quality
- It helps Implementation of management actions when and where monitoring suggests that standards of quality have been violated or are in danger of being violated.

The impact of these variables on provided service was examined using the following model:

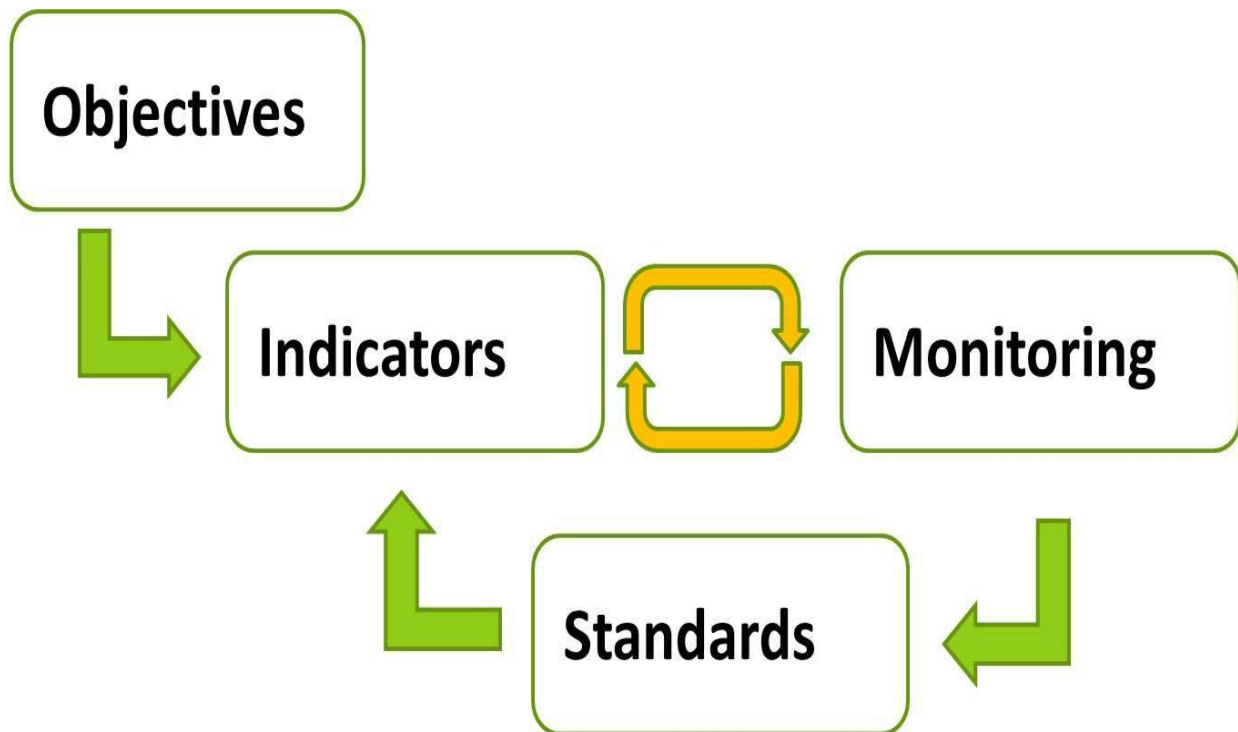


Figure 26: model for rail freight quality indicator [17]

Rail freight transportation quality measurement Points

Quality measurement for railway transport is generally split into three phases:

1. Logistics prior to departure (terminal-railway interface):
 - Provision of wagons;
 - Handover of train;
 - Handover of documentation.
2. Rail journey (railway-railway interface):
 - Departure from departure railway station;
 - Changes of locomotives and crew;
 - Border crossings;
 - Arrival to destination station.
3. Logistics (railway-terminal interface):
 - Time at which the train is handed over or made available for unloading

Measurement should be concentrated at spots, which are either known or hidden weak points.

Rail freight model = f (Safety of cargoes during transportation, Regularity of cargo arrival, Just-in-time delivery, Security of carriages, Proper maintenance of the cargoes, Availability of cargo handling equipment at loading points).

5.1 Safety of cargoes during transportation: this is an important requirement especially for users who use the freight services for cargoes that have already been sold and issued guarantees and import licenses. As it's very important that the goods are in good condition, it is the operator of the carriage as the direct executor of transportation required to strictly comply with established lines of transportation, as well as to pay attention to the operations of loading, storage and unloading of cargo concerned.

This group of indicators, depending on their characteristics, can be divided into the following *indicators*:

5.1.1 Delivery of goods without losses: These indicators reflect property of transportation service to maintain steady mass of the cargo in the beginning and the end of the carriage or decreased mass

depending on natural or specified cargo losses. These indicators are more suitable for perishable, bulk and break bulk cargoes. These indicators may include:

- Loss norms;
- Comparative losses of the cargoes;
- Average losses of the cargoes;
- Value of losses of the cargoes;
- Number of cargoes delivered without losses;
- Cargo quality reduction factor during transportation.

5.1.2 Without damages: Freight transportation without damages means that during the carriage of goods the preservation and suitability to use them according to the purposes after their transportation is ensured. These indicators are very important for the transportation of various household appliances and other devices. These indicators may include:

- Part of the cargoes delivered without damages;
- The average losses due to cargo damage;
- Comparative costs due to cargo damage.

5.1.3 Without losses: Freight transportation without losses describes property of transportation service to save the number of packages of the cargo in the beginning and the end of transportation process. These indicators may include:

- Comparative costs for the lost cargo;
- Percent of cargo losses during transportation;
- The average losses due to cargo disappearance.

5.1.4 Without contaminations: These indicators describe the property of transportation service to maintain cleanliness of the cargo according to established standards and requirements. These indicators may include:

- Factor of contamination of the cargo during transportation (ratio between contaminated cargo and the total quantity of cargo transported);
- Part of the cargo which the consignee has not accepted due to the contamination during transportation;
- Percentage of allowable extraneous impurities of the cargo;
- Part of extraneous impurities

5.2 Regularity of cargo arrival: These parameters describe the properties of the carriages, which resulting by receipt of cargo within the stipulated time frame:

- Average number of cargo receipts within the time frame;
- Minimum number of cargo receipts within the time frame;
- The average time between receipts of cargoes;
- The maximum time between the receipts of cargoes;
- The minimum time between the receipts of cargoes;
- Number of deviations from the regularity of the receipt of cargoes;
- Number of received cargoes on pre-determined (agreed) regularity

5.3 Freight transportation in term. These indicators describe transportation of the goods for which date of arrival is pre-determined:

- The average deviation from the cargo arrival pre-determined date;
- The average exceed of the pre-determined date;
- Maximum exceed of the pre-determined date;
- The maximum allowable deviation from the pre-determined date;
- Number of deviations from the pre-determined date of arrival of cargo;
- Number of timely (on time) completed carriages.

5.4 Security of carriages: this is assumed to be due to the nature of the loading/unloading operations carried out in port facilities, where public access is somewhat difficult and restricted.

- Anti-theft measures(constituting measures for protecting the cargo against thefts) and
- Anti-pilferage measure.

The transport of cars was the only other significant issue in cargo care raised by forwarders. Cars are shipped in open wagons and sometimes suffer from vandalism or pilfering of parts if trains are parked in sidings. For this reason, car manufacturers prefer trains which move direct from origin to destination without stopping.

5.5 Proper maintenance of the cargos:

- Prevent cargo damage from unnecessary frictional movement
- Prevention of damage to the cargo from falling

- Maintenance of temperature and freshness
- Prevention of rusting and dewing
- Prevention of unpleasant smells
- Sterilization and maintenance of sanitation
- Prevention of water leakage damage to cargo

5.6 Availability of cargo handling equipment at loading point

A lot of terminal or port cargo handling equipment is provided to facilitate movement of the cargo to and from the ship's side and the transit shed, warehouse, barge, railway wagon or road vehicle. These include two-wheeled hand barrows and four-wheeled trucks either manually or mechanically propelled, and mechanically or electrically propelled tractors for hauling four wheeled trailers. Ro-ro trailers are moved by tug-masters or ro-ro tractors. There are also belt conveyors mechanically or electrically operated, or rollers, all perhaps extending from the quayside to the transit shed, warehouse, railway wagon or road vehicle. Containers are loaded and unloaded by means of the quayside container cranes, i.e. container gantries also called shiptainers.

CHAPTER SIX

6. CONCLUSION

In this chapter, we provide answers to my objectives by summarizing our findings from the analysis and discussion and model development chapters. This chapter also covers the recommendation and suggestions for further research.

6.1 Summery of findings

Firstly, I have examined the important quality indicator of rail freight transportation in the respondantes of freight experts/ specialist, freight importer/ exporter and Freight transportation organization (company). Those are Safety of cargoes during transportation, Regularity of cargo arrival, Just-in-time delivery, Security of carriages, Proper maintenance of the cargos and Availability of cargo handling equipment at loading points. From descriptive statistic analysis most important quality indicators are (>4.5) so, Safety of cargoes during transportation, we found that the respondents' overall expectation on a scale of 1 to 5 is 4.6069. This is high and implies that the indicator should be implemented. Looking at the individual dimensions we realize that respondents expect a lot from the delivery of goods without losing, delivery of goods without contaminating and delivery of goods without damaging dimensions.

In the case of Regularity of cargo arrival, Just-in-time delivery, Security of carriages, Proper maintenance of the cargos and Availability of cargo handling equipment at loading points, I found that the respondents' overall expectation on a scale of 1 to 5 are 4.6622, 4.5356, 4.6438, 4.6491 and 4.5753. Those are high and implies that the indicators should be implemented. Looking at the individual dimensions we realize that respondents expect a lot from each dimensions.

Secondly, it can be realized that items from different dimensions are regrouped under the same factor. This factor analysis proves that the model is not a good measure of a quality indicator of freight transportation because we expect to see similar items fall under the same factor showing that they measure the same thing. Those are, the Performance of customs, Delivery of the cargo (D_L), Access to reliable information about (A_H), Presence of different levels of transport services; (P_I), Adapting to customer needs; (A_K) Supply of documentary; (S_M), Comparative total costs of

freight delivery (C_G) and Handling and warehousing costs (H_S) dimensions fall under the same factor.

Thirdly, based on the developed model we can monitor quality indicators of rail freight transportation through standards. This model describes how this complimentary quality indicator can be integrated to manage freight transportation in right manner.

6.2 Recommendation

Rail freight transportation is an economic sector which, in the current conditions of globalization, is exposed to fierce competition. This competition is forcing rail freight industry to improve their services, and constantly updating and developing their management system. The processes that occur within the rail freight industry that Operate Cargo Railway Transport Services, whose main task is implementation of quality indicator, are very important which gives the best results in terms of quality and safety of currently constructing Ethiopian rail freight transportation services for the users. In other words, the quality of service is fundamental requirements for users of freight delivery, which may be measurable in several dimensions shown in this paper. Hence, in order to achieve smooth rail freight service in the country the following recommendations are in order:

Those important quality indicators have emerged as an important framework in rail freight transportation management. This framework can help define, monitor and manage high quality freight transportation opportunities.

Moreover these important quality indicator and its implementation is in achieving more quality ratings in the rail freight transport these will enhance the socio-economic activities and in introducing necessary measures to improve and guarantee the success of a railway company, or more broadly, of a region or a railway country.

6.3 Future study

The suggestion that could be given for future research is related to the process and analysis of survey in which by taking larger sampling the result will be more accurate and this factor analysis proves that the model is not a good measure of a quality indicator of freight transportation because we get similar items fall under the same factor showing that they measure the same thing. So, by providing a better model will get accurate result. In addition, research can be carried out not only for train transportation mode but also for other mode like air and sea

transportation mode. Such a research also needs to be conducted annually because respondent's perception always changes time to time.

Appendix 1 Questionnaire

Rank the following statements from 1 to 5, according to your feeling (**which one is the important quality indicator for freight transportation**) please mark [√] in the relevant box to indicate your opinion regarding each of the statement. **That is Likert 5 point scale [1 indicates strongly Disagree, 2 indicate Disagree, 3 indicate somewhat Agree, 4 indicate Agree and 5 indicate strongly Agree].**

1. Safety of cargoes during transportation (statement 1-3)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
1	delivery of goods without damaging					
2	delivery of goods without contaminating					
3	delivery of goods without losing					
2. Speed of freight carriage(duration of carriage) (statement 4-6)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
4	Agreed duration of freight transportation (timeframe);					
5	Average duration of freight transportation (timeframe);					
6	The maximum allowable duration of freight transportation (timeframe);					
3. Regularity of cargo arrival; These parameters describe the properties of the carriages, which resulting by receipt of cargo within the stipulated time frame: (statement 7-11)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
7	Average number of cargo receipts within the time frame;					
8	Minimum number of cargo receipts within the time frame;					

9	The average time between receipts of cargoes;					
10	The maximum time between the receipts of cargoes;					
11	The minimum time between the receipts of cargoes;					
1. 4. Freight transportation in term(Just-in-time delivery). These indicators describe transportation of the goods for which date of arrival is pre-determined: (statement 12-14)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
12	The average deviation from the cargo arrival pre-determined date;					
13	The average exceed of the pre-determined date;					
14	Maximum exceed of the pre-determined date;					
5. Security of carriages; (statement 15-16)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
15	anti theft measure					
16	anti pilferage measure					
6. Proper maintenance of the cargos (statement 17-22)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
17	Prevention of water leakage damage to cargo					
18	Prevention of rusting and dewing					
19	prevention of unpleasant smell,					
20	Sterilization and maintenances of sanitation					
21	prevention of dangerous from unnecessary friction movement,					

22	prevention of damage to cargo from falling					
7. Comparative total costs of freight delivery (statement 23-24)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
23	Total costs of freight delivery by rail					
24	Total costs of freight delivery by track					
8. Access to reliable information about (statement 25-27)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
25	rates of the cargo					
26	conditions of carriage and					
27	the location of the cargo;					
9. Presence of different levels of transport services; (statement 28-31)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
28	Truck Parking Spaces in Freight Terminals					
29	Provision of Loading Platform					
30	Permitting Change of Destinations					
31	Labeling of Wagons					
10. Adapting to customer needs; (statement 32)						
No.	statement	Likert 5 point scale				

		1	2	3	4	5
32	service flexibility(Permitting Change of Destinations)					
11. supply of documentary; (statement 33-34)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
33	Adequate supply of documentary					
34	Additional logistic/documentary supply (veterinary certificates, etc)					
12. Delivery of the cargo (statement 35)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
35	Delivery of the cargo from door to door					
13. price of services (statement 36)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
36	Acceptable (proportional) price of services					
14. Performance of customs formalities; (statement 37-39)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
37	Clearance of Loaded Wagons					
38	Providing Timely Information					
39	Using Discretionary Powers for Customer Benefit					
15. handling units						

(statement 40)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
40	Availability of necessary handling units (pallets, containers, wagons, etc.)					
16. cargo handling equipment: (statement 41)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
41	Availability of cargo handling equipment at loading points:					
17. Handling and warehousing costs: (statement 42-43)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
42	Handling cost					
43	warehousing cost					
18. Environmental protection (statement 44)						
No.	statement	Likert 5 point scale				
		1	2	3	4	5
44	Environmental protection					

If you have any comments please give as provided sheet

• • • • • • • •

Date_____

Signature_____

Thank you from the bottom of my heart for your time.

Appendix 2 Friction factors

Material combination in contact surface	Dry	Wet
SAWN TIMBER/WOODEN PALLET		
Sawn timber/wooden pallet against plywood/wood	0.45	0.45
Sawn timber/wooden pallet against grooved aluminium	0.4	0.4
Sawn timber/wooden pallet against stainless steel sheet	0.3	0.3
Sawn timber/wooden pallet against shrink film	0.3	-
PLANED WOOD		
Planed wood against fabric base laminate/plywood	0.3	0.3
Planed wood against grooved aluminium	0.25	0.25
Planed wood against smooth steel	0.3	0.3
PLASTIC PALLETS		
Plastic pallet against plywood/wood	0.2	0.2
Plastic pallet against grooved aluminium	0.15	0.15
Plastic pallet against smooth steel sheet	0.15	0.15
CARDBOARD (UNTREATED)		
Cardboard against cardboard	0.5	-
Cardboard against wooden pallet	0.5	-

STEEL AND SHEET METAL		
Flat steel against sawn timber	0.5	-
Unpainted metal with rough surface against sawn timber	0.5	-
Painted metal with rough surface against sawn timber	0.5	-
Unpainted metal with rough surface against unpainted rough metal	0.4	-
Painted metal with rough surface against painted rough metal	0.3	-
Painted metal with smooth surface against painted smooth metal	0.2	-
Metal with smooth surface against metal with smooth surface	0.2	
Material combination in contact surface	Dry	Wet
STEEL CRATES		
Steel crate against plywood/plyfa/wood	0.45	0.45
Steel crate against grooved aluminium	0.3	0.3
Steel crate against smooth steel	0.2	0.2
CONCRETE		
Concrete with rough surface against sawn wood	0.7	0.7
Concrete with smooth surface against sawn wood	0.55	0.55
ANTI-SLIP MATERIAL		
Rubber against other materials when contact surfaces are clean	0.6	0.6]

Appendix 3 Reliability Coefficient (Cronbach's alphas)

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent (High-Stakes testing)
$0.7 \leq \alpha < 0.9$	Good (Low-Stakes testing)
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

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