INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO
MESTRADO EM ENGENHARIA MECÂNICA

redução do tempo de inatividade no elevador

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Outubro de 2017

POLITÉCNICO
DO PORTO

Instituto Superior de Engenharia do Porto

CALL-OUT REDUCTION IN ELEVATORS

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Dissertation presented to ISEP – School of Engineering to fulfill the requirements necessary to obtain a Master's degree in Mechanical Engineering, carried out under the guidance of Hermenegildo Manuel Cristina Pereira

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ACKNOWLEDGEMENTS

I would like to express my special thanks of gratitude to professor Hermenegildo Manuel Cristina Pereira for mentoring and guiding me thought the project as well as supporting me with the thesis.

I would take this as an opportunity to thank all my professors at ISEP for guiding me during the masters and the director of masters in mechanical engineering professor Francisco J. G. Silva for trusting me & allowing me to do the thesis outside Portugal.

Special thanks to John Mearns, Major project director, KONE Philippines; for giving me freedom during the entire project and providing me the opportunity to do the project.

Last but not the least, I would like to thank my parents for allowing me to follow my instinct and providing me all the necessary support.

KEYWORDS

Call-out, elevators, FYCOR, quality, classification, Pareto analysis, ABC analysis correlation, DMAIC, LIFT, operations, improvement.

ABSTRACT

This project aims to reduce the call-out in the elevator which is produced due to various reasons. Call-out is any calls from a customer whose equipment are not functioning as desired by the them or the end user. It is not desirable for any companies to have such customer calls very often. This indicates the satisfaction of customer and the quality of service that the company is providing. Call-out and customer satisfaction are inversely proportional (i.e. as the call-out increases the customer satisfaction is reduced).

So, if we need the customer to be happy, we should have least call-out as possible. The project approaches the challenge by implementing one of the renowned lean method DMAIC along with LIFT; attempting to reduce the call-out as much as possible.

Initially, the data related to the call-out are collected from the customer care, from which the relevant information is studied. Once all the contents in the data are familiar, then the proposed method is applied.

Before starting the project, the KPI is measured to have a reference of the performance. As the project proceeds, the KPI is measured to have a track of the performance. The KPI is measured at the end of the project one final time to verify the performance changes. Furthermore, a control plan is implemented to restrict the KPI within the specified limit. At the end of the project, measuring the KPI shows that there is improvement in the performance.

LIST OF SYMBOLS AND ABBREVIATIONS

List of abbreviations

Term	Designation
CAS	Corrective action system
CDW	Conventional double wrap
COR	Call out rate
CR	Change request
CRM	Customer relationship management
CSW	Conventional single wrap
DFM	design for maintainability
DMAIC	Define measure analyze improve control
ERP	Enterprise resource management
ESW	Extended single wrap
FMEA	Failure mode effect analysis
FYCOR	First-year call-out rate
IT	Information technology
KPI	Key performance indicator
LHS	Left-hand side
LIFS	Lift in free service
LIFT	List all the aspect of problem; identify several root causes; formulate action plan; terminate an action plan
MBM	Modular based maintenance
NEB	New equipment business
PCM	Product change management
RCM	reliability centered maintenance
RHS	Right-hand side
SEB	Service business
SIPOC	Suppliers, input, process, output, customer
SPC	Statistical process control
TPM	Total productive maintenance

List of units

unit	parameter
Meters per second	velocity
Meters	Travel distance
KG	Load

GLOSSARY OF TERMS

Term	Definition
Call-out	Call from the customer regarding any issue with the equipment or service
call-out rate	average calls that are recorded considering all the equipment in service
first year call out rate	average calls in new equipment up to one year after the handover
monospace elevators	elevators without machine room
mini space elevators	elevators with machine room

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INTRODUCTION

1 INTRODUCTION

1.1 Scope

As the world moved toward the age of customer capitalism, the KONE corporation made a change in their strategy on January 26, 2017, to “winning with customers”, keeping the financial targets unchanged until the year 2020.

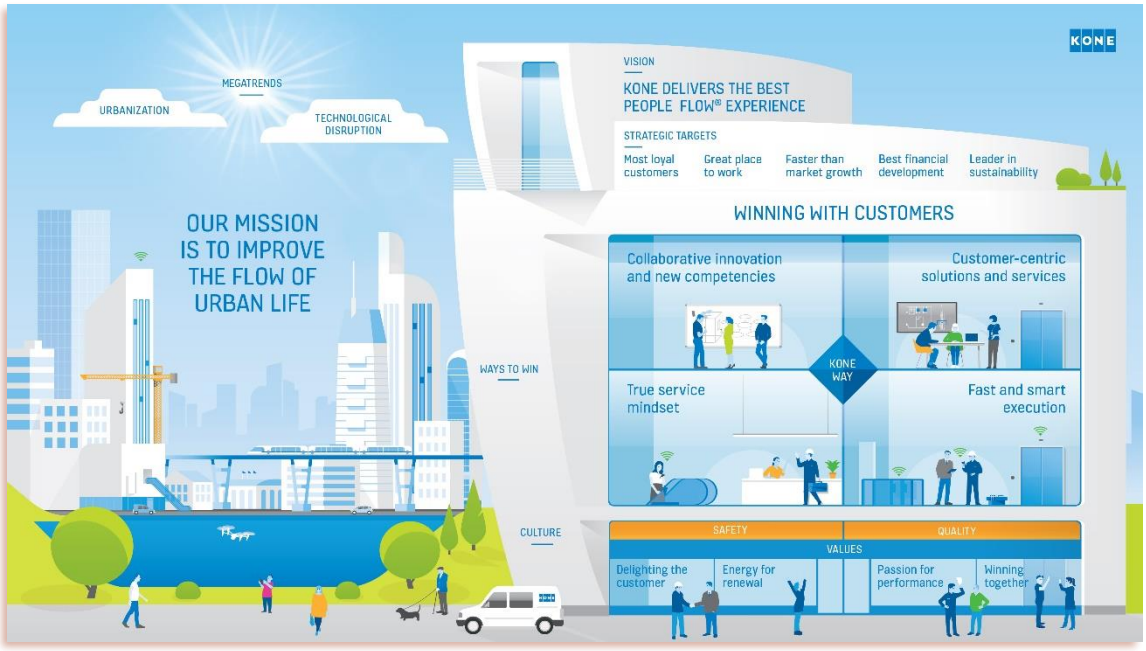


Figure 1: KONE’s new strategy (since 2017) (KONE itranet 2017)(KONE website 2017)

Thus, it was decided to strengthen the quality of the product and provide better service to the customers. KONE manufactures, installs, and maintains all kinds of elevator and escalators for any purposes. KONE is also the pioneer in monospace (machine room less elevators) and n-monospace (smaller and efficient version of the monospace) elevators, also are the technological leader in the business. Even after being very much advanced in technology than the competitors, providing completely customised products to the customers, the KONE Corporation stands third in terms of market share as of 2017. It is important to know why the company fails to be the market leader even after having the good competitive advantage that no other elevator manufacturer has.

It is found out that the call-outs in the elevators were more in the early stage after the equipment handover. In many cases, call-outs reduce as the equipment is used and eventually increases as the equipment gets very old. The customer is fine if there are call-out in the old equipment, but are very disappointed if the equipment is new. It is obvious that no one is happy when anything new is not working well. Any equipment

will have a bad reputation even if it is aesthetically designed and manufactured, have all the innovative technology; but fails to serve its function i.e. transport people to the desired location safely and comfortably.

1.2 Objective

The KONE has a policy of providing free maintenance and service to all their equipment's for one year after its handover. After the free maintenance period, there is the option to have a maintenance contract, annually renewed if the customer wishes to continue. Thus, it is very important to have least call-outs in the first year not only to keep the customers happy but also reduce the service costs.

A term FYCOR is used to study the performance of equipment in the early stages around the world within the company. Currently, the FYCOR and COR for the year 2107 are 1.47and 2.80 respectively (average value in Jan 2017), this is the average of the yearly call-outs of all the newly installed elevator for that period.

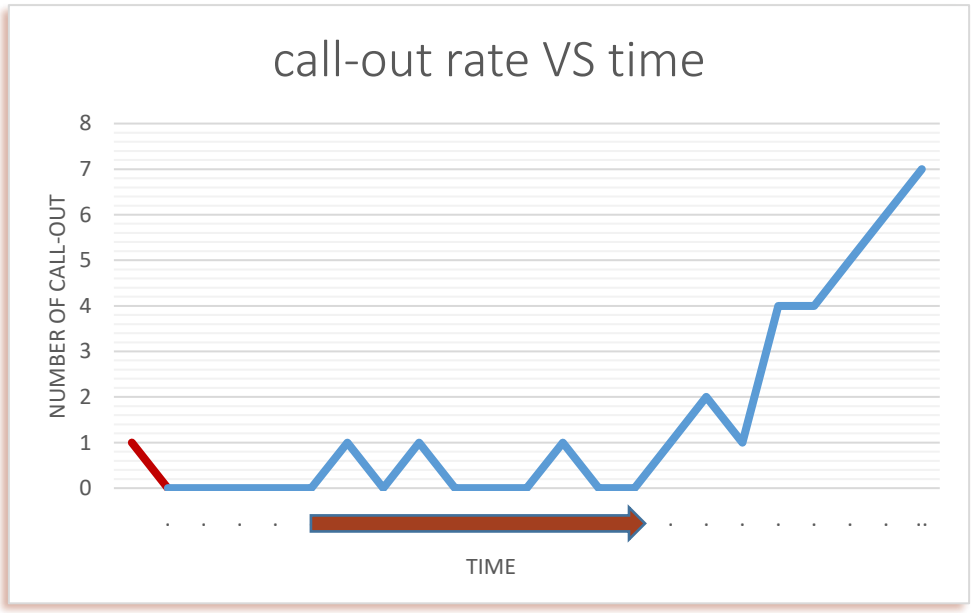


Figure 2: Annual call-out rate

The equipment should not have any call-out during the first year, which means in the first year after the elevator is handed over to the customer, the equipment should not have any call-outs. Apart from this, it's also desired to reduce the total call-out (i.e. reduce the calls including the new and old equipment)

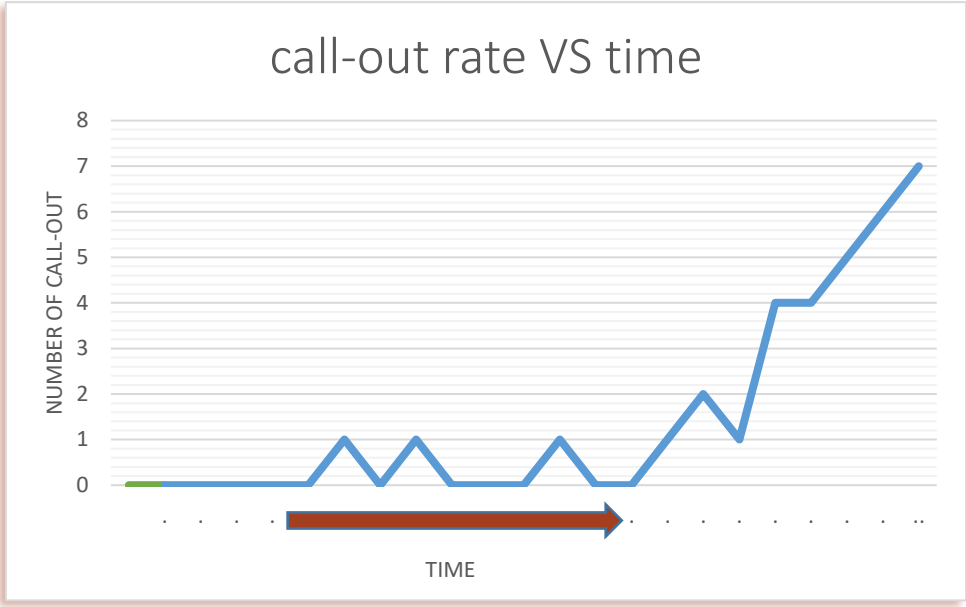


Figure 3: Desired annual call-out rate

If the equipment didn't give early call-out it usually means less call-out in a later stage of its life cycle. But the once early call-out may occur, it tends to produce more, even in the later stage of the life cycle. Besides that, the call-out in the later stages can be prevented whenever the early ones are eliminated and attended properly.

1.3 Company history synthesis

The company was born in a machine repair shop called "KONE" in Helsinki, Finland in 1910. "Machine" is the Finnish translation for KONE. Finland was part of Russia, in 1914 and during the period of the first world war that had struck Europe, and KONE produced 10 million brass shells and casings for the Russian army, with a high impact on company revenues and business growth.

In 1918, the first manufactured elevator was installed in Helsinki area. After world war, the annual demand was about four elevators but in 1924 the sales grew up to 100 units. The business was growing and at the end of 1928, the company produces one elevator by day.

From 1930 KONE was leading the Finnish elevator market but it was small as a business so the Company decides to start manufacturing cranes and electric motors to increase sales. In 1939, KONE produces its 3000th elevator.

During second world war, the Company was converted to serve Finland's defense force by manufacturing ammunitions and wood gas generators for vehicles keeping also capacity to produce a decent number of cranes and elevators.

The logo created in 1910 was modified in 1948 which had a cogwheel behind the nameplate which focused on elevators, industrial cranes, and hoisting machines.

After second world war, the construction business took a long time to recover which resulted in low elevators demand, but from 1950 housing complexes, shopping centers,

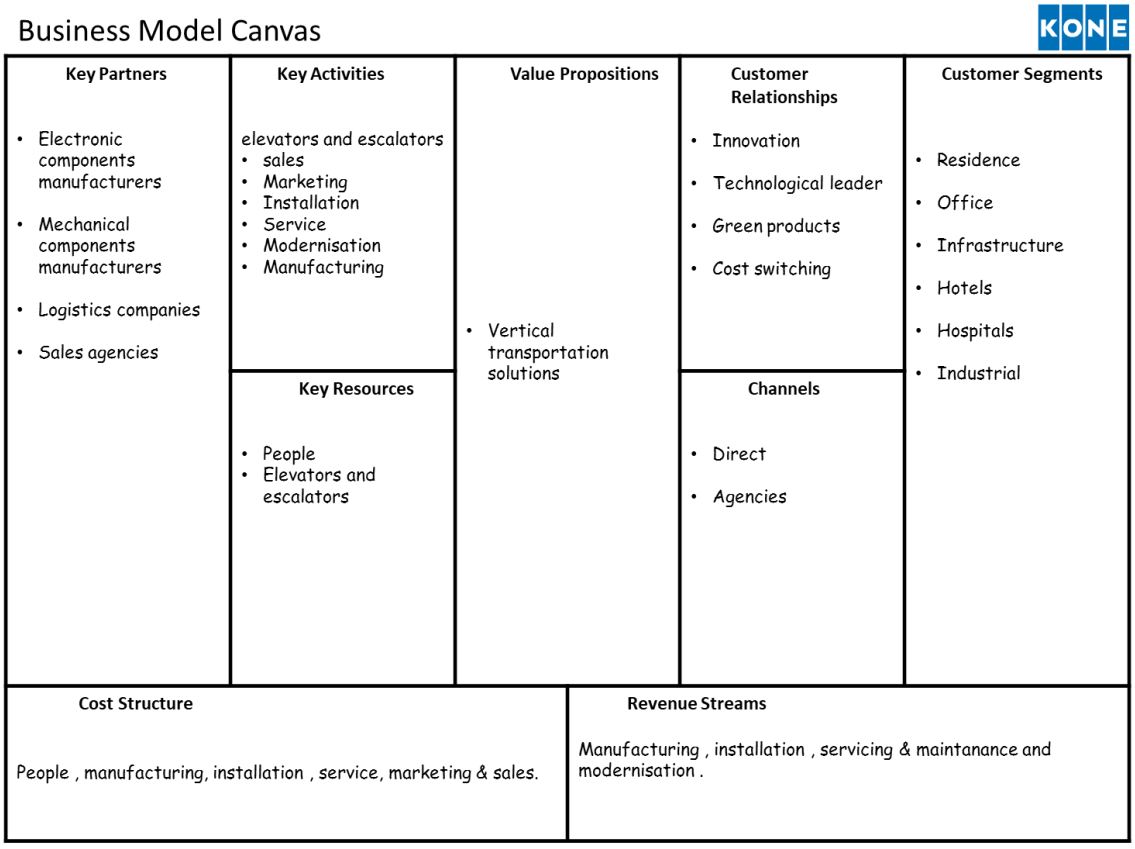
hospital, and office building started growing up. Taller and larger buildings pull KONE to develop sophisticated group controls and automatic doors for its elevators.
It was unfortunate for KONE to lose many of its workers during the war and consequently it was necessary to develop skills and capacity of new workers to satisfy the large and sophisticated demand of the Soviet regime.
In the late 1950s, a new management team re-thought the way to improve the outmoded production process and the developing of its products.
In 1967 KONE opened a new plant with an annual capacity of 2000 elevators, that new offer represented to double the size of Finland's total elevator market. The business was growing and the logo was redesigned but the change with greater impact arrived when KONE brought ASEA's elevator business. The company became the leader in northern Europe.
In 1974 KONE brought elevators business from Westinghouse, that was a market leader in both France and Belgium. It's business, with a high-rise expertise, was larger than the KONE's entire international operations. In less than four years, it was established as a major European player. KONE opened laboratories to test new equipment's and started testing elevators speeds up to 7 meters per second. And in 1977 KONE started producing its own escalators.
In the 1980s the Company became a conglomerate with a presence in several markets. By late 1980 KONE was one of the top 3 companies in elevators & escalators, cranes, wood-handling system, and shipboard cargo handling system.
In 1994 KONE brought a large elevator company Montgomery which was fourth largest in the USA and after that, the Company planned to move to China and expand operations in India. In just a few years KONE covered a huge market around the world.
In 1996 KONE introduces the world's first machine room less elevators, the KONE Monospace changed the whole elevator industry. This was Powered by KONE EcoDisc, hoisting machine places inside the elevator shaft, it was the most efficient and environmentally friendly elevator of the time. It soon became the industry standard and KONE adopted it the low-rise technology to mid and high-rise elevators.

2001 was the time for jump lifts, where the elevators grow with the building and elevator can be moved upwards floor by floor as high-rise building construction progresses. Also, the company got into an alliance with Toshiba elevators and building system corporation giving permission to Toshiba to make elevators based on KONE's machine room-less technology in Japan.
In 2008, KONE was awarded as the first company getting a design award as a manufacturer of elevators and escalators.
In 2010 the company celebrates its 100th year anniversary at 1,000 locations around the world, employing 34,000 people and delivered 60,000 elevators and escalator per year.
In 2013 KONE created a ground-breaking, "KONE ultrarope", which is a super light hoisting cable with a carbon fiber core that eliminates the disadvantage of a conventional rope and enabling elevators to travel one kilometer. In the same year

"People flow intelligence" was equipped with a software aimed to enable people moving smoothly around the building.

KONE is listed as one of the world's most innovative companies by Forbes for the sixth year running (Forbes n.d.). Over one billion of people moved by KONE elevators and escalators every day in 2015. KONE's head office remains in Helsinki while operating expands to 60 countries and 400,000 customers. (KONE website 2017)

To understand the big picture, the business model canvas of the company is given below. The model may be applicable to other elevator and escalator companies as well.



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2 BIBLIOGRAPHIC WORK

2.1 Summary on elevators

Elevators transport passenger vertically from one place to another in a comfortable and desired time. The function of an elevator depends on the purpose for what it is built. Elevators useful in residence, hospitals, shuttle launch stations, and so on, answering to specific needs and requirements.

2.1.1 Importance of a good elevator system

- Transport people and goods
- Are essential in tall buildings with more than three levels
- A good system must be designed to serve the specific traffic flows and service expectation of an individual building
- A good system offers ease of movements to users in a safe environment and in a timely manner to many people.

2.2 Types of elevator

Elevators are classified into three categories based on the working mechanism

1. Hydraulic
2. Drum drive
3. Traction sheave

2.2.1 Hydraulic elevators

Mechanism:

- A plunder pushes the elevator car up as the cylinder is filled with oil.
- Gravitation lowers the elevator car when the oil from the cylinder is let out.

(KONE learning 2017)

Advantage:

- A hydraulic elevator is cheaper to build than the other elevator types.

Disadvantage:

- Deep pits must be dug for the plunger.
- The travel distance of the car is limited.

Uses:

- It is used mainly for lifting very heavy loads for short distances.

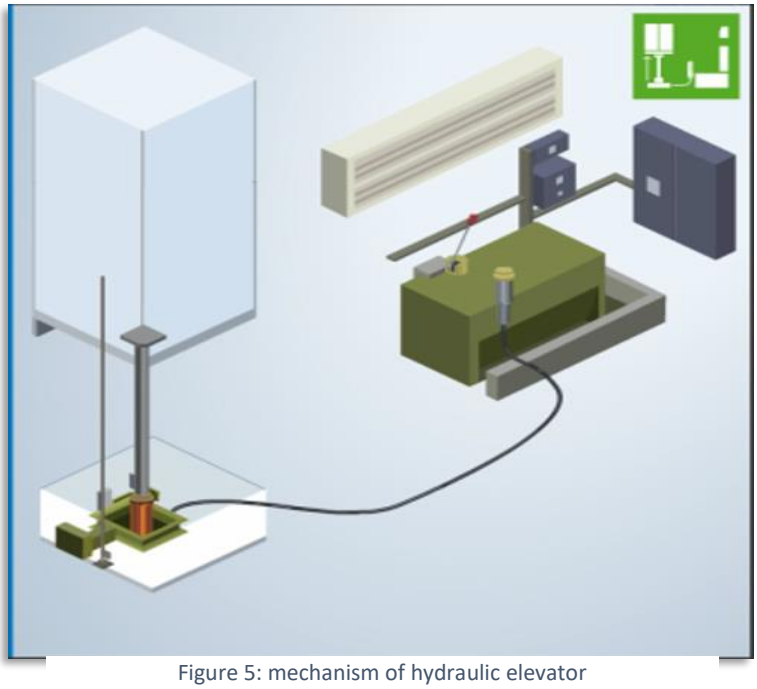


Figure 5: mechanism of hydraulic elevator

2.2.2 Drum drive elevators

Mechanism:

- it contains a steel drum powered by an electric motor or a steam.
- The hoist rope is wound around the steel drum
- The hoisting rope pulls the elevator car up when it is wound around the steel drums.
- As the hoisting rope unwinds, the elevator car descends.

Disadvantage:

- The maximum length of the hoisting rope depends on the size of the drum, which affects the travel distance of the elevator car.
- Heavy power is required to pull the weight of the elevator car, hoisting rope, passenger, and payload.

Uses:

- They are not used much nowadays because of their disadvantages, it was used before.

Figure 6:mechanism of drum drive elevator

2.2.3 Traction sheave elevators:

Mechanism:

- The hoisting rope passes over a traction sheave.
- The hoisting ropes have the elevator car hanging at one end and the counterweight on the other end.
- The counterweight balances the weight of the elevator car and half of the rated load.
- It provides friction on the reaction sheave to stop the ropes from slipping.

Advantages:

- There is no limitation on the travel distance as it is not dependent on drum size.
- It saves energy and power since due to the counterweight, the machinery does not need to pull the combined weights of the elevator car, passengers, and the payloads.
- It is the most common elevator used nowadays.

Figure 7: mechanism of traction sheave elevators

2.3 Main components in a traction sheave elevator

1. Hoisting
2. Electrification
3. Signalisation
4. Doors

2.3.1 Hoisting

Includes any equipment that must do with the actual physical lifting.

Machinery:

- Can be located on the top or at the bottom of the shaft, or off to one side.
- Is usually located in a separate machine room.
- Contains the brakes, which are incorporated in the machinery itself.
- It is divided into two main types: geared and gearless.
- Its core purpose is to drive the car.

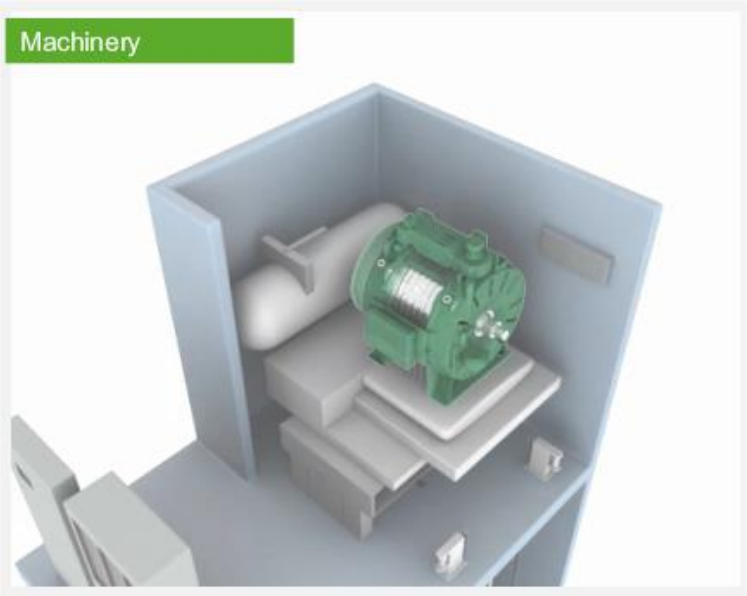


Figure 8: machinery of an elevator system

Hoisting ropes:

- Transfers work done by the machinery into moving the elevator car
- It passes over the traction sheaves and as the machinery rotates the traction sheaves, the friction between the sheave and the ropes moves the ropes.

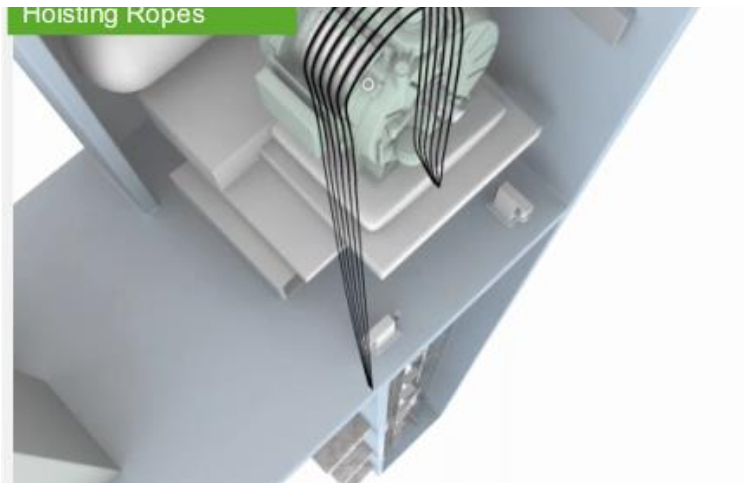


Figure 9: hoisting ropes of an elevator system

Types of roping configuration:

1. 1:1 roping
2. 2:1 roping
3. 4:1 roping

1:1 roping

- In this configuration, the elevator car is attached directly to one end of the rope and the counterweight to the other end.
- The rotation of the traction sheave is directly converted to elevator car movement.

Figure 10 1:1 roping configuration

2:1 roping

- In this configuration, the elevator car moves only half as fast as the ropes
- Machinery takes only half the power to move the elevator car.
- Doubles the load capacity of the elevator

Figure 11 2:1 roping configuration

4:1 roping

- The elevator only moves one-quarter as fast as the ropes
- These type of configuration is very useful in freight elevators since it allows four-time capacity of the 1:1 roping arrangement

Figure 12 4:1 roping configuration

Types of wrapping arrangements:

1. Conventional single wrap (CSW)
2. Extended single wrap (ESW)
3. Conventional double wrap(CDW)

Figure 13: conventional single wrap configuration

Conventional single wrap(CSW)

- It's the simplest form of wrapping
- The rope passes once over the traction sheave and goes down again.

extended single wrap(ESW)

- The ropes are wrapped around the traction sheave from the other side
- It increases the contact area between the ropes and the traction sheave, thus increasing friction and improving traction.

Figure 14 extended single wrap configuration

Conventional double wrap(CDW)

- The rope passes around the traction sheave, over a diverter pulley, and again over the traction sheave
- The ropes are interleaved with some space between them
- interleaving eliminates rope wear resulting from contact with other ropes.

Figure 15 conventional double wrap configuration

Compensating ropes

- The core purpose of the compensating ropes is to counterbalance the weight of the hoisting ropes
- They run from the bottom of the elevator car through a delivery pulley at the bottom of the elevator shaft and run back up the shaft to the bottom of the counterweight
- Together with the hoisting ropes, they create a loop of rope with a balanced weight on both sides of the traction sheave.
- It affects the workload of the machinery when an elevator travel is long (over 40m)

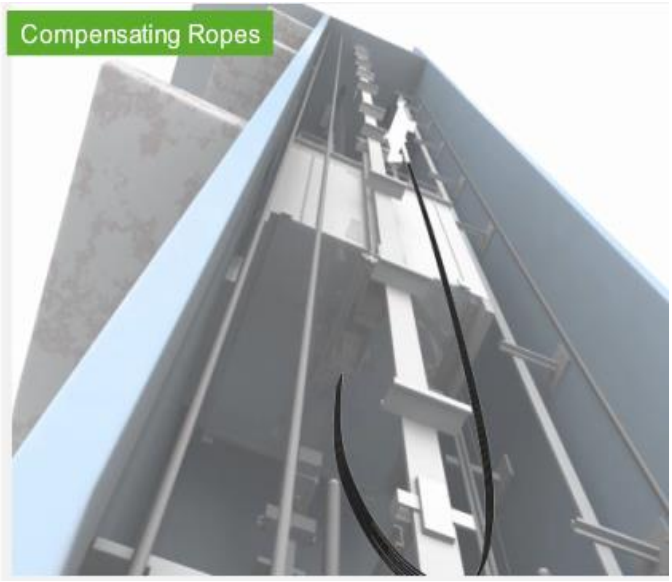


Figure 16 compensating ropes of an elevator

Counterweight

- The counterweight pulls on the hoisting ropes on the opposite side from the elevator car.
- It generates sufficient friction to resist slipping on the traction sheave as the weight of the elevator car and counterweight pull the hoist rope against the traction sheave.
- It resists the weight of the cat so that the machinery is not pulling the whole weight of the elevator car and passengers.

Figure 17 counter weight of an elevator

Guide rails

- These are just like vertical railway tracks that keep the elevator car and the counterweight traveling in a straight line.
- They are fixed firmly to the shaft walls
- They are also used for emergency stops as the safety gear grips them to stop the elevator car.
- They must be installed correctly to ensure a comfortable ride.

Figure 18 guide rails of an elevator

Elevator car:

- it carries a passenger and other goods.
- Ensures a comfortable ride.
- Also, isolates passengers from the shaft equipment and machinery.
- Muffles noises and vibrations
- Provides comfortable surroundings.

Figure 19 car of an elevator

Buffers

- Are devices designed to limit the elevator car or counterweight beyond its lowest level.
- It also reduces the impact force when the elevator goes down the pit in an emergency.
- It may be polyurethane or oil type depending on the rated speed of elevator.

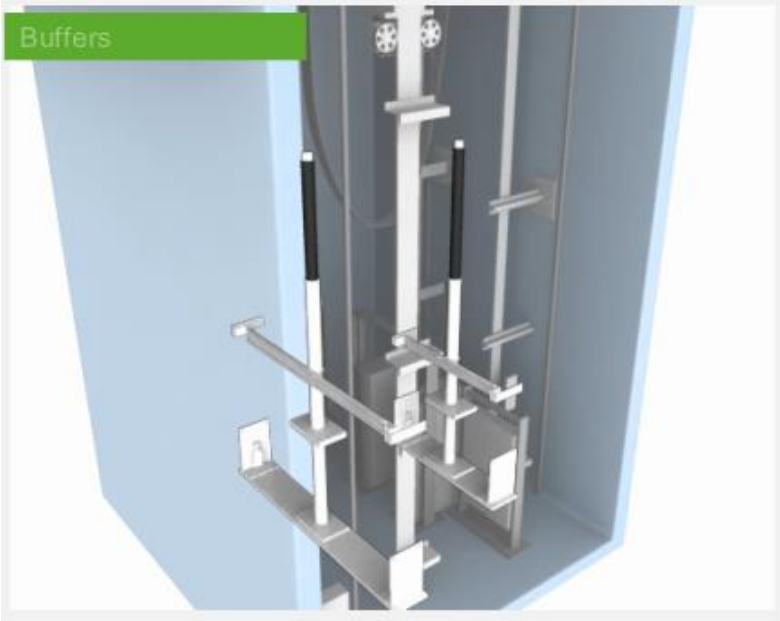


Figure 20 buffer of an elevator

Safety gear and speed governor:

- These are emergency safety devices used to prevent the elevator free falling into the pit in an emergency.
- The speed governor is a centrifugal governor which trips when the velocity of the elevator goes beyond its maximum operating speed. the tripping speed varies depending on operating speed.
- The safety gear is a device that grips the guide rail when the speed governor trips. they are connected to the governor via ropes.

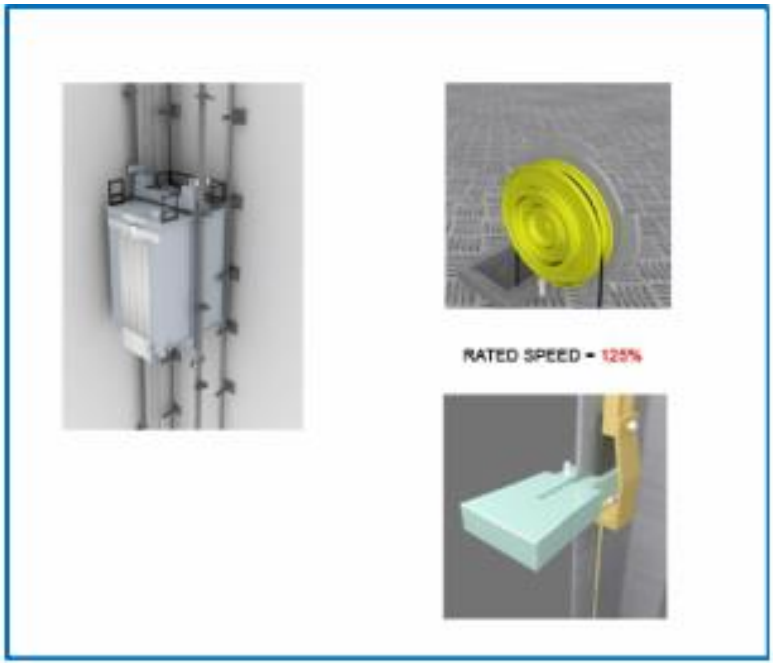


Figure 21 safety gear & speed governor

- The safety gear is mostly present in the elevator car and counterweight.

2.3.2 Electrification

Electrification includes all the electrical parts and connections that power the elevator and controls its movement

Drive

- The drive takes commands from the controller and is located in the machine room
- It is often incorporated in the same control cabinet as the controller.
- It feeds power to the machinery and regulates the current and voltage feed into the machinery.
- It makes the machinery run at different levels of torque and speed.

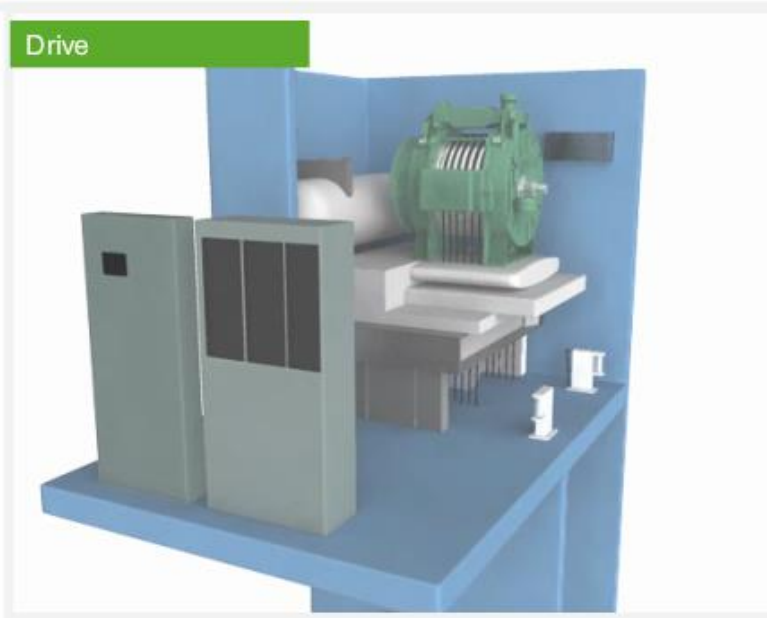


Figure 22: drive of elevator

Controller

- The controller receives the calls from the push button in the car and on landings and determines where is located and defines the suitable direction of travel.
- It gives the start command to the drive system and the stop command inappropriate landing.
- It also provides the door drive with an opening, closing, and locking commands.
- It provides necessary indication signals to the passengers through the position indicators.

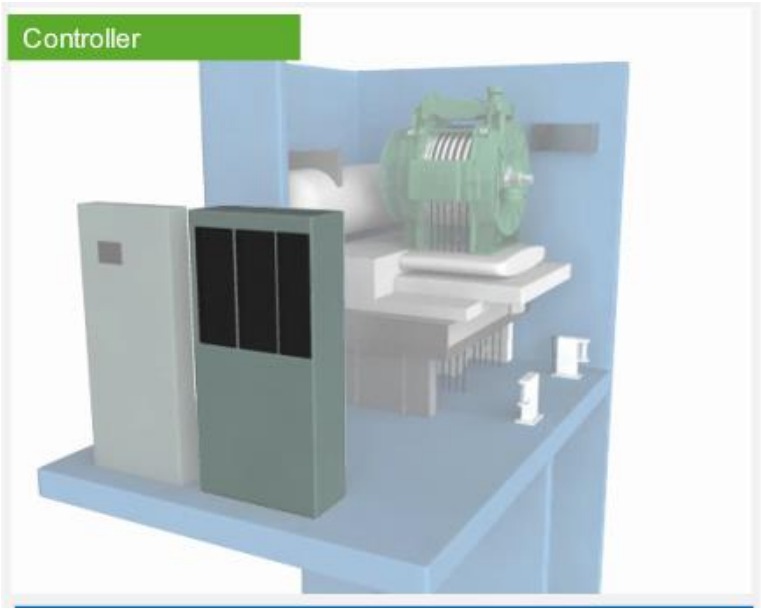


Figure 23 controller of an elevator

Shaft switches

- They are operated by fixtures attached to the elevator shaft as the elevator car moves past them
- It provides the controller information about the location of the elevator car.
- They are fixed in every level, each time the elevator car passes through the switch, a signal is sent to the controller and the controller decides if the elevator car should accelerate, decelerate, or maintain the same speed
- If any of the switches is missing in a level the elevator skips that level and goes to next level.
- These are the reference for the levels for the controller.

Figure 24 shaft switch of an elevator

Travelling cable

- Travel cable relays power and information between different components of the elevator system
- It is connected to the control equipment on the top of the elevator shaft and to the elevator car interface.

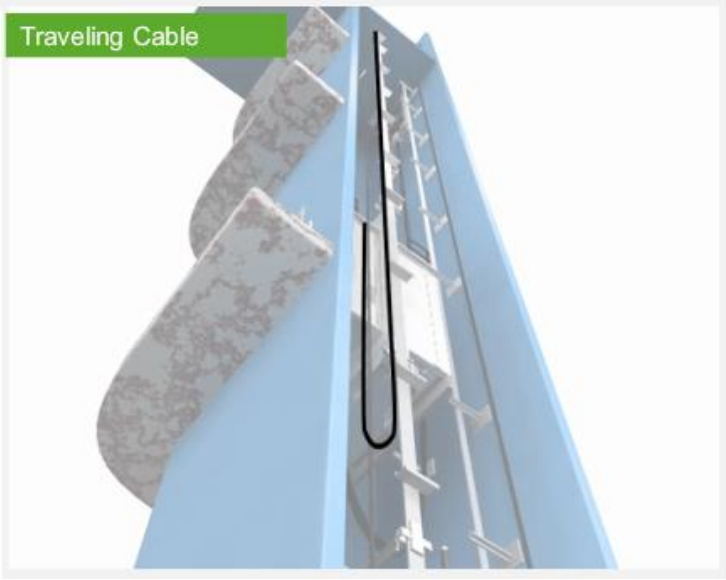


Figure 25 travelling cable of an elevator

2.3.3 Signalisation

Signalisation components serve as an interface between a passenger and the elevator by indicating what the elevator is doing. It also provides passengers a means of controlling the elevator

Car operating panel

- The passengers use it to instruct the elevators to direct to the desired destination
- Sends information to controller
- It also has the alarm switch and can be used to contact the call center in case of emergency

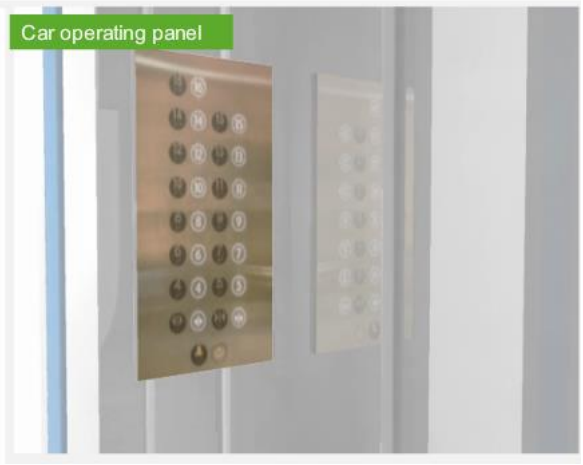


Figure 26 car operating panel of an elevator

Position indicator

- It is used to display the position of an elevator.
- It is present in each level.
- It also indicates the direction of the travel.

Figure 27 position indicator of an elevator

Landing call station

- It's used to call the elevator to the level and specify the direction of the travel.

Figure 28: landing call button

2.3.4 Door

Doors are integral for safety, comfort, and efficiency. It also separates the passengers from the shaft equipment.

Different types of doors

1. Automatic and manual
2. Centre opening and side opening
3. Car door and landing doors

Automatic and manual doors are self-explanatory, they are operated automatically and manually respectively.

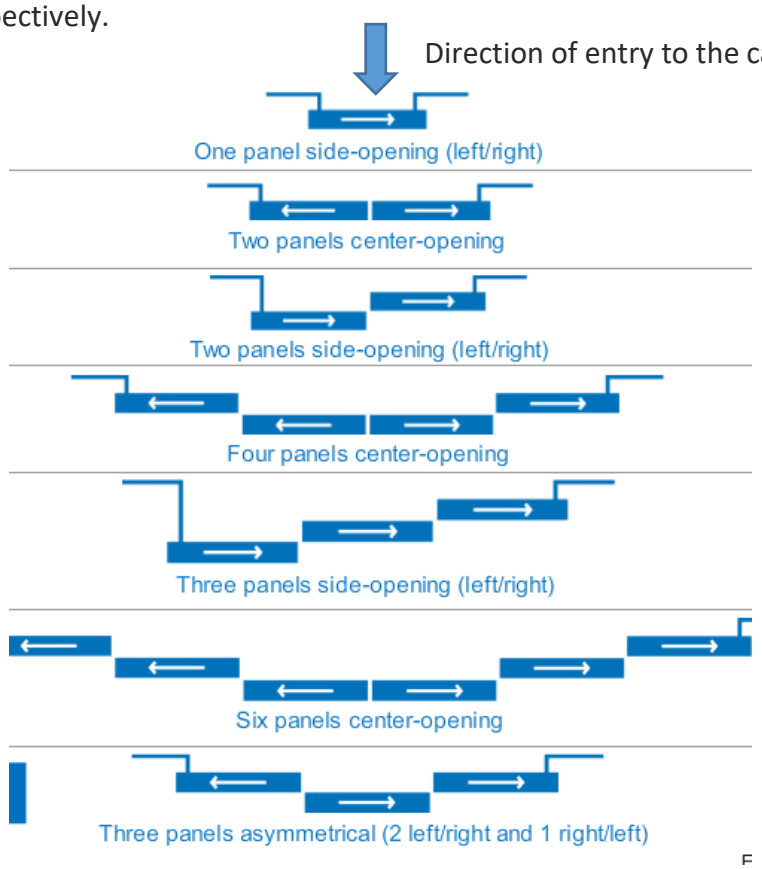


Figure 29 different types of centre and side opening door configurations

Car and landing doors

The doors that are present at each level at the entrance are the landing doors, and the doors that are present on the car are the car doors

Car door functions

- Lock automatically when the elevator leaves the landing
- Cannot be opened until the elevator stops safely on a landing
- They are fixed to the front edge of the elevator car
- They travel by the elevator car providing a sealed silent, and safe environment.

Landing door functions

- Lock automatically when the elevator is not behind them
- The opening elevator car door automatically opens them
- Usually, don’t have their own drive system.

The door couplers are responsible for opening the landing door when the elevator doors open. It is connected to elevator car door, are a simple bracket that fits a counter piece in the landing door. It is on the railing (top track) of the car door. This connects to the landing door when the elevator car enters.

Safety devices

Elevators have one mandatory safety devices: the closing force limiter. Other optional safety devices such as safety edge and the curtain of light, ensures that doors don't close if there is an obstruction between the doors. These devices are fixed on the elevator car door because the car door usually operates the landing doors.

Door drive control

Door drive is used drive the door, i.e. it closes and opens the door. It controls the opening and closing speed of the door by altering voltage and frequency fed into the door operators motor

When the controller sends the command to the door drive, it activates the door operator

Figure 30 door drive

Door operator

The door operators work based on the command received by the door drive. When the door drive receives an open command, it operates the door operator.
It opens and closes the automatic doors on the elevator. These are also located on the railing of the car just like door drive.

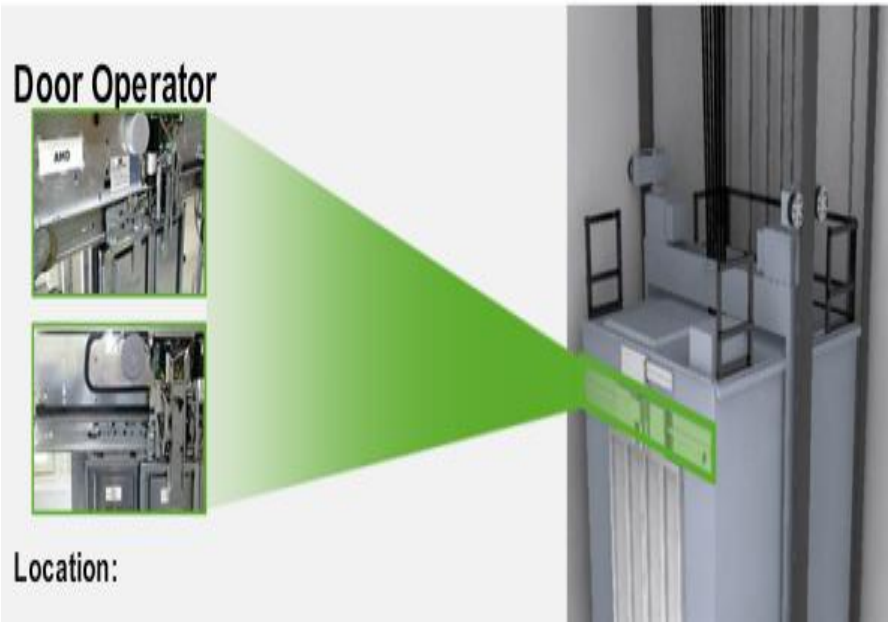


Figure 31 door operator

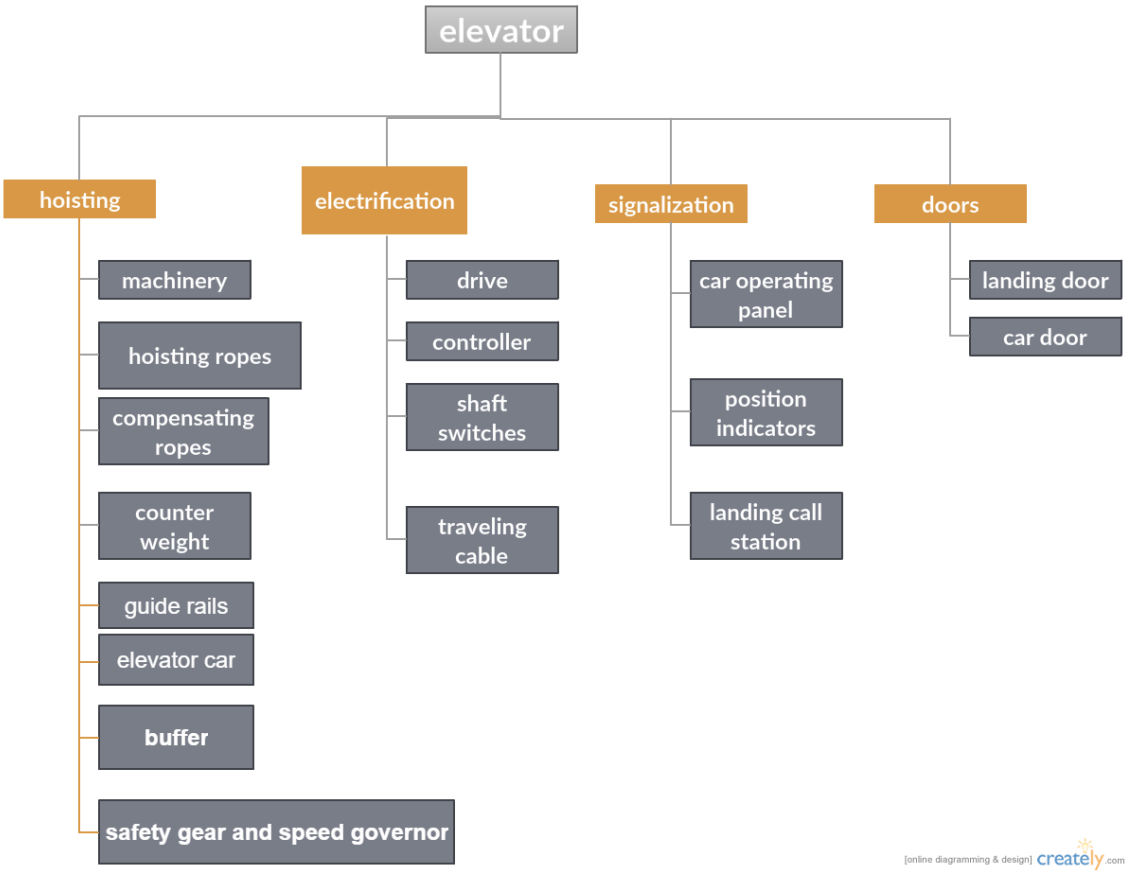


Figure 32 overview of the component classification in an elevator

2.4 Safety

2.4.1 The safety chains

The safety chain connects every switch and instrument monitoring the elevator system. It is arranged as a “chain” that passes through all the safety devices. It cuts off the power if the chain is broken and stops the elevator and automatically engages the brakes.

2.4.2 Safety components

These components keep the passenger’s safe when

1. Entering & exiting an elevator
2. Riding in an elevator

There are various devices that help to achieve this kind of safety, the common ones are listed and described below.

Closing force limiter

These are present in all elevators. It prevents the door from pushing too hard against an obstruction and opens the door if the obstruction is not removed.

Safety edge

They are located on the vertical edge of the door panels. It's operated by compressing if they encounter any obstruction and reopens the door if they detect any obstruction.

Photocells

They are fixed to the vertical edge of the door panel. They project a beam of light to a sensor mounted on the opposite side. They send a request to door drive when the beam is broken.

Curtain of light

It consists of a set photocell installed at different heights in the door opening. They prevent the door from closing if there is an objection or a person blocking the door. Works as the photocells, but cover a wide area of the doorway.

Door contact switch and locks

They keep the safety chain broken until the door is properly closed and locked. Due to the broken safety chain, they prevent the car from moving until the door is properly

closed and locked. They ensure that the passengers stay in the car on the landings and do not fall into the shaft.

Safety gear and speed governor

The purpose of the safety gear is to stop the elevator car from falling in any situation. The safety gear is installed either on the top of the car or bottom of the car and may also be present on the counterweight, and the speed governor is either in the machine room or in the pit. The speed governor is a centrifugal pulley, a rope goes over the governor and rotates at a certain speed depending on the velocity of the elevator car. When the speed of the elevator goes beyond the maximum rated speed the governor stops rotating and pulls a lever that is connected to the safety gear on the car and the safety gear grips the guide rail and stops the elevator. The speed governor trips only when the elevator car goes downward beyond the rated speed, its only works in one direction. Thus, it must be installed properly keeping an eye on the direction of rotation.

2.5 Quality and environment

- Quality planning, development of quality & environmental systems, improvement actions and quality & environment reviews
- Quality & environmental measurements, feedback process and internal quality & environmental audits.
- Preventive and corrective action system (CAS) and method (DMAIC or LIFT)
- Quality & environmental operating model
- Contain and retrofit process.

2.5.1 Quality and environmental planning process

A **quality objective** seeks to increase customer satisfaction, reduce non-conformities and or implement standards a standard process. An **environmental objective** seeks to reduce the impact on the environment by improving performance in specific environmental aspects. A **quality target** is a level to be reached for a quality objective. It is numerical and time-related and is established for every quality objective. An environmental target is a level to be reached for an environmental objective. It is measurable, where practicable, consistent with the environmental policy, time-related and established for the agreed environmental objective.

Planning of quality process and systems to seek to improve the ability of the business process to meet customer and other requirements like feedback process etc**. Planning of improvement** actions incorporates measurable objectives and targets.

Quality and environmental reviews are examined to evaluate the need for corrective and preventive actions. The following aspects are reviewed.

- Previous quality and environmental reviews
- Customer complaints and customer loyalty surveys
- Result of internal and external audits
- Feedback & non-conformance process
- Performance of process and conformity of products & services.
- Quality & environmental objectives monitoring
- Needs and expectations of stakeholders
- Preventive and corrective action list
- Performance of external suppliers and subcontractors
- Other quality and environmental measurements
- Risk and opportunity
- Significant environmental aspects.

2.5.2 Quality and environmental measurements

Quality and environmental measurements help management to monitor the performance of quality and environmental process and the progress of quality and environmental objectives.

Needs and expectations of the interested parties are considered when defining quality and environmental measurements. Monitoring of these measurements is assigned to people who are responsible for taking appropriate actions. Unit measurement team set a target for these quality and environmental meetings. Corrective actions are implemented when a deviation is detected.

2.5.3 Feedback

The relevant feedback, through an internal process, can be got within the organization or from an external interesting part as an improvement opportunity for product, process or service.

2.5.4 Internal and external audits

The purpose of audits includes the following

- Bring objective and information about the performance of the process to management so that it can be initiated the best preventive and corrective actions.
- Enabling management teams to review the strength and weakness of the quality and environmental system and the application of the system and potential risk in reaching the targets.

- Checking that operations are carried out according to process descriptions and related requirements such as legal and other regulatory environmental requirements
- Identifying opportunity to improve business performance in terms of customer satisfaction and loyalty, quality of products and services, interfaces between different organizations and cost reduction.
- Verifying that process meet business objectives.

2.5.5 Preventive and corrective actions

Preventive action:

An action to eliminate the root cause of any item that potentially causes customer dissatisfaction, internal inefficiency or other undesirable situations is preventive actions. Preventive action address potential problems. In general, the preventive action process can be thought of a risk analysis process. An example of this is risk assessment and FMEA during the development phase.

Corrective actions:

A change in the way of doing things that eliminate the root cause of a problem, each problem is an opportunity to improve.

Preventive and **corrective action system** (**CAS**) is used to ensure that problems requiring local preventive or corrective actions are recorded and reviewed and monitored by management.

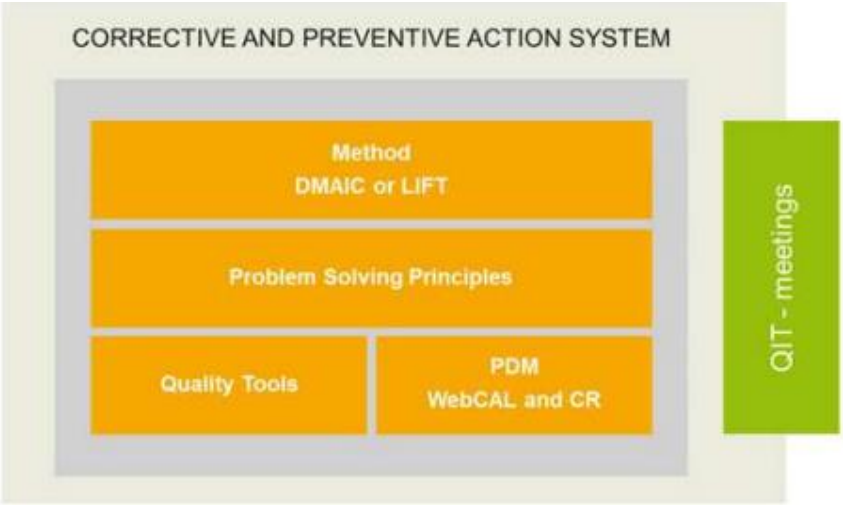


Figure 33: corrective and preventive action system model(Quality and Environmental Manual QM-02263 2017)

Corrective actions are implemented to systematically eliminate problems from our processes and services, thereby leading to improve customer satisfaction and efficiency. Product change management (**PCM**) with a change request (**CR**) is used to manage product changes.

CAS includes the corrective action methods (**DMAIC** and **LIFT**) and use of quality tools when necessary.

2.6 Performance criteria of an elevator system.

The word 'elevator system' can be inferred to an operation of the single elevator or a group of elevators. The algorithm of an elevator attending the call in the grouped elevator is entirely different when compared to the single elevator. The logics work based on certain performance criteria of an elevator system. The criteria's involved in the elevator performance are explained below.

2.6.1 Call time

It's the time spent by a passenger waiting for the elevator car to arrive on the landing after pressing the call button. An efficient elevator system will have less call time.

2.6.2 Waiting time

Waiting time is the time a passenger spends waiting on the landing for the elevator car to arrive.
If there is only one passenger on the landing, the call time and waiting time are the same. If additional passengers arrive at the landing while the first passenger is waiting for the elevator to arrive, the waiting time is shorter than the call time.

2.6.3 Queue in the lobby

This indicates that there are more passengers than the elevator system can handle. It can be due to various reasons such as call time, handling capacity, interval and so on.

2.6.4 Handling capacity

This defines the volume of traffic that the system can handle. It is expressed as a percentage of the building population that the elevator system can handle in 5 minutes.

2.6.5 Interval

It’s defined as the frequency of elevator departures from the main entrance.

2.6.6 Bunching

It is the tendency of the elevator in an elevator group to cluster and run together. It causes the interval time to increase.

2.7 Factors affecting the elevator performance

2.7.1 Group size

Number of the elevator in a group with the same purpose of service. It is the main factor that affects handling capacity and interval of an elevator system. It is proportional to the handling capacity i.e. handling capacity increase as the group size increases.

2.7.2 Rated load

It's the load capacity of an elevator. It improves the handling capacity of an elevator system, on the other hand, it increases the loading time and interval.

2.7.3 Rated speed

It is the speed of the elevator. It decreases the travel time. It is the key for the elevator having long travel distance.

2.7.4 Other factors

Sometimes acceleration and jerk affect the performance of the elevator, it can lead to passenger discomfort. The door closing and opening speed, and door type (center or side opening)

2.8 Traffic condition

The conditions of traffic mentioned, hereinafter, may be considered when the elevator system is planned and designed. For example, the traffic in a corporate building is high in the morning in the lobby this is obvious since people use the elevator from the lobby to get to their workplace.

The different traffic conditions are as mentioned below

2.8.1 Up peak:

All the traffic if from the lobby to the upper floors. The passenger takes the elevator up, where the elevator becomes vacant. The group controller sends all the elevator down as soon as they become vacant.

2.8.2 Down peak

It occurs whenever the people are traveling from the upper floors to the lobby. The passengers take the elevator down, where the elevators become vacant. The group controller automatically sends all the elevator up as soon as they become vacant.

2.8.3 One floor peak

It occurs whenever the people are traveling when there are suddenly more people waiting on a landing that can be fitted into one elevator car. The group controller sends extra elevator car to that landing.

2.8.4 Light traffic

Whenever the traffic is low, all the elevators are not needed to handle the traffic flow. The group controller parks idle elevators in a dispersal pattern around the building.

2.8.5 Heavy traffic

This is the condition where all the elevators are busy. The elevator collects up calls when they are going up and down calls when they are going up. The group controller ensures that no elevator is idle. The group controller measures & optimises the waiting time by prioritizing the oldest calls.

THESIS DEVELOPMENT

3.1 Segment of the work

3.2 Methodology

3.2.1 LIFT:

3.2.2 DMAIC

3.3 Characterisation / phase of the project

3.4 Define

3.5 Measure

3.5.1 Data collection

3.5.2 Annual call-out

3.5.3 Measuring call-out in projects, equipment, and components

3.5.4 Measuring FYCOR monthly

3.5.5 Measuring call-out in equipment category:

3.5.6 Measuring call-out reasons

3.5.7 measuring call-out actions

3.6 Analyse

3.6.1 Analysis of data for latest 6 months (November 2016 to April 2017) [pareto chart & ABC chart]

3.6.2 Analysis on classified components: [pareto chart & ABC chart]

3.6.3 Correlation study

3.6.4 Call-out pattern

3.6.5 Bench marking

3.6.6 Problem tree analysis:

3.6.7 Analysis on operations (maintenance and breakdown attendance)

3.6.8 Summary of the analysis & findings

3.7 Improve

3.8 Control

3 THESIS DEVELOPMENT

3.1 Structure of the work

To fulfill the ultimate objective of reducing the call-out, the thesis development adopts two strategies.

1. Improvement plans
2. Corrective plans

Both are related to each other for example when there is something rectified in the process then the process is improving or it can also be vice versa if the process is improved, the problem gets rectified.

In the case of elevator call-out, both installation and maintenance can be the reason for the call-out. Hence it is necessary to have few things corrected and few things rectified in the same time. Very often things are corrected and then improved.

3.2 Methodology

Applying LIFT and DMAIC tools provide solutions to problems and improve the process.

3.2.1 LIFT:

LIFT is problem-solving methodology which is used to solve any issues or problem in a systematic way. (Quality and Environmental Manual QM-02263 2017)

The acronym LIFT refers to:

- **L**ist all the aspects of the problem.
- **I**dentify several root causes.
- **F**ormulate an action plan.
- **T**erminate the problem permanently.

The phases of the LIFT will be embedded within the DMAIC process(L & I in the analysis part of the DMAIC and F & T in the improvement and control part of DMAIC)

3.2.2 DMAIC

DMAIC is a famous lean six-sigma project methodology which can be used to stabilize, optimise, and improve any process(George 2003). It is a cyclic process where every result is reviewed and the process is continued.

It refers to:

- **D**efine
- **M**easure
- **A**nalyse
- **I**mprove
- **C**ontrol

As mentioned earlier it is an iterative process and process gets better as the cycle continues. Unlike any process in manufacturing; where the task is continued and repeated, a process in a project is essentially different, since a project is unique and has a definite lifetime. Hence the planning in a project must be very much close to reality because there is only one chance to do it and it must be done right and efficiently the first time.
The elements of DMAIC and the possible tools that can beat each stage are given below in the table.

* -indicates that they are used.

Number	Phases of DMAIC	Description	Tools that can be used	Phases of LIFT
1	Define	Define your goals, Identify KPI and define the KPI	SIPOC diagram, Multi-generational diagram	
2	Measure	Measure your KPI and the parameters that affect the KPI, example data collection.	Box plot* Process observation* histogram FMEA	
3	Analyse	Analyse the data and finding if there is any pattern and finding the root cause of the problem.	Pareto chart, Correlation analysis*, Scatter plot*. Pareto chart* Brainstorming* Nonvalue analysis*	L & I
4	Improve	Suggesting improvement action	5S* Kaizen TPM	F&T
5	Control	Controlling the new or the process that is in action.	SPC Control chart Quality checks*	T

Table 1: DMAIC table

3.2.3 ABC analysis and Pareto diagram

ABC chart splits the any given data into three categories, i.e. category A, category B and category C. The chart helps to identify the critical category of data which will have the maximum impact. The Pareto chart is based on 80-20 principle, the principle is more than a century old, it was developed by an Italian economist Vilfredo Pareto to understand the unequal distribution of wealth in Italy(Reh 2005). The principle states that 20 % of the cause is responsible for 80 % of the problems(effects) and hence elimination of 20 % of cause can resolve 80 % of the problems. The LHS (left-hand side) y-axis represents the frequency/count or percentage and the RHS (right-hand side) Y-axis represents the cumulative percentage and the X-axis represent the cause (project name)

These help managers make important decisions, and usually, they are very significant in inventory management. They are also proven to be significant when there are a lot of data(Chu, Liang, and Liao 2008). In many cases the ABC classification varies for cost and causes(Ramanathan 2006), i.e. there may cases where the item in class A in the cause can shift to class B or class C when it comes to cost.
Both tools are used to analyze the call-out, which can be seen in the chapters 3.6.1 & 3.6.2

3.2.4 Correlation analysis

Correlation is a descriptive parameter, it is used to study or find if there is something common between two numerical variables. It is said that two measures are correlated if it shares something common between them. The correlations can have a negative or positive value, meaning the relation between two measures can be can be proportional or inversely proportional.
The strength of the relationship is indicated by a value called correlation coefficient, which is denoted by the letter “r”. There is various correlation coefficient, in the analysis a famous correlation coefficient called “Pearson coefficient” is used. This was first introduced by Galton in the year 1886, which was formalized by Karl Pearson in 1896 and followed by Fisher in 1935(Abdi et al. 2009). The strength of the correlation is denoted by the value of “r”, higher the “r” value higher the strength of the correlation(Azhar and Bialek 2010).
The correlation analysis is carried out in the session 3.6.3

3.3 Applying DMAIC phases

Using DMAIC phases to the case to have a systematic approach to the problem.

3.4 Define

The proposal is to reduce the call-out(**COR**) of the equipment to achieve low **FYCOR** values, restricted by targets “ZERO” as minimum and “ONE” as a maximum.

Before going further, it is necessary to have knowledge about call-out, FYOCR and know that these terms mean.

Elevator call-out:
An elevator **call-out** is any reason that elevator stopped functioning or malfunctioning. Reasons include noise, smell, comfort etc.

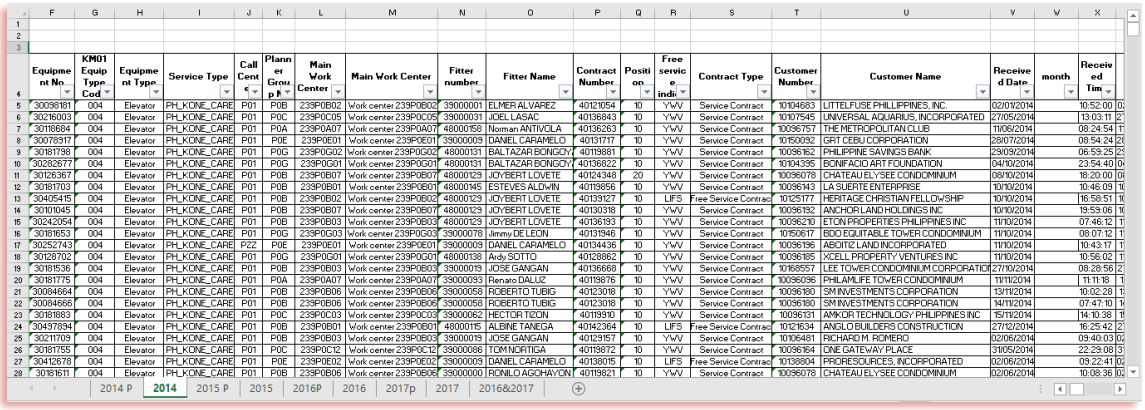
FYCOR- First-Year Call-Out Rate:
This is the relevant **KPI** for monitoring elevator performance. It is defined as the average of elevator call-out in a year. For example, if there are 2 elevator which was handed over to customer 12 months ago and 6 months ago and had call-out of 2 and 1 respectively then the FYCOR for that case is 2. (((2*12/12) +(1*12/6)/2) =2)

3.5 Measure

3.5.1 Data collection

It's a key component for the analysis if the size of data and accuracy have a significant impact on the results. The call-out records are collected from the year January 2014 Up to April 2017.

The data contained a total of 49 variables like site name, equipment type, locations, customer name, and so on. The list of the variable is presented in Annexure 5



Equipment No.	KM01 Equip Type Cod	Equipment Type	Service Type	Call Cent	Planner Group	Main Work Center	Main Work Center	Fitter number	Fitter Name	Contract Number	Position	Free service indi	Contract Type	Customer Number	Customer Name	Received Date	month	Received Tim
30036161	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B02	Work center 239P0B02	39000001	ELMER ALVAREZ	40121054	10	YWV	Service Contract	10104683	LITTELFUSE PHILLIPPINES, INC	02/01/2014		10:52:00
30216003	004	Elevator	PH_KONE_CARE	P01	P0C	239P0C05	Work center 239P0C05	39000031	JOEL LASAC	40136843	10	YWV	Service Contract	10107545	UNIVERSAL AQUARIUS, INCORPORATED	27/05/2014		13:03:11
30118694	004	Elevator	PH_KONE_CARE	P01	P0A	239P0A07	Work center 239P0A07	48000158	Norman ANTIVOLA	40136263	10	YWV	Service Contract	10096757	THE METROPOLITAN CLUB	11/06/2014		08:24:54
30078917	004	Elevator	PH_KONE_CARE	P01	P0E	239P0E01	Work center 239P0E01	39000009	DANIEL CARAMELO	40131717	10	YWV	Service Contract	10150092	GRT CEBU CORPORATION	28/07/2014		08:54:24
30181798	004	Elevator	PH_KONE_CARE	P01	P0G	239P0G02	Work center 239P0G02	48000131	BALTAZAR BONGOY	40119881	10	YWV	Service Contract	10096162	PHILIPPINE SAVINGS BANK	23/09/2014		06:59:25
30282677	004	Elevator	PH_KONE_CARE	P01	P0G	239P0G01	Work center 239P0G01	48000131	BALTAZAR BONGOY	40136822	10	YWV	Service Contract	10104395	BONIFACIO ART FOUNDATION	04/10/2014		23:54:40
30126367	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B07	Work center 239P0B07	48000123	JOYBERT LOVETE	40124348	20	YWV	Service Contract	10096078	CHATEAU ELYSEE CONDOMINIUM	08/10/2014		18:20:00
30181703	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B01	Work center 239P0B01	48000145	ESTEVES ALDWIN	40119856	10	YWV	Service Contract	10096143	LA SUERTE ENTERPRISE	10/10/2014		10:46:03
30405415	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B02	Work center 239P0B02	48000123	JOYBERT LOVETE	40139127	10	LIFS	Free Service Contrac	10125177	HERITAGE CHRISTIAN FELLOWSHIP	10/10/2014		16:58:51
30101045	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B07	Work center 239P0B07	48000123	JOYBERT LOVETE	40130316	10	YWV	Service Contract	10096152	ANCHOR LAND HOLDINGS INC	10/10/2014		19:59:06
30242054	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B03	Work center 239P0B03	48000123	JOYBERT LOVETE	40136193	10	YWV	Service Contract	10096210	ETON PROPERTIES PHILIPPINES INC	11/10/2014		07:46:12
30181653	004	Elevator	PH_KONE_CARE	P01	P0G	239P0G03	Work center 239P0G03	39000078	Jimmy DE LEON	40131946	10	YWV	Service Contract	10150617	BDO EQUITABLE TOWER CONDOMINIUM	11/10/2014		08:07:12
30252743	004	Elevator	PH_KONE_CARE	P2Z	P0E	239P0E01	Work center 239P0E01	39000009	DANIEL CARAMELO	40134436	10	YWV	Service Contract	10096196	ABOITIZ LAND INCORPORATED	11/10/2014		10:43:17
30128702	004	Elevator	PH_KONE_CARE	P01	P0G	239P0G01	Work center 239P0G01	48000138	Andy SOTTO	40128862	10	YWV	Service Contract	10096185	XCELL PROPERTY VENTURES INC	11/10/2014		10:56:02
30181536	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B03	Work center 239P0B03	39000019	JOSE GANCAN	40136668	10	YWV	Service Contract	10195557	LEE TOWER CONDOMINIUM CORPORATIO	27/10/2014		08:28:56
30181775	004	Elevator	PH_KONE_CARE	P01	P0A	239P0A07	Work center 239P0A07	39000093	Renato DALUZ	40119876	10	YWV	Service Contract	10096096	PHILAMLIFE TOWER CONDOMINIUM	11/11/2014		11:11:18
30084664	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B06	Work center 239P0B06	39000058	ROBERTO TUBIG	40123018	10	YWV	Service Contract	10096180	SM INVESTMENTS CORPORATION	13/11/2014		10:02:28
30084666	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B06	Work center 239P0B06	39000058	ROBERTO TUBIG	40123018	10	YWV	Service Contract	10096180	SM INVESTMENTS CORPORATION	14/11/2014		07:47:10
30181883	004	Elevator	PH_KONE_CARE	P01	P0C	239P0C03	Work center 239P0C03	39000062	HECTOR TIZON	40119910	10	YWV	Service Contract	10096131	AMKOR TECHNOLOGY PHILIPPINES INC	15/11/2014		14:10:38
30437894	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B01	Work center 239P0B01	48000115	ALBINE TANEGA	40142364	10	LIFS	Free Service Contrac	10121634	ANGLO BUILDERS CONSTRUCTION	27/12/2014		16:25:42
30211703	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B03	Work center 239P0B03	39000019	JOSE GANCAN	40123157	10	YWV	Service Contract	10106481	RICHARD M. ROMERO	02/06/2014		09:40:03
30181755	004	Elevator	PH_KONE_CARE	P01	P0C	239P0C12	Work center 239P0C12	39000086	TOM NORTIGA	40119872	10	YWV	Service Contract	10096164	ONE GATEWAY PLACE	31/05/2014		22:29:08
30412678	004	Elevator	PH_KONE_CARE	P01	P0E	239P0E02	Work center 239P0E02	39000009	DANIEL CARAMELO	40138015	10	LIFS	Free Service Contrac	10138804	PRORESOURCES, INCORPORATED	02/06/2014		09:22:41
30181611	004	Elevator	PH_KONE_CARE	P01	P0B	239P0B06	Work center 239P0B06	39000000	RONILO AGOHAYON	40119821	10	YWV	Service Contract	10096078	CHATEAU ELYSEE CONDOMINIUM	02/06/2014		10:08:36

Figure 34: call-out records from 2014 to 2017 (data collection)

3.5.2 Annual call-out

An annual call-out is measured, plotted and the behavior is studied to see if there are any pattern. The forecast can be helpful to understand the magnitude of call-out in the near future.

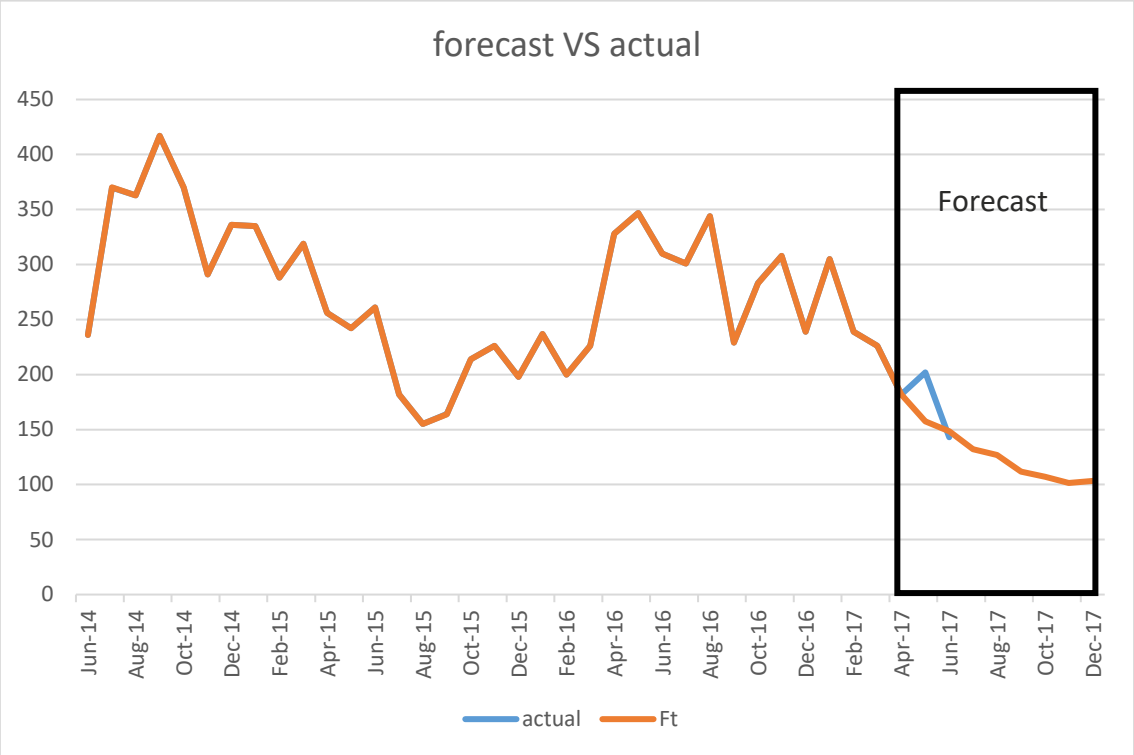


Figure 35 forecast vs actual call-out comparison

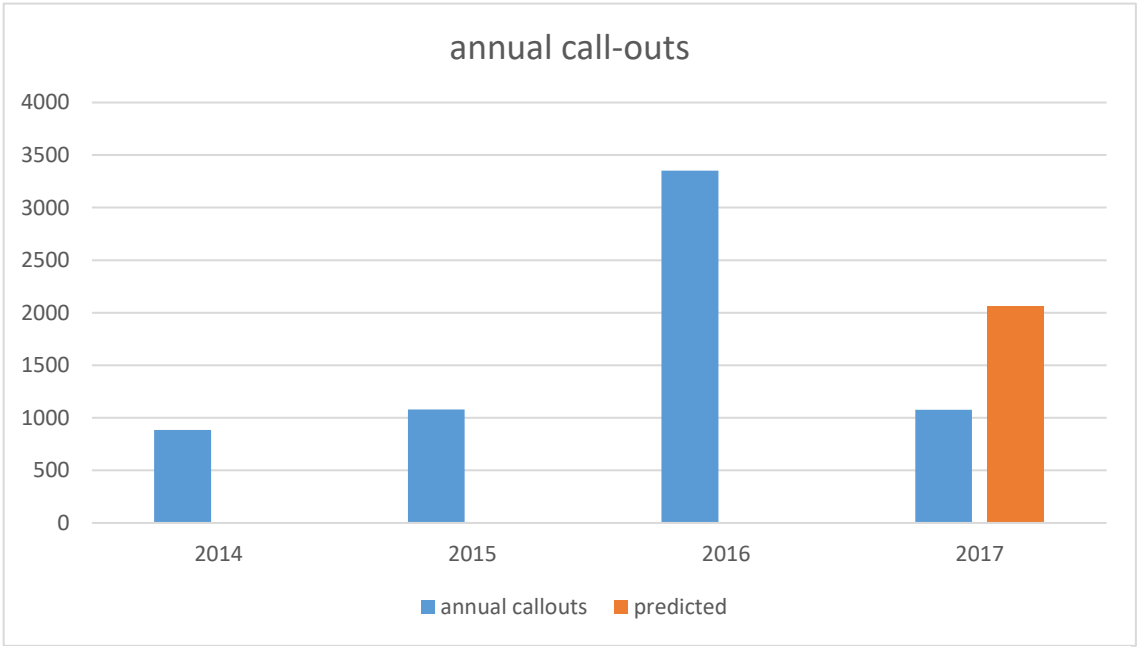


Figure 36 annual call-out

3.5.3 Measuring call-out in projects, equipment, and components

Measuring the call-out based on projects, equipment, and components from November 2016 to April 2017, the following results are obtained

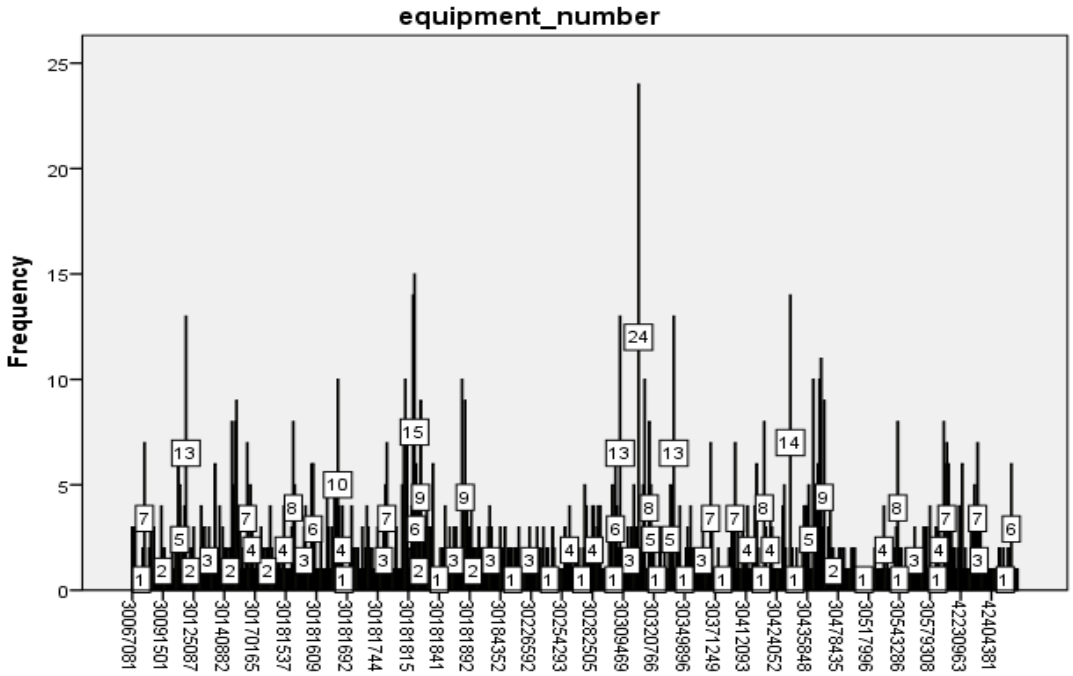


Figure 37:call-out based on equipment

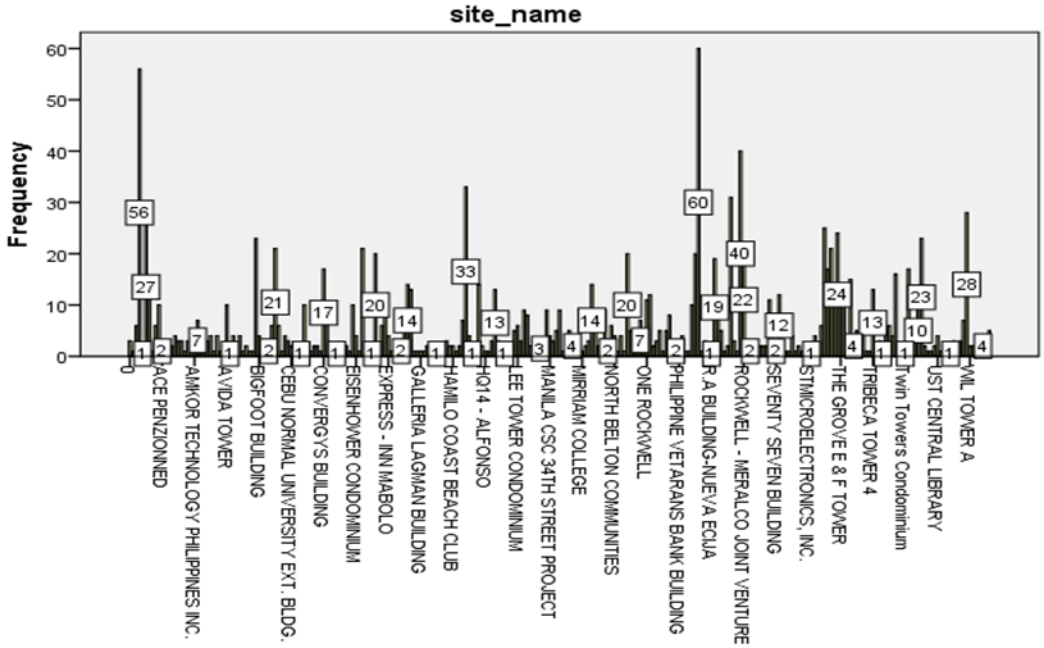


Figure 38: call-out based on projects

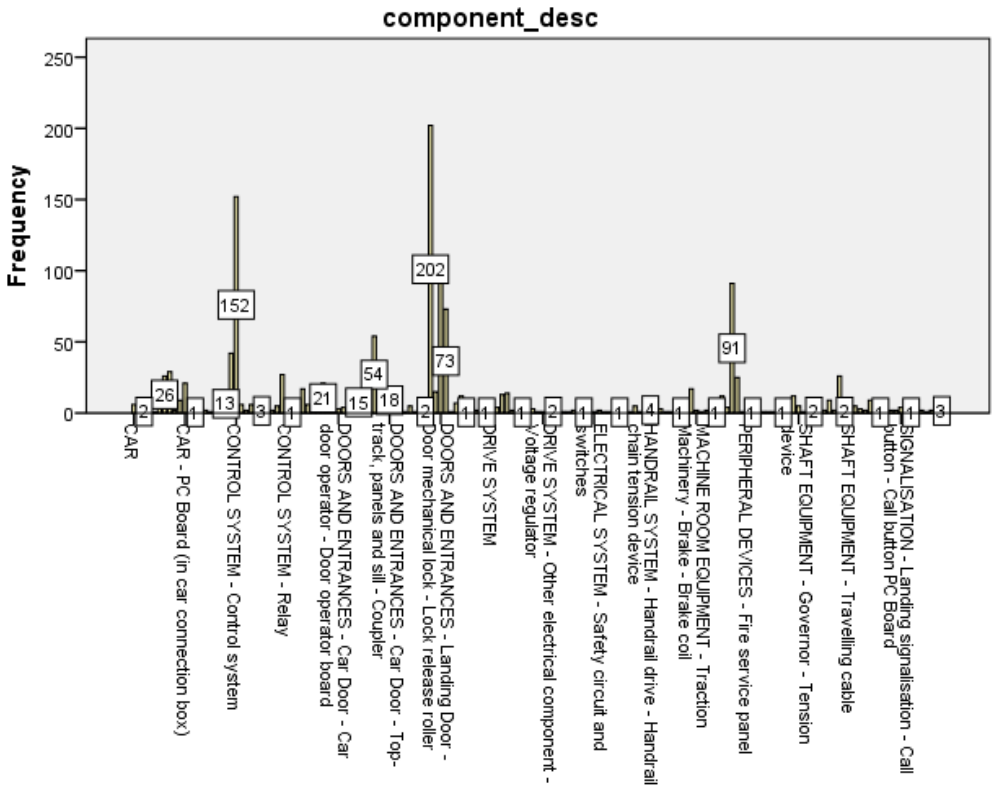


Figure 39:call-out based on components

The table for the above displayed charts are present in Annexure 12, 13, 14

3.5.4 Measuring FYCOR monthly

Measuring FYCOR monthly the following information are obtained as given below.

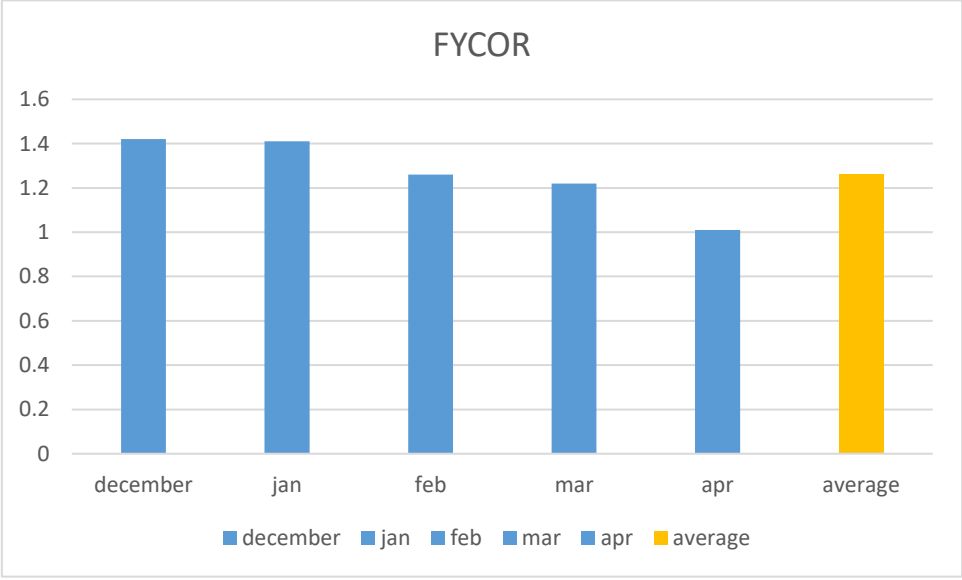


Figure 40 measuring monthly FYCOR

3.5.5 Measuring call-out in equipment category:

Call-outs are recorded on various types of equipment namely elevators, escalators, and automatic doors. The frequency of the call-out is as given below. These are the records from November 2016 to April 2017.

Equipment category	Frequency	Percent	Cumulative Percent
dumbwaiter	3	.2	.2
elevator	1371	96.0	96.2
escalator	54	3.8	100.0
Total	1428	100.0	

Table 2: Frequency of call-out based on equipment category

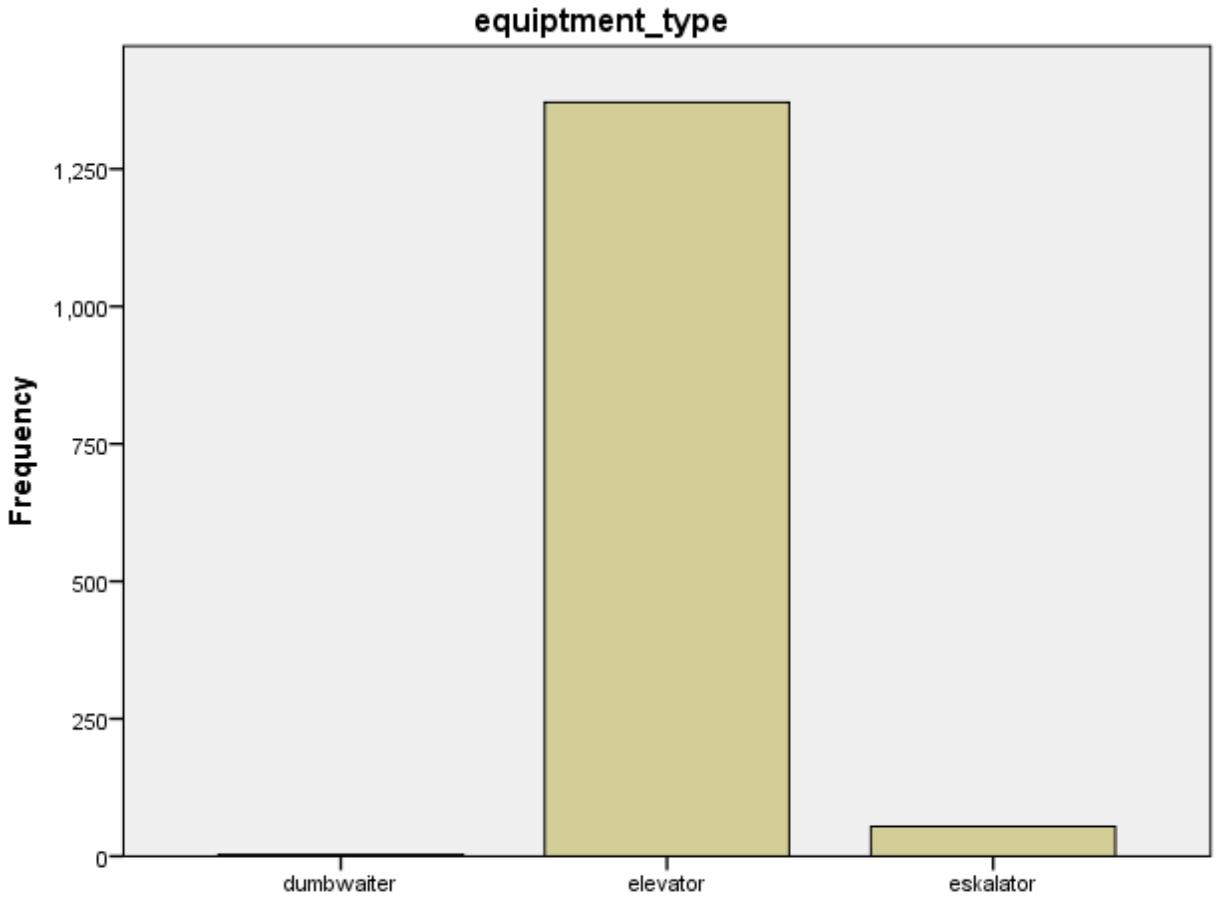


Figure 41:frequency of call-out based on equipment category

It is possible to conclude that most of the call-out is from the elevator, and hence it should be the focus.

3.5.6 Measuring call-out reasons

There are several reasons for the call-out, again these are records from November 2016 to April 2017. The frequency table and the bar chart of the reasons are as follows.

	Reason	Percent	Cumulative Percent
	Building power down	.8	.8
	Misuse	1.3	2.1
	No fault found	2.6	4.7
	Not applicable	7.8	12.7
	Other external reason	1.7	14.4
	Other external reason - Foreign object in door sill	.1	14.5
	Other external reason - Inspection	.1	14.7
	Other external reason - Shutdown by handrail inlet device	.1	14.7
	Other external reason - Shutdown by safety-related device	.1	14.8
	Outdated components	6.0	20.9
	Technical failure	77.2	99.0
	Vandalism	.1	99.1
	Worn component (proactive replacement)	.9	100.0
	Total	98.9	
Missing	System	1.1	
Total		100.0	

Table 3: general call-out reasons category

The major call-outs are technical faults as it Is clear from the measurements.

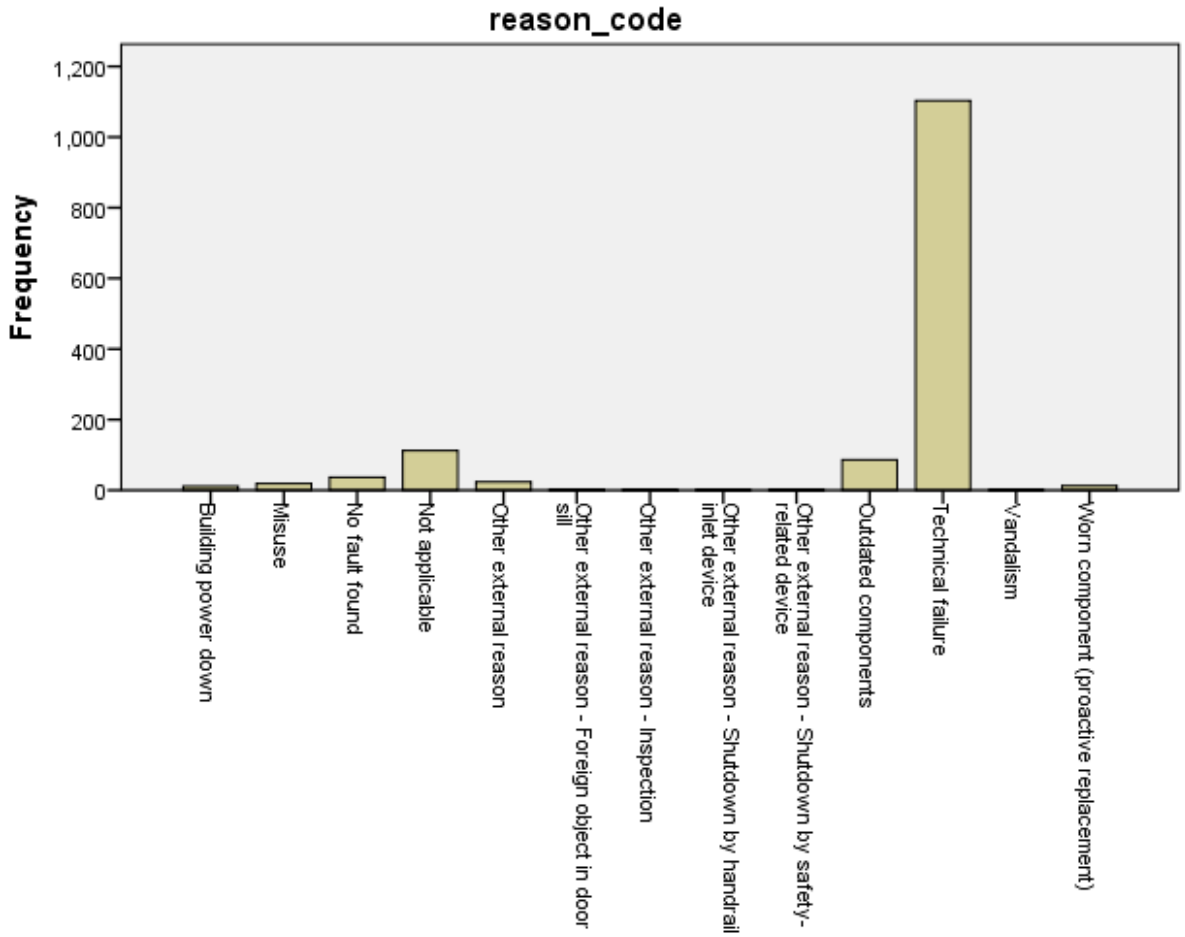


Figure 42: general call-out reasons category

3.5.7 measuring call-out actions

Actions taken on the call-out are as shown below. Initially the descriptive is calculated for 6 months and then for the year 2016 and 2017.

actions	percent	Cumulative
Adjusted	36.55	36.55
Checked operation	28.57	65.13
Cleaned	2.38	67.51
Cleaned - Door	1.68	69.19
Cleaned - Other component	0.56	69.75
Emptied	0.21	69.96
Lubricated	0.07	70.03
Not applicable	3.29	73.32
Repaired	3.78	77.10
Replaced	14.85	91.95
Reset	6.93	98.88
(blank)	1.12	100.00
total	100.00	

Table 4 general actions taken on call-out (taken from November 2016 to April 2017)

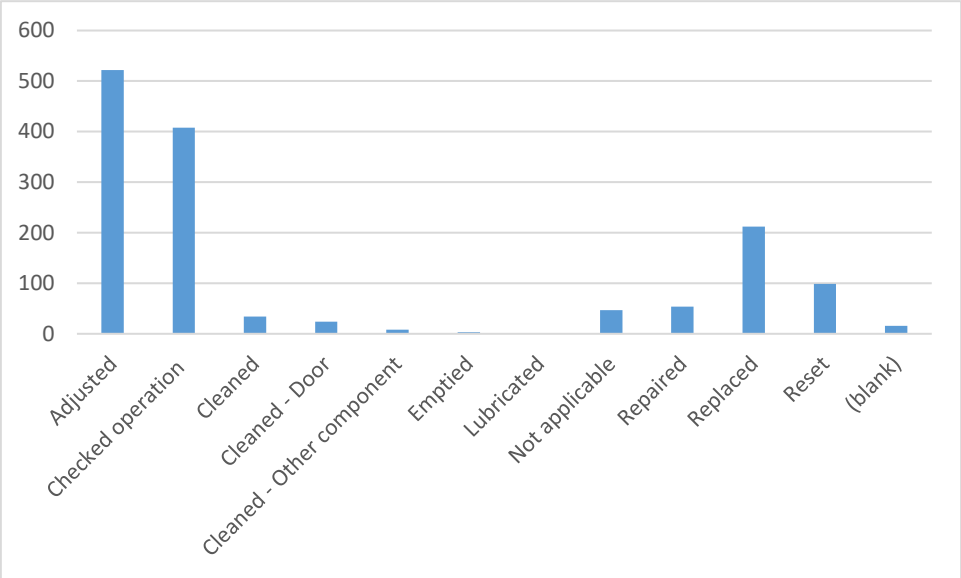


Figure 43:general actions taken on call-out (taken from November 2016 to April 2017)

actions	percent	cumulative
Reset	7.21	7.21
Replaced	14.41	21.62
Repaired	7.76	29.38
Not applicable	3.60	32.98
Lubricated	0.46	33.43
Emptied	0.93	34.37
Cleaned - Pit	0.02	34.39
Cleaned - Other component	0.64	35.03
Cleaned - Machine room	0.05	35.07
Cleaned - Machine parts	0.02	35.09
Cleaned - Door	1.39	36.48
Cleaned	2.39	38.87
Checked operation	27.77	66.64
Adjusted	33.36	100.00
total	100.00	

Table 5: general actions taken on call-out for the year 2016 and 2017

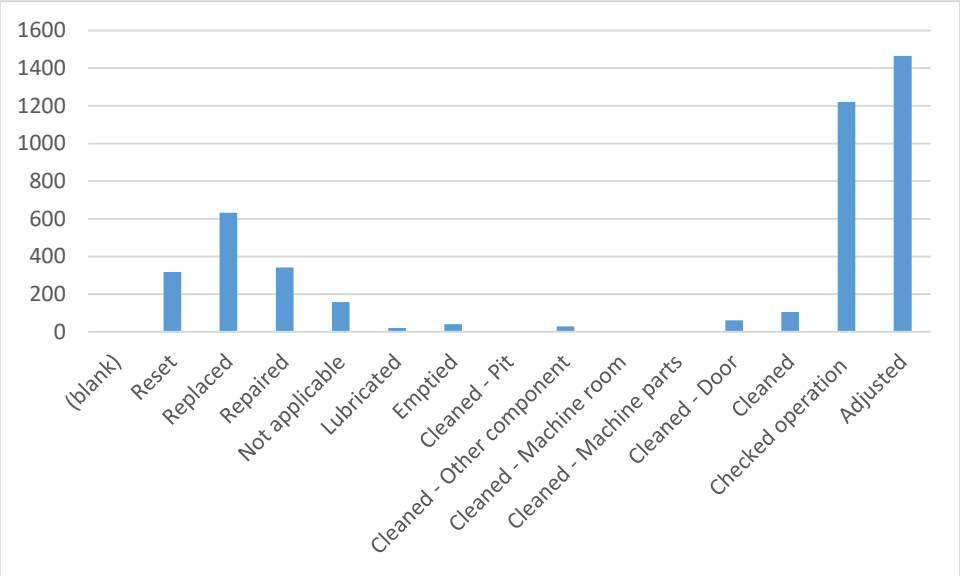


Figure 44: general actions taken on call-out for the year 2016 and 2017

The results show that most of the actions are minor, i.e. most are just adjusted, checked, repaired, etc very few are replaced when compared to the total.

Many theories suggest having the latest information for data analysis since they are more accurate and give weight to the recent actions that are taken(Elizabeth Griffin 2015). But never the less the old data gives a view of seeing how things are evolved. Here the size of the data is quite big and hence initially the analysis can be done on a small and preferably the latest ones to understand the key elements of the data and then analyzed for a bigger or to the desired period. Many big IT and marketing organization rely on the data and invest in a new automated solution for analyzing huge data.
When it comes to data accuracy the places where the data is obtained from humans have certain percentage of error but very often the critical data are on quite accurate and reliable.(Young et al. 2016)

In the case, it best to analyze the data initially for six months and then proceed to analyze for the bigger duration. Moreover 6 months itself have quite a lot of count and details.

3.6 Analyse

The obtained data are subjected to Pareto and ABC analysis for different categories and variables. There are also some punch lists that are collected and correlation analysis are done for the points in the punch list vs call-out categories which will be; Also, some benchmarking and brainstorming are carried out, these will be conferred in the upcoming sections.

3.6.1 Analysis of data for latest 6 months (November 2016 to April 2017) [pareto chart & ABC chart]

This is done to have an idea and to steer the research in the correct direction so that the non-resourceful information can be left untouched before subjecting the complete data to the quality tools which will be a waste of time.

Analysing based on projects:

Statistics	
Project	
Missing value	0
Number of projects	267

Table 6: descriptive of the call-out based on project

ABC analysis:

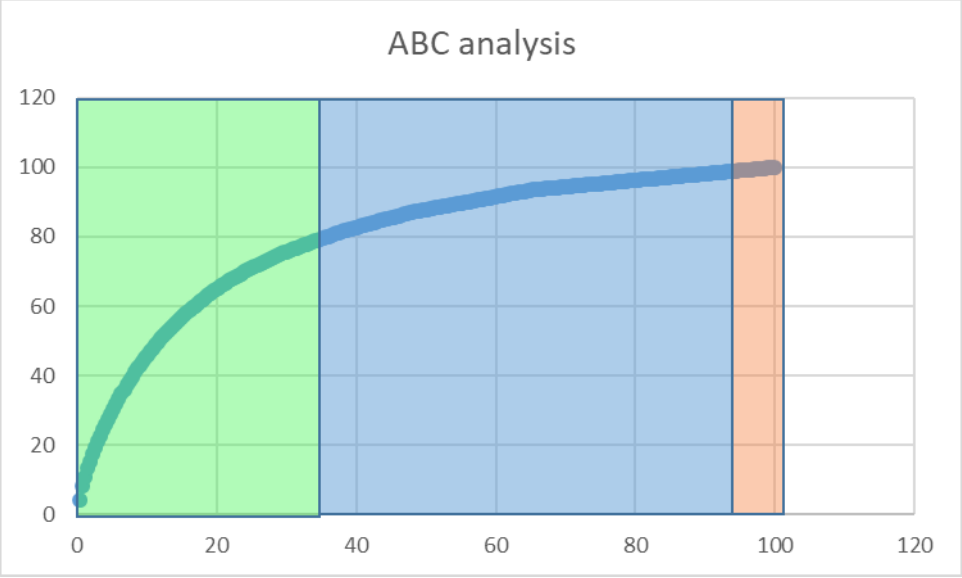


Figure 45: ABC analysis based on project

The region in green contribute to 80%(class A), the region in blue represent 80% to 99%(class B) and the region in red represent 99% to 100 % (class C). The x-axis represents the percentage of a number of item and y-axis represent the total value contributing. This graph is not taken for the cost of the cost incurred is directly proportional to the number of call-outs since there is very less component replaced (which is measured in the previous sections under actions taken on call-outs figure 42 & 43) and some depend on the type of maintenance contract. The ABC classification and Pareto analysis for the costs for different periods are presented in the Annexure 2, and these are the cost obtained after classifying components which can be seen in the upcoming section (section 3.6.2- analysis on classified components).

Pareto principle:

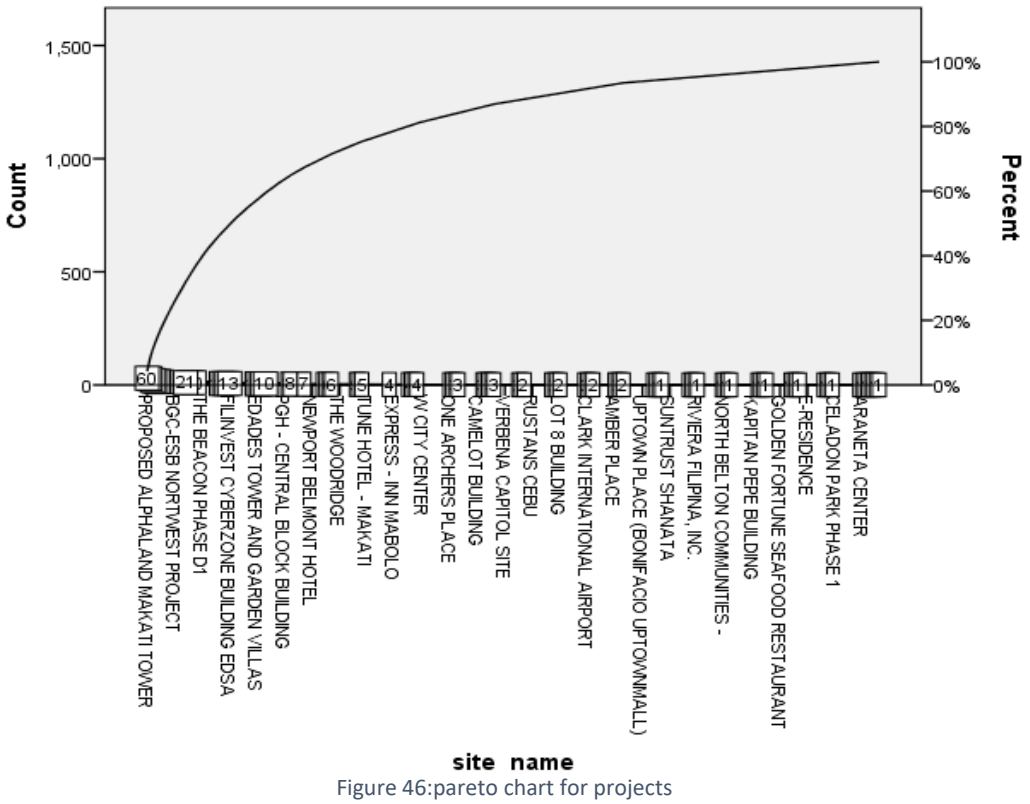


Figure 46:pareto chart for projects

The data used to form the above-mentioned Pareto and ABC chart are presented in Annexure 15

Analysis based on equipment:

Statistics	
Equipment	
Missing value	0
Number of equipment	578

Table 7: descriptive of call-out based on equipment

ABC analysis

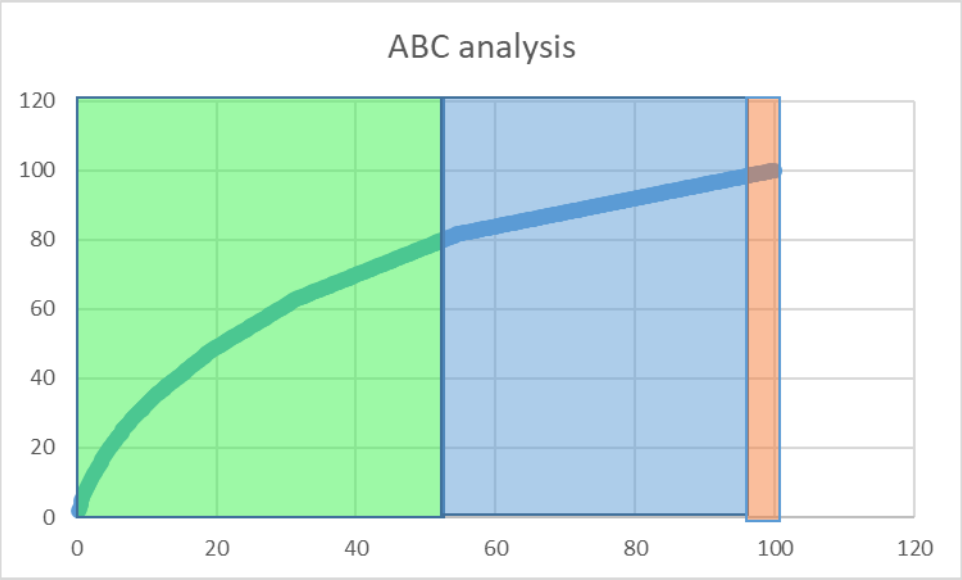


Figure 47: ABC analysis based on equipment

Pareto analysis:

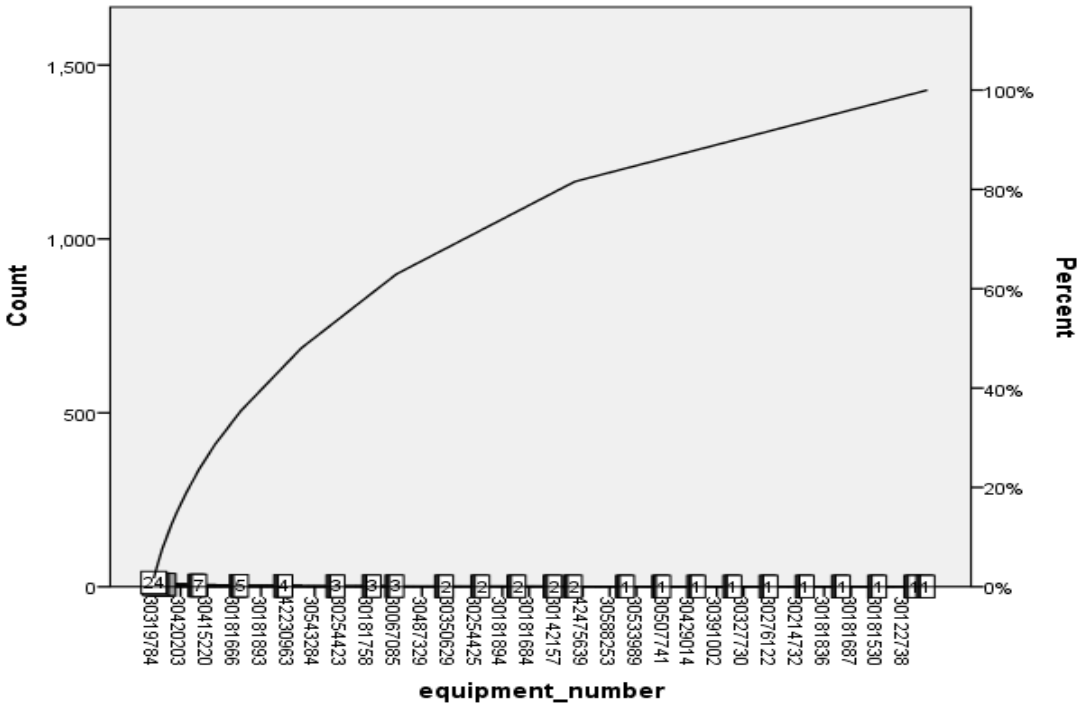


Figure 48:pareto analysis for call-out based on equipment

The contents in the ABC and Pareto chart are same except the fact that these are done for the equipment and hence the X-axis of the Pareto contains the cause as equipment number Since the equipment is recognized by equipment number.

The data used to form the above-mentioned Pareto and ABC chart are presented in Annexure 16

Analysis based on components

Statistics	
component	
Missing value	0
Number of components	159

Table 8: descriptive of call-out based on components

ABC analysis:

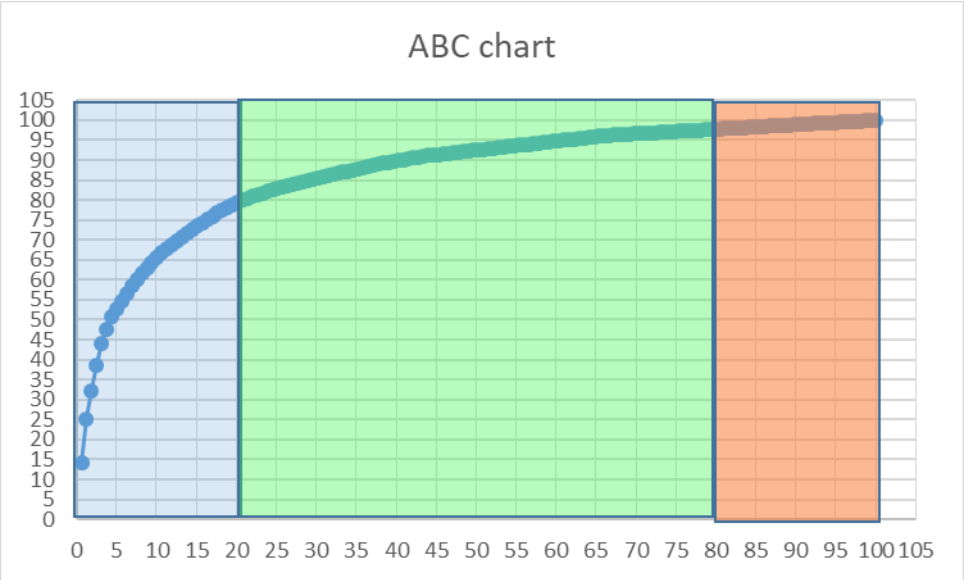


Figure 49 : ABC analysis based on components

Pareto analysis:

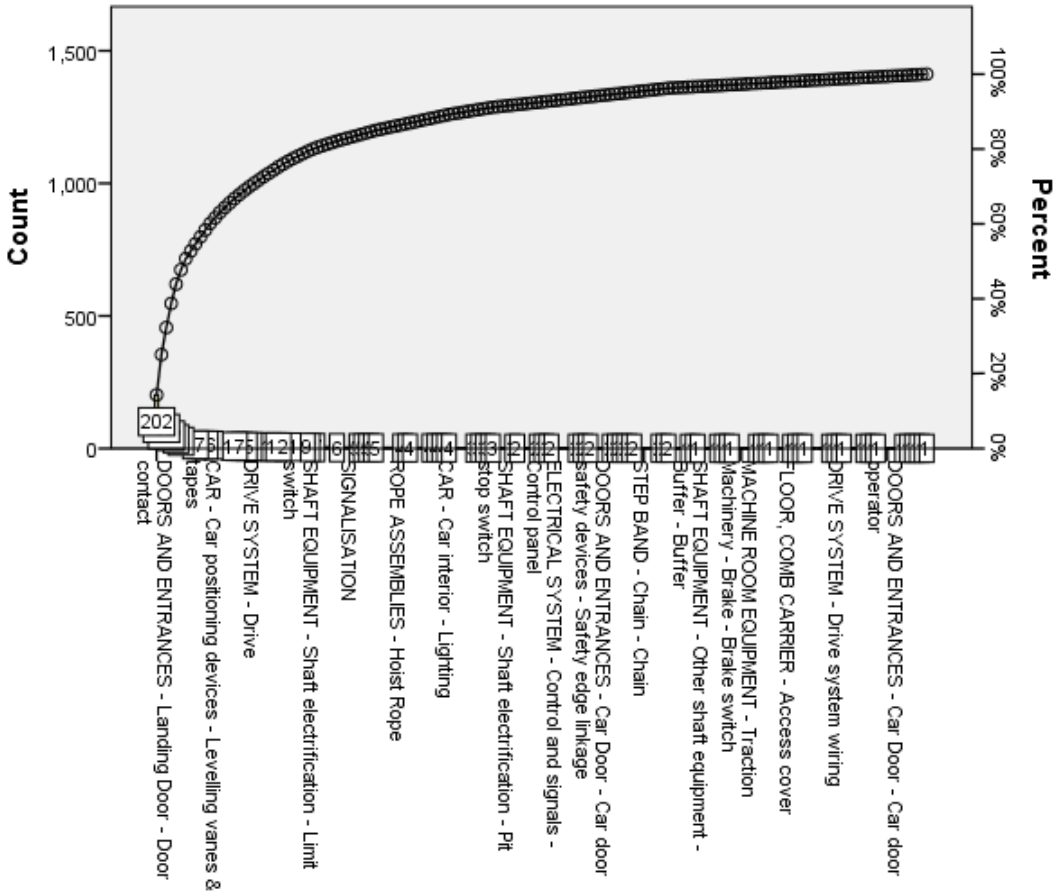


Figure 50: Pareto analysis based on components

It is important to decide which should be considered to have a resolution to the problem (projects or equipment or components). In the case of call-out, it's best to narrow the focus to components since the solution will be applicable to all the cases. When focus is based on projects and equipment then the solution is applicable to only those specific once and not as a whole. There may be a conflict of interest regarding the decision, that it is important to know which are the key equipment and projects so that it is possible to focus on those ones more than the once which are doing fine. Of course, it is important to see the projects and equipment that has a high frequency of call-out, but also it is important to look in a long-term and stop the call-out from occurring in the future. The best option would be going deep to understand something more about the components in details.

The data used to form the above-mentioned Pareto and ABC chart are presented in Annexure 17

The Pareto charts in the previous cases for the components is not very clear. It is possible to categorize or classify the components and analyze so that it is possible to get some clarity. The cases are classified and then the analysis is done again.

3.6.2 Analysis on classified components: [pareto chart & ABC chart]

Since the focus is on the components it interesting to do the analysis in a different period. The 159 components are classified totally under 17 categories. The list of the components (159) is specified in Annexure 1.

Period 1 (November 2016 to April 2017)

statistics	
missing value	107
total components (classified)	17
maximum	590
minimum	1

Table 9: descriptive of the call-out for the classified components from November 2016 to April 2017

ABC analysis

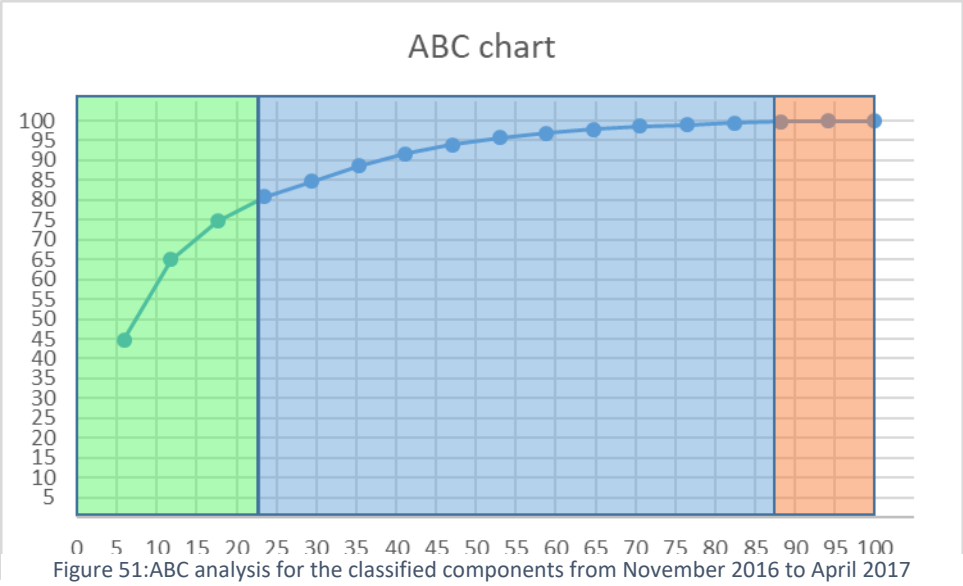


Figure 51:ABC analysis for the classified components from November 2016 to April 2017

Pareto analysis

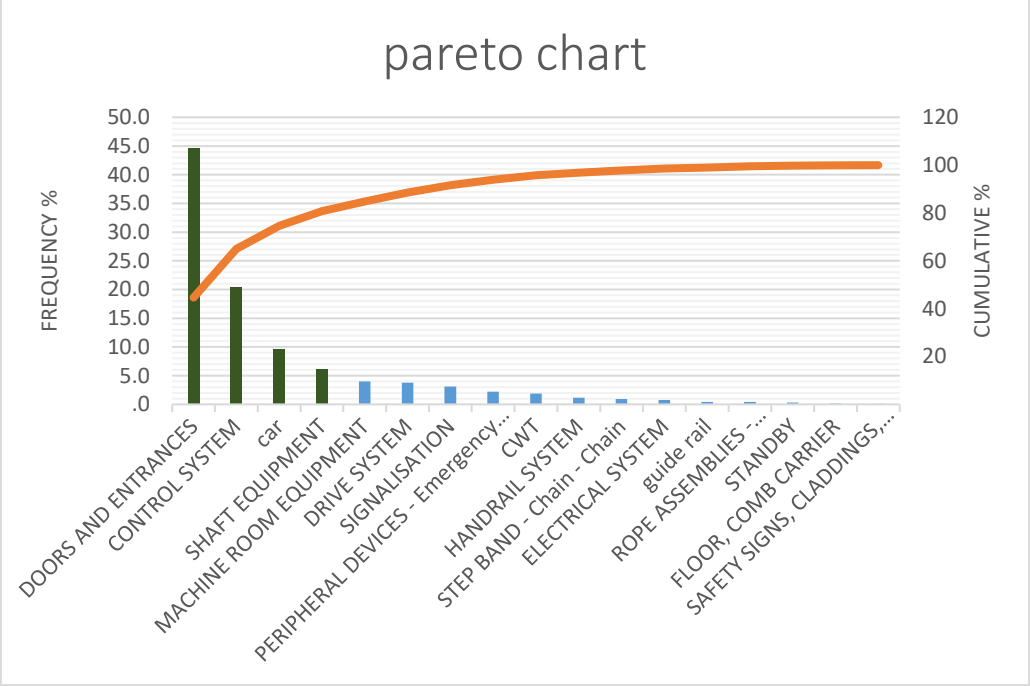


Figure 52: pareto analysis for the classified components from November 2016 to April 2017

NOTE: the previous Pareto chart are made on frequency but these ones are built on % frequencies (i.e. the left-hand side Y axis). Also, to note that the green bars in Pareto represent class “A” of the ABC diagram which represents about 80% of the frequency.

Period 2 (January 2016 to April 2017)

statistics	
missed value	354
total components (classified)	17
maximum	1764
minimum	1

Table 10: descriptive of the call-out for the classified components from January 2016 to April 2017

ABC analysis

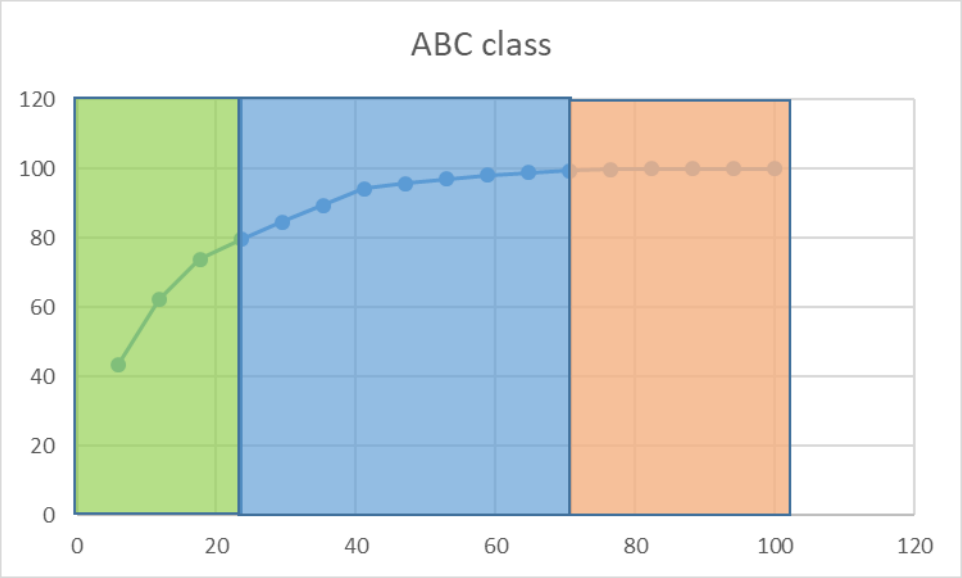


Figure 53:ABC analysis for classified components from January 2016 to April 2017

Pareto analysis

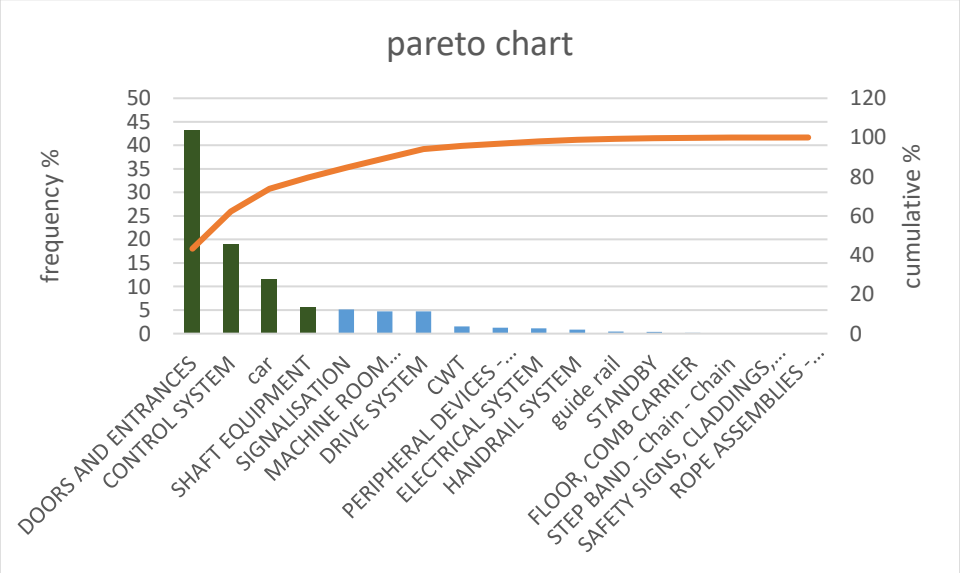


Figure54: Pareto analysis for classified components from January 2016 to April 2017

Period 3 (equipment under LIFS (lift under free service) from 2016)

statistics	
missed value	68
total components (classified)	17
maximum	353
minimum	0

Table 11 :descriptive of the call-out for the classified components under LIFS

ABC analysis:

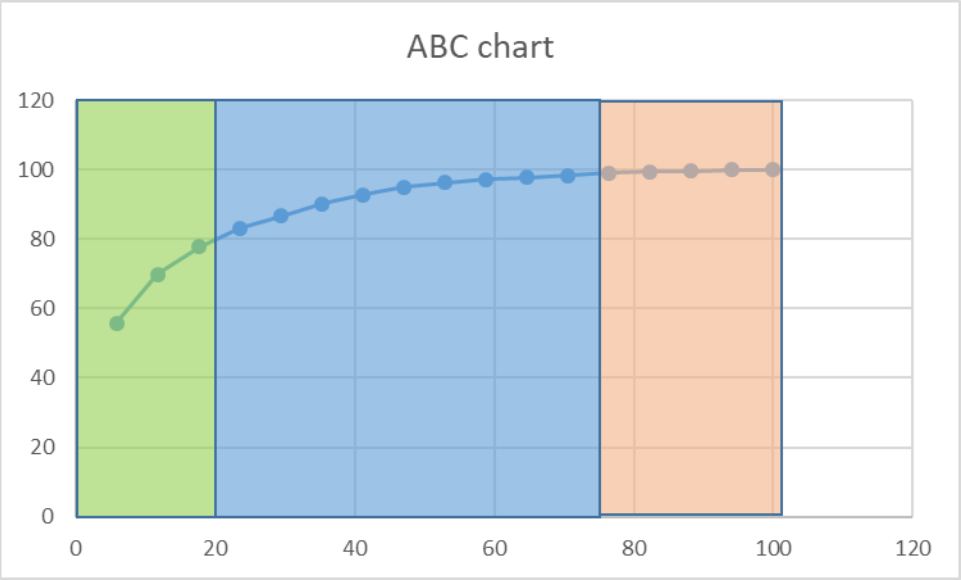


Figure 55: ABC analysis for classified components from 2016 (LIFS)

Pareto analysis:

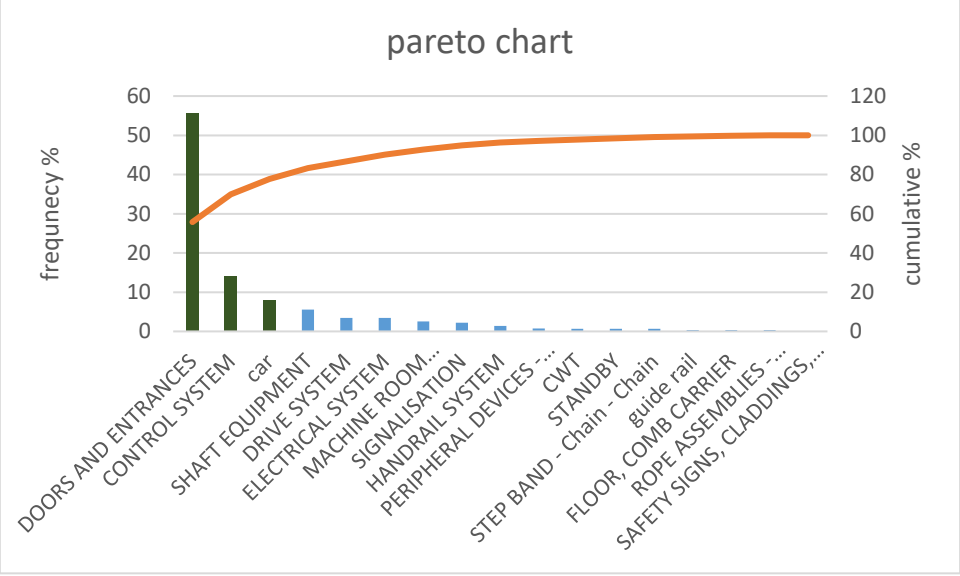


Figure 56:pareto analysis for classified components from 2016 (LIFS)

From the chart, it is inferred that the doors and entrance, control system and car are responsible for about 75 % of the call-outs. Since the components are classified it is possible to further break down the components of doors and entrance, control system and car. Also, it is inferred that the most frequent call-out causes remain the same when it comes to components i.e. the top 3 components, in general, remains the same and probably will remain the same if no actions are taken. Again, the Pareto and ABC analysis is done for these three components to go to specifics.

doors and entrance

period1

statistics	
The percentage in the total call-out	44.66%
total number of components	36
maximum	202
minimum	1

Table 12: descriptive of call-out in doors and entrance (period 1)

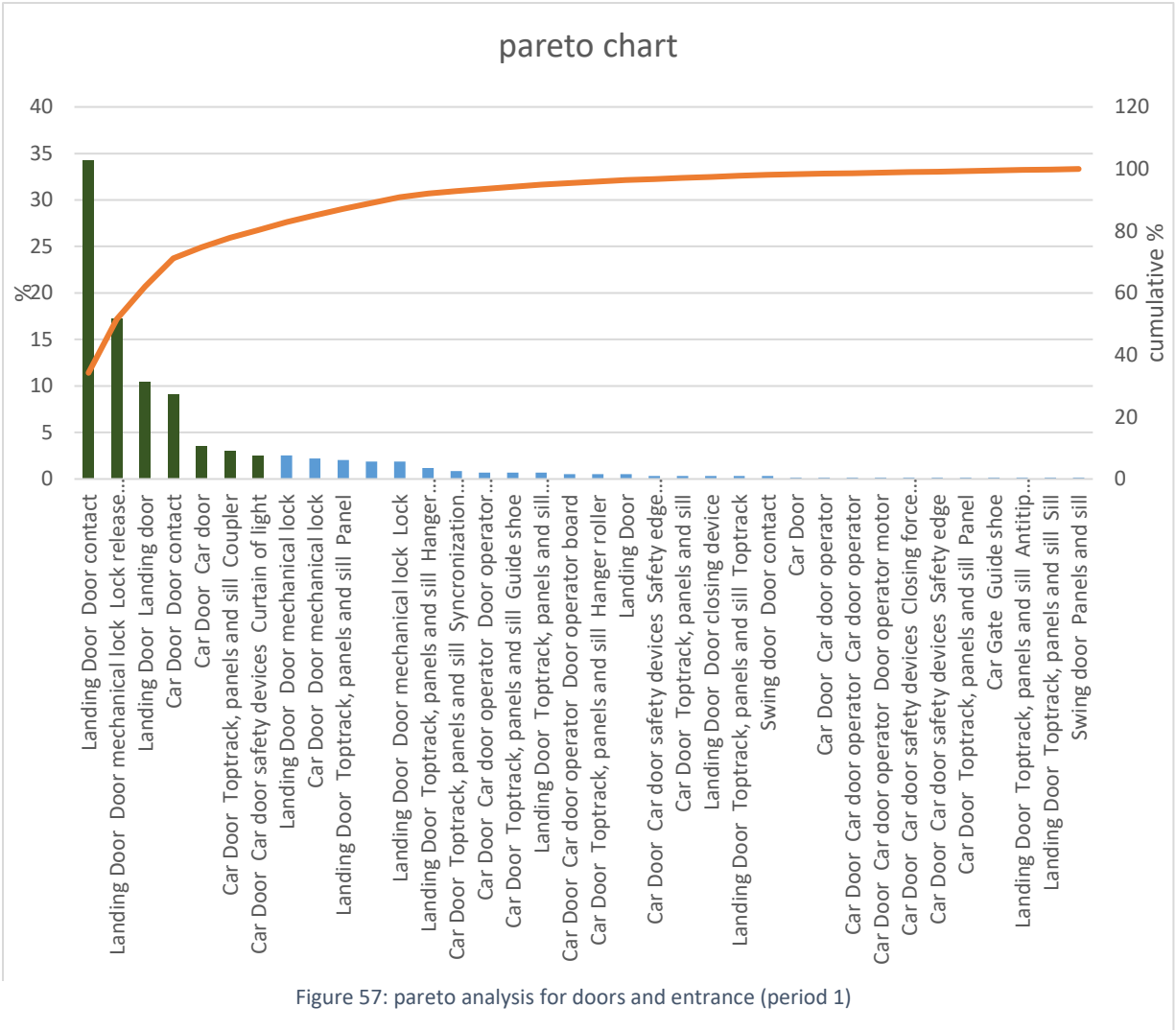


Figure 57: pareto analysis for doors and entrance (period 1)

The ABC analysis for the same is presented in Annexure 3

Period 2

statistics	
the percentage in the total call-out	43.30%
total number of components	51
maximum	407
minimum	1

Table 13: descriptive of call-out in doors and entrance (period 2)

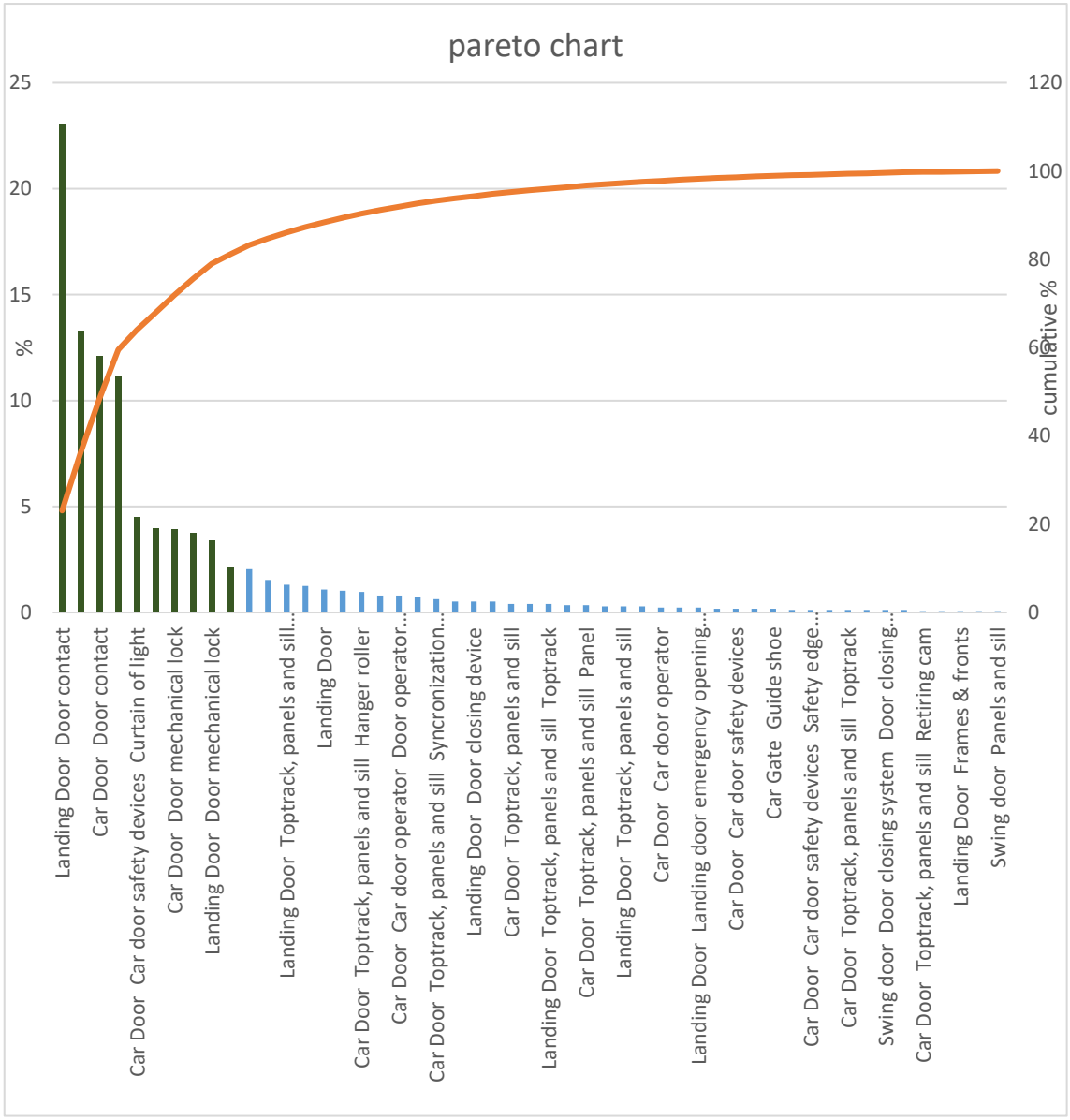


Figure 58: pareto analysis for doors and entrance (period 2)

The ABC analysis for the same is presented in Annexure 3

Period 3

statistics	
the percentage in the total call-out	55.76%
total number of components	35
maximum	72
minimum	1

Table 14: descriptive of call-out in doors and entrance (period 3)

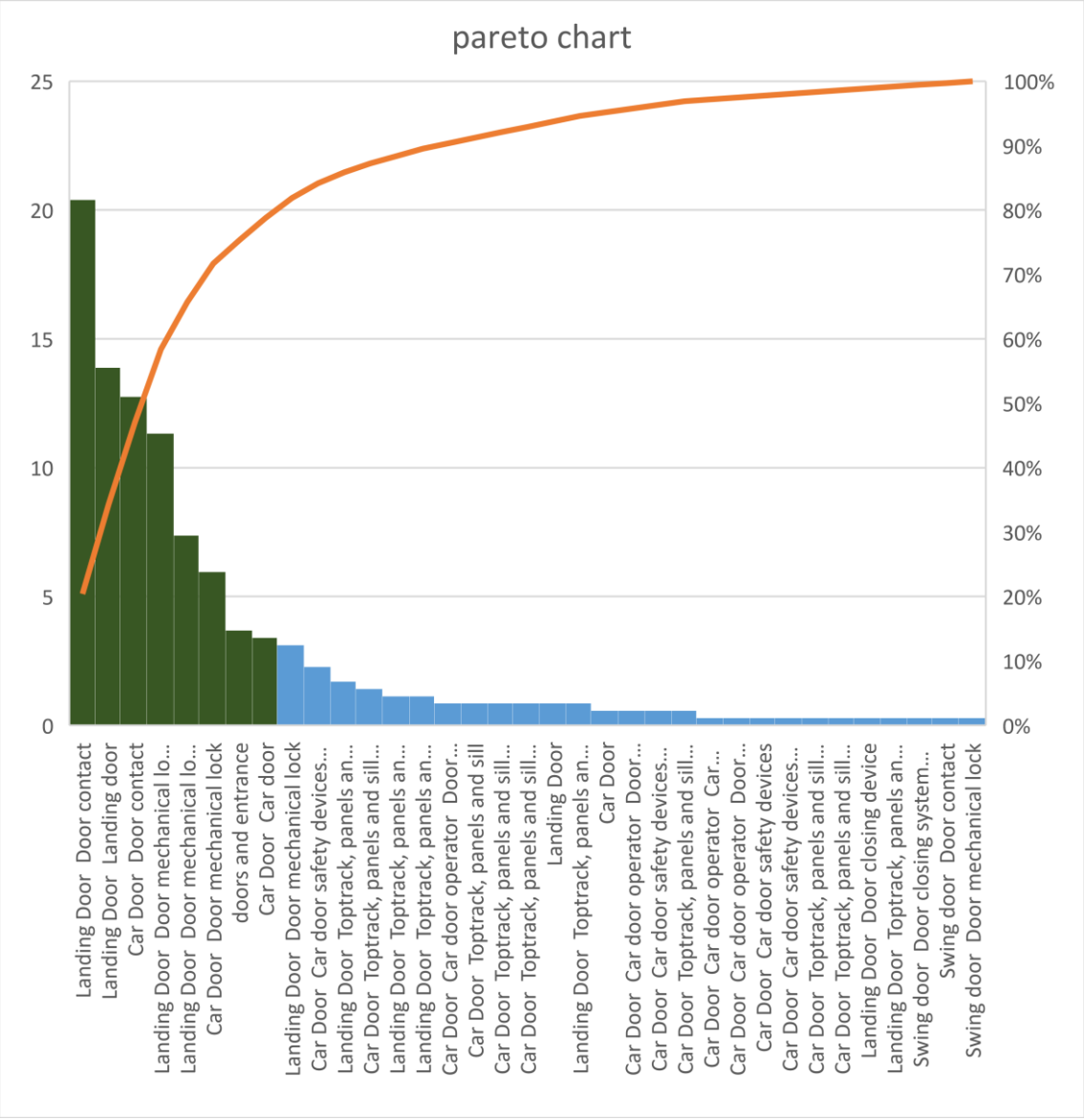


Figure 59:pareto analysis for doors and entrance (period 3)

The ABC analysis for the same is presented in Annexure 3

Control system

Period 1

statistics	
the percentage in the total call-out	20.36%
total number of components	13
maximum	152
minimum	1

Table 15: descriptive of call-out in control system (period 1)

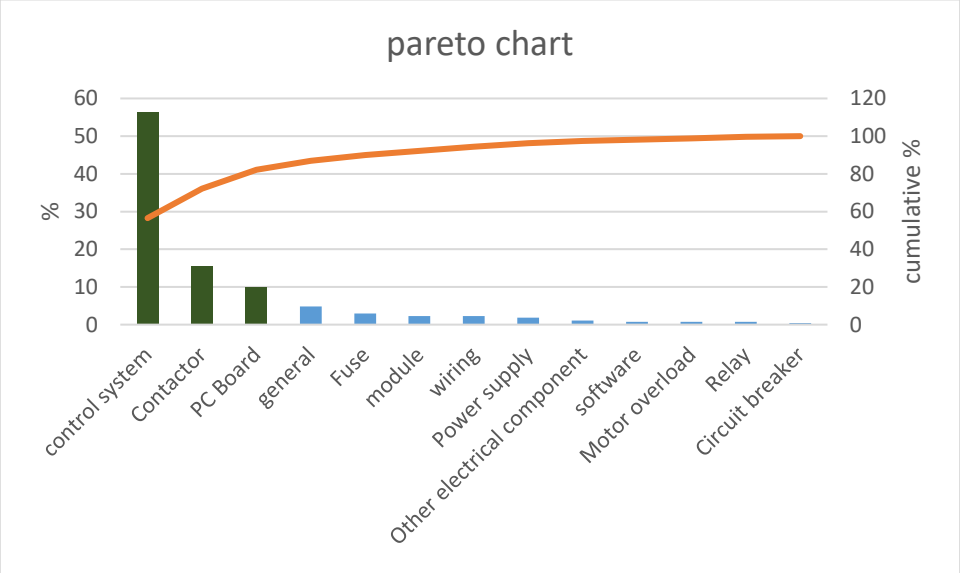


Figure 60:pareto analysis for control system (period 1)

ABC diagram for the same can be viewed in Annexure 4

Period 2

statistics	
the percentage in the total call-out	18.92%
total number of components	16
maximum	347
minimum	1

Table 16:descriptive of call-out in control system (period 2)

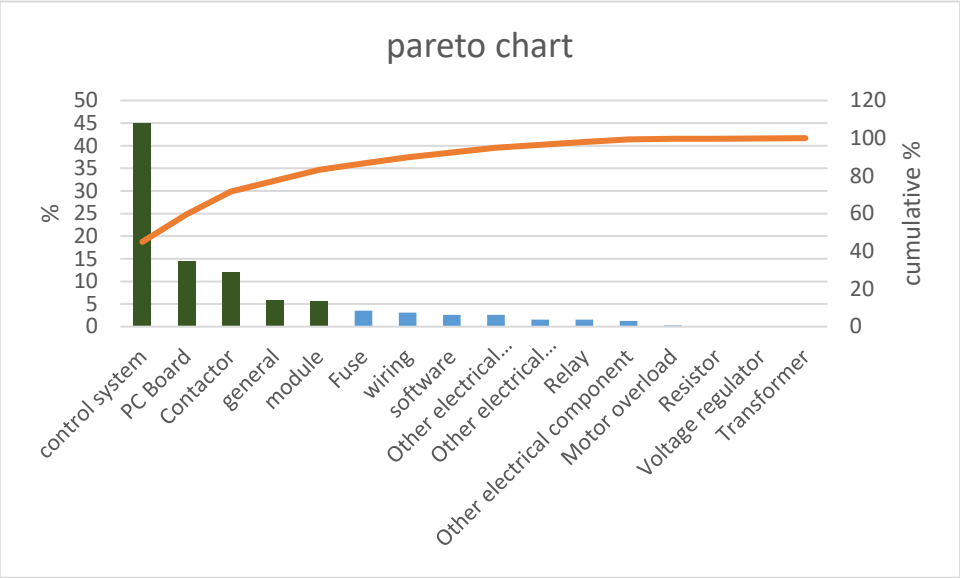


Figure 61:pareto analysis for control system (period 2)

ABC

diagram for the same can be viewed in Annexure 4

Period 3

statistics	
the percentage in the total call-out	14.06%
total number of components	12
maximum	46
minimum	1

Table 17: descriptive of call-out in control system (period 3)

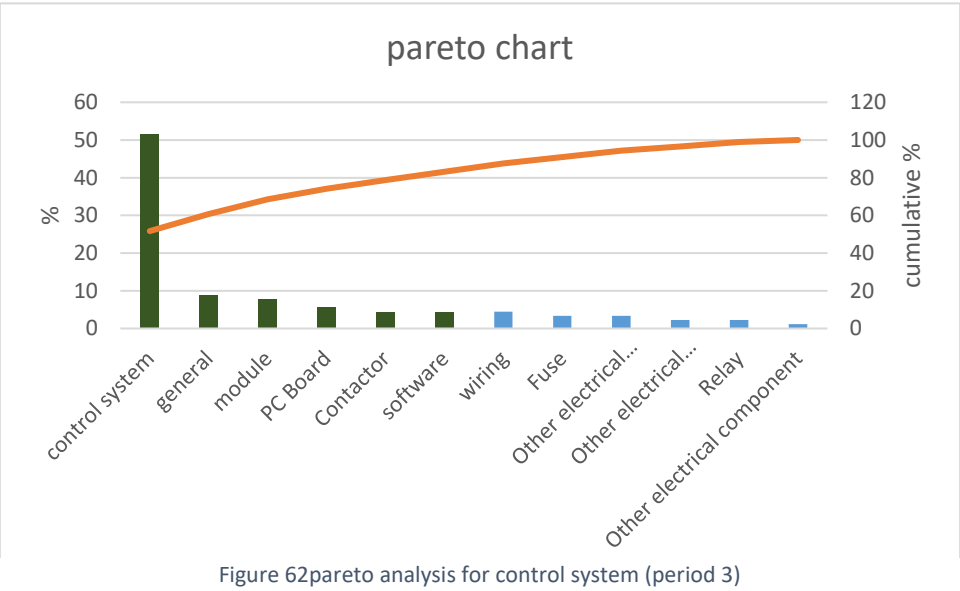


Figure 62pareto analysis for control system (period 3)

Car

Period1

statistics	
the percentage in the total call-out	9.61%
total number of components	18
maximum	29
minimum	1

Table 18: descriptive of call-out in car (period 1)

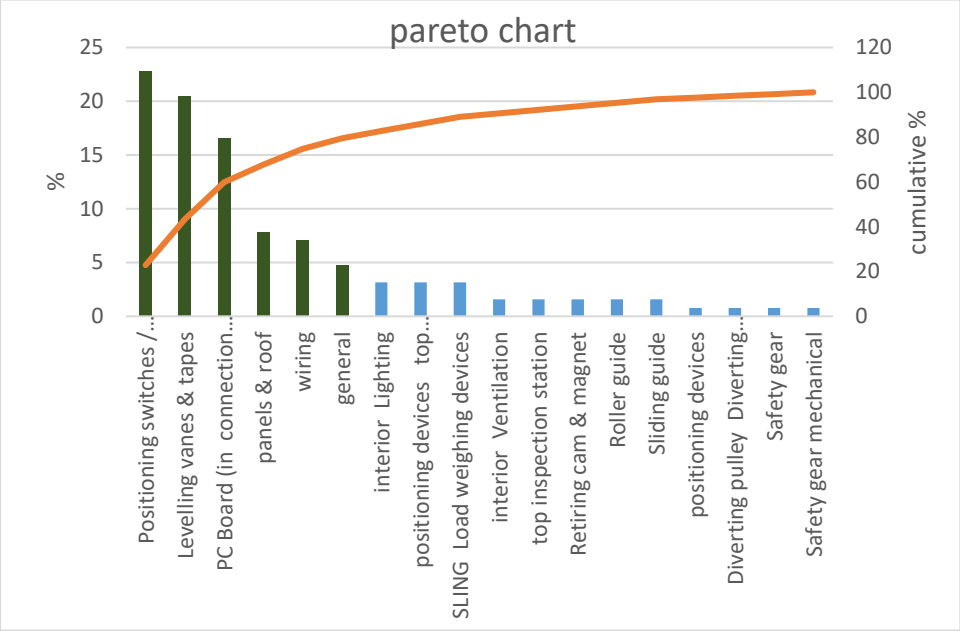


Figure 63:pareto analysis for car (period 1)

ABC diagram for the same can be viewed in Annexure 6

Period 2:

statistics	
the percentage in the total call-out	11.66%
total number of components	29
maximum	81
minimum	1

Table 19: descriptive of call-out in car (period 2)

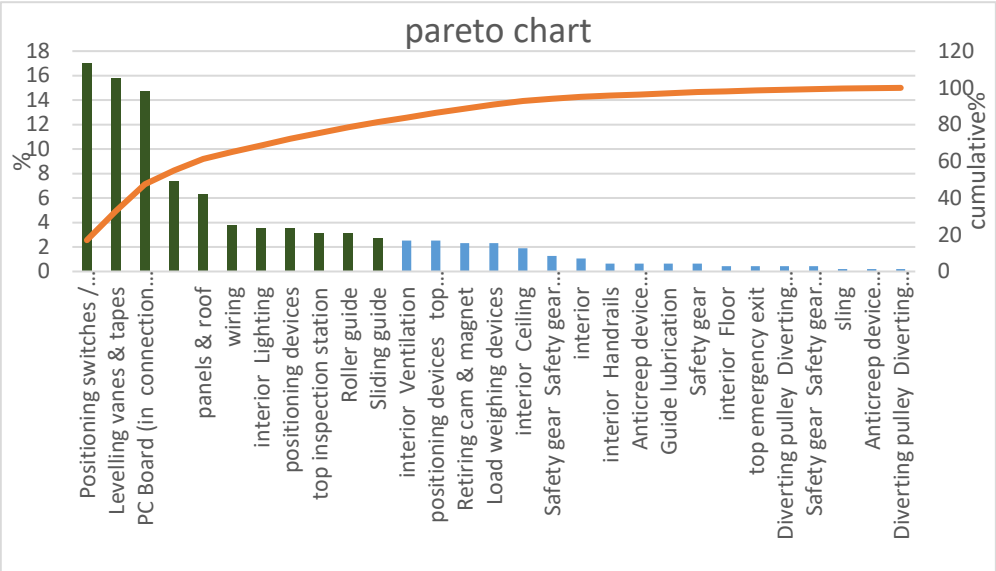


Figure 64:pareto analysis for car (period 2)

Period 3:

statistics	
the percentage in the total call-out	7.89%
total number of components	18
maximum	10
minimum	1

Table 20: descriptive of call-out in car (period 3)

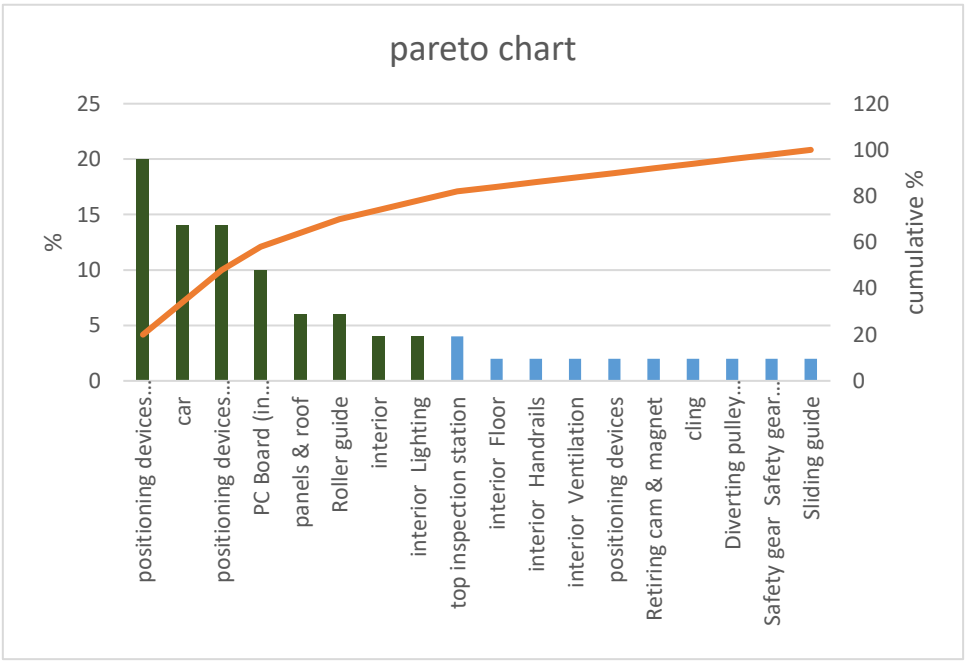


Figure 65:pareto analysis for car (period 3)

Outcome:
The major components that caused the call-out are identified from the doors and entrance, control system and the car.

3.6.3 Correlation study

At the end of the installation just before handing over the equipment to the customer and from NEB and SEB (internally), i.e. from installation to service, a quality check is carried out and set of checklists are checked. An example of one such checklist is produced in annexure7. The checklist contains a comprehensive list of things to be checked before the equipment is handed over. They have OK, corrected, not available, and not ok on the list, and at the end, there are some remarks regarding the inspection. Correlation analysis is done to find if there is any relation between the punch list and Call-outs.
Since the call-out is already classified based on components and the punch list are also classified, it gets easy to carry out the analysis based on classes.

Since it was found that the major call-outs are on doors, control system, and cars the correlation analysis are initially done on these components. The to do the analysis we need two numeric variables, but we the punch list doesn't have any scale variable. To tackle this situation, the labels in the punch list was rated based on the criticality (1 for ok, 2 for correct, 3 for not available, and 4 for not ok). Now there is one variable, the other variable is the count of the call-out on doors and entrance, control system and car.

[NOTE: the handover quality check was started only in the beginning of the year 2016 and hence not all the projects have these documents. And call-outs only from that project are considered.**]**

Also, the punch list is different for the equipment category, i.e. if it is a mono space or mini space. And there is separate punch list for each category.

- Total number of projects handed over: 200 (grouped by network number, for the year 2016 & 2017)
- Total equipment's in the projects: 314
- Actual punch list received: 52
- Punch list equivalent value: 72
- % of actual punch list: 16.5%
- % of equivalent punch list:22.9 ~23%

No	Strength/intensity	"r" value
1	Strong	+/- (1.0 to 0.5)
2	Moderate	+/- (0.5 to 0.3)
3	Weak	+/- (0.3 to 0.1)
4	None or very weak	-0.1 to +0.1

Table 21: correlation coefficient table

The following results are obtained from the correlation analysis. As mentioned earlier, there are 2 punch lists and therefore two different analysis is done.

The given below are results of the analysis which are relevant, never the less the results of all the categories are also performed. They are available in Annexure 8.

The variable used to obtain the correlation are presented in Annexure 11. The table shows the variable used just for the first case i.e. correlation for monospace elevator, doors and entrance, punch list number 11.1 whose 'r' value is 0.283.

Mono space.

Doors and entrance

no	Punch-list number	Description	'r' value	component
1	11.1	The gaps on entrances, car fronts and doors, are correct and equal.	***.283***	landing doors
2	11.2	Landings are clean and surfaces are intact.	***-.297***	
3	11.3	If no longer required, surface protections are completely removed.	***.009***	
4	11.4	Gap between the lock hook and counterpart is about 2mm when hanger plates are against close buffer	***-.284***	
5	11.5	The lock operates freely and closes by itself.	***-.102***	
6	11.6	Landing door locks and contacts operate safety chain.	***.[a]***	
7	11.7	No bends, deformations, scratches, dents, or colour differences and so on, on all visible equipment's.	***.258***	
8	11.8	Landing doors are aligned, moves freely and close automatically. (Check that the door closer works correctly from fully open position and at final close last 15mm)	***-.232***	

9	11.9	Doors are operating smoothly in normal operation.	***.088***	
10	11.10	The anti-tip rollers are correctly adjusted: For ***rubber rollers***, it should be slightly pressed (finger tight) against the rail profile. For ***steel roller, the*** gap between roller and rail is 0.15mm.	***-.207***	
11	11.11	Fire trims are in place.	***-.113***	
12	11.12	The emergency opening device operates and the lock return to automatically locked position.	***-.047***	
13	9.1	Door shoes are securely fastened.	***-.300***	car door
14	9.2	Synchronization rope touches the steel back plate when pressing it with thumb at distance of 10cm from the synchronization roller.	***-.103***	
15	9.3	The motor is vertically aligned, not causing noise.	***-.005***	
16	9.4	The drive belts touch each other when pressed with thumb at the center of the belt.	***-.148***	
17	9.5	Lock roller is in the middle of the coupler.	***.221***	
18	9.6	Couplers engage properly, engagement with rollers 10mm, during the whole cycle. (fully closed to fully open)	***-0.368***	
19	9.7	Door panels are adjusted so that the panels do not touch each other and any gap between frame, sill or another panel is: (maximum 6mm, nominal 5mm)	***.082***	
20	9.8	Panels run smoothly and are aligned with the track.	***.037***	
21	9.9	Hanger plates touch the buffer before the panels touch each other or the slam post.	***.099***	

Table 22: correlation coefficients for doors and entrances (mono space).

.[a-] denotes that correlation could not be found out since there was some blank in the punch-list.

Car

no	Punch-list number	Description	'r' value	component
1	3.1	Car roof stop buttons operates.	**.[a]**	car
2	3.2	Car guide shoes are adjusted, the 1mm gap on both sides.	**.101**	
3	3.3	The car roof is clean.	**.089**	
4	3.4	Blocking devices engages and the contact operates.	**-.075**	
5	3.5	Oil cups are filled.	**-.088**	
6	3.6	Limit switches operate.	**-.075**	
7	10.1	Pit stop button(s) operates.	**.[a]**	
8	10.2	The pit is clean.	**.042**	pit and under the car
9	10.3	OSG rope and tension weight pulley operate freely and quietly (car/cwt).	**-.123**	
10	10.7	OSG tension weights are in correct position to allow rope stretch (car/cwt).	**-.178**	
11	10.8	OSG rope is clean and there are no broken strands, kinks, or twists(car/cwt).	**-.042**	

12	10.4	Oil collectors are in place.	.[a]	
13	10.5	Oil buffers are filled with oil the contact operates.	**0.505**	
14	10.6	Overtravel is correct. (car/cwt)	**-.156**	
15	10.9	Car bottom guide shoes are adjusted, the 1mm gap on both sides.	**-.167**	
16	10.10	The gap between safety gear and rail side, at the fixed side, is 2/3mm. This may vary. Refer to product specific instructions.	**-.167**	
17	12.1	The curtain of lights or photocell re-open the door action when operated.	**-.042**	car interior and landing
18	12.2	Maximum levelling deviation is +/-5mm.	**-.159**	
19	12.3	Gaps on entrances, car fronts, car panels, mirrors, etc., are correct and equal.	**-.030**	
20	12.4	Car interior is clean and intact.	**-.215**	
21	12.5	No bends, deformations, scratches, dents, or colour differences and so on, on all visible equipment's.	**-.159**	
22	12.6	Push buttons and signalization work as expected. The display and floor markings match.	**-.213**	
23	12.7	COP is locked to the position.	**.117**	

Table 23: correlation coefficient for car (mono space)

.[a]- denotes that correlation could not be found out since there were some blank in the punch-list

- indicates highest positive correlation value.

Mini space

Doors and entrances

no	Punch-list number	Description	r' value	component
1	11.1	Door shoes are securely fastened.	**-.239**	car door
2	11.2	Synchronization rope touches the steel back plate when pressing it with thumb at distance of 10cm from the synchronization roller.	.[a]	
3	11.3	The motor is vertically aligned, not causing noise.	.[a]	
4	11.4	The drive belts touch each other when pressed with thumb at the center of the belt.	.[a]	
5	11.5	Lock roller is in the middle of the coupler.	.[a]	
6	11.6	Couplers engage properly, engagement with rollers 10mm, during the whole cycle. (fully closed to fully open)	**-.309**	
7	11.7	Door panels are adjusted so that the panels do not touch each other and any gap between frame, sill or another panel is: (maximum 6mm, nominal 5mm)	**.346**	
8	11.8	Panels run smoothly and are aligned with the track.	.[a]	

9	11.9	Hanger plates touch the buffer before the panels touch each other or the slam post.	**-.431**	
10	11.10	Door panels are correctly aligned with the slam post or side post.	**.267**	
11	11.11	Car door operates smoothly (check by operating manually from car roof). Door panels do not rattle during the drive.	**-.239**	
12	11.12	When door coupler relaxes at the closed position, the landing lock but does not move the doors.	**.051**	
13	11.13	If the doors are opened, the safety circuit is interrupted.	**.[a]**	
14	11.14	Rollers and diverters are properly fixed, not causing noise.	**.[a]**	
15	11.15	The anti-tip rollers are correctly adjusted: For ***rubber rollers***, it should be slightly pressed (finger tight) against the rail profile. For ***steel roller, the*** gap between roller and rail is 0.15mm.	**-.333**	
16	11.16	Car door operator is free from rust.	**-.129**	
17	11.17	Contact bridge pushes the contact surface inwards min. 3mm.	**-.333**	
18	11.18	Door operator buttons must open and close the door.	**.[a]**	
19	14.1	The gaps on entrances, car fronts and doors, are correct and equal.	**-.242**	landing door
20	14.2	Landings are clean and surfaces are intact.	**.130**	
21	14.3	If no longer required, surface protections are completely removed.	**-.033**	
22	14.7	Gap between the lock hook and counterpart is about 2mmwhen hanger plates are against close buffer	**-.258**	
23	14.8	The lock operates freely and closes by itself.	**.[a]**	
24	14.9	Landing door locks and contacts operate safety chain.	**.[a]**	
25	14.4	No bends, deformations, scratches, dents, or colour differences and so on, on all visible equipment's.	**.075**	
26	14.5	Landing doors are aligned, moves freely and close automatically.	**-.092**	
27	14.6	Doors are operating smoothly in normal operation.	**.[a]**	
28	14.10	The anti-tip rollers are correctly adjusted: For ***rubber rollers***, it should be slightly pressed (finger tight) against the rail profile. For ***steel roller, the*** gap between roller and rail is 0.15mm.	**-.203**	
29	14.11	Fire trims are in place.	**-.280**	
30	14.12	The emergency opening device operates and the lock return to automatically locked position.	**.028**	

Table 24: correlation coefficient for doors and entrance (mini space)

.[a-] denotes that correlation could not be found out since there were some blank in the punch-list

Control system

no	Punch-list number	Description	r' value	component
1	3.1	All grounding must be correctly connected.	**-.169**	control and drive panels
2	3.2	Grounding clamps (described in 3.1) must be tight.	**-.203**	
3	3.3	All protections must be correctly positioned.	**-.236**	
4	3.4	All unusual registered faults should be solved and unit reset.	**-.203**	
5	3.5	There should not be any abnormal noise coming from the contractors and so on.	**.[a]**	
6	3.6	All devices used to over bridge parts of the safety chain must have been removed.	**.[a]**	
7	3.7	Electrical drawings and parameter list available in the control panel/machine room	**.022**	
8	3.8	Verify that the parameter 6_75_65 displays between 5 - 6 mA with empty car.	**.135**	
9	3.9	Check settings of LWD. Perform this check both on topmost and bottom floor. Verify that the user interface menu 5_1 displays 0 +/- 2 with an empty car	**-.065**	

Table 25: correlation for control system (mini space)

[a]- denotes that correlation could not be found out since there were some blank in the punch-list

car

no	punch list number	description	r' value	component
1	8.1	Check the rope tension. Check that the spring lengths are equal. Max. The deviation is 3mm. (1:1 roping arrangement)	-0.503	car roof
2	8.2	Check that the rope fixings cannot rotate. (1:1 roping arrangement)	-0.54	
3	8.3	Check that safety pin and locking nuts are in place. (1:1 roping arrangement)	-0.54	
4	8.7	Check the rope collector plate, if applicable. No rattling - double nuts must be installed.	-0.685	
5	8.8	Car top encoder is installed correctly.	-0.683	
6	8.11	Positioning system:	.[a]	
		*if HIPO: Distance of between HIPO code plate and HIPO reader is 11 +/- 1mm.	-0.54	
		*If oscillators: oscillator plates are straight, equal to each other and penetrate 30 - 35mm to oscillator switches.	-.204	
		Terminal switches 77U and 77N magnets are in correct position and the distance between the switch and magnet is 10-15mm.	-.124	
		*If ETSL or NTS magnet switches: switches are in correct position and distance between switch and magnet is 10-15mm.	-.185	

7	8.4	Roller guide shoes have been adjusted.	-.135	
8	8.5	Roller stopper is adjusted correctly.	-.230	
9	8.6	Car roof stop button(s) operates	-.139	
10	8.9	Limit switch 51 operates.	-.157	
11	8.1	The car roof is clean.	-0.685	
12	8.12	There are 0.5mm gaps between the car top isolation pads and the car sling uprights. Isolation pads can slide on the uprights.	0.124	
13				
14				
15	12.1	Pit stop button(s) operates.	-.174	pit and under the car
16	12.2	Pit is clean.	-0.54	
17	12.3	Shaft light operates.	-.387	
18	12.4	Pit ladder is installed according to EN 81-1 / GB7588 or other local code.	-.236	
19	12.5	Counterweight screen is installed correctly.	-.134	
20	12.11	Check the position of the tension weight. Ensure that there is room for rope stretch before the first service visit. The switch contacts must be 100-300mm below the upper guard of the contact cam.	-.091	
21	12.12	OSG rope and tension weight pulley operate freely and quietly (car/cwt).	-.063	
22	12.13	OSG tension weights are in place and locked (car/cwt).	-.139	
23	12.14	OSG rope is clean and there are no broken strands, kinks or twists (car/cwt).	-.083	
24	12.15	Check that the bottom covers of the roller guide shoes have been removed.	-.135	
25	12.16	Oil buffers are filled with oil the contact operates. Oil buffers are vertically straight.	-.159	
26	12.6	Overtravel is correct (car/cwt)	-.067	
27	12.7	Check the traveling cable loops under the car.	-.289	
28	12.8	Check the traveling cable fixing is positioned according to layout drawing. Check traveling cable, hangers, fixings, and loop.	-.200	
29	12.9	Car and counterweight have a running clearance to pit working platform (also when the car is in the compressed buffer).	-.197	
30	12.10	The running clearance between traveling cable and pit working platform is more than 100mm	-.329	
31	12.17	Check the rope compensator. Check that the distance of the top of the tension weight to under the top beam is close to 140mm.	-.202	
32	12.18	Check the distance between upper guide and the lock-down device is 10-30mm.	-.159	
33	12.19	Check the safety switch alignment, the gap between safety switch and rod, safety switch rod tension springs length is 16mm.	-.159	
34	12.20	Check the fixing of the compensator to pit floor and all bolts and nuts are tight.	-.425	
35	12.21	Check the rope guards (4mm gaps)	-.114	
36	12.22	Jack bolt gap is 8mm and there is grease in the thread.	-0.645	

37	15.1	The curtain of lights or photocell re-open the door action when operated.	.[a]	car interior and landing
38	15.2	Maximum leveling deviation is +/-5mm.	-.228	
39	15.3	Gaps on entrances, car fronts, car panels, mirrors, etc., are correct and equal.	-.250	
40	15.4	Car interior is clean and intact.	-0.54	
41	15.5	No bends, deformations, scratches, dents or color differences and so on, on all visible equipment.	-0.537	
42	15.6	Doors are operating smoothly in normal operation.	-.139	
43	15.7	Check the program designations are the same as the buttons and that all indicators are working.	.[a]	
44	15.8	Check push buttons work correctly (back light and acceptance buzzer as required)	-.139	
45	15.9	Check car fan operation.	-.185	
46	15.10	Car emergency light and alarm buzzer must work when power is off.	-.293	
47	15.11	Check all announcements are correct for the installation and the volume is set at an appropriate level for the site.	-0.486	
48	15.12	Check the KRM / alarm dials through. (The service center connected, should be able to identify your location and elevator number).	-.512	

Table 26: correlation coefficient for car (mini space)

[a] denotes that correlation could not be found out since there were some blank in the punch-list

The outcome of the correlation study:

- From the result of the correlation analysis, it can be inferred that there is no strong correlation between any of the points that are related to each other.
- The strongest correlation that was found is 0.505 (seen in the correlation table of cars – table 22)
- There are few moderate correlations but in negative values which don't make sense, since it implies that the call-outs are due to the more number “OK” in the quality check.
- But there is strong correlation where the points are not related to each other (for example there is a strong correlation between a point from rope checklist and door call-out.) Annexure 8

3.6.4 Call-out pattern

Collected data, from equipment’s installed in a similar period, was taken and plotted to find any pattern. The selected equipment is the same project which was handed over in the year 2013. Totally 8 equipment call-out data are sorted and plotted. Doing this helps

to understand a little about the reliability of the equipment. And it's possible to understand the quality of the maintenance, service, and installation.
Talking about reliability and failure pattern, ideas from the bathtub curve can be utilized to a good extent. The bathtub was used to study human fatality in the early days(Chen and Watanabe 1989), and then industries utilized it. The bathtub had 3 regions as shown in the figure below. The first region is called infant mortality, the second is and the middle called random (some literature also call it mature stage). And the third wear out.

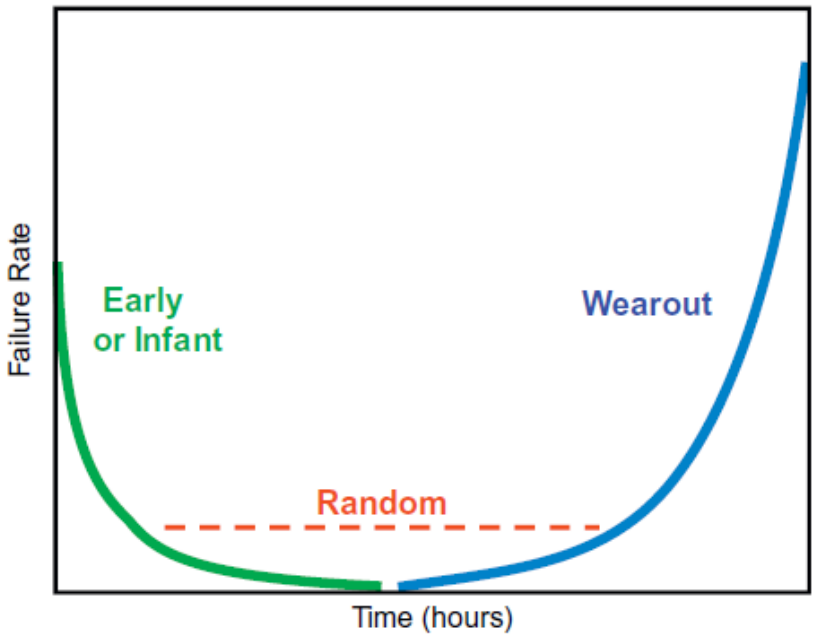


Figure 66:typical bathtub curve(Roesch 2012)

The term "burn in" used in electronic and semiconductor industries instead of infant(Roesch 2012). This is like "burn in" in a headphone, where the sound quality gets better as the number of hours used increases. This is because the failure rate is high in the early stage, gradually decreases and then start to increase as the item gets old and wear out. Wear out are mostly seen in the mechanical system. Usually, these are times when the equipment is modernized or replaced completely.

The call-outs are plotted against the time, like the bathtub curve. The obtained plot is as shown below. This is a consolidated plot of all the equipment. The individual plot is available in the Annexure 9

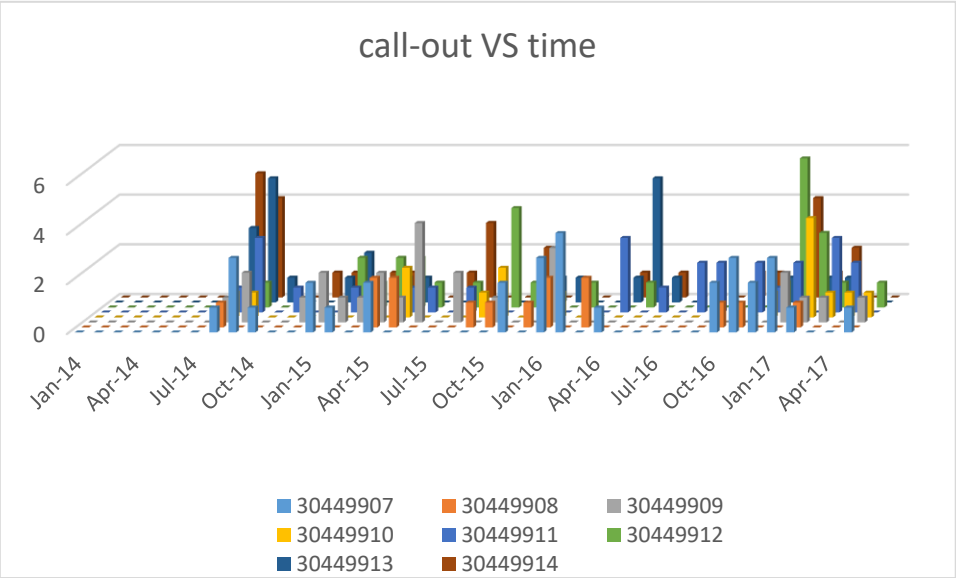


Figure 67: plot of call-out Vs time

As we can see from the graph, there are no pattern or trend in any of the equipment. As stated earlier, these are equipment that is handed over in 2013, and until July 2014 there is no call-out. This means in terms of early call-out, the equipment is good, but the total call-out is high.

The probable reason for the behavior may be due to improper preventive maintenance, in other words, in this case; the quality of installation of the equipment is good but the maintenance is not up to the mark. It is to be noted that this is not the case every time since there is also equipment with early call-out. The causes for the early call-out is probably due to poor installation quality. In this case, there is no evidence of wear out since the call-out is random.

The outcome of the study:

- From the study, it's possible to state that there is no evidence of a pattern in the call-outs and the call-out is completely random.
- There are periods where there is high call-out and there are periods with absolutely no call-outs too.
- It is hard to conclude that the elevator call-out shows any pattern.

3.6.5 Benchmarking

The evaluation was done internally. The FYCOR in the different regions are obtained from December 2016 to April 2017. The values are as shown below.

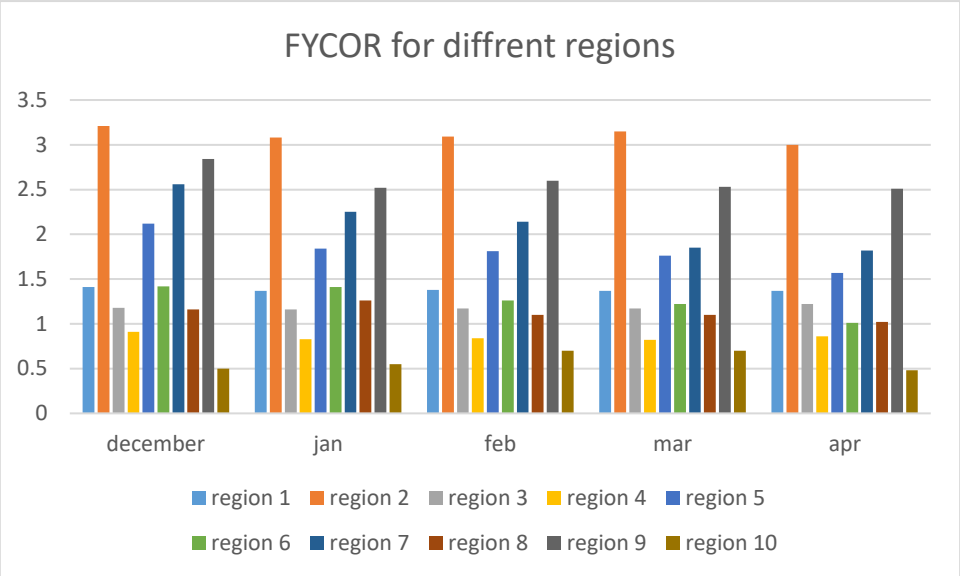


Figure 68: FYCOR for different regions

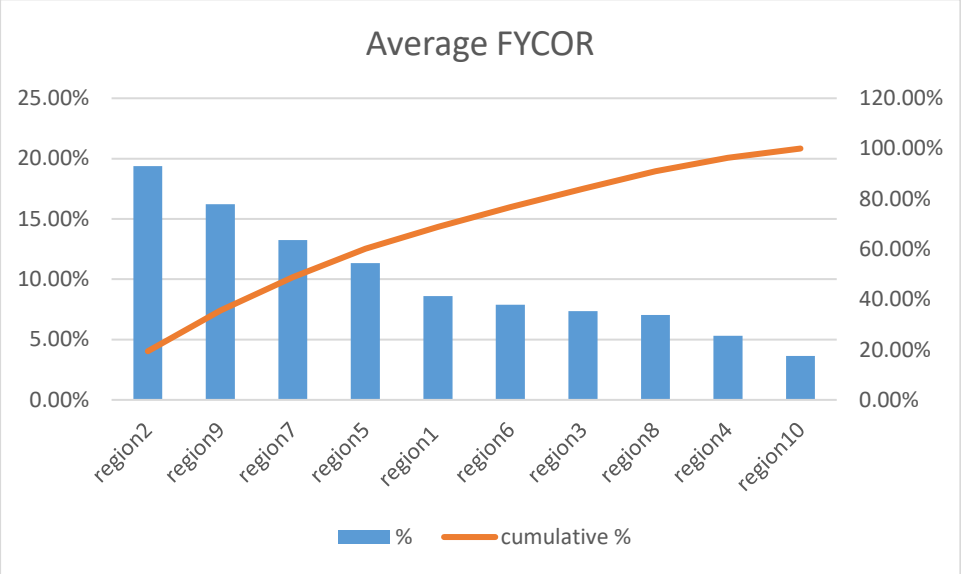


Figure 69: FYCOR average for various locations

It is very important to understand why there is such difference in FYCOR regionally. The equipment is manufactured in the same place, so the only thing that change is people in different places.

Many research provides a proof showing the corporate social performance differ based on countries. Some literature says that the countries having a high income per capita have better corporate social performance(Cai, Pan, and Statman 2016). Corporate social performance is the translation of company's mission into practice. There are also studies that suggest that national culture plays a big role in innovation and performance(Humphries and Whelan 2017).

After the FYCOR from different regions is obtained, it is compared with national culture to find if there is any correlation between them. For this purpose, the countries income per capita and the cultural dimension are noted and studied. Some literature also questions and challenges the Hofstede's Model of National Cultural Differences(McSweeney 2002).

[The values for income per capita and the cultural dimension are obtained from indexmundi.com(income per capita n.d.) and geert-Hofstede.com(Hofstede 2017)]

The correlation is obtained, the moderate and strong correlation values are examined.

	Income per capita	National culture					
		Power Dist.	individualism	masculinity	Uncertainty avoidance	Long-term orientation	indulgence
FYCOR	.745*	-.485	.529	.342	-.459	.006	.446

Table 27:correlation values for FYCOR Vs income per capita & national culture.

In contrary to the literature, here there are higher FYCOR in countries with higher income per capita. Also, the cultural dimensions correlation results are opposite in nature where the theories state that corporate performance positively related to countries individualism value and negatively related with a country's uncertainty-avoidance value, but the results obtained have + 0.529 for individualism and -0.459 for uncertainty avoidance. Even though the correlation is moderate, the expected results are opposite to that of what many kinds of literature suggest. (here we desire less FYCOR and hence the sign is opposite, i.e. the negative correlation is good where the call-out reduces when the other parameter increases). The scatter plot for all the cases are available in Annexure 10

The outcome of the study:

- There are proofs to state that performance doesn't depend on the income per capita, if it was the case then the correlation had to be negative and those countries with high income per capita should have fewer call-outs.
- The culture plays a role in the performance, but from years, the culture of different countries has been changing, there is a high probability that the values of the cultural dimension have changed from years and hence the results are opposite to that of some literature.

Conflict of interest:

- There is a probability that some countries with low income per capita doesn't have many high rise building and towers, and maintaining & installing the elevator in such cases are different when compared to others.
- Never the less the FYCOR are the average that is taken on an equipment considering all the equipment for a year, and the values reduce as a number of equipment increases. There are chances that the countries with high income per capita have more equipment than the one with less income per capita. This must be further studied and examined.

3.6.6 Problem tree analysis:

After gathering all the information and the results of the analysis, problem tree analysis was carried out and the final cause and effects are as shown in the schematic given below.

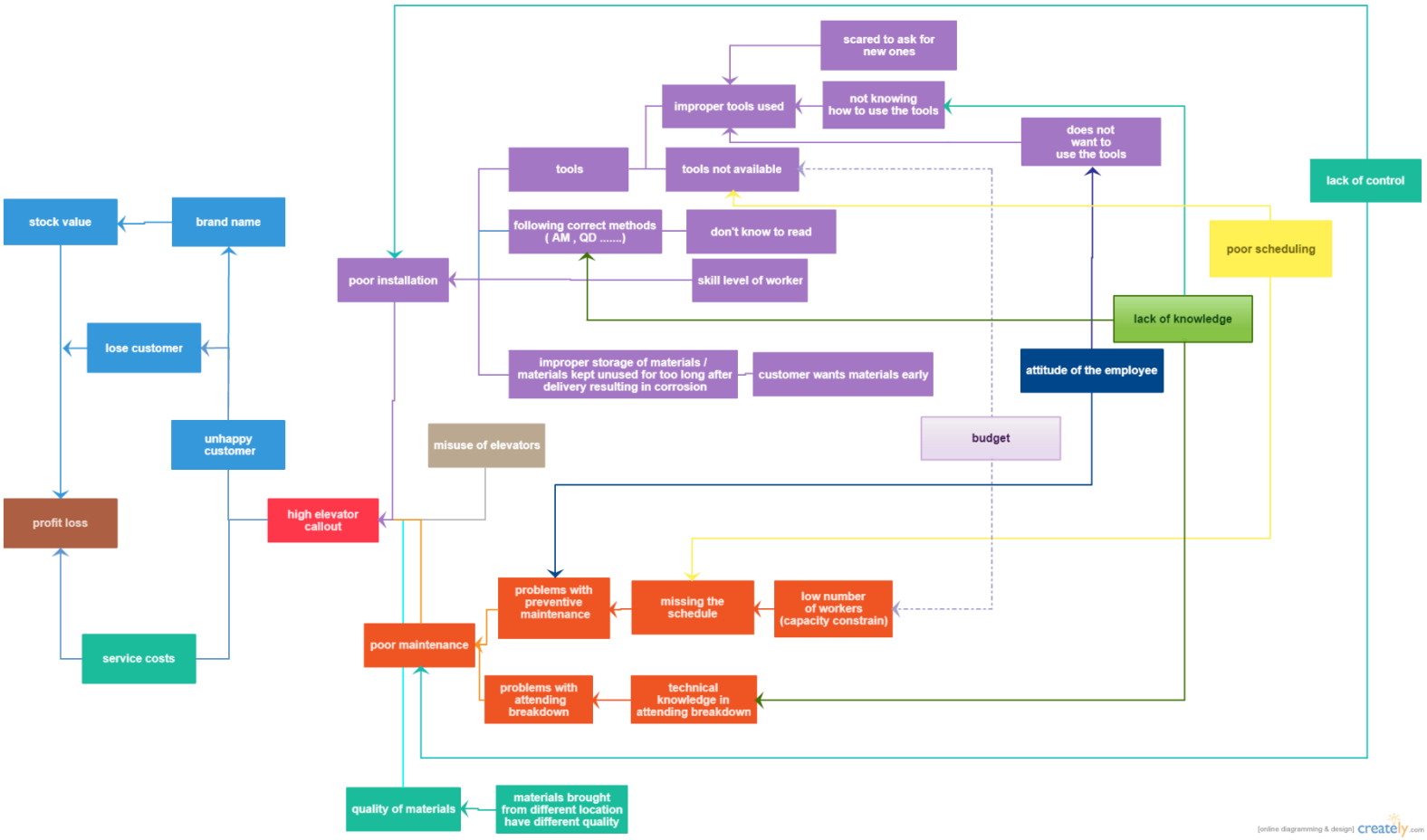


Figure 70: Problem tree analysis

"Hi elevator" call-out is set as the problem and all the aspects of the problem are listed and the causes for the call-out are noted. The right-hand side of the figure represents the causes and the left-hand side represents the probable effects.

Out of all the causes, the "quality of the material" cause seems to be assumptions of people. There is a saying that assumptions are almost wrong most of the time, and the saying turns out to true in the case. The equipment is brought either from China or Finland or from both factories in some projects. During the section, it was claimed that the equipment brought from the factory in China had poor quality when compared to the one brought from Finland. After the section, a study was done and was found that the call-out is independent on the place it was produced, i.e. both the equipment from China as well as Finland had call-out. Besides this, one of the projects where the equipment brought from the Finland had the highest number of first-year call out. Also, the buying the equipment from China has much lower logistic cost.

The outcome of the study:

- The equipment had call-out no matter where it was made.
- And it all comes down to the quality of installation and maintenance and occasionally vandalism by the user.

3.6.7 Analysis of operations (maintenance and breakdown attendance)

There are totally 6 groups of technicians, these 6 groups are based on cities & the technicians maintain and attend the breakdown of the equipment in that city. To simplify the process let's take a case of one group of 10 equipment and 2 technicians. Whenever there is a breakdown, the 2 technicians attend it and there is no equipment assigned to any of them. Say if equipment "A" produces a breakdown and the first

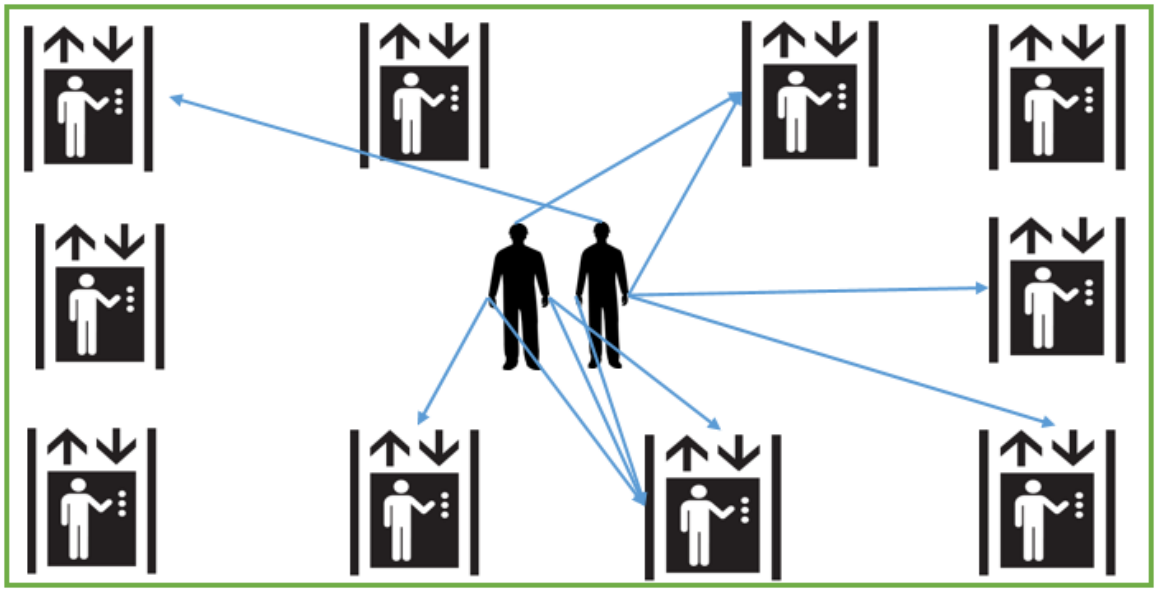


Figure 71: illustration of the operation

technician attends it when there is a breakdown again with the same equipment the other person attends it this time.

Symbol			
meaning	Equipment/elevator	Worker/technician	group

From the figure, some equipment's are handled by various persons, as a result; the person attending the breakdown later doesn't know the actual condition of the elevator and what was changed or modified in the previous repair. This leads to repetitive call-outs and the process continues.

After the study on the repetitions of the call-out, it was found that the high call-out rates are mainly due to the repeated calls. The equipment that had call-out equal and greater than 6 are sorted and the ones less are plotted (i.e. in average one call-out every alternate month). The pie chart given below shows the contribution of these both category on call-out.

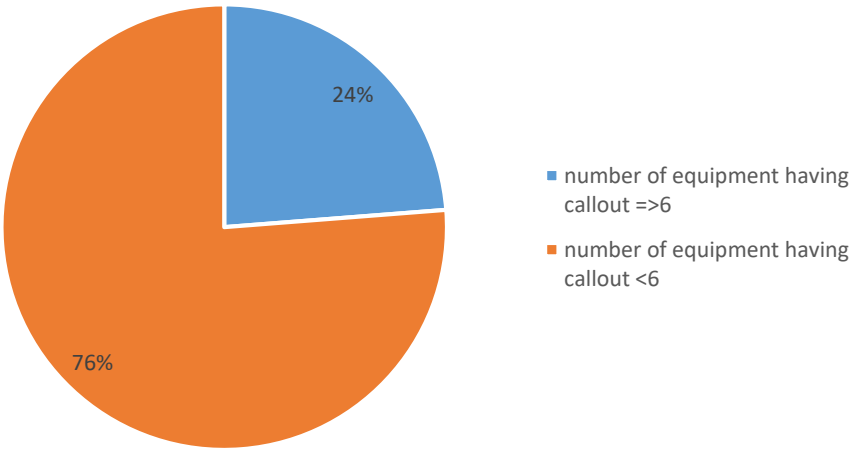


Figure 72: distribution of equipment having repeated call-out.

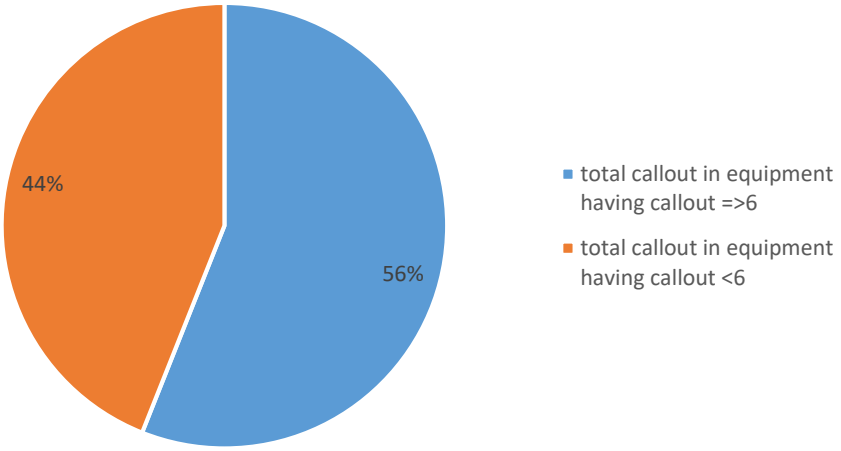


Figure 73: impact of repeated call-out

3.6.8 Summary of the analysis & findings

- From the Pareto analysis, the projects, equipment, and components that have the most call-out are identified
- The punch list (the inspection conducted during the handover) don't have an impact on the call-out. In other words, there are call-out even if the quality of installation was good. Which means either the inspection conducted is not good enough or focused on reducing the call-out.
- In few cases, the calls are due to the worn equipment (i.e. equipment is old and need modernization) and the spare parts are no longer manufactured.
- Also, some customers don't want to pay for the component replacement.
- Also from the cultural study, it can be inferred that culture plays a significant role and have some impact in call-out.
- The high call-out is mainly due to repeated calls in equipment, controlling the repeated calls will have a huge impact on the call-out rate.
- It all boils down to the installation and service quality.

3.7 Improvement and impact

1. **Priority to sick lifts**

    - From the data obtained the equipment that has more than 6 calls a year are sorted out and a team of experienced technicians is formed to attend calls only from equipment that have frequent calls.

2. **Training technicians**

    - Training is given to technicians depending on the data obtained from the call-out log and by asking what training is required by them.
    - Priority is given to training the technicians on troubleshooting problems arising from doors and entrances, control system and cars.

3. **Assigning equipment to technician**

    - Assigning the equipment allows technician to know about the history and condition of the equipment completely since it only him who maintain the equipment
    - Also, it gives a sense of ownership to the technicians

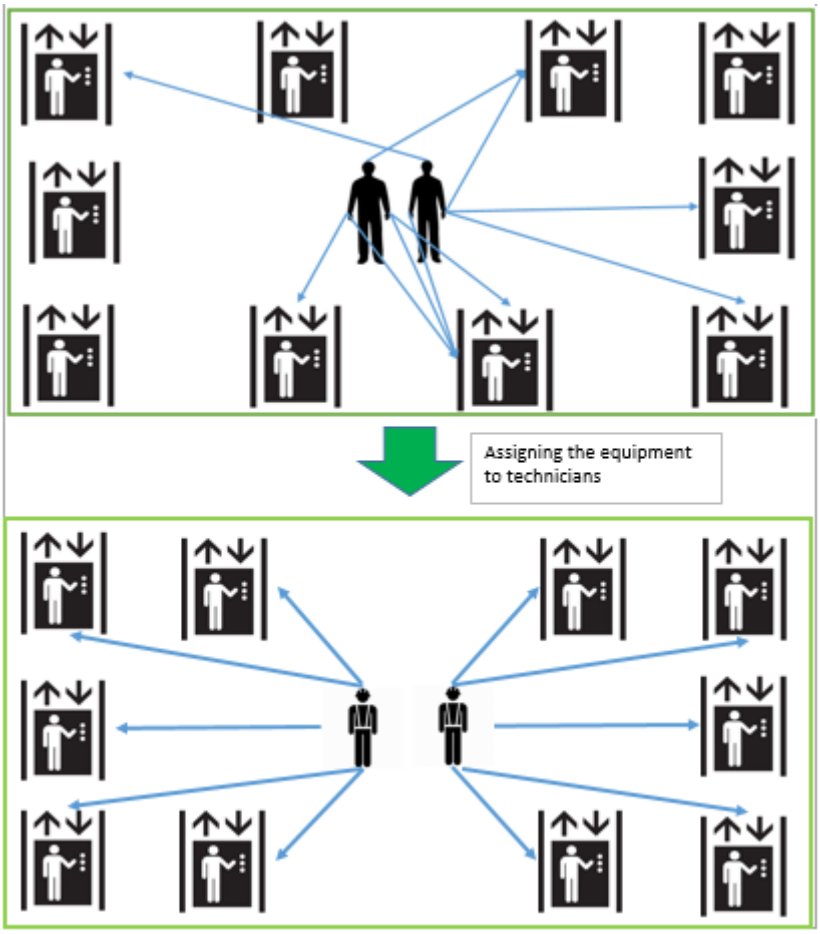


Figure 74: illustration of changed process

- There is a constraint when it comes to assigning the technician to each equipment, i.e. when there is call out in two equipment at the same time the downtime in one of the equipment is high which is undesirable. There will be such situation in the beginning but when the call-out is not repeated, these overlapping situations will be avoided.
- The equipment is assigned in such a way that the time taken to travel between them is minimal. This also improves the response time.

4. Making sure that there are no wrong items delivered from the warehouse, which delay the work.

5. During the handover inspection; the technician and the supervisor who will be maintaining the equipment can be present, and the corrections suggested by them are advised to be made once both the installation and the service team are agreed on it.

no	Actions	Impact on the causes of call-out	Impact strength
1	priority to sick lifts	controls the repeated call-out and better scheduling for troubleshooting	4
2	training the technicians	improves the skill level of technicians, thereby improving the quality of the work. This makes the worker aware of how to use the tools too	5
3	assigning equipment to technician	this makes the technicians responsible for equipment and, they know about the equipment more. It gives them a sense of ownership	4
4	improving the delivery of parts	decreases the downtime of equipment	3
5	handover inspection	avoids the corrective actions to be made after the handover. In such case the elevator need to be stopped; which doesn't give a good impression to customer	3

Table 28: impact of actions made on the call-out

The strength is rated from 1 to 5 depending on the impact, i.e. 5 being the most impact and 1 being the least impact.

3.8 Control

Control plan:

- Whenever there are more than 3 calls from the same equipment, a notification is sent from the call center to the respective director, supervisor and the technicians specifying the details of the history for that month (previous control method).

- During the installation phase, there are various checkpoints made to ensure the proper installation of the equipment. A quality inspection is conducted after completion of each phase. (quality checks were already being done as a part of project management, which is called quality gates. Now there is a dedicated

team to perform the task and the corrections are done after each phase rather than at the end.)

- Apart from that, the equipment that has more than 4 calls every quarter are also informed to be notified. By comparing the call-out in the old control log (called priority elevators) and the elevator having high call-out in 2016, it was found that only about 51 % of the equipment having high call-out were notified. This is because the other 49% of the equipment did not produce more than 3 calls per month but produced calls less than 3 each month, and this equipment was not being identified before.

- Also, there are equipment's where the calls have increased when compared to the previous year, again the system does not capture this. This is also considered, and a request is sent to develop such system.

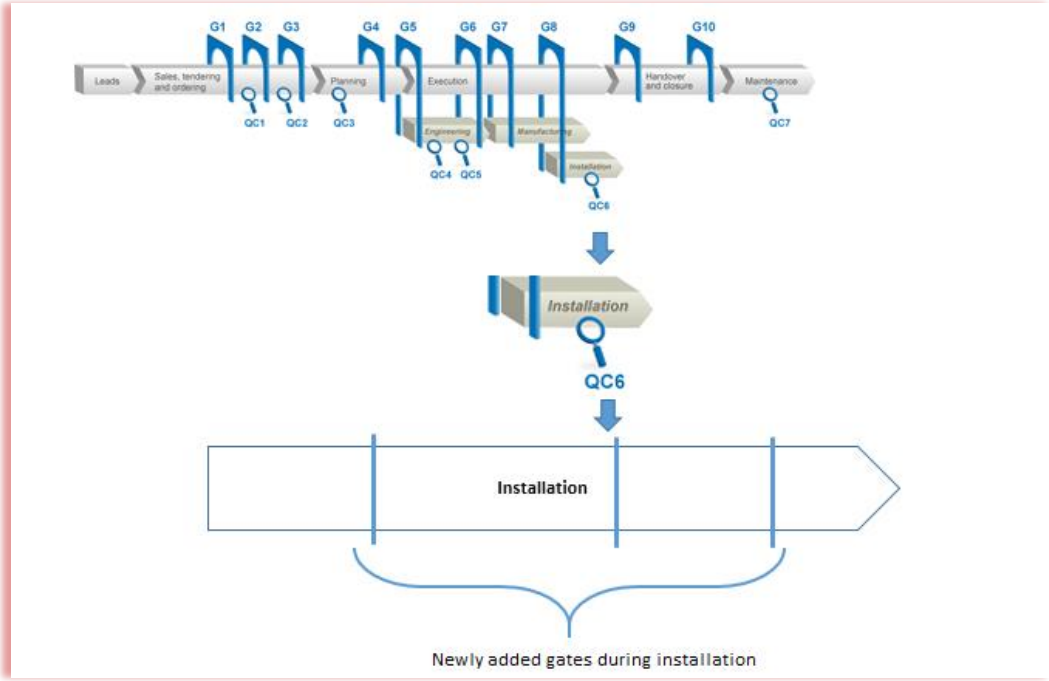


Figure 75: newly implemented quality gates

CONCLUSIONS

4.1 Conclusion & Results

4.2 Proposal for future works

4 CONCLUSIONS AND PROPOSALS OF FUTURE WORKS

4.1 Conclusion & Results

KONE is currently following a maintenance policy called MBM (modular based maintenance), where each module is scheduled for different periods to reduce the downtime of each scheduled maintenance. This is scheduled for every 15 stops (15 level in high-rise building) for every maintenance. There are few things to be considered here, KONE have various types of equipment and component and they have never failed to innovate and redesign their products. This is good since the products are improving, but on the other hand, when there are so many kinds of components and products it gets difficult to maintain such diverse set of components and equipment. Training can be given to people when new products are released but the training takes a certain amount of time, and by the time the people are familiar with the product, a new product is released.

The elevator industry is essentially different compared to automobile industry; mainly when it comes to knowledge level for the common people. When there is a breakdown in an automobile, the customer says if they notice any symptom before the breakdown occurs(feedback), on the other hand, there is no feedback when it comes to elevators and escalators. This makes troubleshooting difficult and in many cases difficult to identify and rectify the problem in the first time.

As the equipment becomes very sophisticated; the system complexity increases, as a result it is very difficult to predict the failure probability. Just like the preventive maintenance, MBM works fine until the system is relatively simple, where the failure probability can be easily predicted. Like the preventive maintenance, even the MBM assumes that the failure can be predicted statistically and it was assumed that as the equipment becomes old, the reliability of the equipment reduces and the reliability can be restored by having shorter maintenance period. It’s not the case today since there are many examples where the new equipment’s caused more breakdown than the older equipment. Researchers prove that there is no cause and effect relationship between scheduled maintenance and the reliability of the equipment; since the failure time of the components are different almost every time. (Williams n.d.) (NASA 2008).

As seen from the study, the call-out is mainly due to installation(project) and maintenance and service (operations). The project is a temporary endeavor and we get to learn from the mistakes from the project once the project is completed, on the other hand, the operations are continuous processes where there is a chance to improve and develop the process without having to wait. As the calls increase it becomes even more difficult to handle the situation and it is best to have the actions planned as soon as possible to avoid thing getting worst.

Also, many times this is the situation of many engineering and tech companies, it is thought that the things that are not in the system don't exist; which may be the software's and other application of customer relationship management(CRM) or the enterprise resource management (ERP) and so on. We rely so much on the system and are depended on it assuming that everything is present in the system, until something unexpected happens, just like the case here where the other 49% of the equipment where the call tends to increase, were not recognised by the system and no action was taken since it was not in the frame of the system. It is always better to have an eye on what is happening rather than completely relying on the system. Also, it's important to understand that all these applications and system are present just to assist us and having them will not necessarily solve the problem.

Measuring back the KPI's in September 2017 the **FYCOR** dropped to **0.85** from **1.47** and the **COR** dropped to **2.25** from **2.80**. The COR hasn't shown a big change, meaning the installations have been developing over time but the operations haven't shown much progress.

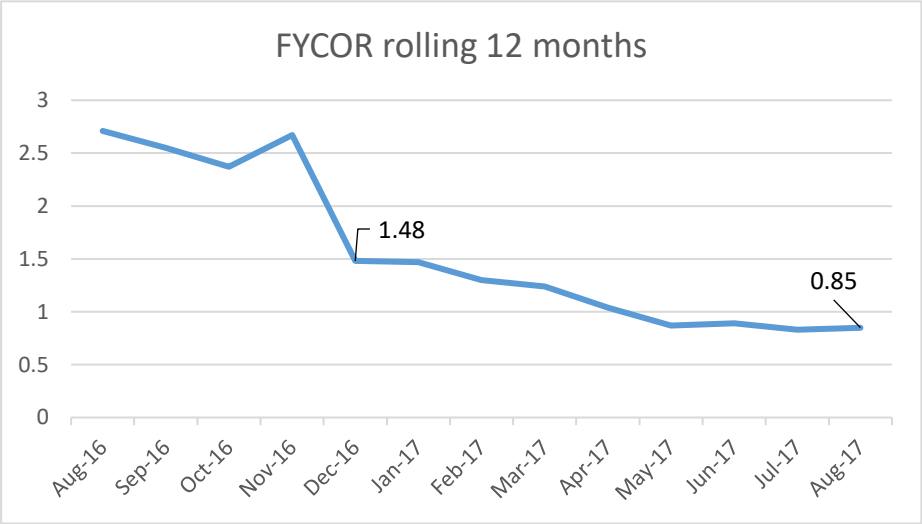


Figure 76:FYCOR rolling 12 months

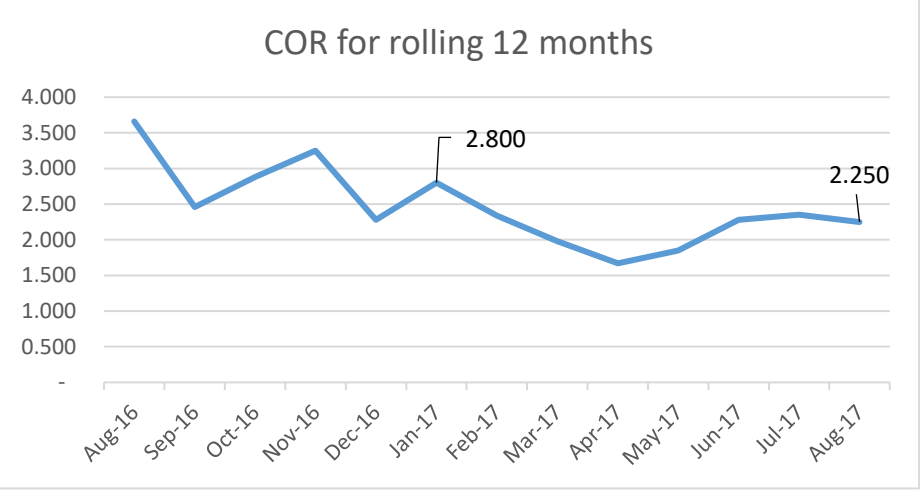


Figure 77:COR rolling 12 months

4.2 Proposal for future works

- Creating simpler and standardized product having less variation by focusing on DFM, this will not only reduce the complexity but also reduce the cost of training the employees.

- Changing maintenance policy to RCM. Implementing the RCM takes some time and capital because it's a data-driven approach which needs some systems to be installed to extract data from the equipment. This will give a positive return after a certain period when the calls reduce.

- Developing a new system that notifies about the critical equipment based on the call-out trend. This will help identify the equipment that might possibly produce call-out another time.

- Standardising a process to create a structured way of approaching the call-out, when it occurs after the handover.

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5.1 Websites and another reference

5.2 Papers in international journal

5 REFERENCES AND OTHER SOURCES OF INFORMATION

5.1 Websites and another reference

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ANNEXES

6 ANNEXES

6.1 ANNEX1: list of components in the call-out log

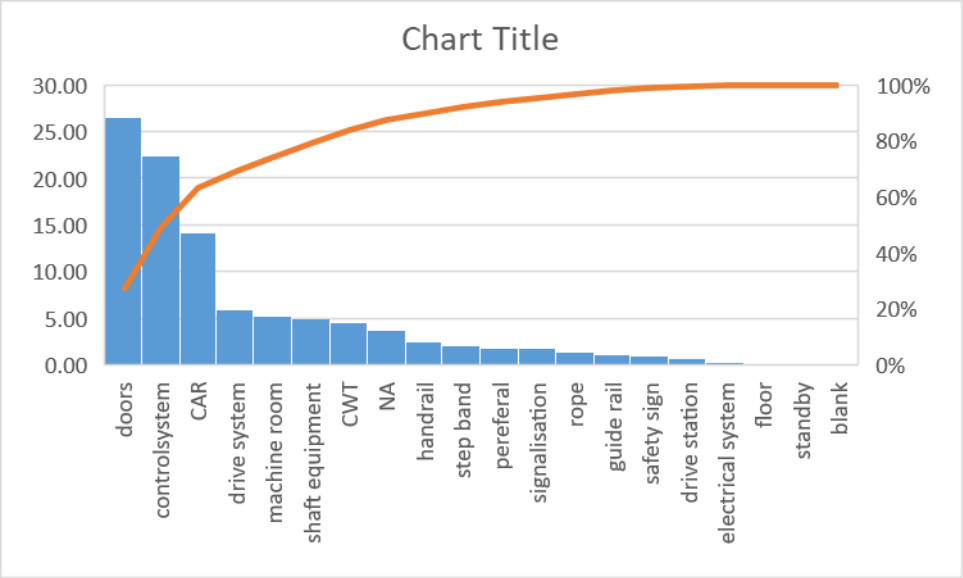
no	name of the components
1	DOORS AND ENTRANCES - Landing Door - Door contact
2	CONTROL SYSTEM - Control system
3	DOORS AND ENTRANCES - Landing Door - Door mechanical lock - Lock release roller
4	Not applicable
5	DOORS AND ENTRANCES - Landing Door - Landing door
6	DOORS AND ENTRANCES - Car Door - Door contact
7	CONTROL SYSTEM - Contactor
8	CAR - Car positioning devices - Positioning switches/readers
9	CONTROL SYSTEM - PC Board
10	CAR - Car positioning devices - Levelling vanes & tapes
11	SHAFT EQUIPMENT - Shaft electrification - Positioning magnet or plate
12	PERIPHERAL DEVICES - Emergency lighting - Emergency battery
13	CAR - PC Board (in car connection box)
14	DOORS AND ENTRANCES - Car Door - Car door
15	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill - Coupler
16	COUNTERWEIGHT - Guide shoe - Sliding guide
17	MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake
18	DOORS AND ENTRANCES - Car Door - Car door safety devices - Curtain of light
19	DOORS AND ENTRANCES - Landing Door - Door mechanical lock
20	DRIVE SYSTEM - Drive system module
21	CONTROL SYSTEM
22	DOORS AND ENTRANCES - Car Door - Door mechanical lock
23	DRIVE SYSTEM - Drive
24	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and still - Panel
25	MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder, and resolver - Tachometer
26	SHAFT EQUIPMENT - Governor - Switch
27	DOORS AND ENTRANCES
28	SHAFT EQUIPMENT - Travelling cable
29	CAR - Car panels & roof
30	CAR - Car wiring
31	SHAFT EQUIPMENT - Shaft electrification - Limit switch
32	SIGNALISATION - Car signalisation - Call button - Call button PC Board
33	CONTROL SYSTEM - Fuse
34	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and sill - Hanger roller
35	CAR
36	CONTROL SYSTEM - Control system module
37	CONTROL SYSTEM - Control system wiring

38	COUNTERWEIGHT - Pulley - Bearing
39	CONTROL SYSTEM - another electrical component - Power supply
40	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill - Synchronizations device
41	HANDRAIL SYSTEM - Handrail - Handrail
42	MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder, and resolver
43	SHAFT EQUIPMENT - Governor - Tension device
44	SIGNALISATION
45	SIGNALISATION - Car signalisation - Call button - Pressel / mechanics
46	SIGNALISATION - Landing signalisation - Call button - Pressel / mechanics
47	CAR - Car Interior - Lighting
48	CAR - Car positioning devices - Car top encoder
49	CAR SLING - Load weighing devices
50	DOORS AND ENTRANCES - Car Door - Car door operator - Door operator mechanical component
51	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill - Guide shoe
52	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and sill - Synchronizations device
53	DRIVE SYSTEM - Contactor
54	GUIDE RAILS - Car guide rail
55	HANDRAIL SYSTEM - Handrail guide - Handrail return guide
56	MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder, and resolver - Tachometer wheel
57	ROPE ASSEMBLIES - Hoist Rope
58	SHAFT EQUIPMENT - Governor - Rope
59	SIGNALISATION - Landing signalisation - Call button - Call button PC Board
60	STANDBY
61	STEP BAND - Step - Roller
62	CONTROL SYSTEM - another electrical component
63	DOORS AND ENTRANCES - Car Door - Car door operator - Door operator board
64	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill - Hanger roller
65	DOORS AND ENTRANCES - Landing Door
66	DRIVE SYSTEM - Other electrical component - Power supply
67	MACHINE ROOM EQUIPMENT
68	PERIPHERAL DEVICES - Fire service panel
69	SIGNALISATION - Car signalization
70	STEP BAND - Step - Step
71	CAR - Car interior - Ventilation
72	CAR - Car top inspection station
73	CAR - Retiring cam & magnet
74	CAR SLING - Roller guide
75	CAR SLING - Sliding guide
76	CONTROL SYSTEM - Control system software
77	CONTROL SYSTEM - Other electrical component - Motor overload
78	CONTROL SYSTEM - Relay
79	DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge linkage

80	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill
81	DOORS AND ENTRANCES - Landing Door - Door closing device
82	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and sill - Top-track
83	DOORS AND ENTRANCES - Swing door - Door contact
84	DRIVE SYSTEM
85	DRIVE SYSTEM - Drive system software
86	DRIVE SYSTEM - PC board
87	DRIVES, STATIONS, TRACK SYSTEM - Drive - Drive
88	DRIVES, STATIONS, TRACK SYSTEM - Drive - Gearbox - Drive chain
89	ELECTRICAL SYSTEM - Control and signals - Control panel
90	ELECTRICAL SYSTEM - Controller - Controller
91	ELECTRICAL SYSTEM - Safety circuit and switches - Step sag device
92	HANDRAIL SYSTEM - Handrail drive - Handrail chain tension device
93	HANDRAIL SYSTEM - Handrail roller
94	MACHINE ROOM EQUIPMENT - Motor generator - Motor generator
95	MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake coil
96	MACHINE ROOM EQUIPMENT - Traction Machinery - Hoist motor - Hoist motor
97	SHAFT EQUIPMENT - Another shaft equipment - Buffer - Buffer switch
98	SHAFT EQUIPMENT - Shaft electrification
99	SHAFT EQUIPMENT - Shaft electrification - Pit stop switch
100	SHAFT EQUIPMENT - Shaft pulleys - Diverting pulley
101	SIGNALISATION - Car signalisation - Call button
102	SIGNALISATION - Car signalization - Key switch
103	SIGNALISATION - Landing signalisation
104	SIGNALISATION - Landing signalisation - Call button
105	STEP BAND - Chain - Chain
106	STEP BAND - Step
107	CAR - Car positioning devices
108	CAR SLING - Diverting pulley - Diverting pulley
109	CAR SLING - Safety gear
110	CAR SLING - Safety gear - Safety gear mechanical
111	CONTROL SYSTEM - Other electrical component - Circuit breaker
112	COUNTERWEIGHT - Guide shoe
113	COUNTERWEIGHT - Guide shoe - Roller guide
114	DOORS AND ENTRANCES - Car Door
115	DOORS AND ENTRANCES - Car Door - Car door operator
116	DOORS AND ENTRANCES - Car Door - Car door operator - Car door operator
117	DOORS AND ENTRANCES - Car Door - Car door operator - Door operator motor
118	DOORS AND ENTRANCES - Car Door - Car door safety devices - Closing force limiter
119	DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge
120	DOORS AND ENTRANCES - Car Door - Top-track, panels, and sill - Panel
121	DOORS AND ENTRANCES - Car Gate - Guide shoe
122	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and sill - Anti-tip roller
123	DOORS AND ENTRANCES - Landing Door - Top-track, panels, and sill - Sill

124	DOORS AND ENTRANCES - Swing door - Panels and sill
125	DRIVE SYSTEM - Drive system wiring
126	DRIVE SYSTEM - Other electrical component
127	DRIVE SYSTEM - Other electrical component - Circuit breaker
128	DRIVE SYSTEM - Other electrical component - Regenerative device
129	DRIVE SYSTEM - Other electrical component - Voltage regulator
130	DRIVES, STATIONS, TRACK SYSTEM - Return Stations - Lower return station - Chain tension device
131	ELECTRICAL SYSTEM
132	ELECTRICAL SYSTEM - Controller
133	ELECTRICAL SYSTEM - Controller - Contactor
134	ELECTRICAL SYSTEM - Safety circuit and switches
135	FLOOR, COMB CARRIER - Access cover
136	FLOOR, COMB CARRIER - Comb carrier - Comb carrier
137	GUIDE RAILS - Counterweight rail
138	GUIDE RAILS - Pulley rail
139	HANDRAIL SYSTEM - Handrail
140	HANDRAIL SYSTEM - Handrail drive
141	MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Hydraulic machinery
142	MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Power unit - Motor blower
143	MACHINE ROOM EQUIPMENT - Motor generator - Winding
144	MACHINE ROOM EQUIPMENT - Traction Machinery
145	MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake switch
146	MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder, and resolver - Resolver
147	PERIPHERAL DEVICES - Emergency lighting - Emergency push button
148	ROPE ASSEMBLIES - Compensation rope and chain
149	ROPE ASSEMBLIES - Hoist rope suspension
150	SAFETY SIGNS, CLADDINGS, DECKINGS, BALUSTRADES - Balustrade - Glass
151	SHAFT EQUIPMENT
152	SHAFT EQUIPMENT - Governor
153	SHAFT EQUIPMENT - Governor - Governor mechanical
154	SHAFT EQUIPMENT - Other shaft equipment - Balancer
155	SHAFT EQUIPMENT - Other shaft equipment - Buffer - Buffer
156	SHAFT EQUIPMENT - Other shaft equipment - LPT (Low pit / top) device
157	SIGNALISATION - Car signalisation - Car indicator unit - Positioning indicator
158	SIGNALISATION - Landing signalisation - Key switch
159	STEP BAND - Connector

6.2 ANNEX 2: Pareto and ABC chart of costs



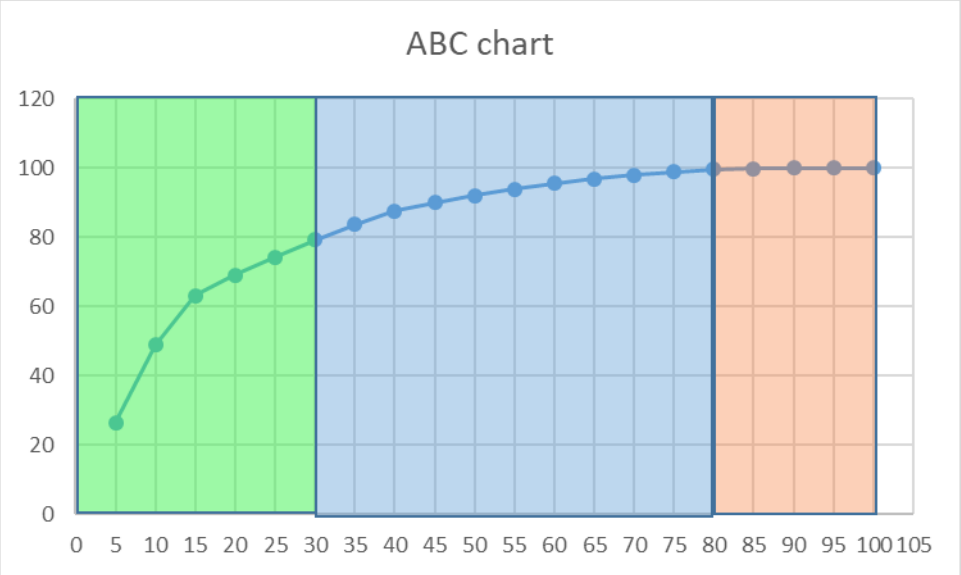
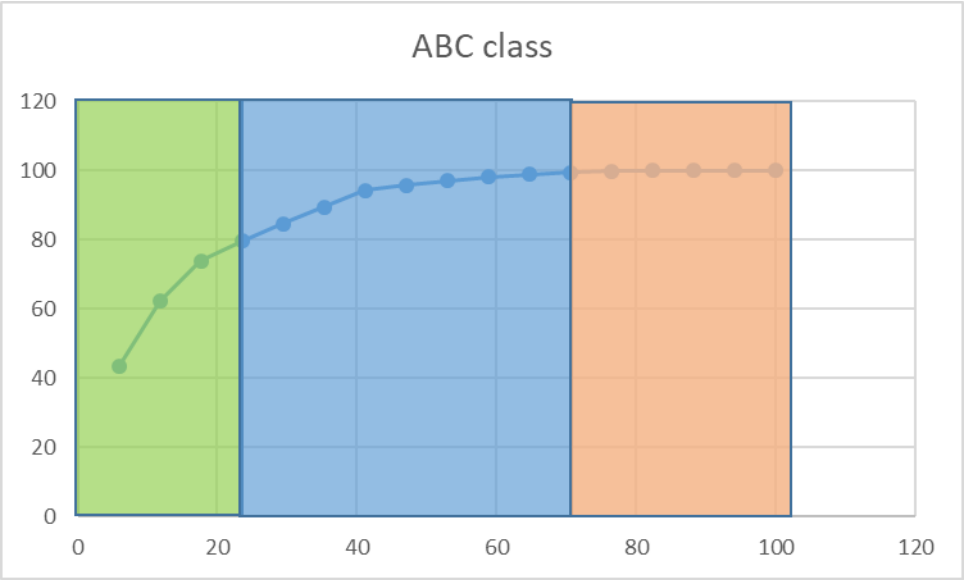


Figure 78: pareto and ABC chart for cost incurred in handling call-out from November 2016 to April 2017



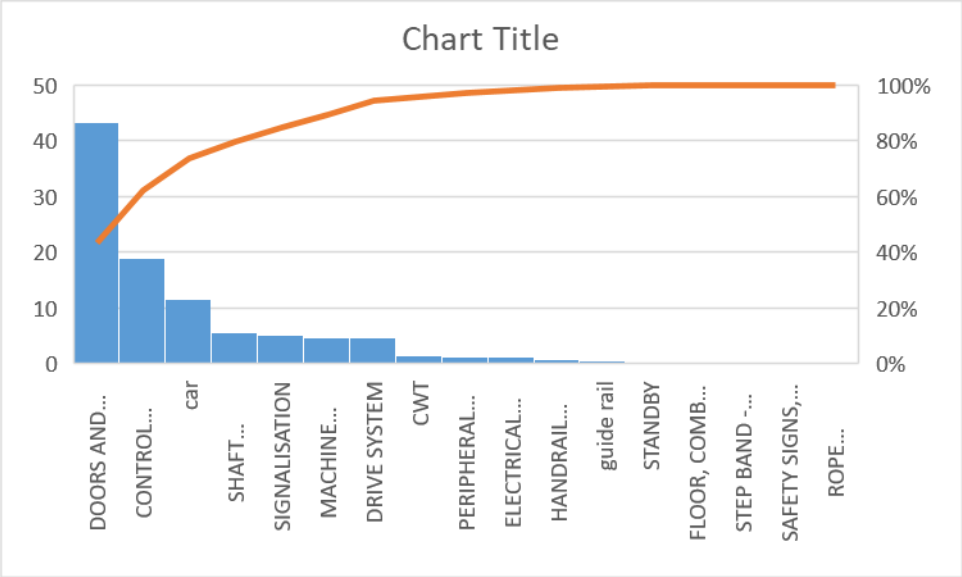
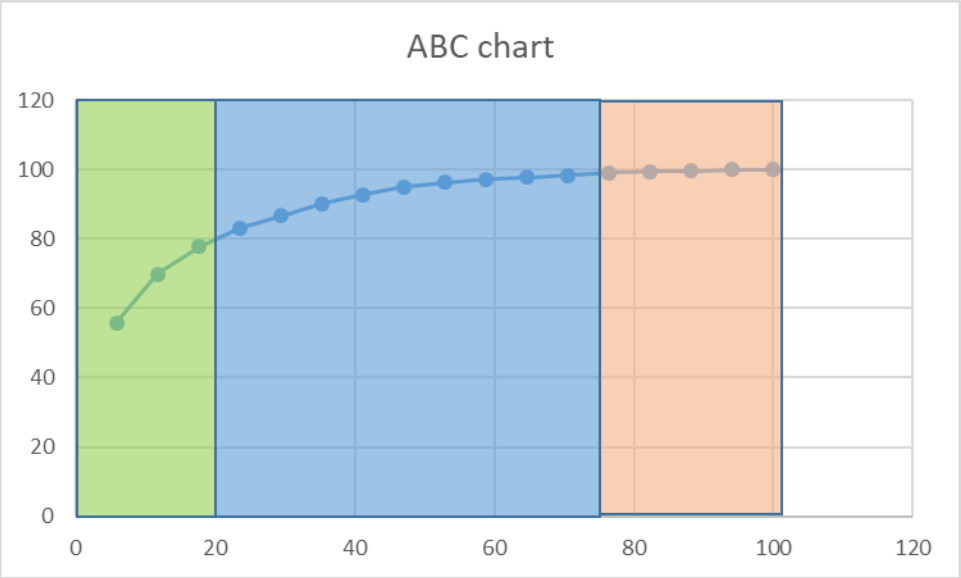


Figure 79:pareto and ABC chart for cost incurred in handling call-out from January 2016 to april 2017



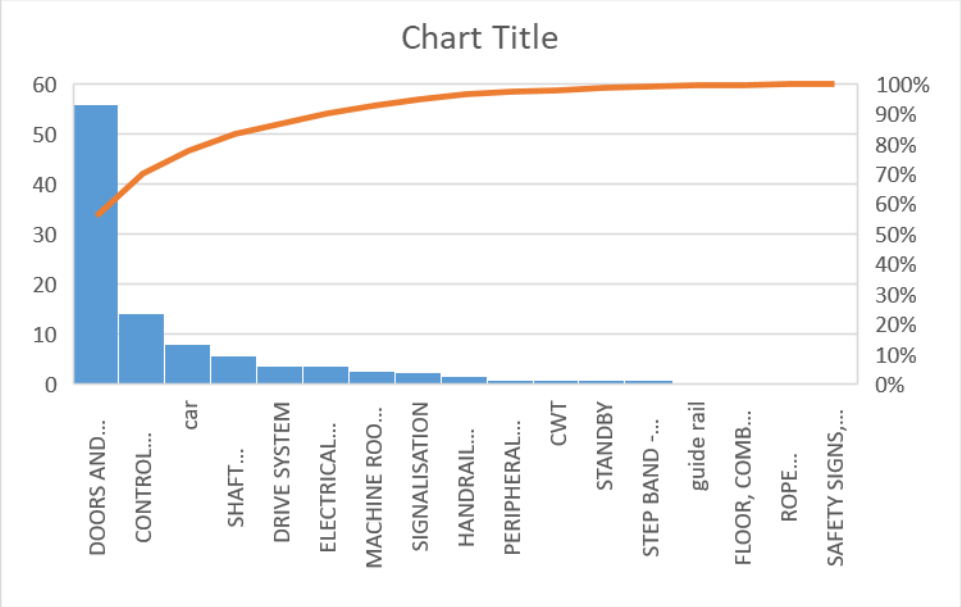


Figure 80: pareto and ABC chart for cost incurred in handling call-out from 2016 (LIFS)

6.3 ANNEX 3: ABC analysis on doors and entrance for different periods

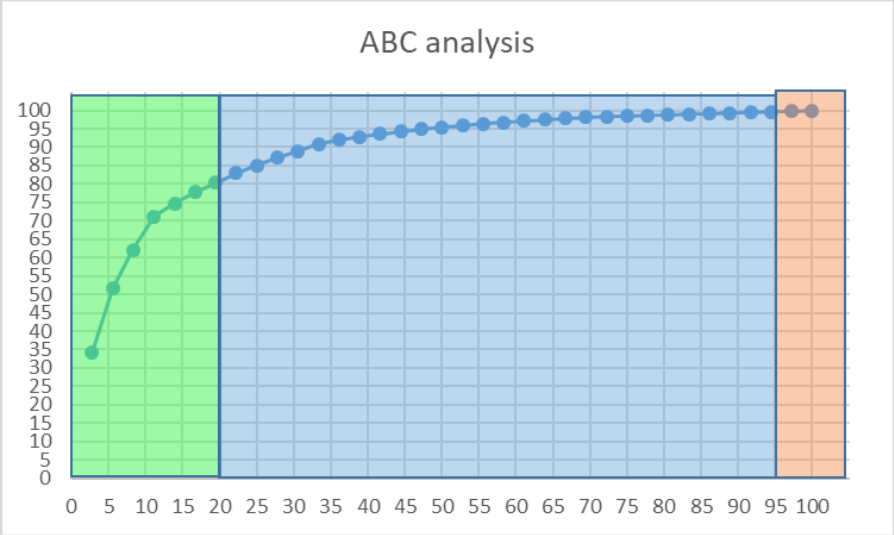


Figure 81: ABC analysis on doors and entrance (period 1)

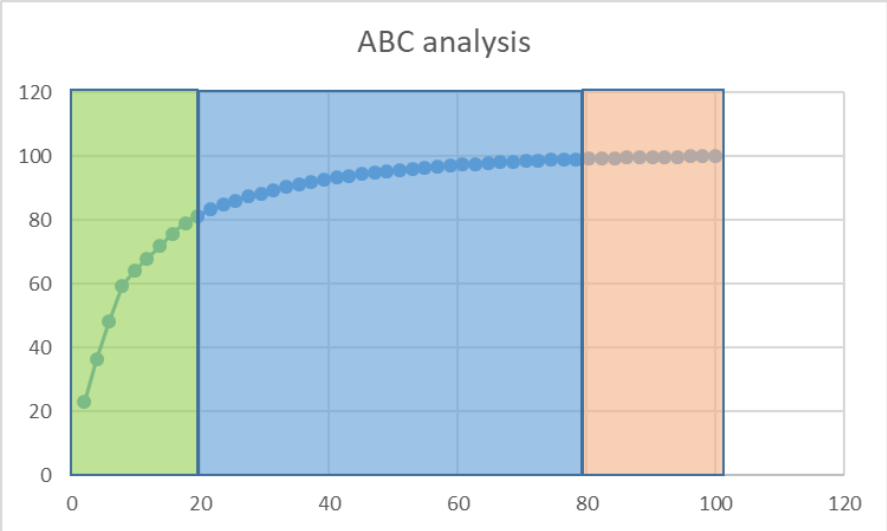


Figure 82:ABC analysis on doors and entrance (period 2)

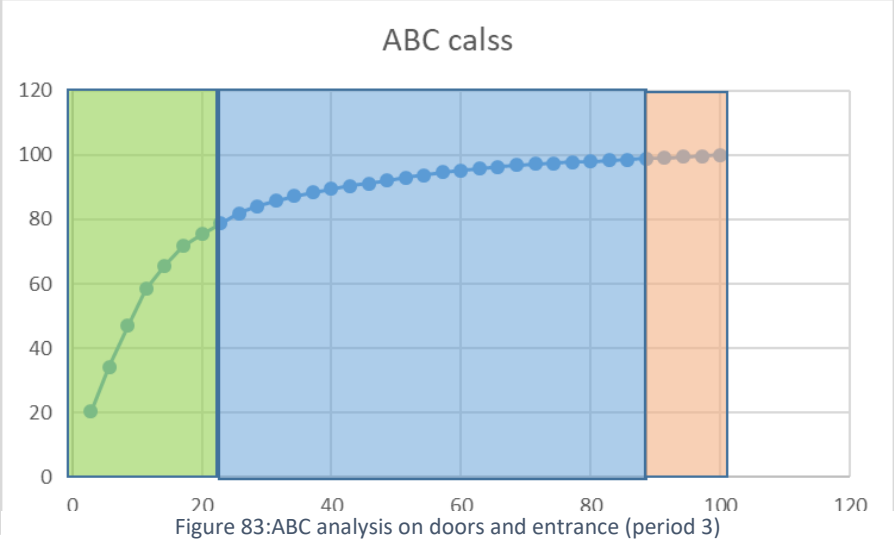


Figure 83:ABC analysis on doors and entrance (period 3)

6.4 ANNEX 4: ABC analysis on control system for different periods

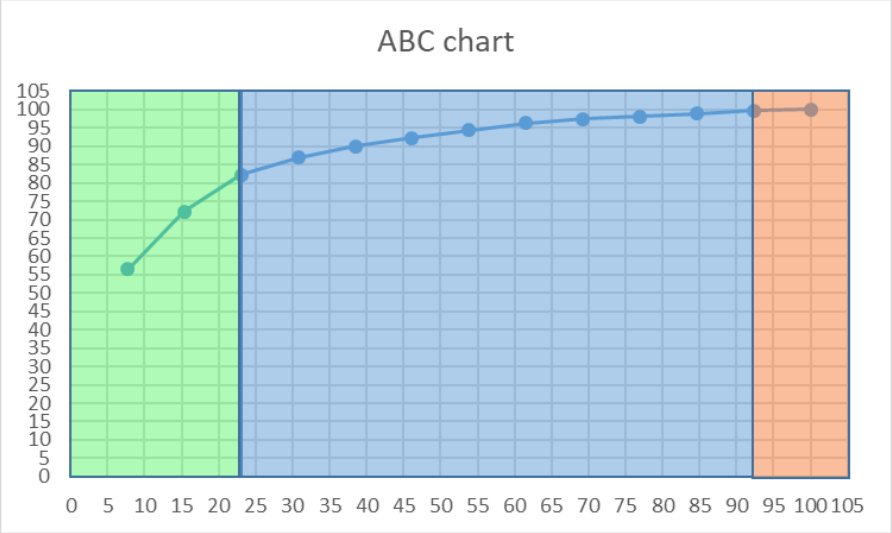


Figure 84:ABC analysis on control system (period 1)

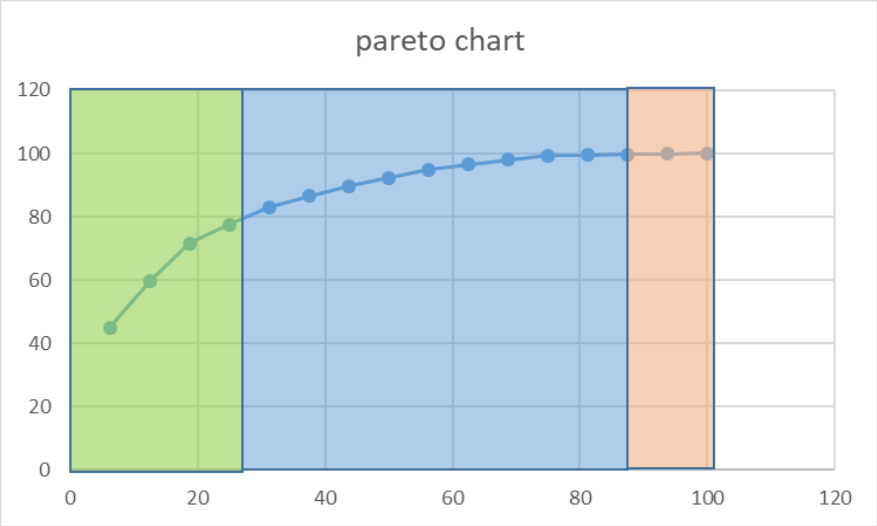


Figure 85:ABC analysis on control system (period 2)

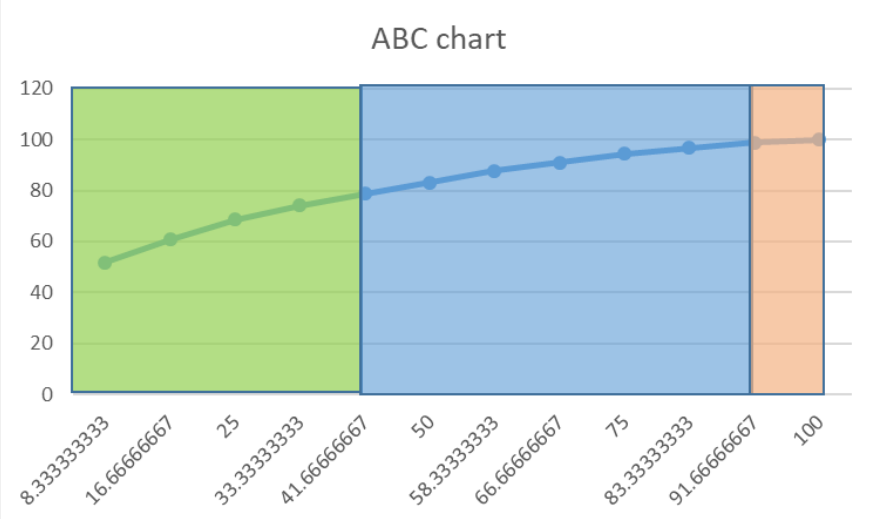


Figure 86:ABC analysis on control system (period 3)

6.5 ANNEX 5: variables in the call-out log

no	Description	no	Description
1	**Dispatch No**	26	**Accepted Date**
2	**Functional Location**	27	**Accepted Time**
3	**Order Status**	28	**Arrived Date**
4	**Site Name**	29	**Arrived Time**
5	**Equipment ID**	30	**Finished Date**
6	**Equipment No**	31	**Finished Time**
7	**KM01 Equip Type Code**	32	**Response Time**
8	**Equipment Type**	33	**Service Time**
9	**Service Type**	34	**Duration Time**
10	**Call Centre**	35	**Failure Desc**
11	**Planner Group No**	36	**Entrapment**
12	**Main Work Centre No**	37	**Person Injured**
13	**Main Work Centre**	38	**Invoice**
14	**Fitter number**	39	**Caller First Name and Caller Last Name**
15	**Fitter Name**	40	**Caller Type**
16	**Contract Number**	41	**Caller Tel**
17	**Position**	42	**Condition on Arrival**
18	**Free service indicator**	43	**Component Code**
19	**Contract Type**	44	**Component Desc**
20	**Customer Number**	45	**Reason Code**
21	**Customer Name**	46	**Reason Desc**
22	**Received Date**	47	**Action Code**
23	**Received Time**	48	**Action Desc**
24	**New Date**	49	**Job Desc**
25	**New Time**		

Table 29: table of variable

6.6 ANNEX 6: ABC analysis on car for different period

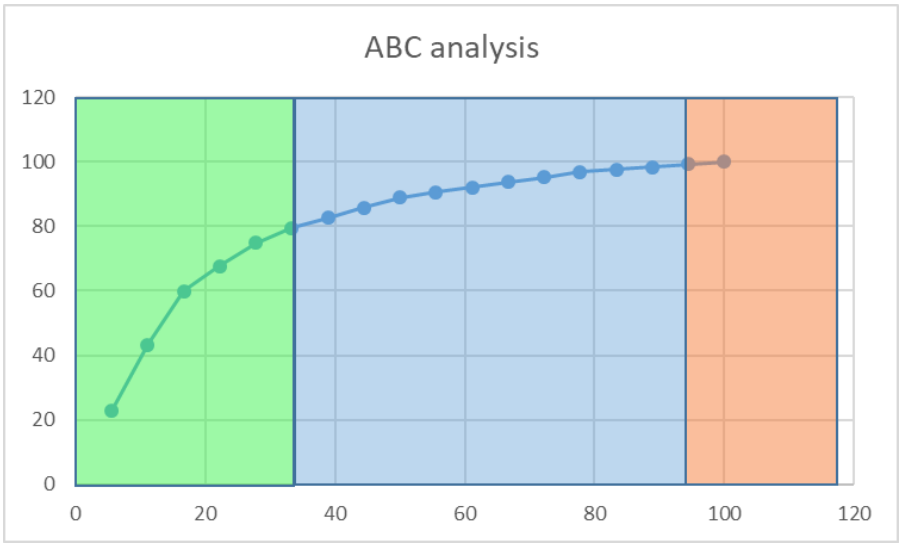


Figure 87:ABC analysis on car (period 1)

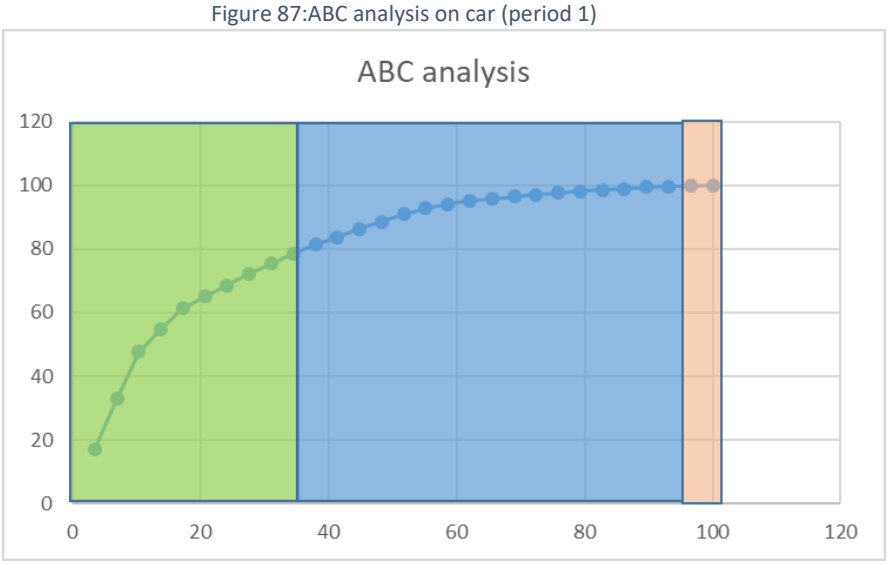


Figure 88:ABC analysis on car (period 2)

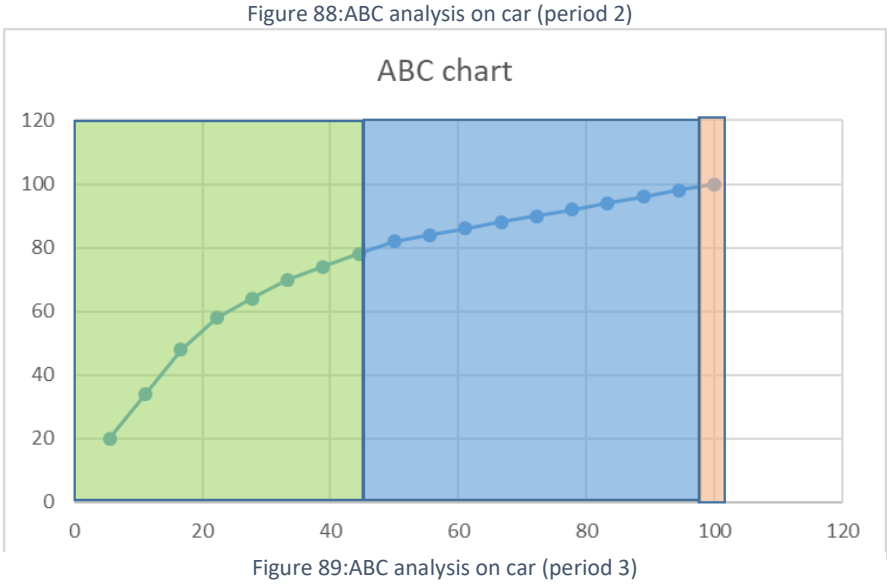
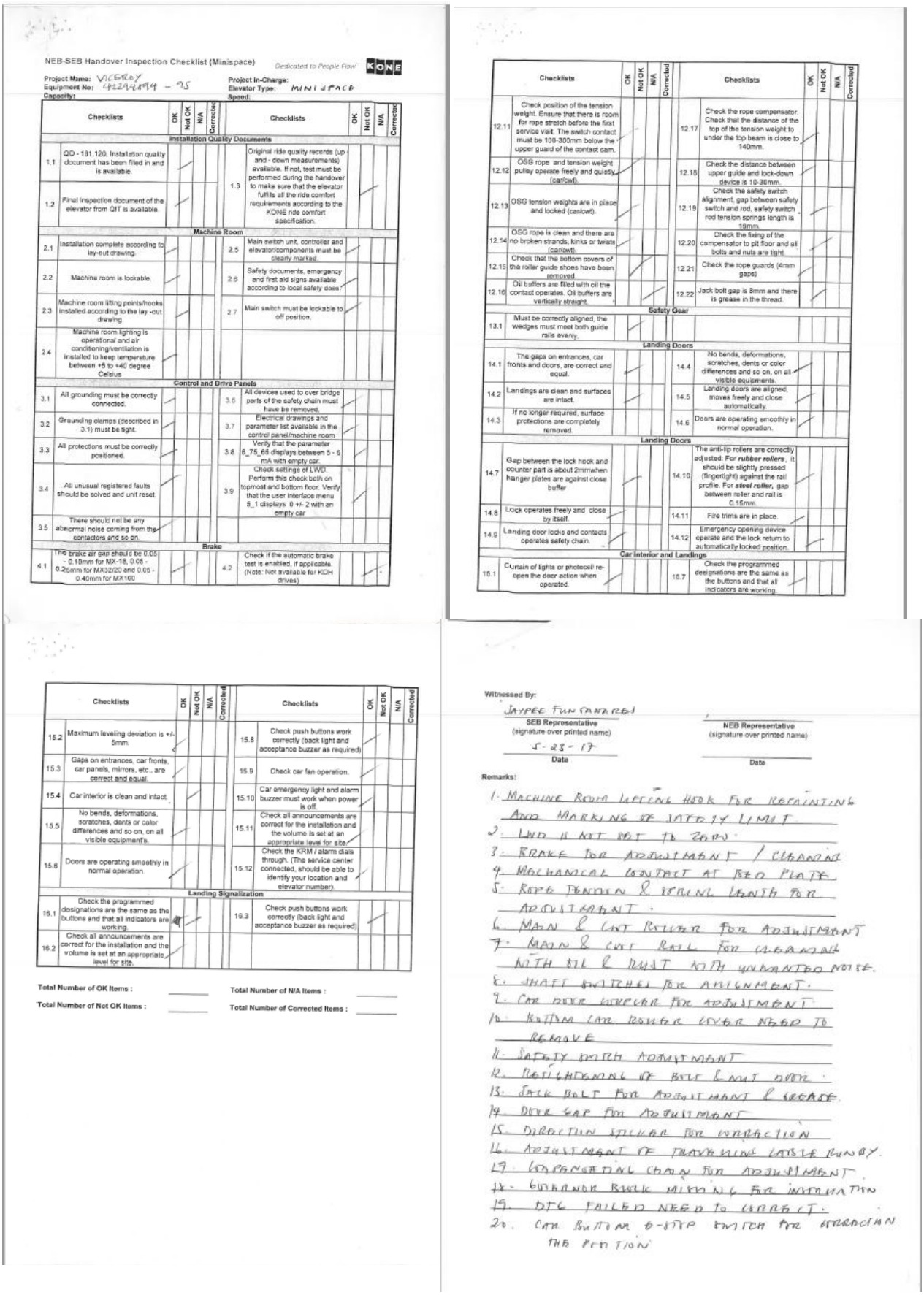


Figure 89:ABC analysis on car (period 3)

6.7 ANNEX 7: Example of NEB-SEB handover punchlist



NEB-SEB Handover Inspection Checklist (Minispace) Dedicated to People Flow

Project Name: VICEROY
Equipment No: 422424894 - 95
Capacity:
Project In-Charge:
Elevator Type: MINISPACE
Speed:

	Checklists	OK	Not OK	N/A	Corrected
Installation Quality Documents					
1.1	QD - 181.120, Installation quality document has been filled in and is available.				
1.2	Final Inspection document of the elevator from QIT is available.				
1.3	Original ride quality records (up and - down measurements) available. If not, test must be performed during the handover to make sure that the elevator fulfills all the ride comfort requirements according to the KONE ride comfort specification.				
Machine Room					
2.1	Installation complete according to lay-out drawing.				
2.2	Machine room is lockable.				
2.3	Machine room lifting points/hooks installed according to the lay -out drawing.				
2.4	Machine room lighting is operational and air conditioning/ventilation is installed to keep temperature between +5 to +40 degree Celsius				
2.5	Main switch unit, controller and elevator/components must be clearly marked.				
2.6	Safety documents, emergency and first aid signs available according to local safety does.				
2.7	Main switch must be lockable to off position.				
Control and Drive Panels					
3.1	All grounding must be correctly connected.				
3.2	Grounding clamps (described in 3.1) must be tight.				
3.3	All protections must be correctly positioned.				
3.4	All unusual registered faults should be solved and unit reset.				
3.5	There should not be any abnormal noise coming from the contactors and so on.				
3.6	All devices used to over bridge parts of the safety chain must have be removed.				
3.7	Electrical drawings and parameter list available in the control panel/machine room				
3.8	Verify that the parameter 6_75_65 displays between 5 - 6 mA with empty car.				
3.9	Check settings of LWD. Perform this check both on topmost and bottom floor. Verify that the user interface menu 5_1 displays 0 +/- 2 with an empty car				
Brake					
4.1	The brake air gap should be 0.05 - 0.10mm for MX-18, 0.05 - 0.25mm for MX32/20 and 0.05 - 0.40mm for MX100				
4.2	Check if the automatic brake test is enabled, if applicable. (Note: Not available for KDH drives)				

	Checklists	OK	Not OK	N/A	Corrected
12.11	Check position of the tension weight. Ensure that there is room for rope stretch before the first service visit. The switch contact must be 100-300mm below the upper guard of the contact cam.				
12.12	OSG rope and tension weight pulley operate freely and quietly (car/cwt).				
12.13	OSG tension weights are in place and locked (car/cwt).				
12.14	OSG rope is clean and there are no broken strands, kinks or twists (car/cwt).				
12.15	Check that the bottom covers of the roller guide shoes have been removed.				
12.16	Oil buffers are filled with oil the contact operates. Oil buffers are vertically straight.				
Safety Gear					
13.1	Must be correctly aligned, the wedges must meet both guide rails evenly.				
Landing Doors					
14.1	The gaps on entrances, car fronts and doors, are correct and equal.				
14.2	Landings are clean and surfaces are intact.				
14.3	If no longer required, surface protections are completely removed.				
Landing Doors					
14.7	Gap between the lock hook and counter part is about 2mmwhen hanger plates are against close buffer				
14.8	Lock operates freely and close by itself.				
14.9	Landing door locks and contacts operates safety chain.				
Car Interior and Landings					
15.1	Curtain of lights or photocell re-open the door action when operated.				

	Checklists	OK	Not OK	N/A	Corrected
12.17	Check the rope compensator. Check that the distance of the top of the tension weight to under the top beam is close to 140mm.				
12.18	Check the distance between upper guide and lock-down device is 10-30mm.				
12.19	Check the safety switch alignment, gap between safety switch and rod, safety switch rod tension springs length is 18mm.				
12.20	Check the fixing of the compensator to pit floor and all bolts and nuts are tight.				
12.21	Check the rope guards (4mm gaps)				
12.22	Jack bolt gap is 8mm and there is grease in the thread.				
Safety Gear					
Landing Doors					
14.4	No bends, deformations, scratches, dents or color differences and so on, on all visible equipments.				
14.5	Landing doors are aligned, moves freely and close automatically.				
14.6	Doors are operating smoothly in normal operation.				
Landing Doors					
14.10	The anti-tip rollers are correctly adjusted: For ***rubber rollers***, it should be slightly pressed (fingertight) against the rail profile. For ***steel roller***, gap between roller and rail is 0.15mm.				
14.11	Fire trims are in place.				
14.12	Emergency opening device operate and the lock return to automatically locked position				
Car Interior and Landings					
15.7	Check the programmed designations are the same as the buttons and that all indicators are working.				

	Checklists	OK	Not OK	N/A	Corrected
15.2	Maximum leveling deviation is +/- 5mm.				
15.3	Gaps on entrances, car fronts, car panels, mirrors, etc., are correct and equal.				
15.4	Car interior is clean and intact.				
15.5	No bends, deformations, scratches, dents or color differences and so on, on all visible equipment's.				
15.6	Doors are operating smoothly in normal operation.				
Landing Signalization					
16.1	Check the programmed designations are the same as the buttons and that all indicators are working.				
16.2	Check all announcements are correct for the installation and the volume is set at an appropriate level for site.				
15.8	Check push buttons work correctly (back light and acceptance buzzer as required)				
15.9	Check car fan operation.				
15.10	Car emergency light and alarm buzzer must work when power is off.				
15.11	Check all announcements are correct for the installation and the volume is set at an appropriate level for site.				
15.12	Check the KRM / alarm dials through. (The service center connected, should be able to identify your location and elevator number).				
16.3	Check push buttons work correctly (back light and acceptance buzzer as required)				

Total Number of OK Items : _____ Total Number of N/A Items : _____

Total Number of Not OK Items : _____ Total Number of Corrected Items : _____

Witnessed By:

JAYPEE FUNDARED
SEB Representative
(signature over printed name)

5-28-17
Date

NEB Representative
(signature over printed name)

Date

Remarks:

1. MACHINE ROOM LIFTING HOOK FOR REPAINTING AND MARKING OF SAFETY LIMIT
2. LWD IS NOT NOT IN ZONE.
3. BRAKE FOR ADJUSTMENT / CLEANING
4. MECHANICAL CONTACT AT BED PLATE
5. ROPE TENSION & SPRING LENGTH FOR ADJUSTMENT.
6. MAIN & CWT ROLLER FOR ADJUSTMENT
7. MAIN & CWT RAIL FOR CLEANING WITH OIL & DUST WITH UNWANTED NOISE.
8. SHAFT SWITCHES FOR ADJUSTMENT.
9. CAR DOOR ROLLER FOR ADJUSTMENT
10. BOTTOM CAR ROLLER COVER NEED TO REMOVE
11. SAFETY SWITCH ADJUSTMENT
12. REALIGNMENT OF BOLT & NUT DOOR.
13. JACK BOLT FOR ADJUSTMENT & GREASE
14. DOOR GAP FOR ADJUSTMENT
15. DIRECTION STICKER FOR CORRECTION
16. ADJUSTMENT OF TRAVELING CABLE RUNBY.
17. COMPENSATING CHAIN FOR ADJUSTMENT
18. GUARD RAIL MISSING FOR INFORMATION
19. DTG FAILED NEED TO CORRECT.
20. CAR BUTTON 6-STOP SWITCH FOR CORRECTION THE POSITION

6.8 ANNEX 8: correlation analysis for all possible cases:

checklist	components	correlation coefficient
The rope should not be dirty and there should be no strands, kink or twist.	doors and entrance	0.772
OSG rope is clean and there are no broken strands, kinks or twists (car/cwt).	doors and entrance	0.746
Brake handle must fully open the brake when operated	machine room equipment	0.685
Ropes are free from rust.	standby	0.683
Check the programme designations are the same as the buttons and that all indicators are working.	doors and entrance	0.645
Check the rope guards (4mm gaps)	drive system	0.611
Check that the safety pin and locking nuts are in place.	drive system	0.574
All grounding must be correctly connected.	doors and entrance	0.573
Check the programme designations are the same as the buttons and that all indicators are working.	doors and entrance	0.564
Check the rope guards (4mm gaps)	doors and entrance	0.562
Roller guide shoes have been adjusted.	drive system	0.554
Check that the bottom covers of the roller guide shoes have been removed.	drive system	0.554
All grounding must be correctly connected.	drive system	0.54
Rope guards are in place. (2:1 roping arrangement)	doors and entrance	0.54
Rope guards are in place. (2:1 roping arrangement)	drive system	0.54
Check that the traction sheave and diverting pulley are aligned horizontally.	drive system	0.54
Ropes (suspension/compensation) are not dry or dirty, and there are no broken strands, kinks or twists	drive system	0.537
There are 0.5mm gaps between the car top isolation pads and the car sling uprights. Isolation pads can slide on the uprights.	drive system	0.537
Counterweight screen is installed correctly.	control system	0.535
Counterweight screen is installed correctly.	machine room equipment	0.535

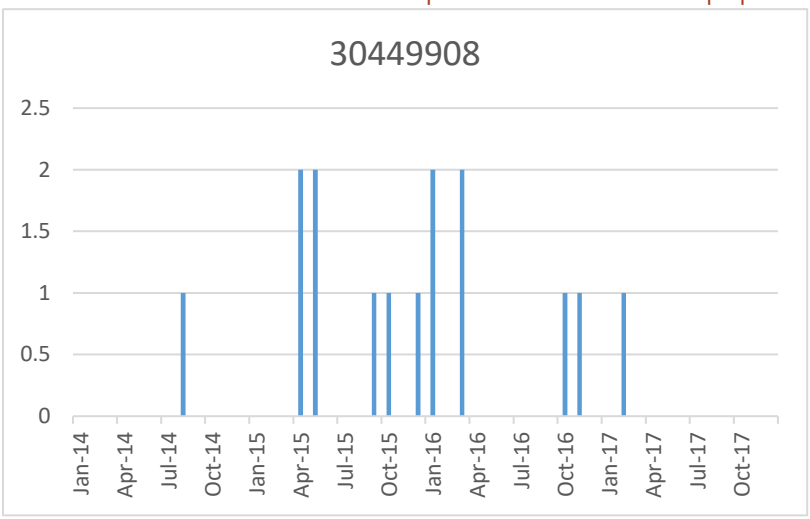
Table 30:strongest correlation values (mini space)

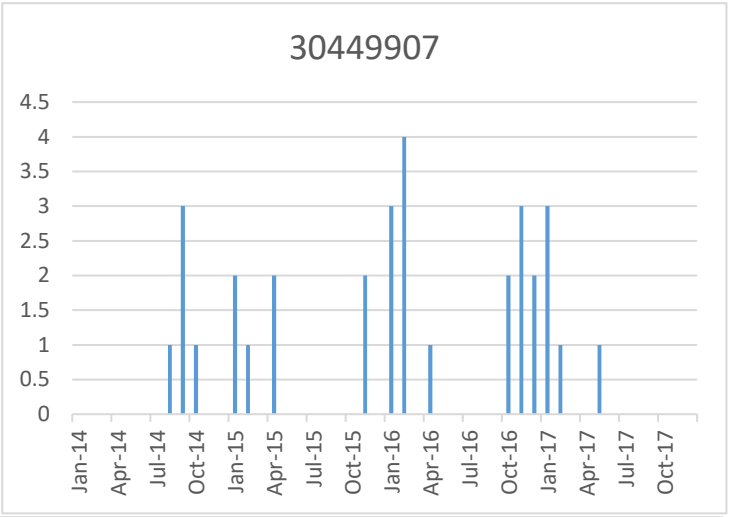
checklist	component	correlation coefficient
Control and electrification panels and cabinets are secure.	car	0.516
Oil buffers are filled with oil the contact operates.	car	0.505
COP is locked to the position.	control system	0.474
Edge trims in counterweight are in place.	control system	0.47
Cable/screenings are correctly earthed and run correctly.	door and entrance	0.466
Cable/screenings are correctly earthed and run correctly.	control system	0.46
Gaps on entrances, car fronts, car panels, mirrors, etc., are correct and equal.	control system	0.452
Doors are operating smoothly in normal operation.	shaft equipment	0.44

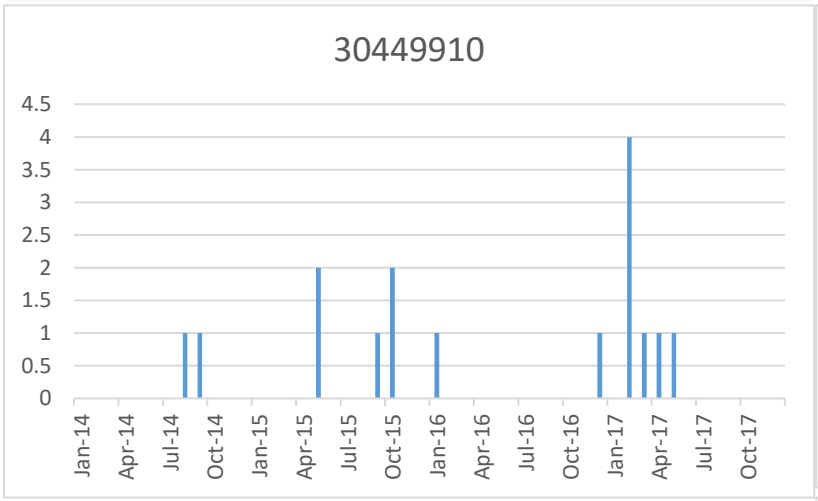
COP is locked to the position.	door and entrance	0.432
Doors are operating smoothly in normal operation.	standby	0.42

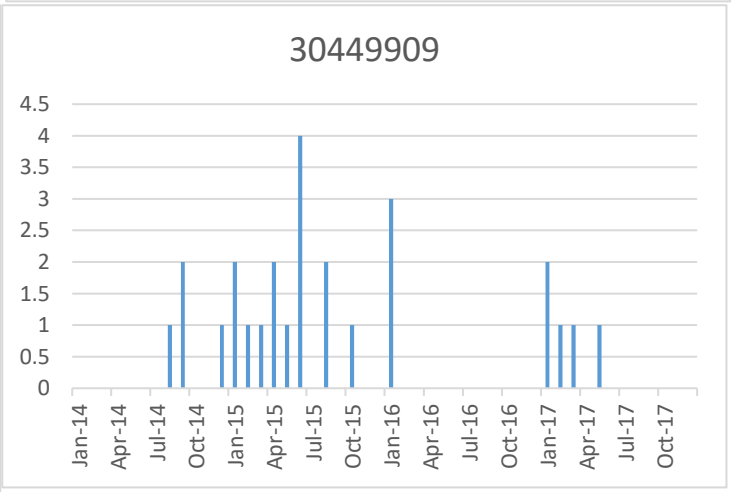
Table 31:strongest correlation values (mono space)

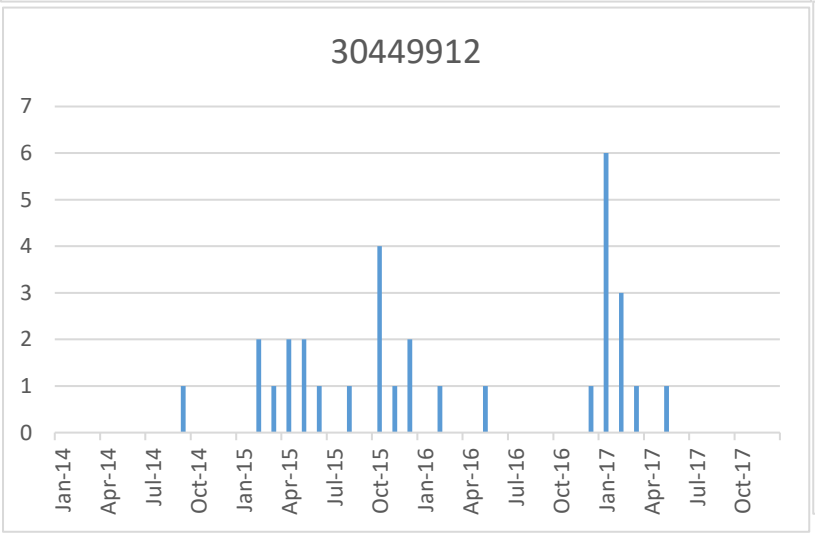
6.9 ANNEX 9: plot for individual equipment

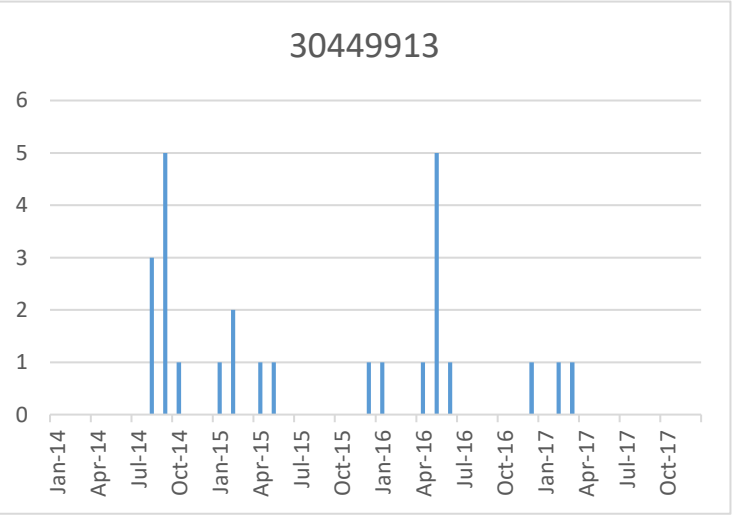


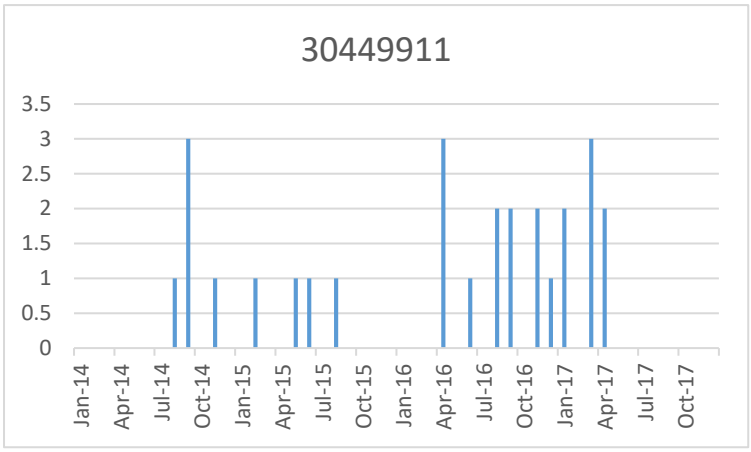


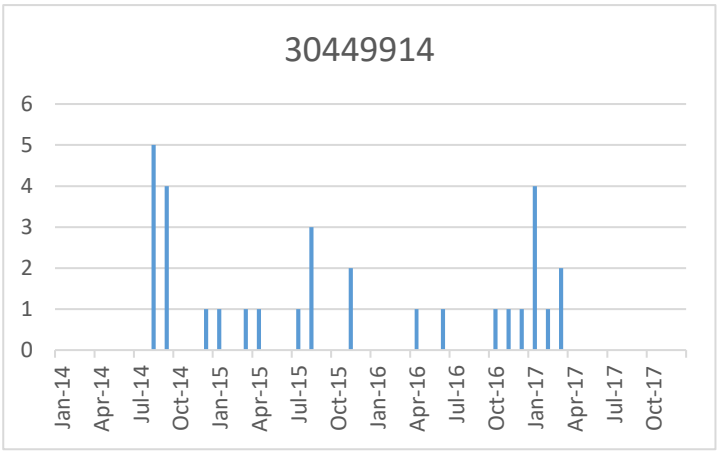




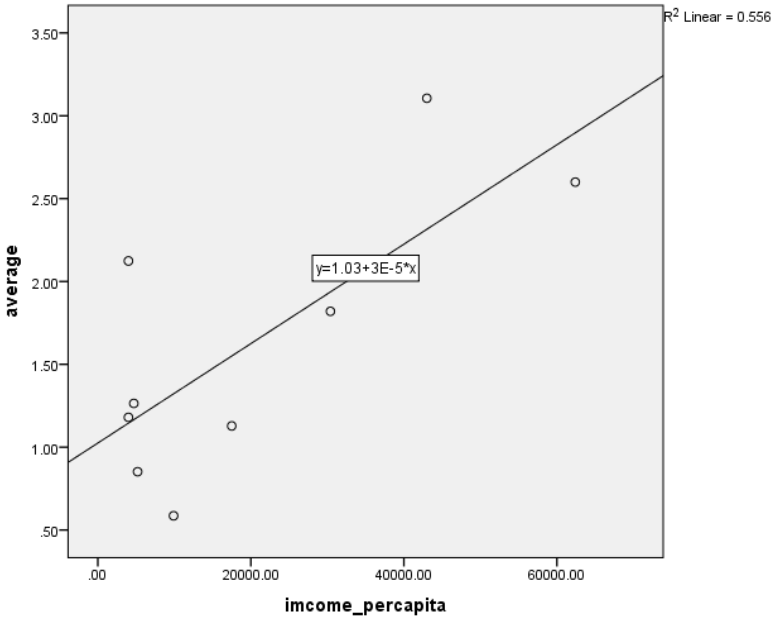


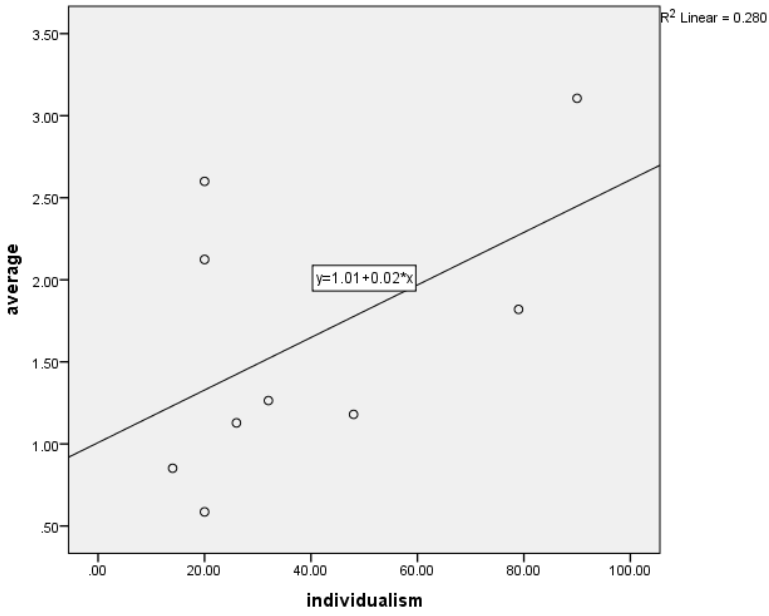


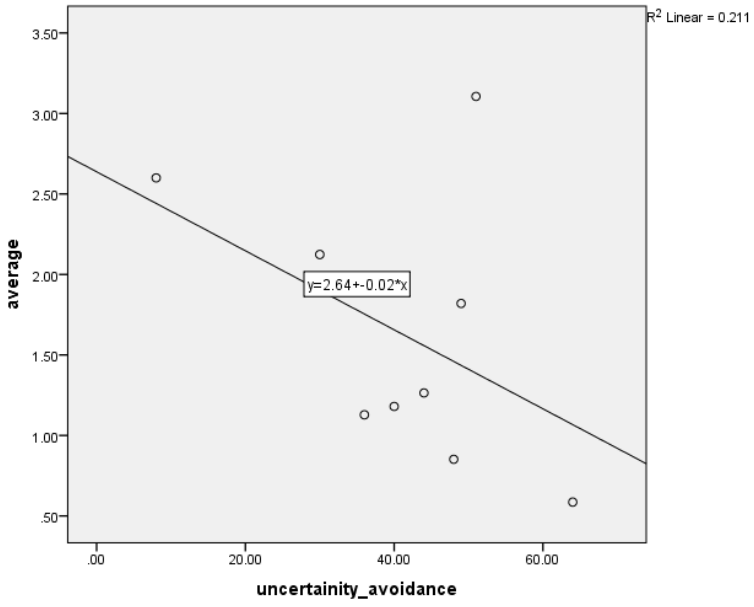


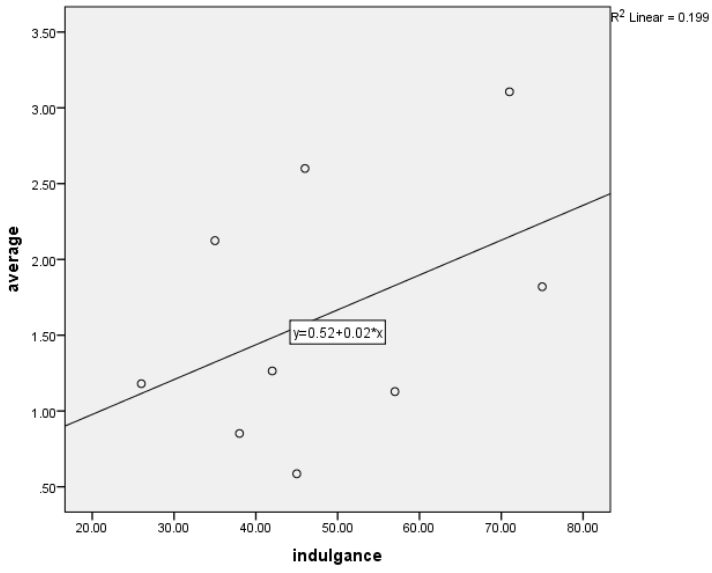


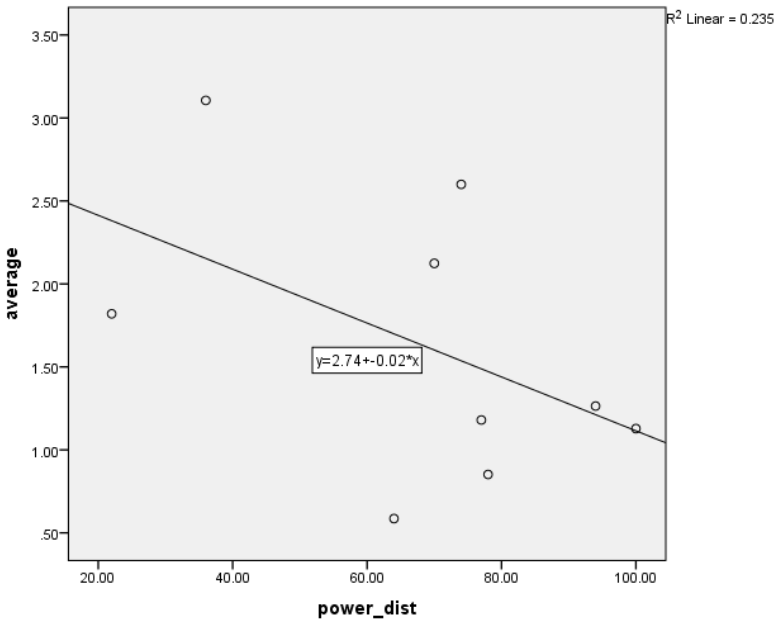
6.10 ANNEX 10: scatter plot for the cultural dimension study

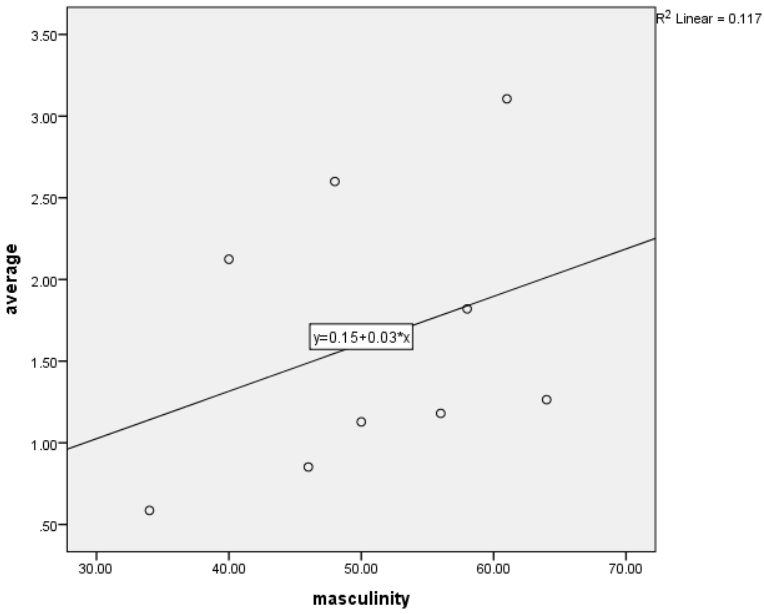


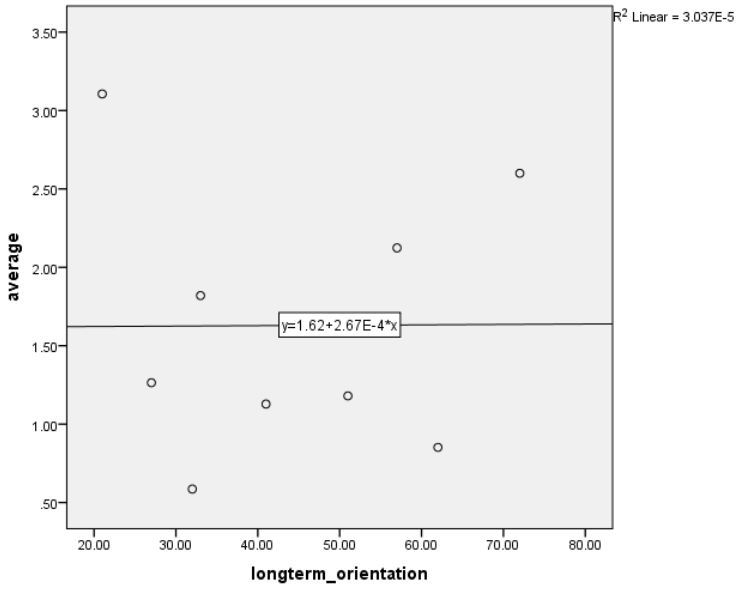







R² Linear = 0.235
y=2.74+-0.02*x
average
power_dist
3.50
3.00
2.50
2.00
1.50
1.00
.50
20.00
40.00
60.00
80.00
100.00


R² Linear = 0.117
y=0.15+0.03*x
average
masculinity
3.50
3.00
2.50
2.00
1.50
1.00
.50
30.00
40.00
50.00
60.00
70.00


R² Linear = 3.037E-5
y=1.62+2.67E-4*x
average
longterm_orientation
3.50
3.00
2.50
2.00
1.50
1.00
.50
20.00
30.00
40.00
50.00
60.00
70.00
80.00

6.11 ANNEX 11: correlation variables

Mono space.

Doors and entrance

1	11.1	The gaps on entrances, car fronts and doors, are correct and equal.	***.283***

equipment	status	calls relevant to component
1	1	0
2	1	0
3	1	1
4	4	1
8	1	4
9	1	0
11	1	0
12	4	0
13	1	1
14	4	6
15	4	3
20	4	1
21	4	0
22	4	1
23	4	4
24	4	3
25	1	0
26	1	0
27	1	0
35	1	0
36	1	2
37	4	0
38	4	0
39	4	0
42	4	0
43	4	0
44	4	0
45	4	0
46	4	6
47	4	3
48	1	0
49	1	0
50	4	0
51	1	0
52	1	0

Table 32: correlation variable

6.12 ANNEX 12: frequency of calls based on equipment

Equipment number	Frequency
30067081	3
30067085	3
30067086	3
30071507	1
30073732	1
30081667	1
30081668	1
30084222	2
30084223	7
30084224	1
30084653	1
30084655	2
30084657	3
30084659	1
30084661	3
30084664	1
30084668	1
30086882	1
30091455	1
30091456	4
30091501	2
30092016	2
30092112	1
30092268	1
30093842	1
30101045	1
30101047	3
30101134	1
30112879	2
30112880	3
30112891	7
30112892	5
30114129	1
30114130	2
30117918	4
30121046	13
30122738	1
30122739	1
30125085	2
30125086	2
30125087	3
30125088	1
30125091	1
30125092	1
30125093	1
30125094	4
30125095	2
30125103	3
30125104	2
30128386	1
30128555	3
30128701	2
30128702	2
30128703	1
30128704	6
30128705	2
30139702	1
30140877	4
30140879	1
30140880	3
30140882	2
30140883	1
30142157	2
30144910	1
30147451	2
30154784	8
30154785	5
30154786	8
30158653	9
30161766	2
30164501	4
30164502	1
30166201	2
30166202	1
30166580	2
30168466	7
30168467	1
30168468	5
30168469	4
30170163	2
30170165	1
30174719	2
30176196	1
30177815	1
30181513	3
30181514	2
30181515	2
30181517	1
30181519	2
30181521	2
30181524	4
30181526	2
30181527	1
30181530	1
30181531	1
30181532	2
30181533	2
30181534	1
30181535	2
30181536	4
30181537	1
30181538	1
30181540	1
30181574	1
30181575	3
30181576	8
30181577	5
30181579	2
30181580	2
30181582	1
30181587	1
30181588	1
30181589	3
30181590	4
30181591	2
30181592	2
30181594	1
30181595	6
30181596	6
30181598	3
30181609	1
30181616	1
30181648	1
30181649	3

30181650	1
30181652	1
30181653	1
30181654	5
30181656	3
30181657	1
30181658	3
30181660	2
30181666	5
30181667	1
30181682	10
30181683	4
30181684	2
30181685	4
30181686	1
30181687	1
30181692	1
30181693	1
30181694	2
30181696	4
30181707	2
30181708	2
30181709	2
30181710	2
30181714	1
30181717	1
30181720	3
30181726	1
30181727	2
30181728	4
30181729	3
30181736	2
30181737	2
30181738	1
30181739	1
30181741	1
30181744	3
30181753	1
30181754	2
30181756	1
30181758	3
30181759	5
30181760	7
30181783	1
30181784	2
30181788	1
30181789	1
30181790	1
30181791	3
30181794	1
30181795	1
30181810	1
30181811	5
30181812	7
30181813	10
30181814	7
30181815	2
30181816	1
30181820	4
30181821	14
30181822	15
30181823	6
30181824	4
30181825	2
30181826	9
30181827	1
30181828	3
30181829	3
30181830	4
30181831	3
30181832	3
30181833	2
30181835	6
30181836	1
30181837	1
30181838	1
30181841	1
30181846	2
30181848	2
30181849	1
30181857	4
30181858	2
30181860	1
30181861	3
30181862	2
30181863	1
30181865	3
30181866	3
30181868	1
30181869	1
30181870	2
30181876	10
30181877	5
30181878	9
30181881	4
30181885	2
30181892	3
30181893	4
30181894	2
30181895	2
30181903	2
30181904	2
30181917	3
30184326	1
30184328	2
30184330	2
30184331	1
30184335	1
30184337	3
30184338	4
30184339	3
30184340	1
30184341	1
30184342	1
30184345	1
30184348	1
30184352	3
30199167	1
30199204	2
30205035	3
30205624	1
30206136	2
30210332	2
30210336	2
30211709	1
30214731	2
30214732	1
30214734	2
30217296	3
30217826	1
30224312	1
30224313	1

30224677	2
30224687	1
30224770	1
30224800	3
30226592	1
30230875	1
30232458	2
30239430	2
30242054	3
30242055	2
30242056	2
30244102	1
30245096	3
30245097	1
30248236	2
30248237	2
30248306	1
30248329	1
30252743	3
30252744	2
30253049	1
30254266	1
30254288	1
30254290	1
30254293	1
30254295	1
30254423	3
30254425	2
30254436	2
30254437	4
30254438	2
30254443	1
30254444	2
30254445	2
30260279	2
30260402	2
30267369	1
30276122	1
30276193	2
30276194	5
30276195	4
30276197	1
30276200	2
30279465	2
30282505	4
30282506	4
30282507	2
30283450	3
30283451	4
30283454	4
30289409	1
30289463	1
30294200	1
30294202	1
30299638	1
30301014	3
30301015	1
30301021	5
30301022	1
30301801	6
30301802	4
30301803	2
30301804	13
30303771	1
30309469	1
30309916	1
30313958	1
30313961	3
30313962	2
30319779	3
30319780	3
30319781	5
30319782	3
30319783	2
30319784	24
30319785	1
30319787	3
30319788	5
30319789	10
30319790	1
30319927	1
30319963	8
30319964	5
30320764	3
30320766	2
30326883	1
30327361	1
30327727	1
30327728	3
30327729	1
30327730	1
30327732	2
30327733	1
30327734	1
30327839	2
30327840	5
30327841	4
30327845	13
30327928	1
30327929	3
30327930	2
30327934	4
30343769	1
30343796	1
30349896	1
30349897	2
30349898	3
30349899	2
30349900	4
30350629	2
30350630	2
30350944	1
30354855	1
30354856	2
30354857	2
30355461	1
30355884	3
30356400	1
30359154	2
30359168	1
30362930	2
30370064	7
30370065	3
30371113	1
30371249	1
30377196	1
30377206	2
30377227	1
30378747	1
30378751	1
30379211	1
30390843	1

30391002	1
30391004	2
30397480	1
30397525	3
30401802	1
30401806	7
30401807	1
30401808	4
30401810	1
30401814	1
30401815	3
30401816	2
30412093	1
30412678	4
30412690	1
30415214	1
30415215	2
30415216	2
30415219	4
30415220	6
30415221	2
30415222	1
30415223	1
30415224	1
30420203	8
30420204	3
30420206	1
30420208	1
30420209	4
30420210	3
30421292	1
30424051	1
30424052	1
30424053	1
30424055	1
30426173	1
30428640	4
30428641	5
30428642	2
30429014	1
30429016	1
30435497	14
30435498	2
30435499	1
30435500	1
30435752	2
30435841	1
30435842	1
30435843	1
30435845	2
30435846	4
30435847	4
30435848	4
30435849	5
30435851	1
30447878	1
30449907	10
30449908	2
30449909	5
30449910	6
30449911	10
30449912	11
30449913	3
30449914	9
30456869	1
30456870	1
30463166	3
30464691	4
30464692	2
30466985	2
30471354	1
30471485	1
30478435	1
30487328	2
30487329	2
30489654	1
30491696	2
30491697	1
30491702	1
30491703	1
30491713	1
30491715	2
30496692	1
30496695	2
30507741	1
30511873	1
30511875	1
30511876	1
30511877	1
30511878	1
30511879	1
30517995	1
30517996	1
30522118	1
30522127	1
30522128	1
30522706	2
30522707	1
30522708	1
30522710	1
30522711	1
30523847	1
30525689	4
30525690	1
30525691	2
30526153	1
30531343	1
30533989	1
30533991	1
30533992	1
30541174	2
30543284	3
30543285	8
30543286	1
30543287	2
30552020	1
30552662	1
30553573	2
30553574	1
30558282	2
30561070	1
30561582	1
30569535	1
30569539	3
30573278	1
30573279	1
30573280	1
30573468	2
30573923	1
30574581	3
30574582	1
30575996	3

30576350	1
30579308	4
30579767	1
30579770	1
30586640	1
30588058	3
30588059	1
30588064	4
30588174	1
30588253	1
30592426	8
30592427	6
30592428	7
30592429	6
30594160	3
30594161	3
30596879	2
42169623	2
42170703	1
42211041	2

42211342	4
42230963	4
42230964	6
42231284	1
42233085	2
42254713	1
42286837	1
42291961	1
42300436	3
42317782	1
42320804	5
42325211	3
42336011	7
42338143	3
42338144	4
42349248	1
42349251	1
42349257	1
42349260	1
42350668	1

42362616	1
42404381	1
42404383	1
42404393	1
42412934	1
42413650	1
42415984	2
42427864	2
42430239	1
42431109	2
42454900	1
42475639	1
42477420	2
42483112	1
42545040	6
42579787	1
42613459	1
42895864	1
Grand Total	**1428**

Table 33:frequency of calls based on equipment

6.13 ANNEX 13: frequency of calls based on project

Project name	Frequency
-	3
1 PARK LANE AND 2 PARK LANE	1
186 WILSON BUILDING	6
3 CYBERPOD CENTRIS - SOUTH TOWER	56
4 STOREY HOTEL AND COMMERCIAL	1
53 BENITEZ BY ROCKWELL	27
8 ADRIATICO	12
A&N HOLDINGS CORP. BUILDING	1
ABS-CBN	6
ABS-CBN BROADCASTING CORPORATION	10
ACE PENZIONNED	2
AITP Retail Strip	2
ALA MERCEDEZ- 7 STOREY BUILDING	1
ALL SONS INN	2
ALL SONS INN - ANNEX BUILDING	4
ALLEGRO MICROSYSTEMS PHILIPPINES,	3
ALPHALAND MAKATI PLACE	3
ALTO PENSION HOUSE	1
AMAIA STEPS NOVA - PHASE 1	3
AMBER PLACE	2
AMKOR TECHNOLOGY PHILIPPINES INC.	2
AMVEL MANSIONS - TOWER 1 & 2	7
AMVEL MANSIONS TOWER 3	2
ANDREA NORTH SKYBREEZE SHOWROOM	1
ANGELES MALL	3
ANUVA TANDEM -1 BUILDING	4
ARANETA CENTER	1
ASIA PREMIER RESIDENCES	4
ASIAN DEVELOPMENT BANK	1

ASSUMPTION COLLEGE	2
AVIDA TOWER	10
AVON PLAZA BUILDING	1
AZOTEA DE BEL AIR CONDOMINIUM	4
B. BLASINO 4 STOREY	2
B.I.G HOTEL	4
BACOOR CITY HALL	1
BAGUIO 5 STOREY HOTEL	2
BAGUIO GENERAL HOSPITAL AND	1
BENGAR INDUSTRIAL	1
BGC-ESB NORTWEST PROJECT	23
BIGFOOT BUILDING	4
BINAN PEOPLE CENTER HUB	3
BJS ANNEX BUILDING	1
BOCOBO PROJECT (FESTIVAL WALK)	2
BPI CONDOMINIUM	6
BPI HEAD OFFICE BLDG.	21
BRCC BLDG.	6
BULWAGANG KARUNUNGAN (BPK) BUILDING	1
BUREAU OF IMMIGRATION	4
CAMELOT BUILDING	3
CEBU NORMAL UNIVERSITY EXT. BLDG.	2
CEBU R HOTEL	1
Cebu R-HOTEL	2
CEBUVIEW TOURIST INN	1
CELADON PARK MANILA PHASE 2	10
CELADON PARK PHASE 1	1
CHANNATHON BED AND BREAKFAST	1
CITY GARDEN SUITES	2
CLARK INTERNATIONAL AIRPORT	2
CO HUN SENG BUILDING	1
CONVERGYS BUILDING	17
CREW CARE BUILDING	7
CROSSROADS	1
DA VINCI CONDOMINIUM	1
DEP ED CEBU CITY SCHOOL DIVISION	1
DONA ARCHANGELA BUILDING	1
DTC BUILDING (ABS-CBN)	1
EAGLENEST CONDOMINIUM	2
EAST OFFICES BUILDING	1
EDADES TOWER AND GARDEN VILLAS	10
EISENHOWER CONDOMINIUM	4
EL-SHADDAI SHRINE	1
EQUITABLE BANK TOWER CONDOMINIUM	21
E-RESIDENCE	1
E-SQUARE MALL	1
ETON CENTRIS BPO 2	1
ETON TOWER	20
EVERGREEN CHAPELS PASIG	1
EVERY NATION LEADERSHIP INSTITUTE,	6
EVIA GLOBAL BUILDING B	8
EXPRESS - INN MABOLO	4
FAIR SHIPPING CORPORATION	1
FAMILY CARE ANNEX BUILDING	2
FAMILY CARE HOSPITAL	1
FASTECH PROPERTIES, INC.	2
FEU SCIENCE & NURSING	6
FEU TEHCNOLOGY MAIN AND ANNEX	14
FILINVEST CYBERZONE BUILDING EDSA	13
FILINVEST LAND SIGNET BUILDING	1
FORTUNE BUILDING 1	1
GALLERIA LAGMAN BUILDING	1
GARDEN SQUARE	1
GMA ANNEX BUILDING	2
GOLDEN FORTUNE SEAFOOD RESTAURANT	1
GOODWILL BUILDING	1
GRAND CONVENTION CENTER CEBU	1
GREEN SUN HOTEL	1
GTK BUILDING	1
GULLAS DORMITORY	3

GV PLACE	2
HAMILO COAST BEACH CLUB	2
HB COMMUNICATION CENTER	1
HEALTHSERV BUILDING	2
HEALTHSERV MEDICAL ARTS BLDG	7
HOLIDAY INN GALLERIA MANILA	33
HOME FOR THE AGED	4
HOPE CHRISTIAN HIGH SCHOOL	1
HORIZON CITY FLAT CONDOMINIUM	2
HOTEL 101	14
HQ14 - ALBERT	2
HQ14 - ALFONSO	1
HQ14 - PALMA	1
HQ14-BURGOS	3
IHUB 3 & 4 (VECTOR 1 & 2)	13
J.P. RIZAL BUILDING (CROSSROADS)	3
JMS WAREHOUSE	1
KAPITAN PEPE BUILDING	1
LANAO DEL NORTE PROVINCIAL CAPITOL	1
LAUDERDALE BUILDING	1
LAURA VICUNA FOUNDATION INC. OFFICE	5
LEE TOWER CONDOMINIUM	6
LIPA MEDICAL CENTER	3
LKG TOWER CONDOMINIUM	9
LOPEZ TOWER AND MUSEUM	8
LOT 8 BUILDING	2
LOTUS GARDEN HOTEL	3
LT CENTER BUILDING	2
MABOLO GARDEN FLATS	3
MACTAN PENSION HOUSE	1
MALATE CROWN PLAZA	9
MANILA CSC 34TH STREET PROJECT	4
MANILA WATER SEWARAGE SYSTEM	3
MARINERS COURT	5
MARKET-MARKET MALL	9
MARYCHILES GENERAL HOSPITAL	1
MATEO'S GENERAL HOSPITAL	1
MAXWELL HOTEL	5
MAYFAIR TOWER	4
MFI BUILDING	1
MING KEE SEAFOOD RESTAURANT	1
MIRRIAM COLLEGE	1
MIVESA GARDEN RESIDENCES	2
MONET @ BRITANNY BAY	3
NAC TOWER BUILDING	14
NATIONAL BUREAU OF INVESTIGATION	9
NATIONAL CHILDREN'S HOSPITAL	2
NESTLE PHILIPPINES - SOCIAL BLOCK	1
NEW FARMERS PLAZA, INC.	9
New P & J Office Building	2
NEWPORT BELMONT HOTEL	6
NORTH BELTON COMMUNITIES	4
NORTH BELTON COMMUNITIES -	1
NORTH BELTON COMMUNITIES-PHASE 2	4
NORTH CAMBRIDGE 3 - WHARTON BUILDING	1
NOVOTEL ARANETA	20
NUTRIASIA TOWER	5
OAS BALOGOS BUILDING	3
ONE ARCHERS PLACE	3
ONE ARCHERS PLACE TOWER 2	7
ONE GATEWAY PLACE	3
ONE ROCKWELL	11
ONE TAGAYTAY PLACE	12
ORACLE RESIDENCES	2
OSRI BUILDING PROJECT	3
PAG-IBIG FUND -WTCI CONDOMINIUM CORPORA	5
PAMPANGA PREMIER MEDICAL CENTER	1
PERSIMMON PHASE 2	5

PGH - CENTRAL BLOCK BUILDING	8
PHILIPPINE BANK OF COMMUNICATION	1
PHILIPPINE GENERAL HOSPITAL	2
PHILIPPINE VETARANS BANK BUILDING	1
PICASSO SUITES	4
PONGOS HOTEL	1
PRIMAVERA RESIDENCES	1
PRIVATO RESIDENTIAL	10
PROPOSED 3 & 4 CYBERPOD CENTRIS	20
PROPOSED ALPHALAND MAKATI TOWER	60
PROPOSED BUSINESS HOTEL	1
PROPOSED EATON-COOPER INDUSTRIES	3
PROPOSED PENSIONNE HOUSE	2
R.A BUILDING-NUEVA ECIJA	1
RAFFLES SUITES & RESIDENCES AND	19
RAMON COJUANGCO BUILDING	8
RECONSTRUCTION & RESTORATION	5
REDD MANOR HOTEL	1
REDEMTORIS MATTER BUILDING	2
RENAISSANCE 2000 CONDOMINIUM	31
RH1 MIRIAM COLLEGE	3
RIVIERA FILIPINA, INC.	1
ROBINSONS CYBERGATE CENTER	40
ROCKWELL - MERALCO JOINT VENTURE	22
RS MAKATI	3
RTV 7 STOREY DORMITEL	2
RUSTANS CEBU	2
RUSTANS GATEWAY	1
SACRED HEART SCHOOL OF THE	2
SAINT ANDREWS SCHOOL	2
SALCEDO SQUARE	2
SAN MIGUEL PROPERTIES CENTRE	11
SCANDIA SUITES 2	1
SEVENTY SEVEN BUILDING	2
SM ONE ECOM CENTER	12
SONRIA CONDOMINIUM	1
SPLICE ASIA BUILDING	1
STA. MONICA HALL	1
STANDFORD SUITES	4
STAR MALL SHAW	1
STARMALL MOLINO	2
STERLING BANK CORPORATION CENTER	1
STI FAIRVIEW BUILDING	1
STMICROELECTRONICS, INC.	1
SUNTRUST SHANATA	1
SURESHOT SPORTSVILLE	4
TANY FOUNDATION BUILDING	1
TESDA ADMINISTRATION BUILDING	6
THE BEACON PHASE 2	25
THE BEACON PHASE D1	17
THE EXCHANGE CENTER	21
THE GROVE BY ROCKWELL	11
THE GROVE C & D TOWER	24
THE GROVE E & F TOWER	10
THE ICON RESIDENCES	13
THE MEDICAL CITY CLARK	1
THE PALMS COUNTRY CLUB	15
THE RESIDENCES AT GREENBELT	4
THE RITZ TOWERS	5
THE ROCKWELL BUSINESS CENTER	3
THE WOODRIDGE	5
TOBIAS RESIDENCE	1
TRES PALMAS BUILDING	1
TRIBECA TOWER 4	13
TRIBECA TOWER 5	1
TSPI DEVELOPMENT CORPORATION	3
TUNE HOTEL - ANGELES	1
TUNE HOTEL - CEBU	5
TUNE HOTEL - ERMITA MANILA	6

TUNE HOTEL - MAKATI	4
TUNE HOTEL - ORTIGAS	16
TUNE HOTEL - QUEZON CITY	2
TUNE HOTEL CAGAYAN DE ORO	1
Twin Towers Condominium	1
TWO LAFAYETTE SQUARE CONDOMINIUM	17
TWO SAN PARQ BUILDING	2
ULAC EXISTING BUILDING	3
ULAC EXPANSION BUILDING	10
UNION BANK PLAZA	23
UNIVERSITY OF BATANGAS	2
UP MANILA - COLLEGE OF DENTISTRY	1
UPTOWN PLACE (BONIFACIO UPTOWNMALL)	1
URBAN DECA HOMES, MUNTINLUPA	2
UST CENTRAL LIBRARY	4
VALDEZ STREET 5 STOREY HOTEL	1
VERBENA CAPITOL SITE	2
VETAF'S SUPERSTORE	2
VIRRO MYRO BUILDING	1
VISAYAS COLUMBIAN FOUNDATION INC.	3
V-PROM BUILDING	1
W CITY CENTER	3
W.H. TAFT RESIDENCES	7
WACK-WACK TWIN TOWERS CONDOMINIUM	28
WIL TOWER A	2
WIL TOWER MALL	2
WILLY CHAN BUILDING	1
WILSON BUILDING	1
WINDLAND RESIDENCES	4
YET CONDOMINIUM BUILDING	1
ZEN TOWER PHASE 2	5
Grand Total	**1428**

Table 34:frequency of calls based on project

6.14 ANNEX 14: frequency of calls based on components

Component	Frequency
CAR	6
CAR - Car interior - Lighting	4
CAR - Car interior - Ventilation	2
CAR - Car panels & roof	10
CAR - Car positioning devices	1
CAR - Car positioning devices - Car top encoder	4
CAR - Car positioning devices - Levelling vanes & tapes	26
CAR - Car positioning devices - Positioning switches / readers	29
CAR - Car top inspection station	2
CAR - Car wiring	9
CAR - PC Board (in car connection box)	21
CAR - Retiring cam & magnet	2
CAR SLING - Diverting pulley - Diverting pulley	1
CAR SLING - Load weighing devices	4
CAR SLING - Roller guide	2
CAR SLING - Safety gear	1
CAR SLING - Safety gear - Safety gear mechanical	1
CAR SLING - Sliding guide	2
CONTROL SYSTEM	13
CONTROL SYSTEM - Contactor	42

CONTROL SYSTEM - Control system	152
CONTROL SYSTEM - Control system module	6
CONTROL SYSTEM - Control system software	2
CONTROL SYSTEM - Control system wiring	6
CONTROL SYSTEM - Fuse	8
CONTROL SYSTEM - Other electrical component	3
CONTROL SYSTEM - Other electrical component - Circuit breaker	1
CONTROL SYSTEM - Other electrical component - Motor overload	2
CONTROL SYSTEM - Other electrical component - Power supply	5
CONTROL SYSTEM - PC Board	27
CONTROL SYSTEM - Relay	2
COUNTERWEIGHT - Guide shoe	1
COUNTERWEIGHT - Guide shoe - Roller guide	1
COUNTERWEIGHT - Guide shoe - Sliding guide	17
COUNTERWEIGHT - Pulley - Bearing	6
DOORS AND ENTRANCES	11
DOORS AND ENTRANCES - Car Door	1
DOORS AND ENTRANCES - Car Door - Car door	21
DOORS AND ENTRANCES - Car Door - Car door operator	1
DOORS AND ENTRANCES - Car Door - Car door operator - Car door operator	1
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator board	3
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator mechanical component	4
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator motor	1
DOORS AND ENTRANCES - Car Door - Car door safety devices - Closing force limiter	1
DOORS AND ENTRANCES - Car Door - Car door safety devices - Curtain of light	15
DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge	1
DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge linkage	2
DOORS AND ENTRANCES - Car Door - Door contact	54
DOORS AND ENTRANCES - Car Door - Door mechanical lock	13
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill	2
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Coupler	18
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Guide shoe	4
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Hanger roller	3
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Panel	1
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Syncronization device	5
DOORS AND ENTRANCES - Car Gate - Guide shoe	1
DOORS AND ENTRANCES - Landing Door	3
DOORS AND ENTRANCES - Landing Door - Door closing device	2
DOORS AND ENTRANCES - Landing Door - Door contact	202
DOORS AND ENTRANCES - Landing Door - Door mechanical lock	15
DOORS AND ENTRANCES - Landing Door - Door mechanical lock - Lock	11

DOORS AND ENTRANCES - Landing Door - Door mechanical lock - Lock release roller	102
DOORS AND ENTRANCES - Landing Door - Landing door	62
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Anti-tip roller	1
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Hanger roller	7
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Panel	12
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Sill	1
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Syncronization device	4
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Top-track	2
DOORS AND ENTRANCES - Swing door - Door contact	2
DOORS AND ENTRANCES - Swing door - Panels and sill	1
DRIVE SYSTEM	2
DRIVE SYSTEM - Contactor	4
DRIVE SYSTEM - Drive	13
DRIVE SYSTEM - Drive system module	14
DRIVE SYSTEM - Drive system software	2
DRIVE SYSTEM - Drive system wiring	1
DRIVE SYSTEM - Other electrical component	1
DRIVE SYSTEM - Other electrical component - Circuit breaker	1
DRIVE SYSTEM - Other electrical component - Power supply	3
DRIVE SYSTEM - Other electrical component - Regenerative device	1
DRIVE SYSTEM - Other electrical component - Voltage regulator	1
DRIVE SYSTEM - PC board	2
DRIVES, STATIONS, TRACK SYSTEM - Drive - Drive	2
DRIVES, STATIONS, TRACK SYSTEM - Drive - Gearbox - Drive chain	2
DRIVES, STATIONS, TRACK SYSTEM - Return Stations - Lower return station - Chain tension device	1
ELECTRICAL SYSTEM	1
ELECTRICAL SYSTEM - Control and signals - Control panel	2
ELECTRICAL SYSTEM - Controller	1
ELECTRICAL SYSTEM - Controller - Contactor	1
ELECTRICAL SYSTEM - Controller - Controller	2
ELECTRICAL SYSTEM - Safety circuit and switches	1
ELECTRICAL SYSTEM - Safety circuit and switches - Step sag device	2
FLOOR, COMB CARRIER - Access cover	1
FLOOR, COMB CARRIER - Comb carrier - Comb carrier	1
GUIDE RAILS - Car guide rail	4
GUIDE RAILS - Counterweight rail	1
GUIDE RAILS - Pulley rail	1
HANDRAIL SYSTEM - Handrail	1
HANDRAIL SYSTEM - Handrail - Handrail	5
HANDRAIL SYSTEM - Handrail drive	1

HANDRAIL SYSTEM - Handrail drive - Handrail chain tension device	2
HANDRAIL SYSTEM - Handrail guide - Handrail return guide	4
HANDRAIL SYSTEM - Handrail roller	2
MACHINE ROOM EQUIPMENT	3
MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Hydraulic machinery	1
MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Power unit - Motor blower	1
MACHINE ROOM EQUIPMENT - Motor generator - Motor generator	2
MACHINE ROOM EQUIPMENT - Motor generator - Winding	1
MACHINE ROOM EQUIPMENT - Traction Machinery	1
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake	17
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake coil	2
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake switch	1
MACHINE ROOM EQUIPMENT - Traction Machinery - Hoist motor - Hoist motor	2
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver	5
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Resolver	1
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Tachometer	12
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Tachometer wheel	4
Not applicable	91
PERIPHERAL DEVICES - Emergency lighting - Emergency battery	25
PERIPHERAL DEVICES - Emergency lighting - Emergency push button	1
PERIPHERAL DEVICES - Fire service panel	3
ROPE ASSEMBLIES - Compensation rope and chain	1
ROPE ASSEMBLIES - Hoist Rope	4
ROPE ASSEMBLIES - Hoist rope suspension	1
SAFETY SIGNS, CLADDINGS, DECKINGS, BALUSTRADES - Balustrade - Glass	1
SHAFT EQUIPMENT	1
SHAFT EQUIPMENT - Governor	1
SHAFT EQUIPMENT - Governor - Governor mechanical	1
SHAFT EQUIPMENT - Governor - Rope	4
SHAFT EQUIPMENT - Governor - Switch	12
SHAFT EQUIPMENT - Governor - Tension device	5
SHAFT EQUIPMENT - Other shaft equipment - Balancer	1
SHAFT EQUIPMENT - Other shaft equipment - Buffer - Buffer	1
SHAFT EQUIPMENT - Other shaft equipment - Buffer - Buffer switch	2
SHAFT EQUIPMENT - Other shaft equipment - LPT (Low pit / top) device	1
SHAFT EQUIPMENT - Shaft electrification	2
SHAFT EQUIPMENT - Shaft electrification - Limit switch	9
SHAFT EQUIPMENT - Shaft electrification - Pit stop switch	2
SHAFT EQUIPMENT - Shaft electrification - Positioning magnet or plate	26
SHAFT EQUIPMENT - Shaft pulleys - Diverting pulley	2

SHAFT EQUIPMENT - Travelling cable	11
SIGNALISATION	5
SIGNALISATION - Car signalisation	3
SIGNALISATION - Car signalisation - Call button	2
SIGNALISATION - Car signalisation - Call button - Call button PC Board	9
SIGNALISATION - Car signalisation - Call button - Pressel / mechanics	5
SIGNALISATION - Car signalisation - Car indicator unit - Positioning indicator	1
SIGNALISATION - Car signalisation - Key switch	2
SIGNALISATION - Landing signalisation	2
SIGNALISATION - Landing signalisation - Call button	2
SIGNALISATION - Landing signalisation - Call button - Call button PC Board	4
SIGNALISATION - Landing signalisation - Call button - Pressel / mechanics	5
SIGNALISATION - Landing signalisation - Key switch	1
STANDBY	4
STEP BAND - Chain - Chain	2
STEP BAND - Connector	1
STEP BAND - Step	2
STEP BAND - Step - Roller	4
STEP BAND - Step - Step	3
(blank)	
Grand Total	**1412**

Table 35:frequency of calls based on components

6.15 ANNEX 15: table for pareto and ABC chart based on project

project	frequency	%	% for each value	cumulative %	cumulative % for each value
PROPOSED ALPHALAND MAKATI TOWER	60	4.249292	0.37453184	0.374532	4.249292
3 CYBERPOD CENTRIS - SOUTH TOWER	56	3.966006	0.37453184	0.749064	8.215297
ROBINSONS CYBERGATE CENTER	39	2.76204	0.37453184	1.123596	10.97734
HOLIDAY INN GALLERIA MANILA	33	2.33711	0.37453184	1.498127	13.31445
RENAISSANCE 2000 CONDOMINIUM	31	2.195467	0.37453184	1.872659	15.50992
53 BENITEZ BY ROCKWELL	27	1.912181	0.37453184	2.247191	17.4221
WACK-WACK TWIN TOWERS CONDOMINIUM	27	1.912181	0.37453184	2.621723	19.33428
THE BEACON PHASE 2	24	1.699717	0.37453184	2.996255	21.03399
THE GROVE C & D TOWER	24	1.699717	0.37453184	3.370787	22.73371
BGC-ESB NORTWEST PROJECT	23	1.628895	0.37453184	3.745318	24.36261
UNION BANK PLAZA	23	1.628895	0.37453184	4.11985	25.9915
ROCKWELL - MERALCO JOINT VENTURE	22	1.558074	0.37453184	4.494382	27.54958
BPI HEAD OFFICE BLDG.	21	1.487252	0.37453184	4.868914	29.03683
THE EXCHANGE CENTER	21	1.487252	0.37453184	5.243446	30.52408

EQUITABLE BANK TOWER CONDOMINIUM	20	1.416431	0.37453184	5.617978	31.94051
ETON TOWER	20	1.416431	0.37453184	5.992509	33.35694
NOVOTEL ARANETA	20	1.416431	0.37453184	6.367041	34.77337
PROPOSED 3 & 4 CYBERPOD CENTRIS	19	1.345609	0.37453184	6.741573	36.11898
RAFFLES SUITES & RESIDENCES AND	18	1.274788	0.37453184	7.116105	37.39377
CONVERGYS BUILDING	17	1.203966	0.37453184	7.490637	38.59773
THE BEACON PHASE D1	17	1.203966	0.37453184	7.865169	39.8017
TWO LAFAYETTE SQUARE CONDOMINIUM	17	1.203966	0.37453184	8.2397	41.00567
TUNE HOTEL - ORTIGAS	16	1.133144	0.37453184	8.614232	42.13881
THE PALMS COUNTRY CLUB	15	1.062323	0.37453184	8.988764	43.20113
FEU TEHCNOLOGY MAIN AND ANNEX	14	0.991501	0.37453184	9.363296	44.19263
HOTEL 101	14	0.991501	0.37453184	9.737828	45.18414
NAC TOWER BUILDING	14	0.991501	0.37453184	10.11236	46.17564
FILINVEST CYBERZONE BUILDING EDSA	13	0.92068	0.37453184	10.48689	47.09632
IHUB 3 & 4 (VECTOR 1 & 2)	13	0.92068	0.37453184	10.86142	48.017
THE ICON RESIDENCES	13	0.92068	0.37453184	11.23596	48.93768
TRIBECA TOWER 4	13	0.92068	0.37453184	11.61049	49.85836
8 ADRIATICO	12	0.849858	0.37453184	11.98502	50.70822
ONE TAGAYTAY PLACE	12	0.849858	0.37453184	12.35955	51.55807
SM ONE ECOM CENTER	12	0.849858	0.37453184	12.73408	52.40793
ONE ROCKWELL	11	0.779037	0.37453184	13.10861	53.18697
SAN MIGUEL PROPERTIES CENTRE	11	0.779037	0.37453184	13.48315	53.96601
THE GROVE BY ROCKWELL	11	0.779037	0.37453184	13.85768	54.74504
ABS-CBN BROADCASTING CORPORATION	10	0.708215	0.37453184	14.23221	55.45326
AVIDA TOWER	10	0.708215	0.37453184	14.60674	56.16147
CELADON PARK MANILA PHASE 2	10	0.708215	0.37453184	14.98127	56.86969
EDADES TOWER AND GARDEN VILLAS	10	0.708215	0.37453184	15.35581	57.5779
PRIVATO RESIDENTIAL	10	0.708215	0.37453184	15.73034	58.28612
THE GROVE E & F TOWER	10	0.708215	0.37453184	16.10487	58.99433
ULAC EXPANSION BUILDING	10	0.708215	0.37453184	16.4794	59.70255
LKG TOWER CONDOMINIUM	9	0.637394	0.37453184	16.85393	60.33994
MALATE CROWN PLAZA	9	0.637394	0.37453184	17.22846	60.97734
MARKET-MARKET MALL	9	0.637394	0.37453184	17.603	61.61473
NATIONAL BUREAU OF INVESTIGATION	9	0.637394	0.37453184	17.97753	62.25212
NEW FARMERS PLAZA, INC.	9	0.637394	0.37453184	18.35206	62.88952
EVIA GLOBAL BUILDING B	8	0.566572	0.37453184	18.72659	63.45609
LOPEZ TOWER AND MUSEUM	8	0.566572	0.37453184	19.10112	64.02266
PGH - CENTRAL BLOCK BUILDING	8	0.566572	0.37453184	19.47566	64.58924
RAMON COJUANGCO BUILDING	8	0.566572	0.37453184	19.85019	65.15581

AMVEL MANSIONS - TOWER 1 & 2	7	0.495751	0.37453184	20.22472	65.65156
CREW CARE BUILDING	7	0.495751	0.37453184	20.59925	66.14731
HEALTHSERV MEDICAL ARTS BLDG	7	0.495751	0.37453184	20.97378	66.64306
ONE ARCHERS PLACE TOWER 2	7	0.495751	0.37453184	21.34831	67.13881
W.H. TAFT RESIDENCES	7	0.495751	0.37453184	21.72285	67.63456
186 WILSON BUILDING	6	0.424929	0.37453184	22.09738	68.05949
ABS-CBN	6	0.424929	0.37453184	22.47191	68.48442
BPI CONDOMINIUM	6	0.424929	0.37453184	22.84644	68.90935
BRCC BLDG.	6	0.424929	0.37453184	23.22097	69.33428
EVERY NATION LEADERSHIP INSTITUTE,	6	0.424929	0.37453184	23.59551	69.75921
FEU SCIENCE & NURSING	6	0.424929	0.37453184	23.97004	70.18414
LEE TOWER CONDOMINIUM	6	0.424929	0.37453184	24.34457	70.60907
NEWPORT BELMONT HOTEL	6	0.424929	0.37453184	24.7191	71.03399
TESDA ADMINISTRATION BUILDING	6	0.424929	0.37453184	25.09363	71.45892
TUNE HOTEL - ERMITA MANILA	6	0.424929	0.37453184	25.46816	71.88385
LAURA VICUNA FOUNDATION INC. OFFICE	5	0.354108	0.37453184	25.8427	72.23796
MARINERS COURT	5	0.354108	0.37453184	26.21723	72.59207
MAXWELL HOTEL	5	0.354108	0.37453184	26.59176	72.94618
NUTRIASIA TOWER	5	0.354108	0.37453184	26.96629	73.30028
PAG-IBIG FUND -WTCI CONDOMINIUM CORPORA	5	0.354108	0.37453184	27.34082	73.65439
PERSIMMON PHASE 2	5	0.354108	0.37453184	27.71536	74.0085
THE RITZ TOWERS	5	0.354108	0.37453184	28.08989	74.36261
TUNE HOTEL - CEBU	5	0.354108	0.37453184	28.46442	74.71671
ZEN TOWER PHASE 2	5	0.354108	0.37453184	28.83895	75.07082
ALL SONS INN - ANNEX BUILDING	4	0.283286	0.37453184	29.21348	75.35411
ANUVA TANDEM -1 BUILDING	4	0.283286	0.37453184	29.58801	75.63739
ASIA PREMIER RESIDENCES	4	0.283286	0.37453184	29.96255	75.92068
AZOTEA DE BEL AIR CONDOMINIUM	4	0.283286	0.37453184	30.33708	76.20397
B.I.G HOTEL	4	0.283286	0.37453184	30.71161	76.48725
BIGFOOT BUILDING	4	0.283286	0.37453184	31.08614	76.77054
BUREAU OF IMMIGRATION	4	0.283286	0.37453184	31.46067	77.05382
EISENHOWER CONDOMINIUM	4	0.283286	0.37453184	31.83521	77.33711
EXPRESS - INN MABOLO	4	0.283286	0.37453184	32.20974	77.6204
HOME FOR THE AGED	4	0.283286	0.37453184	32.58427	77.90368
NORTH BELTON COMMUNITIES	4	0.283286	0.37453184	32.9588	78.18697
NORTH BELTON COMMUNITIES-PHASE 2	4	0.283286	0.37453184	33.33333	78.47025
PICASSO SUITES	4	0.283286	0.37453184	33.70787	78.75354
RECONSTRUCTION & RESTORATION	4	0.283286	0.37453184	34.0824	79.03683
STANDFORD SUITES	4	0.283286	0.37453184	34.45693	79.32011
SURESHOT SPORTSVILLE	4	0.283286	0.37453184	34.83146	79.6034
THE RESIDENCES AT GREENBELT	4	0.283286	0.37453184	35.20599	79.88669

THE WOODRIDGE	4	0.283286	0.37453184	35.58052	80.16997
TUNE HOTEL - MAKATI	4	0.283286	0.37453184	35.95506	80.45326
UST CENTRAL LIBRARY	4	0.283286	0.37453184	36.32959	80.73654
-	3	0.212465	0.37453184	36.70412	80.94901
ALLEGRO MICROSYSTEMS PHILIPPINES,	3	0.212465	0.37453184	37.07865	81.16147
ALPHALAND MAKATI PLACE	3	0.212465	0.37453184	37.45318	81.37394
AMAIA STEPS NOVA - PHASE 1	3	0.212465	0.37453184	37.82772	81.5864
ANGELES MALL	3	0.212465	0.37453184	38.20225	81.79887
BINAN PEOPLE CENTER HUB	3	0.212465	0.37453184	38.57678	82.01133
CAMELOT BUILDING	3	0.212465	0.37453184	38.95131	82.2238
GULLAS DORMITORY	3	0.212465	0.37453184	39.32584	82.43626
HQ14-BURGOS	3	0.212465	0.37453184	39.70037	82.64873
J.P. RIZAL BUILDING (CROSSROADS)	3	0.212465	0.37453184	40.07491	82.86119
LIPA MEDICAL CENTER	3	0.212465	0.37453184	40.44944	83.07365
LOTUS GARDEN HOTEL	3	0.212465	0.37453184	40.82397	83.28612
MABOLO GARDEN FLATS	3	0.212465	0.37453184	41.1985	83.49858
MANILA CSC 34TH STREET PROJECT	3	0.212465	0.37453184	41.57303	83.71105
MANILA WATER SEWARAGE SYSTEM	3	0.212465	0.37453184	41.94757	83.92351
MAYFAIR TOWER	3	0.212465	0.37453184	42.3221	84.13598
MONET @ BRITANNY BAY	3	0.212465	0.37453184	42.69663	84.34844
OAS BALOGOS BUILDING	3	0.212465	0.37453184	43.07116	84.56091
ONE ARCHERS PLACE	3	0.212465	0.37453184	43.44569	84.77337
OSRI BUILDING PROJECT	3	0.212465	0.37453184	43.82022	84.98584
RH1 MIRIAM COLLEGE	3	0.212465	0.37453184	44.19476	85.1983
RS MAKATI	3	0.212465	0.37453184	44.56929	85.41076
THE ROCKWELL BUSINESS CENTER	3	0.212465	0.37453184	44.94382	85.62323
TSPI DEVELOPMENT CORPORATION	3	0.212465	0.37453184	45.31835	85.83569
ULAC EXISTING BUILDING	3	0.212465	0.37453184	45.69288	86.04816
VISAYAS COLUMBIAN FOUNDATION INC.	3	0.212465	0.37453184	46.06742	86.26062
W CITY CENTER	3	0.212465	0.37453184	46.44195	86.47309
WINDLAND RESIDENCES	3	0.212465	0.37453184	46.81648	86.68555
ACE PENZIONNED	2	0.141643	0.37453184	47.19101	86.8272
AITP Retail Strip	2	0.141643	0.37453184	47.56554	86.96884
ALL SONS INN	2	0.141643	0.37453184	47.94007	87.11048
AMBER PLACE	2	0.141643	0.37453184	48.31461	87.25212
AMKOR TECHNOLOGY PHILIPPINES INC.	2	0.141643	0.37453184	48.68914	87.39377
AMVEL MANSIONS TOWER 3	2	0.141643	0.37453184	49.06367	87.53541
ASSUMPTION COLLEGE	2	0.141643	0.37453184	49.4382	87.67705
B. BLASINO 4 STOREY	2	0.141643	0.37453184	49.81273	87.8187
BAGUIO 5 STOREY HOTEL	2	0.141643	0.37453184	50.18727	87.96034
BOCOBO PROJECT (FESTIVAL WALK)	2	0.141643	0.37453184	50.5618	88.10198

CEBU NORMAL UNIVERSITY EXT. BLDG.	2	0.141643	0.37453184	50.93633	88.24363
Cebu R-HOTEL	2	0.141643	0.37453184	51.31086	88.38527
CITY GARDEN SUITES	2	0.141643	0.37453184	51.68539	88.52691
EAGLENEST CONDOMINIUM	2	0.141643	0.37453184	52.05993	88.66856
FAMILY CARE ANNEX BUILDING	2	0.141643	0.37453184	52.43446	88.8102
FASTECH PROPERTIES, INC.	2	0.141643	0.37453184	52.80899	88.95184
GMA ANNEX BUILDING	2	0.141643	0.37453184	53.18352	89.09348
GV PLACE	2	0.141643	0.37453184	53.55805	89.23513
HAMILO COAST BEACH CLUB	2	0.141643	0.37453184	53.93258	89.37677
HEALTHSERV BUILDING	2	0.141643	0.37453184	54.30712	89.51841
HORIZON CITY FLAT CONDOMINIUM	2	0.141643	0.37453184	54.68165	89.66006
HQ14 - ALBERT	2	0.141643	0.37453184	55.05618	89.8017
LOT 8 BUILDING	2	0.141643	0.37453184	55.43071	89.94334
LT CENTER BUILDING	2	0.141643	0.37453184	55.80524	90.08499
MIVESA GARDEN RESIDENCES	2	0.141643	0.37453184	56.17978	90.22663
NATIONAL CHILDREN'S HOSPITAL	2	0.141643	0.37453184	56.55431	90.36827
New P & J Office Building	2	0.141643	0.37453184	56.92884	90.50992
ONE GATEWAY PLACE	2	0.141643	0.37453184	57.30337	90.65156
ORACLE RESIDENCES	2	0.141643	0.37453184	57.6779	90.7932
PROPOSED EATON-COOPER INDUSTRIES	2	0.141643	0.37453184	58.05243	90.93484
PROPOSED PENSIONNE HOUSE	2	0.141643	0.37453184	58.42697	91.07649
REDEMTORIS MATTER BUILDING	2	0.141643	0.37453184	58.8015	91.21813
RTV 7 STOREY DORMITEL	2	0.141643	0.37453184	59.17603	91.35977
RUSTANS CEBU	2	0.141643	0.37453184	59.55056	91.50142
SACRED HEART SCHOOL OF THE	2	0.141643	0.37453184	59.92509	91.64306
SAINT ANDREWS SCHOOL	2	0.141643	0.37453184	60.29963	91.7847
SEVENTY SEVEN BUILDING	2	0.141643	0.37453184	60.67416	91.92635
STARMALL MOLINO	2	0.141643	0.37453184	61.04869	92.06799
TUNE HOTEL - QUEZON CITY	2	0.141643	0.37453184	61.42322	92.20963
TWO SAN PARQ BUILDING	2	0.141643	0.37453184	61.79775	92.35127
UNIVERSITY OF BATANGAS	2	0.141643	0.37453184	62.17228	92.49292
URBAN DECA HOMES, MUNTINLUPA	2	0.141643	0.37453184	62.54682	92.63456
VERBENA CAPITOL SITE	2	0.141643	0.37453184	62.92135	92.7762
VETAF'S SUPERSTORE	2	0.141643	0.37453184	63.29588	92.91785
WIL TOWER A	2	0.141643	0.37453184	63.67041	93.05949
WIL TOWER MALL	2	0.141643	0.37453184	64.04494	93.20113
1 PARK LANE AND 2 PARK LANE	1	0.070822	0.37453184	64.41948	93.27195
4 STOREY HOTEL AND COMMERCIAL	1	0.070822	0.37453184	64.79401	93.34278
A&N HOLDINGS CORP. BUILDING	1	0.070822	0.37453184	65.16854	93.4136
ALA MERCEDEZ- 7 STOREY BUILDING	1	0.070822	0.37453184	65.54307	93.48442
ALTO PENSION HOUSE	1	0.070822	0.37453184	65.9176	93.55524
ANDREA NORTH SKYBREEZE SHOWROOM	1	0.070822	0.37453184	66.29213	93.62606

ARANETA CENTER	1	0.070822	0.37453184	66.66667	93.69688
ASIAN DEVELOPMENT BANK	1	0.070822	0.37453184	67.0412	93.76771
AVON PLAZA BUILDING	1	0.070822	0.37453184	67.41573	93.83853
BACOOR CITY HALL	1	0.070822	0.37453184	67.79026	93.90935
BAGUIO GENERAL HOSPITAL AND	1	0.070822	0.37453184	68.16479	93.98017
BENGAR INDUSTRIAL	1	0.070822	0.37453184	68.53933	94.05099
BJS ANNEX BUILDING	1	0.070822	0.37453184	68.91386	94.12181
BULWAGANG KARUNUNGAN (BPK) BUILDING	1	0.070822	0.37453184	69.28839	94.19263
CEBU R HOTEL	1	0.070822	0.37453184	69.66292	94.26346
CEBUVIEW TOURIST INN	1	0.070822	0.37453184	70.03745	94.33428
CELADON PARK PHASE 1	1	0.070822	0.37453184	70.41199	94.4051
CHANNATHON BED AND BREAKFAST	1	0.070822	0.37453184	70.78652	94.47592
CLARK INTERNATIONAL AIRPORT	1	0.070822	0.37453184	71.16105	94.54674
CO HUN SENG BUILDING	1	0.070822	0.37453184	71.53558	94.61756
CROSSROADS	1	0.070822	0.37453184	71.91011	94.68839
DA VINCI CONDOMINIUM	1	0.070822	0.37453184	72.28464	94.75921
DEP ED CEBU CITY SCHOOL DIVISION	1	0.070822	0.37453184	72.65918	94.83003
DONA ARCHANGELA BUILDING	1	0.070822	0.37453184	73.03371	94.90085
DTC BUILDING (ABS-CBN)	1	0.070822	0.37453184	73.40824	94.97167
EAST OFFICES BUILDING	1	0.070822	0.37453184	73.78277	95.04249
EL-SHADDAI SHRINE	1	0.070822	0.37453184	74.1573	95.11331
E-RESIDENCE	1	0.070822	0.37453184	74.53184	95.18414
E-SQUARE MALL	1	0.070822	0.37453184	74.90637	95.25496
ETON CENTRIS BPO 2	1	0.070822	0.37453184	75.2809	95.32578
EVERGREEN CHAPELS PASIG	1	0.070822	0.37453184	75.65543	95.3966
FAIR SHIPPING CORPORATION	1	0.070822	0.37453184	76.02996	95.46742
FAMILY CARE HOSPITAL	1	0.070822	0.37453184	76.40449	95.53824
FILINVEST LAND SIGNET BUILDING	1	0.070822	0.37453184	76.77903	95.60907
FORTUNE BUILDING 1	1	0.070822	0.37453184	77.15356	95.67989
GALLERIA LAGMAN BUILDING	1	0.070822	0.37453184	77.52809	95.75071
GARDEN SQUARE	1	0.070822	0.37453184	77.90262	95.82153
GOLDEN FORTUNE SEAFOOD RESTAURANT	1	0.070822	0.37453184	78.27715	95.89235
GOODWILL BUILDING	1	0.070822	0.37453184	78.65169	95.96317
GRAND CONVENTION CENTER CEBU	1	0.070822	0.37453184	79.02622	96.03399
GREEN SUN HOTEL	1	0.070822	0.37453184	79.40075	96.10482
GTK BUILDING	1	0.070822	0.37453184	79.77528	96.17564
HB COMMUNICATION CENTER	1	0.070822	0.37453184	80.14981	96.24646
HOPE CHRISTIAN HIGH SCHOOL	1	0.070822	0.37453184	80.52434	96.31728
HQ14 - ALFONSO	1	0.070822	0.37453184	80.89888	96.3881
HQ14 - PALMA	1	0.070822	0.37453184	81.27341	96.45892
JMS WAREHOUSE	1	0.070822	0.37453184	81.64794	96.52975
KAPITAN PEPE BUILDING	1	0.070822	0.37453184	82.02247	96.60057

LANAO DEL NORTE PROVINCIAL CAPITOL	1	0.070822	0.37453184	82.397	96.67139
LAUDERDALE BUILDING	1	0.070822	0.37453184	82.77154	96.74221
MACTAN PENSION HOUSE	1	0.070822	0.37453184	83.14607	96.81303
MARYCHILES GENERAL HOSPITAL	1	0.070822	0.37453184	83.5206	96.88385
MATEO'S GENERAL HOSPITAL	1	0.070822	0.37453184	83.89513	96.95467
MFI BUILDING	1	0.070822	0.37453184	84.26966	97.0255
MING KEE SEAFOOD RESTAURANT	1	0.070822	0.37453184	84.64419	97.09632
MIRRIAM COLLEGE	1	0.070822	0.37453184	85.01873	97.16714
NESTLE PHILIPPINES - SOCIAL BLOCK	1	0.070822	0.37453184	85.39326	97.23796
NORTH BELTON COMMUNITIES -	1	0.070822	0.37453184	85.76779	97.30878
NORTH CAMBRIDGE 3 - WHARTON BUILDING	1	0.070822	0.37453184	86.14232	97.3796
PAMPANGA PREMIER MEDICAL CENTER	1	0.070822	0.37453184	86.51685	97.45042
PHILIPPINE BANK OF COMMUNICATION	1	0.070822	0.37453184	86.89139	97.52125
PHILIPPINE GENERAL HOSPITAL	1	0.070822	0.37453184	87.26592	97.59207
PHILIPPINE VETARANS BANK BUILDING	1	0.070822	0.37453184	87.64045	97.66289
PONGOS HOTEL	1	0.070822	0.37453184	88.01498	97.73371
PRIMAVERA RESIDENCES	1	0.070822	0.37453184	88.38951	97.80453
PROPOSED BUSINESS HOTEL	1	0.070822	0.37453184	88.76404	97.87535
R.A BUILDING-NUEVA ECIJA	1	0.070822	0.37453184	89.13858	97.94618
REDD MANOR HOTEL	1	0.070822	0.37453184	89.51311	98.017
RIVIERA FILIPINA, INC.	1	0.070822	0.37453184	89.88764	98.08782
RUSTANS GATEWAY	1	0.070822	0.37453184	90.26217	98.15864
SALCEDO SQUARE	1	0.070822	0.37453184	90.6367	98.22946
SCANDIA SUITES 2	1	0.070822	0.37453184	91.01124	98.30028
SONRIA CONDOMINIUM	1	0.070822	0.37453184	91.38577	98.3711
SPLICE ASIA BUILDING	1	0.070822	0.37453184	91.7603	98.44193
STA. MONICA HALL	1	0.070822	0.37453184	92.13483	98.51275
STAR MALL SHAW	1	0.070822	0.37453184	92.50936	98.58357
STERLING BANK CORPORATION CENTER	1	0.070822	0.37453184	92.8839	98.65439
STI FAIRVIEW BUILDING	1	0.070822	0.37453184	93.25843	98.72521
STMICROELECTRONICS, INC.	1	0.070822	0.37453184	93.63296	98.79603
SUNTRUST SHANATA	1	0.070822	0.37453184	94.00749	98.86686
TANY FOUNDATION BUILDING	1	0.070822	0.37453184	94.38202	98.93768
THE MEDICAL CITY CLARK	1	0.070822	0.37453184	94.75655	99.0085
TOBIAS RESIDENCE	1	0.070822	0.37453184	95.13109	99.07932
TRES PALMAS BUILDING	1	0.070822	0.37453184	95.50562	99.15014
TRIBECA TOWER 5	1	0.070822	0.37453184	95.88015	99.22096
TUNE HOTEL - ANGELES	1	0.070822	0.37453184	96.25468	99.29178
TUNE HOTEL CAGAYAN DE ORO	1	0.070822	0.37453184	96.62921	99.36261

Twin Towers Condominium	1	0.070822	0.37453184	97.00375	99.43343
UP MANILA - COLLEGE OF DENTISTRY	1	0.070822	0.37453184	97.37828	99.50425
UPTOWN PLACE (BONIFACIO UPTOWNMALL)	1	0.070822	0.37453184	97.75281	99.57507
VALDEZ STREET 5 STOREY HOTEL	1	0.070822	0.37453184	98.12734	99.64589
VIRRO MYRO BUILDING	1	0.070822	0.37453184	98.50187	99.71671
V-PROM BUILDING	1	0.070822	0.37453184	98.8764	99.78754
WILLY CHAN BUILDING	1	0.070822	0.37453184	99.25094	99.85836
WILSON BUILDING	1	0.070822	0.37453184	99.62547	99.92918
YET CONDOMINIUM BUILDING	1	0.070822	0.37453184	100	100
grand total	1412				

Table 36:table for pareto and ABC chart based on project

6.16 ANNEX 16: table for pareto and ABC chart based equipment number

Row Labels	Count of Equipment No	%	% for each value	cumulative %	cumulative % for each value
30319784	24	1.68%	0.17301	0.17301	1.68%
30181822	15	1.05%	0.17301	0.346021	2.73%
30435497	14	0.98%	0.17301	0.519031	3.71%
30181821	14	0.98%	0.17301	0.692042	4.69%
30301804	13	0.91%	0.17301	0.865052	5.60%
30327845	13	0.91%	0.17301	1.038062	6.51%
30121046	13	0.91%	0.17301	1.211073	7.42%
30449912	11	0.77%	0.17301	1.384083	8.19%
30449911	10	0.70%	0.17301	1.557093	8.89%
30319789	10	0.70%	0.17301	1.730104	9.59%
30449907	10	0.70%	0.17301	1.903114	10.29%
30181813	10	0.70%	0.17301	2.076125	10.99%
30181682	10	0.70%	0.17301	2.249135	11.69%
30181876	10	0.70%	0.17301	2.422145	12.39%
30449914	9	0.63%	0.17301	2.595156	13.03%
30158653	9	0.63%	0.17301	2.768166	13.66%
30181826	9	0.63%	0.17301	2.941176	14.29%
30181878	9	0.63%	0.17301	3.114187	14.92%
30543285	8	0.56%	0.17301	3.287197	15.48%
30592426	8	0.56%	0.17301	3.460208	16.04%
30319963	8	0.56%	0.17301	3.633218	16.60%
30420203	8	0.56%	0.17301	3.806228	17.16%
30154784	8	0.56%	0.17301	3.979239	17.72%
30181576	8	0.56%	0.17301	4.152249	18.28%
30154786	8	0.56%	0.17301	4.32526	18.84%
30592428	7	0.49%	0.17301	4.49827	19.33%

42336011	7	0.49%	0.17301	4.67128	19.82%
30370064	7	0.49%	0.17301	4.844291	20.31%
30401806	7	0.49%	0.17301	5.017301	20.80%
30181814	7	0.49%	0.17301	5.190311	21.29%
30084223	7	0.49%	0.17301	5.363322	21.78%
30168466	7	0.49%	0.17301	5.536332	22.27%
30181812	7	0.49%	0.17301	5.709343	22.76%
30112891	7	0.49%	0.17301	5.882353	23.25%
30181760	7	0.49%	0.17301	6.055363	23.74%
42230964	6	0.42%	0.17301	6.228374	24.16%
30449910	6	0.42%	0.17301	6.401384	24.58%
30301801	6	0.42%	0.17301	6.574394	25.00%
30592429	6	0.42%	0.17301	6.747405	25.42%
30592427	6	0.42%	0.17301	6.920415	25.84%
30415220	6	0.42%	0.17301	7.093426	26.26%
42545040	6	0.42%	0.17301	7.266436	26.68%
30181835	6	0.42%	0.17301	7.439446	27.10%
30128704	6	0.42%	0.17301	7.612457	27.52%
30181823	6	0.42%	0.17301	7.785467	27.94%
30181595	6	0.42%	0.17301	7.958478	28.36%
30181596	6	0.42%	0.17301	8.131488	28.78%
30319964	5	0.35%	0.17301	8.304498	29.13%
30449909	5	0.35%	0.17301	8.477509	29.48%
30319788	5	0.35%	0.17301	8.650519	29.83%
30327840	5	0.35%	0.17301	8.823529	30.18%
30276194	5	0.35%	0.17301	8.99654	30.53%
30301021	5	0.35%	0.17301	9.16955	30.88%
30319781	5	0.35%	0.17301	9.342561	31.23%
30428641	5	0.35%	0.17301	9.515571	31.58%
30435849	5	0.35%	0.17301	9.688581	31.93%
42320804	5	0.35%	0.17301	9.861592	32.28%
30181877	5	0.35%	0.17301	10.0346	32.63%
30112892	5	0.35%	0.17301	10.20761	32.98%
30181811	5	0.35%	0.17301	10.38062	33.33%
30154785	5	0.35%	0.17301	10.55363	33.68%
30168468	5	0.35%	0.17301	10.72664	34.03%
30181759	5	0.35%	0.17301	10.89965	34.38%
30181666	5	0.35%	0.17301	11.07266	34.73%
30181577	5	0.35%	0.17301	11.24567	35.08%
30181654	5	0.35%	0.17301	11.41869	35.43%
30276195	4	0.28%	0.17301	11.5917	35.71%
30525689	4	0.28%	0.17301	11.76471	35.99%
42230963	4	0.28%	0.17301	11.93772	36.27%
30327841	4	0.28%	0.17301	12.11073	36.55%

30588064	4	0.28%	0.17301	12.28374	36.83%
30435846	4	0.28%	0.17301	12.45675	37.11%
30349900	4	0.28%	0.17301	12.62976	37.39%
30435847	4	0.28%	0.17301	12.80277	37.68%
30464691	4	0.28%	0.17301	12.97578	37.96%
30435848	4	0.28%	0.17301	13.14879	38.24%
30579308	4	0.28%	0.17301	13.3218	38.52%
30401808	4	0.28%	0.17301	13.49481	38.80%
30283451	4	0.28%	0.17301	13.66782	39.08%
30412678	4	0.28%	0.17301	13.84083	39.36%
30327934	4	0.28%	0.17301	14.01384	39.64%
30415219	4	0.28%	0.17301	14.18685	39.92%
42211342	4	0.28%	0.17301	14.35986	40.20%
30282505	4	0.28%	0.17301	14.53287	40.48%
30301802	4	0.28%	0.17301	14.70588	40.76%
30282506	4	0.28%	0.17301	14.87889	41.04%
30420209	4	0.28%	0.17301	15.0519	41.32%
42338144	4	0.28%	0.17301	15.22491	41.60%
30428640	4	0.28%	0.17301	15.39792	41.88%
30283454	4	0.28%	0.17301	15.57093	42.16%
30181696	4	0.28%	0.17301	15.74394	42.44%
30168469	4	0.28%	0.17301	15.91696	42.72%
30181893	4	0.28%	0.17301	16.08997	43.00%
30181536	4	0.28%	0.17301	16.26298	43.28%
30181683	4	0.28%	0.17301	16.43599	43.56%
30117918	4	0.28%	0.17301	16.609	43.84%
30181728	4	0.28%	0.17301	16.78201	44.12%
30140877	4	0.28%	0.17301	16.95502	44.40%
30181824	4	0.28%	0.17301	17.12803	44.68%
30181590	4	0.28%	0.17301	17.30104	44.96%
30181830	4	0.28%	0.17301	17.47405	45.24%
30164501	4	0.28%	0.17301	17.64706	45.52%
30181857	4	0.28%	0.17301	17.82007	45.80%
30181820	4	0.28%	0.17301	17.99308	46.08%
30254437	4	0.28%	0.17301	18.16609	46.36%
30091456	4	0.28%	0.17301	18.3391	46.64%
30181881	4	0.28%	0.17301	18.51211	46.92%
30184338	4	0.28%	0.17301	18.68512	47.20%
30181524	4	0.28%	0.17301	18.85813	47.48%
30125094	4	0.28%	0.17301	19.03114	47.76%
30181685	4	0.28%	0.17301	19.20415	48.04%
42325211	3	0.21%	0.17301	19.37716	48.25%
30588058	3	0.21%	0.17301	19.55017	48.46%
30283450	3	0.21%	0.17301	19.72318	48.67%

30397525	3	0.21%	0.17301	19.89619	48.88%
30355884	3	0.21%	0.17301	20.0692	49.09%
30319787	3	0.21%	0.17301	20.24221	49.30%
30349898	3	0.21%	0.17301	20.41522	49.51%
30401815	3	0.21%	0.17301	20.58824	49.72%
30574581	3	0.21%	0.17301	20.76125	49.93%
30313961	3	0.21%	0.17301	20.93426	50.14%
30594160	3	0.21%	0.17301	21.10727	50.35%
30420204	3	0.21%	0.17301	21.28028	50.56%
30463166	3	0.21%	0.17301	21.45329	50.77%
30320764	3	0.21%	0.17301	21.6263	50.98%
42338143	3	0.21%	0.17301	21.79931	51.19%
30420210	3	0.21%	0.17301	21.97232	51.40%
30543284	3	0.21%	0.17301	22.14533	51.61%
30327728	3	0.21%	0.17301	22.31834	51.82%
30569539	3	0.21%	0.17301	22.49135	52.03%
30319779	3	0.21%	0.17301	22.66436	52.24%
30575996	3	0.21%	0.17301	22.83737	52.45%
30319780	3	0.21%	0.17301	23.01038	52.66%
30319782	3	0.21%	0.17301	23.18339	52.87%
30327929	3	0.21%	0.17301	23.3564	53.08%
30594161	3	0.21%	0.17301	23.52941	53.29%
30301014	3	0.21%	0.17301	23.70242	53.50%
42300436	3	0.21%	0.17301	23.87543	53.71%
30449913	3	0.21%	0.17301	24.04844	53.92%
30370065	3	0.21%	0.17301	24.22145	54.13%
30184337	3	0.21%	0.17301	24.39446	54.34%
30181866	3	0.21%	0.17301	24.56747	54.55%
30245096	3	0.21%	0.17301	24.74048	54.76%
30084657	3	0.21%	0.17301	24.91349	54.97%
30181575	3	0.21%	0.17301	25.08651	55.18%
30084661	3	0.21%	0.17301	25.25952	55.39%
30205035	3	0.21%	0.17301	25.43253	55.60%
30181791	3	0.21%	0.17301	25.60554	55.81%
30181861	3	0.21%	0.17301	25.77855	56.02%
30181589	3	0.21%	0.17301	25.95156	56.23%
30140880	3	0.21%	0.17301	26.12457	56.44%
30067086	3	0.21%	0.17301	26.29758	56.65%
30181729	3	0.21%	0.17301	26.47059	56.86%
30125087	3	0.21%	0.17301	26.6436	57.07%
30184339	3	0.21%	0.17301	26.81661	57.28%
30101047	3	0.21%	0.17301	26.98962	57.49%
30224800	3	0.21%	0.17301	27.16263	57.70%
30181598	3	0.21%	0.17301	27.33564	57.91%

30181758	3	0.21%	0.17301	27.50865	58.12%
30181649	3	0.21%	0.17301	27.68166	58.33%
30181865	3	0.21%	0.17301	27.85467	58.54%
30125103	3	0.21%	0.17301	28.02768	58.75%
30067085	3	0.21%	0.17301	28.20069	58.96%
30181656	3	0.21%	0.17301	28.3737	59.17%
30181720	3	0.21%	0.17301	28.54671	59.38%
30181658	3	0.21%	0.17301	28.71972	59.59%
30181892	3	0.21%	0.17301	28.89273	59.80%
30128555	3	0.21%	0.17301	29.06574	60.01%
30181917	3	0.21%	0.17301	29.23875	60.22%
30181828	3	0.21%	0.17301	29.41176	60.43%
30181744	3	0.21%	0.17301	29.58478	60.64%
30181829	3	0.21%	0.17301	29.75779	60.85%
30184352	3	0.21%	0.17301	29.9308	61.06%
30112880	3	0.21%	0.17301	30.10381	61.27%
30217296	3	0.21%	0.17301	30.27682	61.48%
30181831	3	0.21%	0.17301	30.44983	61.69%
30242054	3	0.21%	0.17301	30.62284	61.90%
30181832	3	0.21%	0.17301	30.79585	62.11%
30252743	3	0.21%	0.17301	30.96886	62.32%
30181513	3	0.21%	0.17301	31.14187	62.54%
30254423	3	0.21%	0.17301	31.31488	62.75%
30067081	3	0.21%	0.17301	31.48789	62.96%
30350629	2	0.14%	0.17301	31.6609	63.10%
30558282	2	0.14%	0.17301	31.83391	63.24%
42211041	2	0.14%	0.17301	32.00692	63.38%
30415221	2	0.14%	0.17301	32.17993	63.52%
30435845	2	0.14%	0.17301	32.35294	63.66%
30327930	2	0.14%	0.17301	32.52595	63.80%
30313962	2	0.14%	0.17301	32.69896	63.94%
30260402	2	0.14%	0.17301	32.87197	64.08%
42233085	2	0.14%	0.17301	33.04498	64.22%
30401816	2	0.14%	0.17301	33.21799	64.36%
30573468	2	0.14%	0.17301	33.391	64.50%
30282507	2	0.14%	0.17301	33.56401	64.64%
30327732	2	0.14%	0.17301	33.73702	64.78%
30301803	2	0.14%	0.17301	33.91003	64.92%
30354856	2	0.14%	0.17301	34.08304	65.06%
30349897	2	0.14%	0.17301	34.25606	65.20%
30596879	2	0.14%	0.17301	34.42907	65.34%
30415215	2	0.14%	0.17301	34.60208	65.48%
30359154	2	0.14%	0.17301	34.77509	65.62%
30320766	2	0.14%	0.17301	34.9481	65.76%

30319783	2	0.14%	0.17301	35.12111	65.90%
42415984	2	0.14%	0.17301	35.29412	66.04%
30435498	2	0.14%	0.17301	35.46713	66.18%
42431109	2	0.14%	0.17301	35.64014	66.32%
30254445	2	0.14%	0.17301	35.81315	66.46%
30491696	2	0.14%	0.17301	35.98616	66.60%
30349899	2	0.14%	0.17301	36.15917	66.74%
30491715	2	0.14%	0.17301	36.33218	66.88%
30327839	2	0.14%	0.17301	36.50519	67.02%
30496695	2	0.14%	0.17301	36.6782	67.16%
30350630	2	0.14%	0.17301	36.85121	67.30%
30522706	2	0.14%	0.17301	37.02422	67.44%
30354857	2	0.14%	0.17301	37.19723	67.58%
30415216	2	0.14%	0.17301	37.37024	67.72%
30276193	2	0.14%	0.17301	37.54325	67.86%
30525691	2	0.14%	0.17301	37.71626	68.00%
42169623	2	0.14%	0.17301	37.88927	68.14%
30541174	2	0.14%	0.17301	38.06228	68.28%
30279465	2	0.14%	0.17301	38.23529	68.42%
42477420	2	0.14%	0.17301	38.4083	68.56%
30362930	2	0.14%	0.17301	38.58131	68.70%
30276200	2	0.14%	0.17301	38.75433	68.84%
30449908	2	0.14%	0.17301	38.92734	68.98%
30543287	2	0.14%	0.17301	39.10035	69.12%
30260279	2	0.14%	0.17301	39.27336	69.26%
30553573	2	0.14%	0.17301	39.44637	69.40%
30464692	2	0.14%	0.17301	39.61938	69.54%
30377206	2	0.14%	0.17301	39.79239	69.68%
30466985	2	0.14%	0.17301	39.9654	69.82%
42427864	2	0.14%	0.17301	40.13841	69.96%
30487328	2	0.14%	0.17301	40.31142	70.10%
30391004	2	0.14%	0.17301	40.48443	70.24%
30487329	2	0.14%	0.17301	40.65744	70.38%
30428642	2	0.14%	0.17301	40.83045	70.52%
30435752	2	0.14%	0.17301	41.00346	70.66%
30239430	2	0.14%	0.17301	41.17647	70.80%
30184330	2	0.14%	0.17301	41.34948	70.94%
30128701	2	0.14%	0.17301	41.52249	71.08%
30181521	2	0.14%	0.17301	41.6955	71.22%
30210332	2	0.14%	0.17301	41.86851	71.36%
30084655	2	0.14%	0.17301	42.04152	71.50%
30252744	2	0.14%	0.17301	42.21453	71.64%
30181526	2	0.14%	0.17301	42.38754	71.78%
30181903	2	0.14%	0.17301	42.56055	71.92%

30181784	2	0.14%	0.17301	42.73356	72.06%
30181710	2	0.14%	0.17301	42.90657	72.20%
30181532	2	0.14%	0.17301	43.07958	72.34%
30181727	2	0.14%	0.17301	43.2526	72.48%
30181533	2	0.14%	0.17301	43.42561	72.62%
30181736	2	0.14%	0.17301	43.59862	72.76%
30181535	2	0.14%	0.17301	43.77163	72.90%
30181754	2	0.14%	0.17301	43.94464	73.04%
30128705	2	0.14%	0.17301	44.11765	73.18%
30181894	2	0.14%	0.17301	44.29066	73.32%
30112879	2	0.14%	0.17301	44.46367	73.46%
30170163	2	0.14%	0.17301	44.63668	73.60%
30181815	2	0.14%	0.17301	44.80969	73.74%
30254438	2	0.14%	0.17301	44.9827	73.88%
30125085	2	0.14%	0.17301	45.15571	74.02%
30128702	2	0.14%	0.17301	45.32872	74.16%
30140882	2	0.14%	0.17301	45.50173	74.30%
30214731	2	0.14%	0.17301	45.67474	74.44%
30181579	2	0.14%	0.17301	45.84775	74.58%
30181514	2	0.14%	0.17301	46.02076	74.72%
30181580	2	0.14%	0.17301	46.19377	74.86%
30242055	2	0.14%	0.17301	46.36678	75.00%
30142157	2	0.14%	0.17301	46.53979	75.14%
30248237	2	0.14%	0.17301	46.7128	75.28%
30181825	2	0.14%	0.17301	46.88581	75.42%
30254425	2	0.14%	0.17301	47.05882	75.56%
30147451	2	0.14%	0.17301	47.23183	75.70%
30181885	2	0.14%	0.17301	47.40484	75.84%
30181591	2	0.14%	0.17301	47.57785	75.98%
30181694	2	0.14%	0.17301	47.75087	76.12%
30181592	2	0.14%	0.17301	47.92388	76.26%
30181895	2	0.14%	0.17301	48.09689	76.40%
30125086	2	0.14%	0.17301	48.2699	76.54%
30181904	2	0.14%	0.17301	48.44291	76.68%
30084222	2	0.14%	0.17301	48.61592	76.82%
30184328	2	0.14%	0.17301	48.78893	76.96%
30091501	2	0.14%	0.17301	48.96194	77.10%
30174719	2	0.14%	0.17301	49.13495	77.24%
30181833	2	0.14%	0.17301	49.30796	77.38%
30181709	2	0.14%	0.17301	49.48097	77.52%
30125095	2	0.14%	0.17301	49.65398	77.66%
30199204	2	0.14%	0.17301	49.82699	77.80%
30181846	2	0.14%	0.17301	50	77.94%
30206136	2	0.14%	0.17301	50.17301	78.08%

30181848	2	0.14%	0.17301	50.34602	78.22%
30210336	2	0.14%	0.17301	50.51903	78.36%
30161766	2	0.14%	0.17301	50.69204	78.50%
30214734	2	0.14%	0.17301	50.86505	78.64%
30181858	2	0.14%	0.17301	51.03806	78.78%
30224677	2	0.14%	0.17301	51.21107	78.92%
30092016	2	0.14%	0.17301	51.38408	79.06%
30232458	2	0.14%	0.17301	51.55709	79.20%
30181862	2	0.14%	0.17301	51.7301	79.34%
30181515	2	0.14%	0.17301	51.90311	79.48%
30166201	2	0.14%	0.17301	52.07612	79.62%
30242056	2	0.14%	0.17301	52.24913	79.76%
30181660	2	0.14%	0.17301	52.42215	79.90%
30248236	2	0.14%	0.17301	52.59516	80.04%
30181870	2	0.14%	0.17301	52.76817	80.18%
30181737	2	0.14%	0.17301	52.94118	80.32%
30166580	2	0.14%	0.17301	53.11419	80.46%
30181519	2	0.14%	0.17301	53.2872	80.60%
30125104	2	0.14%	0.17301	53.46021	80.74%
30254436	2	0.14%	0.17301	53.63322	80.88%
30114130	2	0.14%	0.17301	53.80623	81.02%
30181684	2	0.14%	0.17301	53.97924	81.16%
30254444	2	0.14%	0.17301	54.15225	81.30%
30181708	2	0.14%	0.17301	54.32526	81.44%
30181707	2	0.14%	0.17301	54.49827	81.58%
42349260	1	0.07%	0.17301	54.67128	81.65%
30588059	1	0.07%	0.17301	54.84429	81.72%
30569535	1	0.07%	0.17301	55.0173	81.79%
30435500	1	0.07%	0.17301	55.19031	81.86%
30421292	1	0.07%	0.17301	55.36332	81.93%
30354855	1	0.07%	0.17301	55.53633	82.00%
30350944	1	0.07%	0.17301	55.70934	82.07%
30435841	1	0.07%	0.17301	55.88235	82.14%
30574582	1	0.07%	0.17301	56.05536	82.21%
30435842	1	0.07%	0.17301	56.22837	82.28%
30415224	1	0.07%	0.17301	56.40138	82.35%
30435843	1	0.07%	0.17301	56.57439	82.42%
30424053	1	0.07%	0.17301	56.7474	82.49%
30313958	1	0.07%	0.17301	56.92042	82.56%
30309469	1	0.07%	0.17301	57.09343	82.63%
30294202	1	0.07%	0.17301	57.26644	82.70%
30553574	1	0.07%	0.17301	57.43945	82.77%
30355461	1	0.07%	0.17301	57.61246	82.84%
30573280	1	0.07%	0.17301	57.78547	82.91%

30326883	1	0.07%	0.17301	57.95848	82.98%
30579767	1	0.07%	0.17301	58.13149	83.05%
30356400	1	0.07%	0.17301	58.3045	83.12%
30289463	1	0.07%	0.17301	58.47751	83.19%
30435851	1	0.07%	0.17301	58.65052	83.26%
42170703	1	0.07%	0.17301	58.82353	83.33%
30447878	1	0.07%	0.17301	58.99654	83.40%
42286837	1	0.07%	0.17301	59.16955	83.47%
30327361	1	0.07%	0.17301	59.34256	83.54%
30319927	1	0.07%	0.17301	59.51557	83.61%
30359168	1	0.07%	0.17301	59.68858	83.68%
42404383	1	0.07%	0.17301	59.86159	83.75%
30327727	1	0.07%	0.17301	60.0346	83.82%
42454900	1	0.07%	0.17301	60.20761	83.89%
30299638	1	0.07%	0.17301	60.38062	83.96%
30435499	1	0.07%	0.17301	60.55363	84.03%
30327729	1	0.07%	0.17301	60.72664	84.10%
30561070	1	0.07%	0.17301	60.89965	84.17%
30371113	1	0.07%	0.17301	61.07266	84.24%
30573278	1	0.07%	0.17301	61.24567	84.31%
30371249	1	0.07%	0.17301	61.41869	84.38%
30573923	1	0.07%	0.17301	61.5917	84.45%
30377196	1	0.07%	0.17301	61.76471	84.52%
30576350	1	0.07%	0.17301	61.93772	84.59%
30456869	1	0.07%	0.17301	62.11073	84.66%
30586640	1	0.07%	0.17301	62.28374	84.73%
30456870	1	0.07%	0.17301	62.45675	84.80%
30588174	1	0.07%	0.17301	62.62976	84.87%
30327730	1	0.07%	0.17301	62.80277	84.94%
30415222	1	0.07%	0.17301	62.97578	85.01%
30377227	1	0.07%	0.17301	63.14879	85.08%
30349896	1	0.07%	0.17301	63.3218	85.15%
30378747	1	0.07%	0.17301	63.49481	85.22%
30294200	1	0.07%	0.17301	63.66782	85.29%
30378751	1	0.07%	0.17301	63.84083	85.36%
30424051	1	0.07%	0.17301	64.01384	85.43%
30471354	1	0.07%	0.17301	64.18685	85.50%
30424052	1	0.07%	0.17301	64.35986	85.57%
30471485	1	0.07%	0.17301	64.53287	85.64%
30426173	1	0.07%	0.17301	64.70588	85.71%
30478435	1	0.07%	0.17301	64.87889	85.78%
42349251	1	0.07%	0.17301	65.0519	85.85%
30379211	1	0.07%	0.17301	65.22491	85.92%
42362616	1	0.07%	0.17301	65.39792	85.99%

30390843	1	0.07%	0.17301	65.57093	86.06%
42412934	1	0.07%	0.17301	65.74394	86.13%
30489654	1	0.07%	0.17301	65.91696	86.20%
42430239	1	0.07%	0.17301	66.08997	86.27%
30391002	1	0.07%	0.17301	66.26298	86.34%
30309916	1	0.07%	0.17301	66.43599	86.41%
30491697	1	0.07%	0.17301	66.609	86.48%
42613459	1	0.07%	0.17301	66.78201	86.55%
30491702	1	0.07%	0.17301	66.95502	86.62%
30276122	1	0.07%	0.17301	67.12803	86.69%
30491703	1	0.07%	0.17301	67.30104	86.76%
30301022	1	0.07%	0.17301	67.47405	86.83%
30491713	1	0.07%	0.17301	67.64706	86.90%
30561582	1	0.07%	0.17301	67.82007	86.97%
30276197	1	0.07%	0.17301	67.99308	87.04%
30412093	1	0.07%	0.17301	68.16609	87.11%
30496692	1	0.07%	0.17301	68.3391	87.18%
30573279	1	0.07%	0.17301	68.51211	87.25%
30397480	1	0.07%	0.17301	68.68512	87.32%
30267369	1	0.07%	0.17301	68.85813	87.39%
30507741	1	0.07%	0.17301	69.03114	87.46%
30412690	1	0.07%	0.17301	69.20415	87.54%
30511873	1	0.07%	0.17301	69.37716	87.61%
30415214	1	0.07%	0.17301	69.55017	87.68%
30511875	1	0.07%	0.17301	69.72318	87.75%
30327928	1	0.07%	0.17301	69.89619	87.82%
30511876	1	0.07%	0.17301	70.0692	87.89%
30579770	1	0.07%	0.17301	70.24221	87.96%
30511877	1	0.07%	0.17301	70.41522	88.03%
30289409	1	0.07%	0.17301	70.58824	88.10%
30511878	1	0.07%	0.17301	70.76125	88.17%
30319785	1	0.07%	0.17301	70.93426	88.24%
30511879	1	0.07%	0.17301	71.10727	88.31%
30588253	1	0.07%	0.17301	71.28028	88.38%
30517995	1	0.07%	0.17301	71.45329	88.45%
30343769	1	0.07%	0.17301	71.6263	88.52%
30517996	1	0.07%	0.17301	71.79931	88.59%
30415223	1	0.07%	0.17301	71.97232	88.66%
30522118	1	0.07%	0.17301	72.14533	88.73%
30343796	1	0.07%	0.17301	72.31834	88.80%
30522127	1	0.07%	0.17301	72.49135	88.87%
30420206	1	0.07%	0.17301	72.66436	88.94%
30522128	1	0.07%	0.17301	72.83737	89.01%
30420208	1	0.07%	0.17301	73.01038	89.08%

30327733	1	0.07%	0.17301	73.18339	89.15%
30303771	1	0.07%	0.17301	73.3564	89.22%
30522707	1	0.07%	0.17301	73.52941	89.29%
42231284	1	0.07%	0.17301	73.70242	89.36%
30522708	1	0.07%	0.17301	73.87543	89.43%
42254713	1	0.07%	0.17301	74.04844	89.50%
30522710	1	0.07%	0.17301	74.22145	89.57%
42291961	1	0.07%	0.17301	74.39446	89.64%
30522711	1	0.07%	0.17301	74.56747	89.71%
42317782	1	0.07%	0.17301	74.74048	89.78%
30523847	1	0.07%	0.17301	74.91349	89.85%
30424055	1	0.07%	0.17301	75.08651	89.92%
30401802	1	0.07%	0.17301	75.25952	89.99%
30319790	1	0.07%	0.17301	75.43253	90.06%
30525690	1	0.07%	0.17301	75.60554	90.13%
42349248	1	0.07%	0.17301	75.77855	90.20%
30327734	1	0.07%	0.17301	75.95156	90.27%
42349257	1	0.07%	0.17301	76.12457	90.34%
30526153	1	0.07%	0.17301	76.29758	90.41%
42350668	1	0.07%	0.17301	76.47059	90.48%
30531343	1	0.07%	0.17301	76.6436	90.55%
42404381	1	0.07%	0.17301	76.81661	90.62%
30533989	1	0.07%	0.17301	76.98962	90.69%
42404393	1	0.07%	0.17301	77.16263	90.76%
30533991	1	0.07%	0.17301	77.33564	90.83%
42413650	1	0.07%	0.17301	77.50865	90.90%
30533992	1	0.07%	0.17301	77.68166	90.97%
30429014	1	0.07%	0.17301	77.85467	91.04%
30401807	1	0.07%	0.17301	78.02768	91.11%
30429016	1	0.07%	0.17301	78.20069	91.18%
30301015	1	0.07%	0.17301	78.3737	91.25%
42475639	1	0.07%	0.17301	78.54671	91.32%
30401810	1	0.07%	0.17301	78.71972	91.39%
42483112	1	0.07%	0.17301	78.89273	91.46%
30543286	1	0.07%	0.17301	79.06574	91.53%
42579787	1	0.07%	0.17301	79.23875	91.60%
30401814	1	0.07%	0.17301	79.41176	91.67%
42895864	1	0.07%	0.17301	79.58478	91.74%
30552020	1	0.07%	0.17301	79.75779	91.81%
30552662	1	0.07%	0.17301	79.9308	91.88%
30184341	1	0.07%	0.17301	80.10381	91.95%
30139702	1	0.07%	0.17301	80.27682	92.02%
30071507	1	0.07%	0.17301	80.44983	92.09%
30181795	1	0.07%	0.17301	80.62284	92.16%

30181788	1	0.07%	0.17301	80.79585	92.23%
30181810	1	0.07%	0.17301	80.96886	92.30%
30205624	1	0.07%	0.17301	81.14187	92.37%
30181538	1	0.07%	0.17301	81.31488	92.44%
30226592	1	0.07%	0.17301	81.48789	92.51%
30181540	1	0.07%	0.17301	81.6609	92.58%
30253049	1	0.07%	0.17301	81.83391	92.65%
30181574	1	0.07%	0.17301	82.00692	92.72%
30177815	1	0.07%	0.17301	82.17993	92.79%
30084668	1	0.07%	0.17301	82.35294	92.86%
30101134	1	0.07%	0.17301	82.52595	92.93%
30140883	1	0.07%	0.17301	82.69896	93.00%
30211709	1	0.07%	0.17301	82.87197	93.07%
30181816	1	0.07%	0.17301	83.04498	93.14%
30181527	1	0.07%	0.17301	83.21799	93.21%
30086882	1	0.07%	0.17301	83.391	93.28%
30181741	1	0.07%	0.17301	83.56401	93.35%
30144910	1	0.07%	0.17301	83.73702	93.42%
30248306	1	0.07%	0.17301	83.91003	93.49%
30091455	1	0.07%	0.17301	84.08304	93.56%
30254293	1	0.07%	0.17301	84.25606	93.63%
30181582	1	0.07%	0.17301	84.42907	93.70%
30181537	1	0.07%	0.17301	84.60208	93.77%
30181587	1	0.07%	0.17301	84.77509	93.84%
30081667	1	0.07%	0.17301	84.9481	93.91%
30181588	1	0.07%	0.17301	85.12111	93.98%
30184345	1	0.07%	0.17301	85.29412	94.05%
30122738	1	0.07%	0.17301	85.46713	94.12%
30181517	1	0.07%	0.17301	85.64014	94.19%
30181827	1	0.07%	0.17301	85.81315	94.26%
30081668	1	0.07%	0.17301	85.98616	94.33%
30122739	1	0.07%	0.17301	86.15917	94.40%
30214732	1	0.07%	0.17301	86.33218	94.47%
30073732	1	0.07%	0.17301	86.50519	94.54%
30224312	1	0.07%	0.17301	86.6782	94.61%
30084224	1	0.07%	0.17301	86.85121	94.68%
30224770	1	0.07%	0.17301	87.02422	94.75%
30181594	1	0.07%	0.17301	87.19723	94.82%
30181738	1	0.07%	0.17301	87.37024	94.89%
30084653	1	0.07%	0.17301	87.54325	94.96%
30181753	1	0.07%	0.17301	87.71626	95.03%
30125088	1	0.07%	0.17301	87.88927	95.10%
30181756	1	0.07%	0.17301	88.06228	95.17%
30164502	1	0.07%	0.17301	88.23529	95.24%

30181534	1	0.07%	0.17301	88.4083	95.31%
30181836	1	0.07%	0.17301	88.58131	95.38%
30254288	1	0.07%	0.17301	88.75433	95.45%
30181837	1	0.07%	0.17301	88.92734	95.52%
30181783	1	0.07%	0.17301	89.10035	95.59%
30181838	1	0.07%	0.17301	89.27336	95.66%
30181790	1	0.07%	0.17301	89.44637	95.73%
30181841	1	0.07%	0.17301	89.61938	95.80%
30184335	1	0.07%	0.17301	89.79239	95.87%
30181609	1	0.07%	0.17301	89.9654	95.94%
30128386	1	0.07%	0.17301	90.13841	96.01%
30181616	1	0.07%	0.17301	90.31142	96.08%
30184340	1	0.07%	0.17301	90.48443	96.15%
30181849	1	0.07%	0.17301	90.65744	96.22%
30184342	1	0.07%	0.17301	90.83045	96.29%
30181648	1	0.07%	0.17301	91.00346	96.36%
30184348	1	0.07%	0.17301	91.17647	96.43%
30125091	1	0.07%	0.17301	91.34948	96.50%
30199167	1	0.07%	0.17301	91.52249	96.57%
30181860	1	0.07%	0.17301	91.6955	96.64%
30181714	1	0.07%	0.17301	91.86851	96.71%
30181650	1	0.07%	0.17301	92.04152	96.78%
30181717	1	0.07%	0.17301	92.21453	96.85%
30181652	1	0.07%	0.17301	92.38754	96.92%
30181726	1	0.07%	0.17301	92.56055	96.99%
30181863	1	0.07%	0.17301	92.73356	97.06%
30128703	1	0.07%	0.17301	92.90657	97.13%
30181653	1	0.07%	0.17301	93.07958	97.20%
30084659	1	0.07%	0.17301	93.2526	97.27%
30166202	1	0.07%	0.17301	93.42561	97.34%
30217826	1	0.07%	0.17301	93.59862	97.41%
30181868	1	0.07%	0.17301	93.77163	97.48%
30224313	1	0.07%	0.17301	93.94464	97.55%
30181869	1	0.07%	0.17301	94.11765	97.62%
30224687	1	0.07%	0.17301	94.29066	97.69%
30125092	1	0.07%	0.17301	94.46367	97.76%
30181530	1	0.07%	0.17301	94.63668	97.83%
30181657	1	0.07%	0.17301	94.80969	97.90%
30230875	1	0.07%	0.17301	94.9827	97.97%
30125093	1	0.07%	0.17301	95.15571	98.04%
30181739	1	0.07%	0.17301	95.32872	98.11%
30168467	1	0.07%	0.17301	95.50173	98.18%
30181531	1	0.07%	0.17301	95.67474	98.25%
30092112	1	0.07%	0.17301	95.84775	98.32%

30244102	1	0.07%	0.17301	96.02076	98.39%
30181667	1	0.07%	0.17301	96.19377	98.46%
30245097	1	0.07%	0.17301	96.36678	98.53%
30092268	1	0.07%	0.17301	96.53979	98.60%
30084664	1	0.07%	0.17301	96.7128	98.67%
30093842	1	0.07%	0.17301	96.88581	98.74%
30248329	1	0.07%	0.17301	97.05882	98.81%
30170165	1	0.07%	0.17301	97.23183	98.88%
30140879	1	0.07%	0.17301	97.40484	98.95%
30101045	1	0.07%	0.17301	97.57785	99.02%
30254266	1	0.07%	0.17301	97.75087	99.09%
30181686	1	0.07%	0.17301	97.92388	99.16%
30254290	1	0.07%	0.17301	98.09689	99.23%
30181687	1	0.07%	0.17301	98.2699	99.30%
30254295	1	0.07%	0.17301	98.44291	99.37%
30181692	1	0.07%	0.17301	98.61592	99.44%
30114129	1	0.07%	0.17301	98.78893	99.51%
30184326	1	0.07%	0.17301	98.96194	99.58%
30181789	1	0.07%	0.17301	99.13495	99.65%
30181693	1	0.07%	0.17301	99.30796	99.72%
30254443	1	0.07%	0.17301	99.48097	99.79%
30176196	1	0.07%	0.17301	99.65398	99.86%
30181794	1	0.07%	0.17301	99.82699	99.93%
30184331	1	0.07%	0.17301	100	100.00%
Grand Total	1428				

Table 37:table for pareto and ABC chart based equipment number

6.17 ANNEX 17: table for pareto and ABC chart based components

name of the components	Frequency	%	% for each value	cumulative %	cumulative % for each value
DOORS AND ENTRANCES - Landing Door - Door contact	202	14.3	0.628931	0.628931	14.30595
CONTROL SYSTEM - Control system	152	10.8	0.628931	1.257862	25.07082
DOORS AND ENTRANCES - Landing Door - Door mechanical lock - Lock release roller	102	7.2	0.628931	1.886792	32.29462
Not applicable	91	6.4	0.628931	2.515723	38.73938
DOORS AND ENTRANCES - Landing Door - Landing door	73	5.2	0.628931	3.144654	43.90935
DOORS AND ENTRANCES - Car Door - Door contact	54	3.8	0.628931	3.773585	47.73371
CONTROL SYSTEM - Contactor	42	3.0	0.628931	4.402516	50.70822
CAR - Car positioning devices - Positioning switches / readers	29	2.1	0.628931	5.031447	52.76204
CONTROL SYSTEM - PC Board	27	1.9	0.628931	5.660377	54.67422
CAR - Car positioning devices - Levelling vanes & tapes	26	1.8	0.628931	6.289308	56.51558
SHAFT EQUIPMENT - Shaft electrification - Positioning magnet or plate	26	1.8	0.628931	6.918239	58.35694
PERIPHERAL DEVICES - Emergency lighting - Emergency battery	25	1.8	0.628931	7.54717	60.12748
CAR - PC Board (in car connection box)	21	1.5	0.628931	8.176101	61.61473

DOORS AND ENTRANCES - Car Door - Car door	21	1.5	0.628931	8.805031	63.10198
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Coupler	18	1.3	0.628931	9.433962	64.37677
COUNTERWEIGHT - Guide shoe - Sliding guide	17	1.2	0.628931	10.06289	65.58074
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake	17	1.2	0.628931	10.69182	66.7847
DOORS AND ENTRANCES - Car Door - Car door safety devices - Curtain of light	15	1.1	0.628931	11.32075	67.84703
DOORS AND ENTRANCES - Landing Door - Door mechanical lock	15	1.1	0.628931	11.94969	68.90935
DRIVE SYSTEM - Drive system module	14	1.0	0.628931	12.57862	69.90085
CONTROL SYSTEM	13	.9	0.628931	13.20755	70.82153
DOORS AND ENTRANCES - Car Door - Door mechanical lock	13	.9	0.628931	13.83648	71.74221
DRIVE SYSTEM - Drive	13	.9	0.628931	14.46541	72.66289
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Panel	12	.8	0.628931	15.09434	73.51275
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Tachometer	12	.8	0.628931	15.72327	74.36261
SHAFT EQUIPMENT - Governor - Switch	12	.8	0.628931	16.3522	75.21246
DOORS AND ENTRANCES	11	.8	0.628931	16.98113	75.9915
SHAFT EQUIPMENT - Travelling cable	11	.8	0.628931	17.61006	76.77054
CAR - Car panels & roof	10	.7	0.628931	18.23899	77.47875
CAR - Car wiring	9	.6	0.628931	18.86792	78.11615
SHAFT EQUIPMENT - Shaft electrification - Limit switch	9	.6	0.628931	19.49686	78.75354
SIGNALISATION - Car signalisation - Call button - Call button PC Board	9	.6	0.628931	20.12579	79.39093
CONTROL SYSTEM - Fuse	8	.6	0.628931	20.75472	79.95751
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Hanger roller	7	.5	0.628931	21.38365	80.45326
CAR	6	.4	0.628931	22.01258	80.87819
CONTROL SYSTEM - Control system module	6	.4	0.628931	22.64151	81.30312
CONTROL SYSTEM - Control system wiring	6	.4	0.628931	23.27044	81.72805
COUNTERWEIGHT - Pulley - Bearing	6	.4	0.628931	23.89937	82.15297
CONTROL SYSTEM - Other electrical component - Power supply	5	.4	0.628931	24.5283	82.50708
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Syncronization device	5	.4	0.628931	25.15723	82.86119
HANDRAIL SYSTEM - Handrail - Handrail	5	.4	0.628931	25.78616	83.2153
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver	5	.4	0.628931	26.41509	83.56941
SHAFT EQUIPMENT - Governor - Tension device	5	.4	0.628931	27.04403	83.92351
SIGNALISATION	5	.4	0.628931	27.67296	84.27762
SIGNALISATION - Car signalisation - Call button - Pressel / mechanics	5	.4	0.628931	28.30189	84.63173
SIGNALISATION - Landing signalisation - Call button - Pressel / mechanics	5	.4	0.628931	28.93082	84.98584
CAR - Car interior - Lighting	4	.3	0.628931	29.55975	85.26912
CAR - Car positioning devices - Car top encoder	4	.3	0.628931	30.18868	85.55241
CAR SLING - Load weighing devices	4	.3	0.628931	30.81761	85.83569
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator mechanical component	4	.3	0.628931	31.44654	86.11898
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Guide shoe	4	.3	0.628931	32.07547	86.40227
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Syncronization device	4	.3	0.628931	32.7044	86.68555
DRIVE SYSTEM - Contactor	4	.3	0.628931	33.33333	86.96884
GUIDE RAILS - Car guide rail	4	.3	0.628931	33.96226	87.25212
HANDRAIL SYSTEM - Handrail guide - Handrail return guide	4	.3	0.628931	34.59119	87.53541

MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Tachometer wheel	4	.3	0.628931	35.22013	87.8187
ROPE ASSEMBLIES - Hoist Rope	4	.3	0.628931	35.84906	88.10198
SHAFT EQUIPMENT - Governor - Rope	4	.3	0.628931	36.47799	88.38527
SIGNALISATION - Landing signalisation - Call button - Call button PC Board	4	.3	0.628931	37.10692	88.66856
STANDBY	4	.3	0.628931	37.73585	88.95184
STEP BAND - Step - Roller	4	.3	0.628931	38.36478	89.23513
CONTROL SYSTEM - Other electrical component	3	.2	0.628931	38.99371	89.44759
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator board	3	.2	0.628931	39.62264	89.66006
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Hanger roller	3	.2	0.628931	40.25157	89.87252
DOORS AND ENTRANCES - Landing Door	3	.2	0.628931	40.8805	90.08499
DRIVE SYSTEM - Other electrical component - Power supply	3	.2	0.628931	41.50943	90.29745
MACHINE ROOM EQUIPMENT	3	.2	0.628931	42.13836	90.50992
PERIPHERAL DEVICES - Fire service panel	3	.2	0.628931	42.7673	90.72238
SIGNALISATION - Car signalisation	3	.2	0.628931	43.39623	90.93484
STEP BAND - Step - Step	3	.2	0.628931	44.02516	91.14731
CAR - Car interior - Ventilation	2	.1	0.628931	44.65409	91.28895
CAR - Car top inspection station	2	.1	0.628931	45.28302	91.43059
CAR - Retiring cam & magnet	2	.1	0.628931	45.91195	91.57224
CAR SLING - Roller guide	2	.1	0.628931	46.54088	91.71388
CAR SLING - Sliding guide	2	.1	0.628931	47.16981	91.85552
CONTROL SYSTEM - Control system software	2	.1	0.628931	47.79874	91.99717
CONTROL SYSTEM - Other electrical component - Motor overload	2	.1	0.628931	48.42767	92.13881
CONTROL SYSTEM - Relay	2	.1	0.628931	49.0566	92.28045
DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge linkage	2	.1	0.628931	49.68553	92.4221
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill	2	.1	0.628931	50.31447	92.56374
DOORS AND ENTRANCES - Landing Door - Door closing device	2	.1	0.628931	50.9434	92.70538
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Top-track	2	.1	0.628931	51.57233	92.84703
DOORS AND ENTRANCES - Swing door - Door contact	2	.1	0.628931	52.20126	92.98867
DRIVE SYSTEM	2	.1	0.628931	52.83019	93.13031
DRIVE SYSTEM - Drive system software	2	.1	0.628931	53.45912	93.27195
DRIVE SYSTEM - PC board	2	.1	0.628931	54.08805	93.4136
DRIVES, STATIONS, TRACK SYSTEM - Drive - Drive	2	.1	0.628931	54.71698	93.55524
DRIVES, STATIONS, TRACK SYSTEM - Drive - Gearbox - Drive chain	2	.1	0.628931	55.34591	93.69688
ELECTRICAL SYSTEM - Control and signals - Control panel	2	.1	0.628931	55.97484	93.83853
ELECTRICAL SYSTEM - Controller - Controller	2	.1	0.628931	56.60377	93.98017
ELECTRICAL SYSTEM - Safety circuit and switches - Step sag device	2	.1	0.628931	57.2327	94.12181
HANDRAIL SYSTEM - Handrail drive - Handrail chain tension device	2	.1	0.628931	57.86164	94.26346
HANDRAIL SYSTEM - Handrail roller	2	.1	0.628931	58.49057	94.4051
MACHINE ROOM EQUIPMENT - Motor generator - Motor generator	2	.1	0.628931	59.1195	94.54674
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake coil	2	.1	0.628931	59.74843	94.68839
MACHINE ROOM EQUIPMENT - Traction Machinery - Hoist motor - Hoist motor	2	.1	0.628931	60.37736	94.83003
SHAFT EQUIPMENT - Other shaft equipment - Buffer - Buffer switch	2	.1	0.628931	61.00629	94.97167
SHAFT EQUIPMENT - Shaft electrification	2	.1	0.628931	61.63522	95.11331
SHAFT EQUIPMENT - Shaft electrification - Pit stop switch	2	.1	0.628931	62.26415	95.25496

SHAFT EQUIPMENT - Shaft pulleys - Diverting pulley	2	.1	0.628931	62.89308	95.3966
SIGNALISATION - Car signalisation - Call button	2	.1	0.628931	63.52201	95.53824
SIGNALISATION - Car signalisation - Key switch	2	.1	0.628931	64.15094	95.67989
SIGNALISATION - Landing signalisation	2	.1	0.628931	64.77987	95.82153
SIGNALISATION - Landing signalisation - Call button	2	.1	0.628931	65.40881	95.96317
STEP BAND - Chain - Chain	2	.1	0.628931	66.03774	96.10482
STEP BAND - Step	2	.1	0.628931	66.66667	96.24646
CAR - Car positioning devices	1	.1	0.628931	67.2956	96.31728
CAR SLING - Diverting pulley - Diverting pulley	1	.1	0.628931	67.92453	96.3881
CAR SLING - Safety gear	1	.1	0.628931	68.55346	96.45892
CAR SLING - Safety gear - Safety gear mechanical	1	.1	0.628931	69.18239	96.52975
CONTROL SYSTEM - Other electrical component - Circuit breaker	1	.1	0.628931	69.81132	96.60057
COUNTERWEIGHT - Guide shoe	1	.1	0.628931	70.44025	96.67139
COUNTERWEIGHT - Guide shoe - Roller guide	1	.1	0.628931	71.06918	96.74221
DOORS AND ENTRANCES - Car Door	1	.1	0.628931	71.69811	96.81303
DOORS AND ENTRANCES - Car Door - Car door operator	1	.1	0.628931	72.32704	96.88385
DOORS AND ENTRANCES - Car Door - Car door operator - Car door operator	1	.1	0.628931	72.95597	96.95467
DOORS AND ENTRANCES - Car Door - Car door operator - Door operator motor	1	.1	0.628931	73.58491	97.0255
DOORS AND ENTRANCES - Car Door - Car door safety devices - Closing force limiter	1	.1	0.628931	74.21384	97.09632
DOORS AND ENTRANCES - Car Door - Car door safety devices - Safety edge	1	.1	0.628931	74.84277	97.16714
DOORS AND ENTRANCES - Car Door - Top-track, panels and sill - Panel	1	.1	0.628931	75.4717	97.23796
DOORS AND ENTRANCES - Car Gate - Guide shoe	1	.1	0.628931	76.10063	97.30878
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Anti-tip roller	1	.1	0.628931	76.72956	97.3796
DOORS AND ENTRANCES - Landing Door - Top-track, panels and sill - Sill	1	.1	0.628931	77.35849	97.45042
DOORS AND ENTRANCES - Swing door - Panels and sill	1	.1	0.628931	77.98742	97.52125
DRIVE SYSTEM - Drive system wiring	1	.1	0.628931	78.61635	97.59207
DRIVE SYSTEM - Other electrical component	1	.1	0.628931	79.24528	97.66289
DRIVE SYSTEM - Other electrical component - Circuit breaker	1	.1	0.628931	79.87421	97.73371
DRIVE SYSTEM - Other electrical component - Regenerative device	1	.1	0.628931	80.50314	97.80453
DRIVE SYSTEM - Other electrical component - Voltage regulator	1	.1	0.628931	81.13208	97.87535
DRIVES, STATIONS, TRACK SYSTEM - Return Stations - Lower return station - Chain tension device	1	.1	0.628931	81.76101	97.94618
ELECTRICAL SYSTEM	1	.1	0.628931	82.38994	98.017
ELECTRICAL SYSTEM - Controller	1	.1	0.628931	83.01887	98.08782
ELECTRICAL SYSTEM - Controller - Contactor	1	.1	0.628931	83.6478	98.15864
ELECTRICAL SYSTEM - Safety circuit and switches	1	.1	0.628931	84.27673	98.22946
FLOOR, COMB CARRIER - Access cover	1	.1	0.628931	84.90566	98.30028
FLOOR, COMB CARRIER - Comb carrier - Comb carrier	1	.1	0.628931	85.53459	98.3711
GUIDE RAILS - Counterweight rail	1	.1	0.628931	86.16352	98.44193
GUIDE RAILS - Pulley rail	1	.1	0.628931	86.79245	98.51275
HANDRAIL SYSTEM - Handrail	1	.1	0.628931	87.42138	98.58357
HANDRAIL SYSTEM - Handrail drive	1	.1	0.628931	88.05031	98.65439
MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Hydraulic machinery	1	.1	0.628931	88.67925	98.72521
MACHINE ROOM EQUIPMENT - Hydraulic Machinery - Power unit - Motor blower	1	.1	0.628931	89.30818	98.79603
MACHINE ROOM EQUIPMENT - Motor generator - Winding	1	.1	0.628931	89.93711	98.86686

MACHINE ROOM EQUIPMENT - Traction Machinery	1	.1	0.628931	90.56604	98.93768
MACHINE ROOM EQUIPMENT - Traction Machinery - Brake - Brake switch	1	.1	0.628931	91.19497	99.0085
MACHINE ROOM EQUIPMENT - Traction Machinery - Tachometer, encoder and resolver - Resolver	1	.1	0.628931	91.8239	99.07932
PERIPHERAL DEVICES - Emergency lighting - Emergency push button	1	.1	0.628931	92.45283	99.15014
ROPE ASSEMBLIES - Compensation rope and chain	1	.1	0.628931	93.08176	99.22096
ROPE ASSEMBLIES - Hoist rope suspension	1	.1	0.628931	93.71069	99.29178
SAFETY SIGNS, CLADDINGS, DECKINGS, BALUSTRADES - Balustrade - Glass	1	.1	0.628931	94.33962	99.36261
SHAFT EQUIPMENT	1	.1	0.628931	94.96855	99.43343
SHAFT EQUIPMENT - Governor	1	.1	0.628931	95.59748	99.50425
SHAFT EQUIPMENT - Governor - Governor mechanical	1	.1	0.628931	96.22642	99.57507
SHAFT EQUIPMENT - Other shaft equipment - Balancer	1	.1	0.628931	96.85535	99.64589
SHAFT EQUIPMENT - Other shaft equipment - Buffer - Buffer	1	.1	0.628931	97.48428	99.71671
SHAFT EQUIPMENT - Other shaft equipment - LPT (Low pit / top) device	1	.1	0.628931	98.11321	99.78754
SIGNALISATION - Car signalisation - Car indicator unit - Positioning indicator	1	.1	0.628931	98.74214	99.85836
SIGNALISATION - Landing signalisation - Key switch	1	.1	0.628931	99.37107	99.92918
STEP BAND - Connector	1	.1	0.628931	100	100
grand total	1412				

Table 38:table for pareto and ABC chart based components