Report/ *Relatório*

Rotational Stage in Operations and Maintenance Units of an Elevator and Automatic Escalators Enterprise in Brazil

Estágio Rotacional em Unidades de Operaçãoes e Manutenção em uma Empresa de Elevadores e Escadas Rolantes Automáticas no Brasil

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If the reader finds any error, incompletion or ambiguity, please help to improve the document by sending your comments to José Fredriksson (eng.fredriksson@gmail.com)

List of contents

Abbraviations

ABNT	Associação Brasileira de Normas Técnicas
ART	Anotação de Responsabilidade Técnica –
CONFEA	Conselho Federal de Engenharia e Agronomia
CAD	Computer Aided Design
EN	Eurpean Norm
ERP	Enterprise Resource Planing
IPD	Ditigital Position Indicator/ *Indicador de posição digital*
KPI	Key Performance Indicator
NBR	Norma Brasileira
NM	Norma Mercosur
MRP	Material Requirement Planing
Obs.	Observation
OM	Manufacturing Order/ *Ordem de Manufatura*
PCP	Production Control Plan/*Plano de Controle de Produção*
PM	Permanent Magnets
PO	Order/ *Ordem de Pedido*
QC	Quality Contronl
RIA	Annual Inspection Report/ *Relatório de Inspeção Anual*
V	Volts
VA	Code for a Document Alteration/*Villarta Alteração*
VVVF	Variable-Voltage/Variable-Frequency

Symbols

a	Accelearation [m/s^2]
F_C	Counterwieght load [N]
F_N	Nominal cabin load [N]
j	Jerk [m/s^3]
h	Height [m]
s	Distance [m]
t	Time [s]
T	Temperature [°C]
v	Velocity [m/s]

Note:

There present report is written mainly in English. However, some sections, abbreviations and standards are referred to in Portuguese.

Nota:
O presente relatório é escrito principalmente em inglês. Não obstante, algumas seções, abreviações e normas são referenciadas em português.

Abstract

The present report contains information about the tasks and works during the stage in Operations, Maintenance and Services units of an elevator and escalator company. It shows several types of machinery equipment of Elevator Types, Escalators and passenger Conveyors that are contained in the company's portfolio. Relevant Brazilian Standards (many derived from European) are referred in the content. Based on them, improvement potentials are identified and solutions are suggested.

Goals

- Get familiar with Standards, Technology and Services to create an emphasis on good practices, responsibility, trust, credibility and guarantee of quality for customers
- Understanding the synergy of different operating units in the elevator and escalator services
- Point out and suggest improvement or optimization potential in Operation and Maintenance (O&M) Services according to the new learnings

Elevadores Villarta Company

Elevadores Villarta Co. is a national Brazilian reference in the market of Elevators and automatic Escalators. The family company is since 1985 in the market, when it started its services in maintenance of elevators. Today it offers efficient solutions for vertical elevation projects in 20 units distributed between São Paulo, Rio de Janeiro, Minas Gerais, Paraná and the Federal District, in addition to representatives throughout Brazil.

The headquarters are located in São Paulo City and its main factory in Taubaté. Only in São Paulo City, Villarta owns and attends more than 3000 equipments between Installation, Maintenance, Modernization and other Services. The company's mission is to be the Brazilian's benchmark in services for vertical elevation with highest customer satisfaction. All of this under three principles and philosophies:

- **Viva a Vida:** Which puts safety and health integrity above all for personal and costumers
- **Vamos Pra Cima**: That highlights the proactive attitude to lead, mark and deliver best services
- **Tamos Juntos:** Aiming highest collaboration and transparency of all functionaries to perform best know-how on every step

Abstrato

O presente relatório contém informações sobre as tarefas e trabalhos durante o stagio em Operações, Manutenção e Serviços de uma empresa de elevadores e escadas rolantes. Ele mostra vários tipos de equipamentos de Elevadores, Escadas Rolantes e Transportadores de passageiros que estão contidos no portfólio da empresa. Normas Brasileiras relevantes (algumas derivadas da Norma Europa) são referidas no conteúdo. Com base nelas, são identificados os potenciais de melhoria e sugestões de soluções.

Objetivos

- Familiarizar-se com Normas, Tecnologia e Serviços para criar uma ênfase nas boas práticas, responsabilidade, credibilidade e garantia de qualidade para os clientes
- Entendimento da sinergia de diferentes unidades operacionais nos serviços da empresa
- Apontar e sugerir potencial de melhoria ou otimização em Serviços de (O&M) de acordo com os novos conhecimentos

Empresa Elevadores Villarta

A Elevadores Villarta é uma referência nacional brasileira no mercado de Elevadores e Escadas Rolantes automáticas. A empresa familiar está no mercado desde 1985, quando iniciou seus serviços de manutenção de elevadores. Hoje oferece soluções eficientes para projetos de elevação vertical em 20 unidades distribuídas entre São Paulo, Rio de Janeiro, Minas Gerais, Paraná e o Distrito Federal, além de representantes em todo o Brasil.

A sede está localizada na cidade de São Paulo e sua principal fábrica em Taubaté. Somente na cidade de São Paulo, Villarta possui e atende mais de 3000 equipamentos entre Instalação, Manutenção, Modernização e outros Serviços. A missão da empresa é ser a referência brasileira em serviços de elevação vertical com a maior satisfação do cliente. Tudo isso sob três princípios e filosofias:

- **Viva a Vida:** O que coloca a segurança e a integridade da saúde acima de tudo
- **Vamos Pra Cima:** Que destaca a atitude proativa para liderar, marcar e prestar os melhores serviços
- **Tamo Juntos:** Visando a mais alta colaboração de todos os funcionários para efetuar con melhor know-how cada etapa e transparencia

1. Introduction

This report shows the tasks, the technologies and the results that were a focus in the stage period. Technologies described and included, represent only an extract of the many technical variants of for example: engines, cabin configurations, pulleys, doors, sensors, etc. The report ticks to the state of the art and emphasizes at times more in-depth details such as innovative features and technical data.

The report gives a technical background on the working principle of elevators and includes a protocol of the equipment visited, as well as a day-to-day record of tasks in the appendix. Subsequently, the Stage-Stations are described including observations of improvements per section. Reference is also made to relevant technical standards and bureaucratic documentations (e.g. types of contract, reports required for prefecture and technical catalogues).

The goal of this rotational internship is the integration into the business of elevator and escalator services. Results can be seen on tables, numbers and diagrams in the content. The information presented here are numbers recorded during field time and equipment inspections. This, in collaboration of the Maintenance, Installation, Modernization, Electrical and Technical Assistance departments. Villarta´s portfolio covers from low, to medium, to heavy traffic duty lifts, for domestic use, offices, airports, hotels and public buildings. So this report will have the purpose to reflect as much of those application as the time allows.

2. Technical Framework

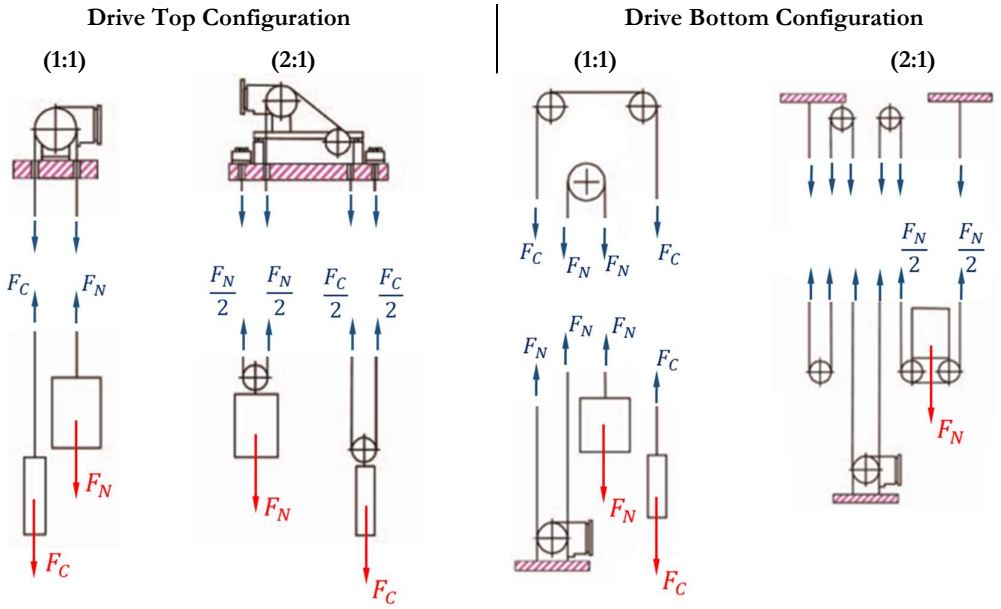


Figure 1 Configurations of electric elevator with pulley systems: 1 to 1 transmission and 2 to 1 transmission [1]

The task of an elevator is the vertical transport of a nominal load both upwards and downwards. In order to perform this task, a mechanical structure and an energized system capable of transporting the load are required. The most conventional forms distinguish between two types of lifts: electric and hydraulic, each with its own variations. The first, implement a pulley system where the principle of "what is saved in work is invested in distance" applies. Figure 1 shows variants in Simplex (1:1) or Duplex (2:1) configurations; further systems have a 4:1 and 8:1 traction. By implementing a system with more pulley elements the force required to move a load would decrease and with this the energy used in the process. However, a larger number of pulleys will imply a longer rope or cable to move

the load the same distance. The complexity of installation, the accuracy and cost of investment increase also with higher traction systems.

The inner tension force in the cable is given with the traction value. Specifications demand the counterweight[2] mass to be approximately 50% more heavy than the nominal mass of the cabin: $F_c = 1.5 \cdot F_N$ (this value is recalculated for each new project with a higher accuracy). Figure 1 differentiates these two forces to exemplify; however, the tension force is constant true the cable.

In a $1:1$ system, to move a mass to a height h, the required distance s would be equal $s = h$. Instead, a $2:1$ system requires 2-times the distance to achieve the required height: $s = 2 \cdot h$. The same would apply for a $n:1$ system: i.e. $s = n \cdot h$. This counts for the top-drive configurations. Figure 2 introduces now the sections of an elevator and main components:

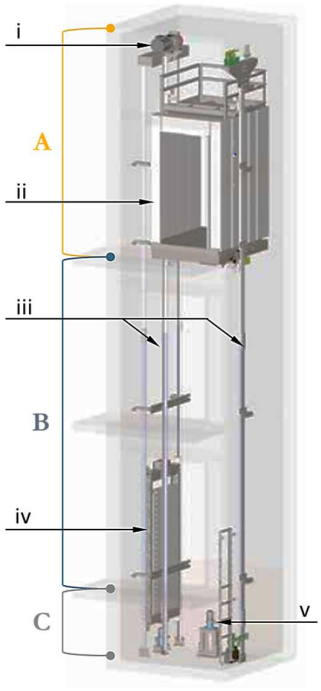


Figure 2 Elevator Elements at the example of a Compaq Slim machine room less [2]

Section:

A. Last height
B. Shaft
C. Pit

Component:

i. Lift machinery space
Modern lifts are equipped with compact gearless and oil-free traction machines. This reduces noise and energy consumption.

ii. Cabine
It is formed by different panels and its interior offers wide combinations of textures and materials

iii. Guiding rails
The guides are fixed on the lift pathway for the cabin and the counterweight.

iv. Counter weight
The counterweight has the function of helping the lift cabin to ascend and descend without the need for traction force from the machine

v. Shock absorber
Impact buffering system according to international standards that minimizes damage in case the cabin exceeds its route limit

Regarding the kinematics of an elevator system, four parameters are important. Acceleration a, velocity v and position s, which are given in the equations motion in dependence of time t. The jerk j, is the first derivate of the acceleration to the time and measures the comfort sensation while acceleration is experienced during trajectory.

$$j(t) = \frac{da}{dt} \quad (1) \qquad v(t) = a(t) \cdot t + v_0 \quad (2)$$

$$a(t) = \frac{dv}{dt} \quad (3) \qquad s(t) = \frac{1}{2}\, a(t) \cdot t^2 + v_0 \cdot t + s_0 \quad (4)$$

Modern elevators implement an VVVF (Variable-Voltage/Variable Frequency) systems, which can regulate the signal frequency of all this parameters at any point of the transport. This component is one of the most frequent elements in the control system to be attached as modernization feature

[2] **NBR 16858-1,** Counterweight: an assembly formed by a frame, masses and accessories designed to counterbalance the weight of the car and part of the nominal load, ensuring traction

of older elevators. The velocity curve, for example, would be continuous and round curve compared to the one shown in Figure 3. This gives a higher comfort and control during every trajectory.

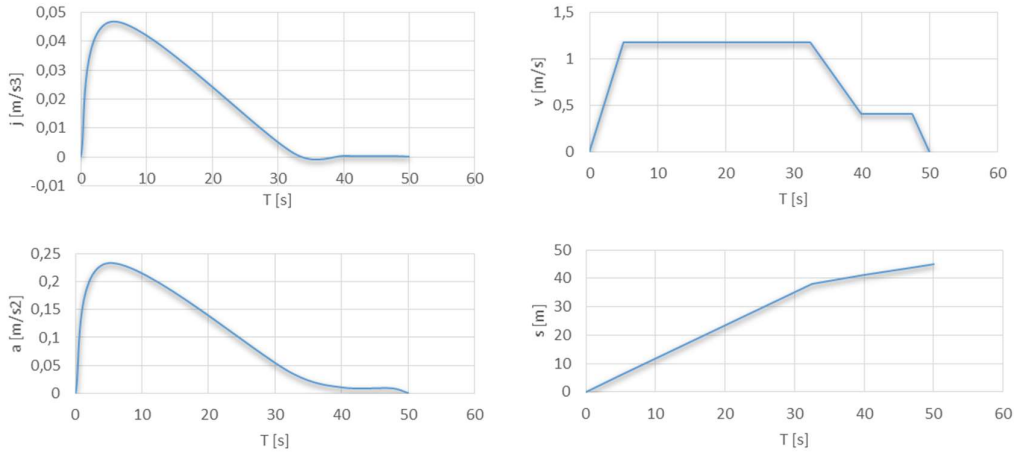


Figure 3 Kinematic and comfort parameters at the example of a 45 m long trajectory in time

2.1 Overview of vertical transport samples

This section shows selected equipment, which was part of the accompaniment of Villarta´s interventions at different costumers. Here it is possible to recognize electric and hydraulic elevator variants that are under monitoring, maintenance, modernization or installation.

2.1.1 Older elevators with machine room

a)  b) 

Figure 4 a) Motor with pinion shaft for 15 floor-building b) control cabinet with relais contacts from the year (1987) (photo, 12.2020)

2.1.2 Modern elevators with machine room

a)  b) 

Figure 5 a-b) Both new installed drives with infinite transmission to the pulley system

2.1.3 Modern (gearless) elevators without machine room

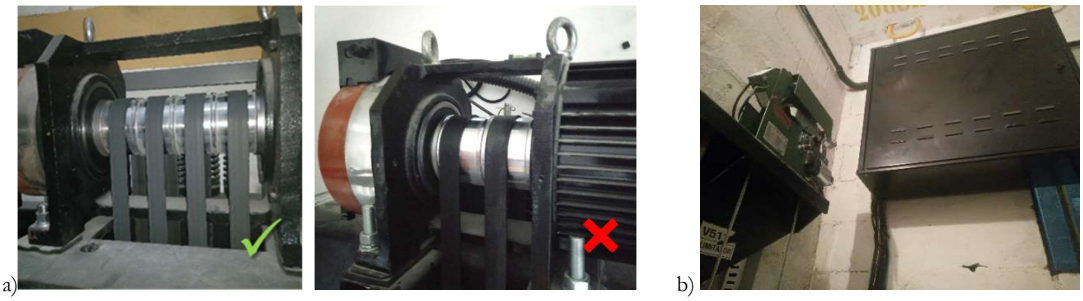
a)  b)

Figure 6 a) Compact drive with belts (instead of steel cables) and minimize drive space for a 5 floor-building (✓observation: belts should be centered to each axis section during operation by standard) b) speed governor (i.e. major security actuator against fall, present in all elevators) and Villarta´s compact control box (photo; 01.2021)

2.1.4 Light Freight Elevator

a)  b) c)

Figure 7 a-b) Cargo elevator with max load m_{max}=100 kg c) button panel and display and ´guillotine´ door mechanism (photo, 19.01.2021)

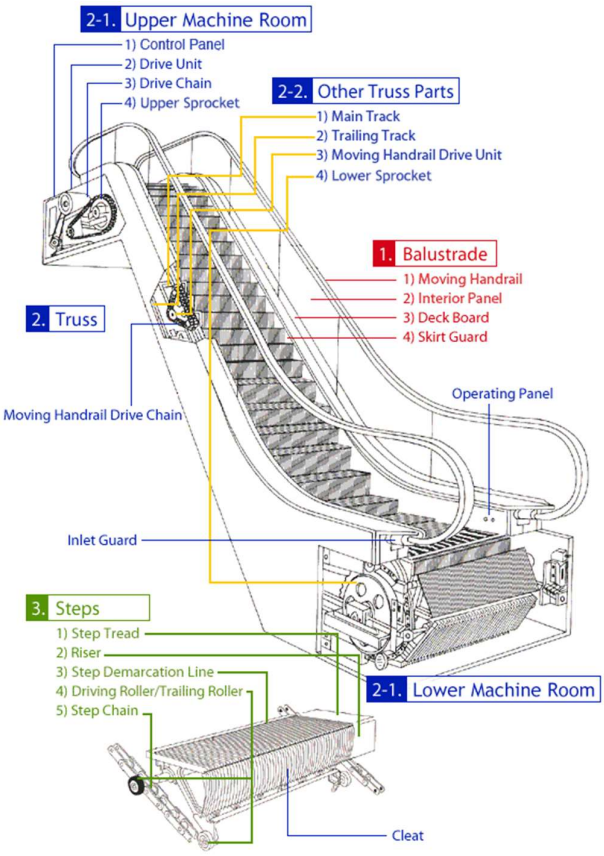
2.1.5 Hydraulic Elevators

a)  b) c)

Figure 8 a) Piston top with wheel and steel cables b) driven piston c) Oil reservoir and cooling fan (photo, 12.2020)

2.1.6 Escalators and Passenger Conveyors

a)



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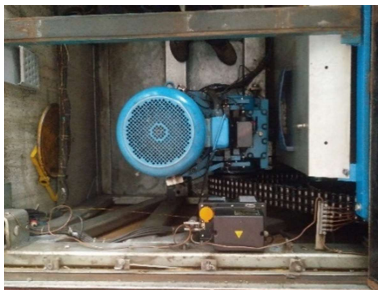

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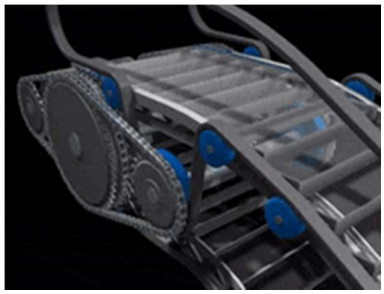

d)

Figure 9 a) Elements of an automatic escalator [3] b) Upper machine room: Drive and chain-to-upper sprocket transmission c) Detail of dynamic system [4] d) Lower machine room: guiding rail of trailing roller

Escalator: A staircase-like structure consisting of a continuous succession of mechanically operated, one-way stair treads used to transport people between two defined levels [1]. It has side balustrades and continuous handrails that move at the same speed as the steps.

Passenger Conveyor: It shares the same structure as the stairway, however, the boards that constitute it are flat (without the shape of a step) which gives the system the appearance of a continuous plane. There are two basic types of platforms: horizontal platforms that are implemented for the rapid transport of people over long distances (e.g. in airports) and those with a small angle of inclination, especially designed for the transport of people with trolleys between different levels in shopping centers [1].

2.2 Standards: Requirements for Safety in Installation and Construction

For the elevators and escalators industry in Brazil, there is a wide range of standards to assure safety to users and to the equipment. The *Norma Brasileira (NBR)* is the prevailing technical standard issued and regulated by the *Associação Brasileira de Normas Técnicas (ABNT)*. Some Standards also extent to the South American region, which comply to the *Normas Mercosusl (NM)* This subsection sums up the most important Standards to be attended for installation, construction and maintenance.

ABNT NBR 16858-1 :2020 (EN 81-20)	Safety rules for the construction and installation of lifts — Lifts for the transport of persons and goods. Passenger and goods passenger lifts *Requisitos de segurança para construção e instalação Parte 1: Elevadores de passageiros e elevadores de passageiros e cargas*
ABNT NBR 16858-2 :2020 (EN 81-50)	Safety rules for the construction and installation of lifts – Examinations and tests. Design rules, calculations, examinations and tests of lift components *Elevadores — Requisitos de segurança para construção e instalação Parte 2: Requisitos de projeto, de cálculos e de inspeções e ensaios de componentes*
ABNT NBR MN 207 [3] (EN 81-1/2)	Electric elevators for passengers – Safety rules for the construction and installation *Elevadores elétricos de passageiros – Requisitos de segurança para construção e instalação*
ABNT NBR MN 267 [2]	Hydraulic lifts of passengers – Safety requirements for construction and installation *Elevadores hidráulicos de passageiros – Requisitos de segurança para construção e instalação*
ABNT NBR 16042 [2]	Electric passenger elevators – Safety rules for the construction and installation of machine room less lifts *Elevadores elétricos de passageiros – Requisitos de segurança para construção e instalação de elevadores sem casa de máquinas*
ABNT NBR MN 313 (EN 81-70)	Passenger elevators (lifts) – Safety rules for the construction and installation – Particular applications for passenger elevators. Acessibility to elevators for persons including persons with disability *Elevadores de passageiros – Requisitos de segurança para construção e instalação – Requisitos particulares para a aacessibilidade das pessoas, incluindo pessoas com deficiência*
ABNT NBR NM 12892	Elevator (lift) for private residence or for restricted use by persons with disability - Safety requirements for construction and installation *Elevadores unifamiliares ou de uso restrito à pessoa com mobilidade reduzida - Requisitos de segurança para construção e instalação*
ABNT NBR MN 195	Escalator and passenger conveyors – Safety rules construction and installation *Escadas rolantes e esteiras rolantes – Requisitos de segurança para construção e instalação*
ABNT NBR 16083 (DIN EN 13015:2001)	Maintenance for lifts, escalators and passenger conveyors - Rules for maintenance instructions *Manutenção de elevadores, escadas rolantes e esteiras rolantes — Requisitos para instruções de manutenção*
ISO 14798	Lifts, escalators and moving walks -- Risk assessment and reduction methodology *Elevadores, escadas rolantes e esteiras rolantes - Avaliação de risco e metodologia de redução*
ABNT NBR 17240	Fire detection and alarm systems - Design, installation, commissioning and service of fire detection and alarm systems *Sistemas de detecção e alarme de incêndio – Projeto, instalação, comissionamento e manutenção de sistemas de detecção e alarme de incêndio – Requisitos*

[3] Standards merged into new **ABNT NBR 16858-1/2:2020**. It is to be fully complied by June 2022.

3. Rotation Stages

This chapter summarizes the knowledge gained in each department of the rotational program (see Annex: A Stage Plan). It includes observations, suggestions and lessons-learned regarding practices or procedures experienced during the stage. In some cases, these observations may be subjective due to the short time spent at each station. However, it is considered pertinent to point out some improvements in order to encourage those developments in the company. An overview of the tasks completed in the stage is contained in Annex: B Daily Protocol as a daily record.

3.1 Maintenance of Elevators and Escalators

In the beginning, Villarta Co. used to specialize on maintenance services. This gave a solid fundament for today's success and special expertise. Nowadays this branch remains as one of the most solid services. The definition is to be understood as follows:

> **Maintenance (NBR16083):** all operations, preventive and corrective, considered necessary for the proper and safe function of the installation and of its components, after completed the installation and during its "useful life" of some components, determining […] the time or condition in which the operation or integrity of each component is no longer assured, even if properly maintained.

The company emphasizes in:

- **Preventive Maintenance:** periodical (monthly, trimestral and annual) inspections and maintenance works to assure the functioning of the equipment. Includes inspection of cabin top and bottom, doors, motor, emergency lights, lubrication of guiding rails, cables, electronics, pit, counterweight, interphone, etc.
- **Corrective Maintenance:** 24 hours service to correct and assist any technical failure during operation. Eventual trapped persons in elevators are assigned as priority number one for this division at any time.

The services are agreed with the costumers and regulated by different types of contract, as follows:

- *Without parts:* It does not include the repair or replacement of parts necessary for operation of the lift or the services linked to these replacements or repairs. Also, it does not include major services outside the scope of preventive maintenance.
- *Partial:* it includes the repair or replacement of specified parts
- *Integral with parts:* it includes the repair or replacement of all parts required for the operation of the lift(s). In addition, there are items where the contract covers repair only

All elevators, in order to operate accordingly to the mandate of Standards should have a corresponding certified maintenance entity able to respond to any incident caused in the elevator**.**

As part of the stage, several clients where provided with the service. A relevant lesson-learned follows next:

Procedure of Intervention:

1) Presentation to client and present personal
2) Inform about the day´s intervention (preventive/corrective/inspectional)
3) Attend **Safety access protocol for an elevator** (shutdown Energy, open door to pit 15cm, close door, call and wait reaction, check if manual/inspection modus is working, when secure and elevator does not respond to external signals to operate → access secured)
4) Proceed to intervention and Fill Equipments Protocol Maintenance sheet at the end
5) Documentation (via *Ficha Técnica, Ordem de Serviço* or *Btime App*) and signature of client.

3.2 Escalators and conveyors unit

In this unit, the main task was to identify, why the unit is not working as expected. The unit is conformed of 8 technicians that fulfill tasks in corrective and preventive maintenance, as well as in new installations of escalators and conveyors. To understand in a week the way of work and optimization potential, a few data is collected during the intervention periods. To offer more precise arguments on how to improve the performance of the unit, a continuous follow up of the Quantity and Time of interventions should be done over a period of 4 weeks.

The team work strong together, supportive with each and are highly capable of full filling their tasks.

In the week of the stage the unit mainly had preventive interventions, two calls in a day and no modernization or installation services. The following results show only a period of a week, It is important to consider the performance of the one before and the following to it, for a better overview. It is also to remark, that the team has worked and works on weekends and extraordinary hours to accomplish installation works. Also some preventive interventions are constrained by the time of disposition of the client.

The unit serves preventive maintenance in 129 equipment. Each equipment is to be maintained according to the contract 1 time per month. This sets an objective for a service of 30 equipment per week or, 6 equipments per day, by the whole team (it can be also considered as a **simple Key Performance Indicator KPI**). Table 1 shows the number of equipment intervened through the week on the different routes. The KPI reaches 26 (87%) of conformity, leaving 4 (13%) equipments without maintenance for this week. Figure 10 complements Table 1 and shows a daily goal vs. the actual status of interventions. This in the framework of preventive maintenance. **Not full-filled tasks will have to be added to the goals of next week.** Regarding corrective maintenance, only two calls were to attend.

The time in Figure 11 of each day was recorded to be able to show a tendency of time distribution during a workday of 9:00h (including 1:00 of lunch). Time values are estimated as the mean value of the tasks during the week.

3.2 Unidade Scadas e Steiras de passageiros

Nesta unidade, a principal tarefa era identificar, por que a unidade não está funcionando como esperado. A unidade é formada por 8 técnicos que cumprem tarefas de manutenção corretiva e preventiva, bem como em novas instalações de escadas rolantes e transportadores. Para entender em uma semana a forma de trabalho e o potencial de otimização, alguns dados são coletados durante os períodos de intervenção. Para oferecer argumentos mais precisos sobre como melhorar o desempenho da unidade, deve ser feito um acompanhamento contínuo da Quantidade e do Tempo das intervenções durante um período de 4 semanas.

A equipe trabalha forte em conjunto, apóia cada um e é altamente capaz de realizar suas tarefas de acordo com determinados acordos de manutenção.

Na semana da etapa, a unidade teve principalmente intervenções preventivas, duas chamadas em um dia e nenhum serviço de modernização ou instalação. Os resultados a seguir mostram apenas um período de uma semana, É importante considerar o desempenho do anterior e do seguinte, para uma melhor visão geral. É também de se destacar que a equipe trabalhou e trabalha nos finais de semana e horas extraordinárias para realizar os trabalhos de instalação. Também algumas intervenções preventivas são condicionadas pelo tempo de disposição do cliente.

A unidade atende a manutenção preventiva em 129 equipamentos. Cada equipamento deve ser mantido de acordo com o contrato 1 vez por mês. Isto estabelece um objetivo para um serviço de 30 equipamentos por semana ou, 6 equipamentos por dia, por toda a equipe (também pode ser considerado como um simples **KPI - Key Performance Indicator**). A Tabela 1 mostra o número de equipamentos que intervêm durante a semana nas diferentes rotas. O KPI atinge 26 (87%) de conformidade, deixando 4 (13%) equipamentos sem manutenção para esta semana. A Figura 5 complementa a Tabela 1 e mostra uma meta diária versus o status real das intervenções. Isto no âmbito da manutenção preventiva. **As tarefas não realizadas terão que ser adicionadas às metas da próxima semana, aumentando assim a meta para aquela semana.** Em relação à manutenção corretiva, apenas duas chamadas deveriam ser atendidas.

O tempo na Figura 7 de cada dia foi registrado para poder mostrar uma tendência de distribuição do tempo durante um dia de trabalho de 9:00h (incluindo 1:00 de almoço). Os valores de tempo são estimados como o valor médio das tarefas durante a semana.

Table 1 Number of interventions per route and day in a week / *Número de intervenções por rota e dia em uma semana*

Preventive Maintenance	11.01	12.01	13.01	14.01	15.01	*Σ Equipment per Route*	
Route of:*							
Alex and Antonio		2	2			*4*	
Cicero		2			1	*3*	
Diego	1					*1*	
Gleydson		4	5			*9*	
CPTM		2	4	3		*9*	
Σ Equipment per day	*1*	*10*	*11*	*3*	*1*	***26***	**(87%)**
						Δ -4	(13%)
Corrective Mantainance							
Alex and Antonio		2				2	

*Technicians route, Igor and Adriano cover interventions as well depending on other labors
Source: Technical Service Sheet

Table 2 Summary of on-site morning interventions of the week/ *Resumo das intervenções presenciais na manhã da semana*

	Marisa, Guarulhos	**CPTM, V.Aurelia**	**CPTM, Franco da Rocha**		**Sodimac, Convayors**
	11.01	12.01	13.01	14.01	15.01.2020
Quantity of Equipments	1	2	4	3	2
Hours morining intervention	**03:15 h**	**03:30 h**	**06:20 h**	**07:20 h**	**04:00 h**
start	*08:15*	*08:15*	*08:20*	*08:00*	*08:00*
arrive	*11:30*	*11:45*	*14:40*	*15:20*	*12:00*
Technicians on-site	**1**	**2**	**4**	**2**	**2**
Total hours of Team	**3,3 h**	**7 h**	**28,7 h**	**14,6 h**	**8 h**

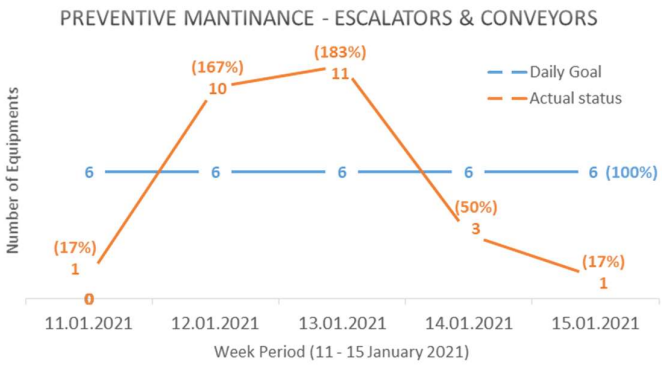

Figure 10 Goal of preventive interventions per week vs. actual interventions of the team in a week / *Meta de intervenções preventivas por semana versus intervenções reais da equipe em uma semana*

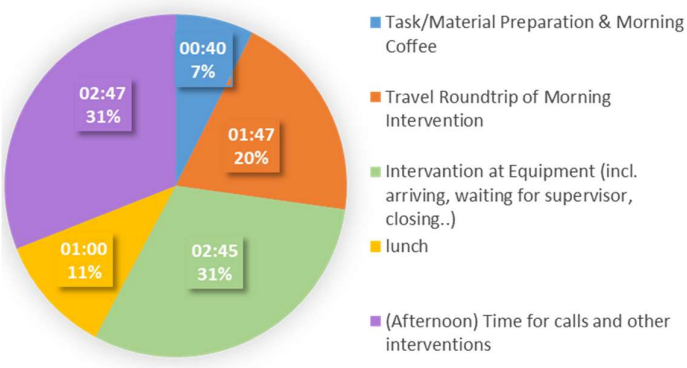

Figure 11 Task time of morning preventive maintenance intervention (Mean Value of Week) / *Tempo da tarefa da intervenção de manutenção preventiva matinal (Valor médio da semana)*

3.2.1 Observations & Suggestions

- Transparency in documentation of interventions.
  - Let the team Visualize their Objective of day/week/month (Diagramms)
  - This can help easier evaluation of performance. Btime was no successfully implemented in this Unit. Following up "Service technical sheets" is the only way to know who did what, when and where.
  - Adriano suggests signing with Date on Intervention Board
  - "Pending Board". Should include date and be constantly actualized
  - Supervisors have to find a way to create transparency in the interventions in the afternoon. Only two calls where attend in a day in the whole week. This raises the question: What where all the workers doing in the afternoon, that did not attend corrective calls?
- Use proper Tools for corresponding task
  - Screwdriver as is used as lid-lifter and is totally bend. Use Iron lever.
  - Screwdriver used as a hammer. It broke its head, causing unnecessary degradation of tools. Use Rubber Hammer.
  - According to **NBR 16083** a copy of the standard should be taken to any intervention
  - According to **NBR 16083,** chalk is material to bring. One task was counting "degradus", they were marked with permanent marker. As the counting was over, the prints were not removed and client remained with marked equipment.
- Incentivize the respect of traffic laws (speed, passive driving, not yelling to other drivers,…). Reasons **Safety** and **Image of Villarta**
- **Substitute installation turtles for new ones**

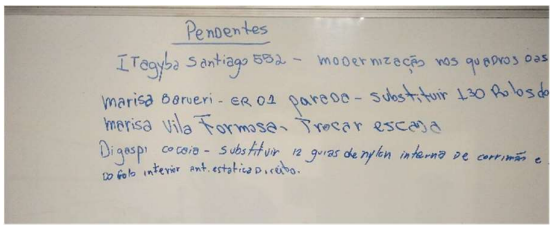

Figure 12 Pending Board/ *Lousa de Pendentes*

3.2.1 Observações e Sugestõess

- Transparência na documentação das intervenções como uma melhoria potencial.
  - Deixar a equipe visualizar seu Objetivo de dia/semana/mês (Diagramas)
  - Isto pode ajudar a facilitar a avaliação do desempenho. O Btime não foi implementado com sucesso nesta Unidade. O acompanhamento das "fichas técnicas de serviço" é a única maneira de saber quem fez o quê, quando e onde.
  - Adriano sugere assinar com a Data na Tábua de Intervenção
  - "Lousa de Pendentes" Deve incluir data e ser constantemente atualizado
  - Os supervisores têm que encontrar uma maneira de criar transparência nas intervenções da tarde. Apenas dois telefonemas onde se atende em um dia durante toda a semana. Isto levanta a questão: O que todos os trabalhadores fazem à tarde, que não atenderam às chamadas corretivas?
- Usar as ferramentas adequadas para a tarefa correspondente
  - Chave de fenda como é usada como levantador de tampa é totalmente dobrada. Usar alavanca de ferro.
  - Chave de fenda usada como martelo. Ela quebrou sua cabeça, causando degradação desnecessária das ferramentas. Usar martelo de borracha.
  - A **NBR 16083** suggiere levar uma cópia da norma a qualquer intervenção
  - A **NBR 16083** suggiere, o giz como material a ser trazido. Uma tarefa era contar degraus, eles eram marcados com um marcador permanente. Como a contagem estava terminada, as marcas não foram removidas e o cliente permaneceu com o equipamento marcado.
- Incentivar o respeito às leis de trânsito (velocidade, direção passiva, não gritaria para outros motoristas,...). Razões de **segurança** e **imagem** de Villarta
- **Substituir as tartarugas para instalação por nouvas**

3.3 Technical Assistance

Unit composed of 2 employees and a part-time assistant, dedicated to immediate customer service. The unit attends client issues in the first line and activate inspection works, corrective interventions, prioritize eventual release of trapped people and eventualities for all equipments in the city of São Paulo. This unit mainly has three direct channels of information: externally from the customer and internally from the commercial and corrective maintenance department. The information flux according the functionaries is shown in Figure 13.

Information flux at operational level: Call Opening to Call Closing

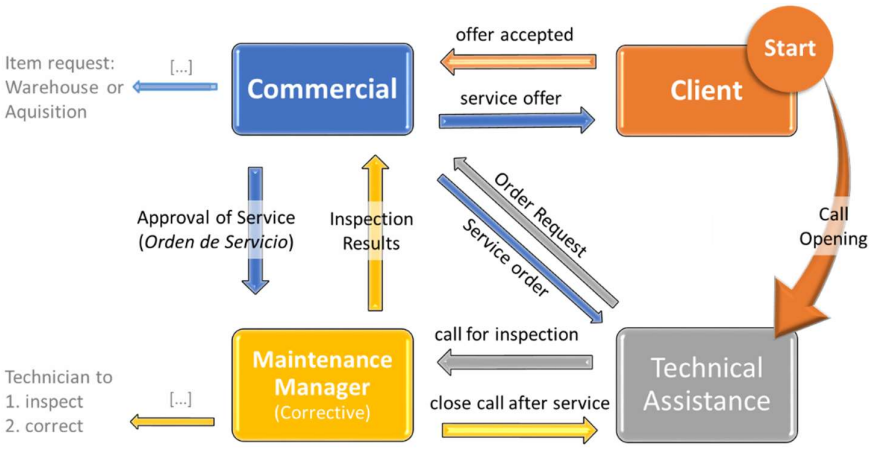

Figure 13 Information flux response to client´s technical call. Simplified sample of an approved intervention

Service Orders are generated in SAP and are the same as the "PO Orçamento".

Main tasks of functionaries:

- Opening a Call for Corrective Intervention
- Assign Tasks in B-Time to technicians
- Control of every single preventive and corrective intervention
- Documentation of Operational Services
- Activate intervention cases with Commercial and Maintenance Department
- Prefecture bureaucracy: RIA[4], ART [5].
- Technicians Mobilization (Via App 99)
- Conduct Performance/Status Reports of interventions in elevators and escalators
- Generation of "Order Request for Budgeting"

Tools for work: SAP, B-time, Technical Sheets (*Fichas Técnicas*), WhatsApp, Call-Control Sheet (*controle de chamadas*), Pending Board

RIA (*Relatório de Inspeção Anual*)**:** This document is regulated by the Prefecture authorities for companies to renew the permit of operation, which certifies that their equipments are under proper conditions to operate based on the required standards. The permit has to be renewed every two years. Not all Prefectures request this documentation; Sao Paulo does.

[4] http://ria.prefeitura.sp.gov.br/sd0244/Welcome.do

[5] https://www.confea.org.br/servicos-prestados/anotacao-de-responsabilidade-tecnica-art

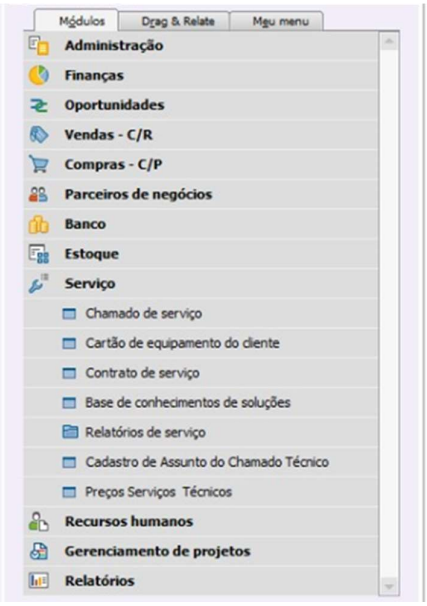

Figure 14 SAP interface for technical assistance service

Identified Problem: Response to sheet-reports for the RIA. The RIA is sent to the prefecture together with the ART (*Anotação de Responsabilidade Técnica*) document, which is regulated by the CONFEA (*Conselho Federal de Engenharia e Agronomia*). This document generates a cost and is covered, depending on agreement, by Villarta or the Lift Owner.

Observation. High number of equipment inspection were not concluded in 2020. Leaving a high workload for 2021. Inspections are only conducted by the supervisors of corrective and preventive maintenance (i.e. 2 functionaries). If they did "2 inspections per day they would be up to date" parallel to the other responsibilities. This observation has already been reported; subject needs a new accredited Supervisor. On average, there are 207 equipments between elevators and escalators...in Condominiums, Public Order, Companies, and Maintenance (with regularization).

3.4 Installation

Villarta offers the development of customized elevators for each project independently. In the case of new construction projects, Villarta also offers a close civil engineering support to costumers, thus assuring pre-installation phase conformity. Prevailing standards define dimensions of the shaft, the position of the beams and their resistance, the unevenness of the pavement, as well as the positioning of installation hooks at the end of the course to lift heavy items. This accompaniment is crucial to ensure the equipment´s installation according to the projected dimensions and to guarantee the staff´s safety on site. In addition, standards specify the clearance dimensions (*folgas*) that the equipment must have when installed on site in order to operate.

To coordinate these procedures in the numerous parallel projects, Villarta counts with engineering and inspector teams who work together with customers and installation technicians. At the same time, the team relies on a high-level collaboration with the commercial and warehouse departments to guarantee the on-time delivery of each component from each supplier. In other words, Villarta has a solid supply chain[6] and acts, in this respect, as a logistics company. As a preparation for this stage-phase, some documents were addressed for better understanding the project management strategy.

Documents of the Engineering Division for Installation and Inspection/ *Documentos da Divisão de Engenharia para Instalação e Inspeção*

- Operation and Assembly Manual/ *Manual Operação e Montagem*
- Check List Ajuste Final - Elevador Hidraulico, Elevador electrico e Plataforma/ *Check List Ajuste Final - Elevador Hidráulico, Elevador Elétrico e Plataforma*
- Check List of Safety and Machine Roomless Electric Elevator/ *Check List de Segurança e Elevador Elétrico Sem Casa de Máquinas*
- Constructor's Guidebook/ *Cartilha do Construtor*
- Installation and Commissioning/ *Instalaçao e comissionamento*
- Guarantee Booklet/ *Manual de Garantia*

[6] 80% of the equipment are imported raw materials or final products from (e.g. China or Europe)

For organizational and bureaucratic reasons with some construction companies, the installation week was productive to visit only one construction site in an advanced stage. Other visits were rather completed and ready to handover. On this construction site, an electric elevator was installed without machine room and with traction belts. The elevation was a three-way lift for office use. The accompanying day consisted of the installation of the operator's doors and two mechanisms with their respective support panels. According to the manufacturer of the doors (Fermator), the door type 40/10 estimates an installation time of 25 minutes per door for 1 technician [5]. On site, it took 6 hours to install 3 doors (1 operator, 2 mechanisms) with 2 technicians. The reason was numerous adjustments that the technicians had to make and unmake repeatedly. One assumption is that the alignment of the components could have been more precise. Figure 15 shows details of this work.

a)  b)  c) 

Figure 15 a) Floor-Door Installation b) Guiding and pulley structure during installation, yellow hooks installed by civil workers as prerequisite for installation c) Door protection example [6]

Another important task of the installation team is to make a final inspection. With this done, the work is handed over to the client and to the preventive maintenance unit. In this type of inspection, both the installation supervisor and the maintenance supervisor meet. The purpose of the inspection is to recognize minimum irregularities and technical details that may need to be corrected.

Obs. Control of hired third party Installation Team. We showed up to an installation to chek the advance and we realize that technicians were absent (were not there) the whole day, without acknowledgement or consent of supervisor. Suggestion: Introduce a monitory system for third party installation workforce and also an evaluation sheet of their Service Quality. (Include a Control of Assembly Time)

Obs. Demand proactively proper storage of equipment. A client's package set of new doors was damaged due to heavy rains. Reason was the location of the equipment in open space on a mudy area. It is however the clients responsibility to assure the safety of this products after delivery [7]. Villarta could, however, insist in a proper storage of the equipment to avoid major project set-backs.

3.5 Electronic and Modernization

During the rotations, both the electrical part of elevators and modernization works were carried out simultaneously, since a modernization project required a new installation of several electrical components. This work was mainly accompanied by two technicians and consisted of two outdated Atlas Schindler elevators in a 14-stop office building. Practical work was served in the following tasks:

- Installation of control panel with inverter and control board[7].

[7] NBR 5410-2004 - Low voltage electrical installations /*Instalações elétricas de baixa tensão*

- Installation of a transformer for the derivation of a DC direct current with a building input tension of 380 V.
- Modernization of the electrical circuit and maneuvering cable
- Cleaning of revolved oil in the cabin´s and counterweight´s guiding rails (~160 meters)
- Modernization of IPD's (Digital Position Indicator) and floor/cabin button panels
- Modernization of cabin lighting and installation of a Mirror
- Modernization of inspection box on the cabin´s top
- Electrical installation of shaft and shock absorber sensors
- Installation of Barrier sensors on the operator´s door
- Accompanying wiring of IPD and button panels
- Upgrading of stop limit sensors and door speed control sensors
- De-installation of Direct Current DC Generator
- De-installation of DC motor
- De-installation of old IPDs and button panels
- Installation of an asynchronous motor type WEG AC (Alternate Current)
- De-installation of stop selector (old contactor belt that operated the relays for each stop)

Figure 16 Before and after modernization of some components during rotation

The control cabinet in the machine room substituted the old outdated relais contact principle. Instead, it implements a much simpler configuration as shown in Figure 16. Important devices that are located in the command box are for example the following [1]:

- Control board, the real programmable "brain" of the lift from which all the orders are managed and the contactors are centralized.
- transformer, where the input voltage is adapted to the voltages used for the control system
- cab, shaft and machine room connections
- rectifier plate, where the alternating current is transformed into direct current for use by the control system
- thermoprobe plate, for temperature control of the electronic equipment
- control relays, control fuses, main switch, frequency inverter (optional)

Obs. Adopt Clear Planning of Modernization Phases. Works were carried out every day, but apparently without plan, in occasions sometimes time was not use efficiently. This is an observation to guarantee transparency in the project and to plan better the supply of material coming from the warehouse from Taubaté.

Obs. Electronic Laboratory. Introduce 5´S philosophy: Sort, Set in Order, Shine, Standardize, Sustain

3.6 Factory

The factory, of about 20.000 m² of area, follows a lean management concept for its production line. So it only produces when there is a manufacturing order (MO) approved by the corresponding team. In Villarta, the Production Control Plan (PCP) does this, which is the interface between technical project developers and production floor. The Taubeté Factory houses those highly specialized mechanical and civil engineering teams for the development of all elevator projects in accordance with the requirements of its customers. In addition, there are employees from the commercial, marketing areas and of course, the production team, which is in charge of coordinating and controlling the manufacturing of the elevators. Following working areas are located on the production floor:

1. Reception of raw material for production plant
2. Preparation of stainless steel or carbon steel sheets
3. Plasma sheet cutting machine
4. CNC stamping machines
5. Bending machines (thickness 1 mm - >26 mm)
6. Guillotines
7. Sheet metal bending machines
8. Manual welding station
9. Manual painting station
10. Ambient drying station
11. Assembly area for roof and floor frames, brakes, pulleys, cabin covering, etc.
12. Quality checkpoint for assembly, disassembly, packaging, etc.

In the same area:

13. An electrical laboratory that tests drives, assembles control panels and control interfaces.
14. Office of the production manager and machine programmer.

Continuous to production hall:

15. Warehousing of manufactured and imported products for expedition

Each day of the week had a different focus related to Engineering, Production, Service and Quality. This section gives a brief overview of the activities, but also intends to include observations that are more subjective than in the past stations.

Day 1: Intro Engineering, Project Management and PCP

- Introduction to the Factory: material flux in the production line and manufacturing process, Stock/Warehouse and Engineering Department.
- Introduction to relevant Documentation for each project development: Standards (*Normas*), Delivery Handbook/*Manual de Entrega*: Inspection of mechanical and electrical items before handing over according to Standards, Record/*Registro* (record of technical changes during lifetime of an Elevator), Technical Brief/*Dossiê Técnico* and Calculations.

Day 2: Calculations in compliance to NBR 16858:2020[8]

- Guiding Rails of Cabin, Guiding Rails of Counterweight, Mechanical Bulking (*Flambagem*), Maximal distances structure, Buffer Calculations, Traction of Cables, Mass distribution

Day 3: Handover tests of Installation and Electronic

- Accompaniment of electrical inspection on-site for final handover to customer and maintenance team
- Electronic Laboratory: assembly of Villarta´s control panel and command interfaces. Quality Check-Point of command box including motor run-test.

Day 4: Production

- Accompaniment of each manufacturing station: Plasma Cutter, CNC Stamp, Bender, Welding, Painting, Assembly of floor and roof structure with pulleys and breaks.

Day 5: Engineering

- Accompaniment of Mechanical CAD Designers, Documentation, Details Special Parts like structure and Emergency Breaks, Alteration Procedure of Documents, Creation of Part-lists

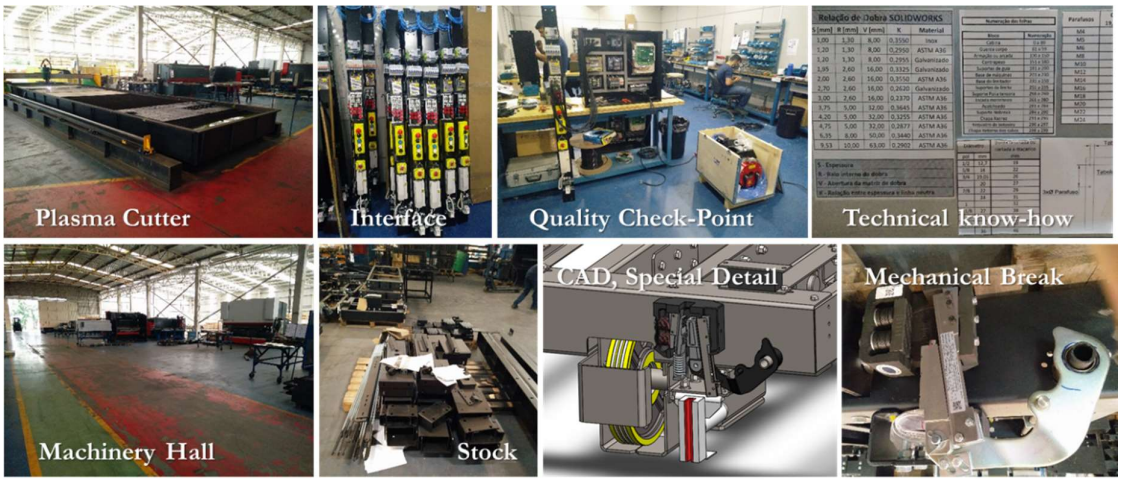

Figure 17 A week at Villarta Production Plant, Taubaté, Brazil

Summary of Observations/Suggestions:

- **Integration of Product Data Management (PDM)[9] in Engineering Department.** It helps to get design data under control and improve the way teams manage and collaborate on product development. Current Server "projeto" is been used, the system is working good, but since Villarta´s aim is to expand and offer new elevator developments, this tool may bring performance and qualitative advantages like: Creation of Libraries and Smart Part-list generation (see footnote). This suggestion is for a mid/long-term decision, since it might involve a higher financial requirement.
- **Integrate Auxiliary Hardware in Engineering Department:** 3D Mouse for CAD-Design: reduces hand movements, increases productivity while designing and brings an ergonomic feature for the designers.

- **Introduction of Constructor Design Book/ *Manual do Constructor*: (not to be misunderstood with the *Cartilha do Construtor*)** It is a document to reinforce standardization of Engineering Documents and Procedures. It mainly concerns mechanical

[8] Additional literature for elevator technology[8, 9]
[9]Product Data Management example: https://www.solidworks.com/product/solidworks-pdm

and civil CAD-Designers. It explains procedures, Standards to use for Part-lists, "VA" Document Alterations Procedures, How to Highlight those changes in the documents, Technical Drawings, Assembly Instruction Specifications, Design Data Tables of Tolerances used in Villarta´s Machines, Specification of Material rules, etc.

- **Production Hall: Since the production Hall is under expansion, it is understandable that some of the suggestions will make sense only when the prodcution floor has its final layout**

  Reinforce 5´S and Kaizen:
  - #VIVAVIDA not attended: (sparks of operational laser cutter fly on the transport pathway as a potential harm to a passant at the end!!!) → Apply a protection fence, for example like one similar to the welding section, see Figure 17 ´Plasma Cutter´
  - Same machine invades the transport pathway (i.e. red zone), see Figure 17 ´Laser Cutter´
  - Drying parts at Painting station also invade the transport zone. Developing Vertical Rack Structures could reduce the items per area (m^2)
  - Instruction of operational machines are degraded and with small letter (difficult of clarity). Perhaps an update of these instructions is coming as well as the signalization of each work station (e.g. At the assembly area, locate above a shield saying *´Assembly Area´* perhaps also *´Quality Check-Point´*).
  - Mark and define functional spaces for specific items…where they systematically belong (sorting)…Example Figure 17 ´Stock´, a mix of non-systematically organized items can be seen
  - Develop movable Racks for specific parts (e.g. instead of a horizontal positioning of the Standard Cabin Sheets, Pile them vertically on a movable rack)
- **Electronic Laboratory**: Electric Diagrams. Transformer drawings double check completeness of circuit; Technician precise; Panel is Quality Product, with many practical and safety features for equipment and personal

3.7 External Station: Training at Fermator Technoamerica

To conclude the rotational stage, Fermator, Villarta's main supplier of lift doors, hosted a 32h training with special emphasis on its product range: installation, production, quality and relevant technical data. The production plant in Taubaté, Brazil is responsible for attending the LATAM market, which covers all of South and Central America up to Mexico.

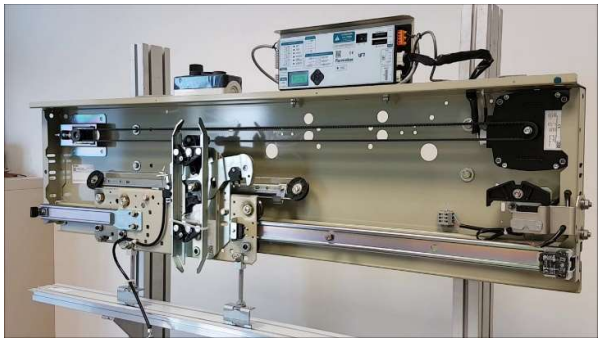

Figure 18 A Fermator Product: 40/10 PM Operator with Telescope Aperture, VVVF7 Module, Permanent Magnets (PM) Motor, Skates, Car Door Lock (CDL), Clips instead of Slides and Pit Egress Feature (Door Leafs excluded). Follows EN 81-20/50 [8]

Fermator Group is the leading mono-product manufacturer of automatic doors for lifts in the world and has customers present in more than 90 countries. With headquarters in Spain and production plants located in France, Italy, Poland, Greece, India, China and Brazil, the Fermator Group responds effectively to the demands of all markets requiring automatic doors for lifts resulting in a major worldwide market share. The automatic doors manufactured by Fermator comply with

International Standards: EN 81-20/50, ASME A17.1, GB 7588, and fire requirements EN 81-58 among numerous others [9].

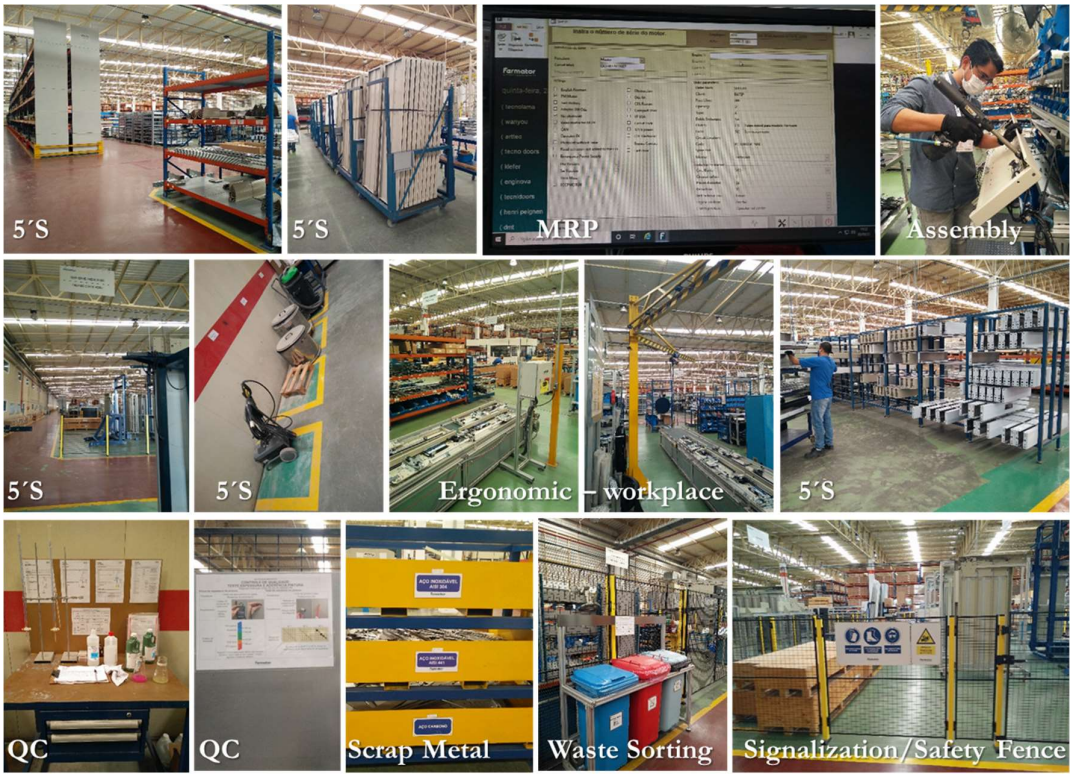

Figure 19 Automatic Elevator Doors Producer Fermator Technoamerica hosts a Training

Day 1. Introduction to manufacturing line, evident emphasis on Lean Manufacturing

Day 2. Training: VF5+ Module Training, Mechanical Parts-Design, Standard conformity Features, Quality Checkpoint Installation of Mechanism and Operator Doors

Day: 3. Training: Production Line tour with focus on Lean Manufacturing Features and Quality Control Procedures. Assembly and Quality Check of Operator and Mechanism

Day 4. Training Special Orders, Manual of Maintenance, Manual of Installation of Commodity products (40/10 PM, Premium, Bus, etc.)

Lessons-Learned:

- Doorframe installation and knowledge of programmable parameters in the VF5+ module.
- Assembly of Operator and Mechanism in the Production Line
- Quality Control and Assurance Procedures: "Quality does not bring any direct financial active to the company, but it assures that the products and the processes will do so"

Observations:

- Solid MRP Systems and Quality Control Checkpoints from reception, through manufacturing stations to expedition
- Highly Standardized Products which facilitate Kaizen in Production line
- Poka-Yoke reinforced with MO Verification System (QR-Scanning, Optical Metrics Verification, Semi-Automation of process, etc.)
- Implementation of ISO 14001 basically in each activity of the plant

4. Conclusion & Outlook

The content reports about a general understanding of how Operational and Maintenance units of an elevator and escalator company work. It also includes as part of the training suggestions for improvement, according to business practices and standards in force in Brazil for each station of the program. Advantageously, the rotation planning managed to include a period of one week at the Production Plant of Elevators of Villarta and an external training with focus on elevator doors at the Production Plant of Fermator Group, manufacturer of automatic elevator doors. This was an opportunity to consolidate all the knowledge acquired during the service interventions.

The numerous visits to customers and construction sites provided a broad overview of existing brands on the market, types of mechanisms and the reason for their designs thanks to the study of technical standards that are referred in this report. A majority of those sites had COMPACTQ type elevators from Villarta´s catalogue. That product is not only a standardized product, but it also represents the state of the art of that type of elevator. Particularly the maintenance, modernization and electrical phases allowed more practical involvement and assistance in the construction sites.

Working aside different supervisor teams and specialized technicians also helped to adopt characteristics in the approach to the customer that strongly promote transparency, accountability and credibility. This been one valuable lesson-learned. On the engineering side, it was also favorable to note lessons-learned regarding calculations of kinematic parameters and mechanical development of elevators according to the new ABNT standard NBR 16858-1/2:2020 largely derived from EN 81-20/50. In the weeks on the factory floor it was possible to observe a substantial part of the Lean Manufacturing ideology and the implementation of ISO 9001 and ISO 14001 standards in both visited plants.

Regarding the observations and suggestions made, it is reiterated that some of them can be considered subjective due to the period planned for each stage. However, it is relevant to point out some of them, whose implementation may even be an extension of this work. Under the agreed criteria, some points are identified and briefly mentioned (among others, which are more detailed in each section):

- **3.2 Escalators and conveyors unit:** a simple KPI to monitor the performance of escalator crews
- **3.3 Technical Assistance:** improve the performance of RIA inspections
- **3.4 Installation:** better monitoring of third-party installers (Performance and Quality)
- **3.5 Electronic and Modernization:** introducing timelines for transparency purposes and coordination with suppliers
- **3.6 Factory:** some points: for engineering the integration of a PDM system, extension of 3D Mouse for Designers, *Constructor Design Book* and for production some punctual suggestions according to 5'S. It is worth highlighting a point that does not satisfy #VIVAVIDA, which is developed in 3.6.

Each of these ideas is further detailed in their respective sections.

This period from December 2020 to March 2021 exceeded all learning expectations in terms of both technical knowledge and interpersonal skills with colleagues and clients in a foreign language. This report has a brief form, focusing on the highlights of the program regarding lessons-learned and points of views for improvement. The latter could serve as a starting point to derive future tasks. What is clear is that every unit has essential responsibilities that influence customer´s satisfaction and that each functionary proactively advocates for this to be the highest. From Villarta Elevadores I adopt a highly specialized knowledge in Elevators and Escalators and its three philosophies:

Vamos pra Cima, Tamos Junto e Viva a Vida.

4. Conclusão & Perspectivas

O conteúdo deste relatório teve como objetivo desenvolver uma compreensão geral de como funcionam as unidades operacionais e de manutenção de uma empresa de elevadores e escadas rolantes. Também teve como parte do treinamento o desafio de apresentar sugestões de melhoria, de acordo com as práticas e padrões comerciais vigentes no território brasileiro para cada estação do programa. De forma vantajosa, o planejamento de rotação pôde incluir um período de uma semana na Planta de Produção de Villarta Elevadores e uma semana externa na Planta de Produção do Grupo Fermator, fabricante de portas automáticas para elevadores. Esta foi uma oportunidade para consolidar todo o conhecimento adquirido durante as intervenções de serviço.

Numerosas visitas a clientes para intervenções e locais de construção proporcionaram uma ampla visão geral das marcas existentes no mercado, tipos de mecanismos e a razão de seus desenhos, graças ao estudo das normas técnicas que são referidas no relatório. Além disso, pudemos acompanhar vários trabalhos com elevadores tipo COMPACTQ do catálogo Villarta, que não é somente o produto padrão, mas também um produto que representa o estado da arte em tecnologia de elevadores. Principalmente nas fases de manutenção, modernização e elétrica, houve maior envolvimento prático e assistência nas tarefas no lugar da obra.

O trabalho com equipes de supervisores também ajudou a adotar características na aproximação com o cliente que promovem muito a transparência, responsabilidade e credibilidade. Durante este período, aprende-se sobre cálculos de parâmetros cinemáticos e projeto mecânico de elevadores de acordo com a nova norma ABNT NBR 16858-1/2:2020, em grande parte derivada da EN 81-20/50. Durante as semanas no chão de fábrica foi possível observar muita da ideologia do Lean Manufacturing nas duas fábricas visitadas e a implementação das normas ISO 9001 e ISO 14001.

Com relação às observações e sugestões feitas, reitera-se que algumas delas podem ser consideradas subjetivas devido ao período planejado para cada etapa. Entretanto, considera-se pertinente apontar alguns deles, cuja implementação pode até ser uma extensão deste trabalho. Sob os critérios acordados, alguns pontos são identificados:

- **3.2 Escadas:** um KPI simples para monitorar o desempenho de equipes de escada rolante
- **3.3 Manutenção assistência técnica:** agilizar as inspeções RIA
- **3.4 Instalação:** melhor monitoramento de instaladores de terceirizados
- **3.5 Eletónica e Modernização:** introdução de cronogramas para transparência e coordenação com os fornecedores
- **3.6 Fábrica:** para Engenharia a integração de um sistema PDM, extensão de Mouse 3D para Designers, Manual do Construtor e para produção algumas sugestões pontuais de acordo com os 5'S. Vale destacar um ponto que não satisfaz o #VIVAVIDA, desenvolvido nessa seção.

Cada uma dessas idéias, entre outros mais, é mais detalhada em suas respectivas seções.

Este período de dezembro de 2020 a março de 2021 superou todas as expectativas de aprendizagem tanto em termos de conhecimento técnico quanto de habilidades interpessoais com colegas e clientes em língua estrangeira. Este relatório é escrito de forma resumida, escolhendo os destaques deste programa tanto em termos de lições aprendidas quanto de pontos de perspectiva de melhoria. Este último pode até mesmo ser o começo para a derivação de tarefas no futuro. O que é claro é que cada unidade tem responsabilidades essenciais que influenciam a satisfação do cliente e que cada funcionário advoga proativamente para que isto seja o mais alto. De Villarta Elevadores adoto um conhecimento altamente especializado e suas três filosofias:

Vamos pra Cima, Tamos Junto e Viva a Vida.

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Annex

A. Stage Plan

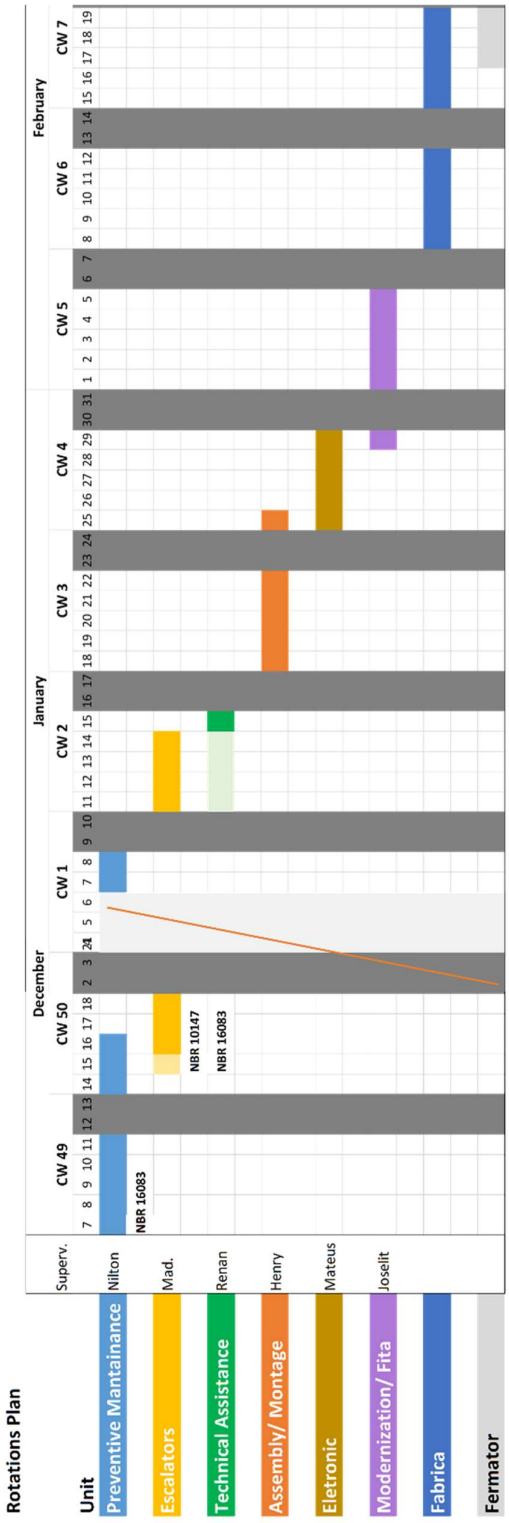

Figure 20 Stage plan in different service units (December 2020 to March 2021)

B. Daily Protocol

2020 December.

06.
- Status check of installation site of 4 escalators in a new supermarket hall

08.
- Introduction to Departments and Personnel of Villarta Elevadores São Paulo
- Introduction in Mantainance
- Safety awareness and Indications for height works and electric panel
- Inspection: Hydraulic Elevator in a House; Undesired Noise
  - → Obs.: Adjustment of a fixing blade required at piston level
- Inspection: Electric Elevator in a 15 floor building, Modernization of button panel

09.
- Intervention: Modernization of button panel
- Locksmith and Electrician, Material Preparation at Villarta, Preparation works onsite, Exchange Cables, Whole Drilling and threated cutting
  - → **Obs.: Inconclusive intervention due to lack of mechanical material preparation and installation execution (drilling holes insufficient);**
  - → **Obs.: 9.30-18.30, 1.45 h lunch because of traffic and transport to ´Matriz´**

10.
- Finalization: Modernization of button panel
  - → **Lesson Learned.:** Ensure that the steps are carried out correctly to work efficiently, and next time do so in the first intervention (not in the third) (e.g. ask for a ladder for high hole-drilling, measure position correctly, use the panel as a model, DO NOT modify the new panel to adapt it to poorly made holes, bring the appropriate material to the working site, Erase the measurement pilot marks on panel before handing over to the client)

11.
- Exchange with Manager of Preventive Maintenance, Elevators
- Types of Maintenance, Information Flow in Department (call for action), Types of Contracts, Prioritization of Cases

12.
- Internal Meeting with Technical & Commercial Operations Managers
- Gant-Diagram for Rotation Stations, approval
- Hydraulic Elevator, wear of cabin slides (nylon) to guiding rail, normal intervention, Wear of items causes shaking of the cabin
  - → Obs.: **Documentation to check the type slide material?**

14.
- Familiarization with Mercosul Standards for elevators ABNT NBR NM313:2007 derived from EN 81-70:2003
- @C4: Hydraulic Elevator, Preventive Maintenance; Building used to be a Bank, now it is a supermarket (meaning a more frequent use of Elevator)
  - → **Obs.: Higher number of travels, higher Temperature of motors, Implementation of a Fan/Radiator cooling system of the fluid; important: guarantee ventilation opening so the heat dissipates to the outside of the room**
  - → Problem: Thermistors shot down the circuit, due to erroneous overheating signal. T sensors near Motor, thus cooling cut-temperature activates.
  - → **Intervention Inconclusive, thread fell in reservoir by mistake, Attempt of extraction caused two failures of electrical contacts prorogating intervention by ~1 h, Threat not extracted, lid of reservoir closed and threat missing as intervention ended. Observation: Happening was not documented.**
- Electric Elevator, (1987) previous inspection for changing crone and cables. Introduction to Simple and Double Traction Elevator Mechanisms

15.
- Escalators of a Train Station, Preventive Maintenance

16.
- Hydraulic Elevator; Display Issue: after oscilloscope measurements in the basement an inductive interference was detected in the signal of the display, this caused an undesired noise. Change of cables with better isolation on 4 floors.
  - → **Obs.: Inconclusive intervention. Incomplete material thus error not corrected in first attempt of intervention, else professional and qualitative intervention**

2021 January

07.
- Handover of installed Electric Elevators machine less room; compactq model.
- NBR 16042; Safety Rules for the construction and installation of machine less lifts

08.
- Inspection, Elevators and machine room for tender of the Ministry of Economy of Brazil
- Inspection for caption of client for a modernization project: doors, motors, machine room, carbine interior, button panels

11.
- Preventive Maintenance, Escalators, Cleaning and Inspection security sensors (Guarulhos), 1 Escalator
  - → **Obs.: Visual Error during Maintenance**
  - → 45 min to location, (arrive 9:00, go 11:00) and back to Villarta, worker full filled 1 job

12.
- Preventive Maintenance, Escalators CMPT, Villa Aurora
  - → 45 min to location, (arrive 9:00, go 11:00) and back to Villarta,
  - → 2 Escalators in workers full filled 1 job
  - → Client point out: oil leak in under part of the escalator: Workers commented Villarta did not put the cover and leak might be due to lack of shielding at rotary parts level
  - → **Obs.: During inspection we realized, (2x) bolt missing for proper closing of floor boards, advanced corroded of floor boards, Security signs detached from surface…how to act to raise interest on client?**
  - → Normal preventive work complete
- Maintenance Contract for Elevator or Escalator:
  - → Integral: Substitution or reparation of every necessary part to guarantee the functioning of the transport
  - → Partial: selected parts in doors, mechanisms, and electric…without parts:

13.
- CPTM, 4 Escalators, Franco da Rocha
  - → 1 Locksmith (measurement of axe, for ordering part), 3 Technicians
  - → **Obs.: 1 escalator, Drive compartment, protection-cover was not removed and therefore not cleaned. Neither the top hash of the drive**

14.
- CPTM, 3 Escalators, Franco da Rocha
  - → Normal Maintenance
  - → **Obs.: for a consultation about the escalator teeth, 3rd technician arrived to place without need**
  - → After intervention a technician deserted by train (without any tools)
  - → Lunch place, was far from intervention place (1,5h hours apart), time loss
  - → How do they organize the intervention schedule? They see on the same day

15.
- Maintenance, Sodimac, Conveyor and freight Lift,

18.
- Report, Definition of Key Performance Indicators for the escalator and conveyor Operations Team

19.
- Installation. Working site control visit. Freight Lift (2500kg), Person Lift (1000kg), Small freight transporter (100kg)
- City Hall Sao Paulo, hydraulic Elevator (pending works)

20.
- Installation. Introduction to Installation and Commissioning of equipment

21.
- Installation. Door operator and 3 Floor Door operator installations of an electric elevator without machine room.

22.
- Installation and Preventive Maintenance. Ubatuba Site. Action of disabling and elevator due to failure of door sensors. Hazard for people. Request to client for intervention and change of electric module as well as of the optical sensors at door level. Elevator type: Schindler 001

27.
- Operations: Technical Assistance. Response to client, Annual Reports, CityHall Concessions

28.
- Operations: Corrective Maintenance.
- 1) Change of motor door operator and bovine of speed control. Altas Schidler Elevator, 1970
- 2) Change of Panel control. Inspection of reason for stop. Identify failure, order material, change. VIP Client. Work effected. Atlas Schnidler, 2010

2021 February

04
- Electronic/Modernization: cable braiding, old cables removal, electric modernization motor change (out: DC motor, In: AC motor), Removal of DC generator. Importan comonete: inverter

05
- Electronica/Modernization. Observation. Distribution of task (task(s) of the day…Pro-efficient/proactive thinking executing intervention, Material preparation for defined tasks… Incentivize that standing doing nothing is useless: better seek on material preparation for next task, and next task..

08.
- Display VEGA configuration. Call of Stops and Interphone

09.
- Corrective Intervention. "Inversor" calibration and door module change
- Modernization. Cabling of two pistons and tensor wheel mechanisms in the well and of the encoder of velocity, which is required at the end of drive "eje" to monitor velocity of drive

10
- Modernization: DC motor to AC motor change

12.
- Modernization. Cleaning of guiding rails of cabin and counterweight. Change of Sensor of end stop.

15.
- Modernization. Exchange of old button panels of each floor and cabling

16.
- Modernization. Cabling and connection of new cabin button panel

18.
- Modernization/Electronica. Speed redactor sensors and limit sensors of doors, mounting. **Obs.: Create more assurance in the material preparation to avoid delays of project. Organize and Clean Electronic Laboratory**

22.
- Fábrica Villarta, Taubaté. Introduction material flux, production line, Stock, Supply Chain and Engineering Department (Documentation, Standards, Manual de Entrega, Registro (record of technical changes in Elevator), Sossie Técnico, Calculations)
- **Obs. CAD Design with 3D Mouse? A Type of Vault? Automatic Generation of Part Lists? Do you have a Constructor Guiding Book?**

23.
- Fabrica Villarta. Engineering. Elevator Calculations for Development. (Guiding Rails of Cab, Guiding Rails of Counterweight, Bulking (Knickung), Maximal distances structure, Buffer Calculations, Traction of Cables, according to guidelines

24.
- Fabrica Villarta. Test on site, machine less room…Handover from Installation to Maintenance Unit. Inspection of pulleys, sensors, traction belts, buttons, emergency lights, level to cabin-floor, leveling.
- Electronic laboratory, production of control panel interfaces embedded column. Test of motor drive and components in control box
- **Obs. Power Points out update on quality control sheet; Electric Diagrams i.e, Trafo drawings double check correctness; Technician precise; Panel is Quality Product, with many practical and safety features for equipment and personal**

25.
- Fabrica Villarta. Production, Material Flux and Follow-up of manufacturing process stations. Observation of Lean Management (Applied and Optimization potential)

26.
- Engineering. VA (alterations), CAD Models, OP, Tables
  Obs. PDM Software, and introduction of Manual of Constructor

2021 March – Fermator Tecnomamérica

01
- Fermator. Introduction, Theoretical Training and visit Production Plant

02
- Fermator. Voltage Frequency (VF5+) Module Training, Quality Checkpoint Installation of Mechanism and Operator Doors

03
- Fermator. Factory manufacturing line visit with focus on Lean Manufacturing features and Quality Control Procedures. Assembly and Quality Check of an Operator and Mechanism

04
- Fermator. Special Orders, Manual of Maintenance, Manual of Installation of Commodity products (40/1o PM, Premium, Bus, etc.)

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VILLARTA elevadores

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