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Technical feasibility for a service company through the systematic planning method for plant distribution (SLP)

Factibilidad técnica para una empresa de servicios a través del método de planeación sistemática para la distribución de planta (SLP)

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Abstract

The SLP method (Systematic Layout Planning), is an organized technique for planning a distribution, made up of four phases, in a series of procedures to identify, evaluate and visualize the elements and areas to be distributed. The following case study proposes a new installation of Mathfer Services based on the SLP methodology for the optimization of resources with an efficient and safe handling of electrical materials, considering the dimensions and characteristics of the projects, through macrolocation and microlocation, the selection of equipment for handling raw materials and electrical supplies, the analysis and representation of the interaction of activities, the determination of spaces and general distribution, ending with the design and detailed presentation of the new installation of Mathfer Services through AutoCAD software and the presentation of the renderings of the modeling of the installation in the SketchUp software. Emphasizing that the design of an installation is not exclusive to the manufacturing industry, it is applicable to all types of spaces, as in this case, services.

Planning, Modeling, Interaction

Resumen

El método S.L.P. (Systematic Layout Planning), es una técnica organizada para realizar la planeación de una distribución, integrada por cuatro fases, en una serie de procedimientos para identificar, evaluar y visualizar los elementos y áreas a distribuir. El siguiente caso de estudio propone una nueva instalación de Mathfer Servicios en base a la metodología SLP para la optimización de recursos con un manejo eficiente y seguro de materiales eléctricos, considerando las dimensiones y características de los proyectos, por medio de la macrolocalización y microlocalización, la selección de equipo para manejo de materia prima e insumos eléctricos, el análisis y representación de la interacción de actividades, la determinación de espacios y distribución general, finalizando con el diseño y presentación detallada de la nueva instalación de Mathfer Servicios mediante el software AutoCAD y la presentación de los renders del modelado de la instalación en el software SketchUp. Destacando que el diseño de una instalación no es exclusivo para la industria manufacturera, es aplicable para todo tipo de espacios, como en este caso, los servicios.

Planeación, Modelado, Interacción

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Introduction

This article develops the design of a new facility for the company under study, based on the application of the S.L.P. (Systematic Layout Planning): Systematic Planning of Plant Distribution, for the optimization of resources. The article is made up of sections, the justification and objectives to be fulfilled are presented, starting from the general to the particular, elaborated according to the identified problem, as well as the description of the company under study. Subsequently, there is the methodology, established for the planning and design of the new facility, beginning with the macro-location of the new location, to continue with the micro-location through the application of the Variation Method of Brown and Gibson.

In the next part of the methodology, the selection of the management team for both raw materials and supplies is made, as well as the selection of suppliers for testing and measurement equipment. Based on the S.L.P. (Systematic Layout Planning): Systematic Plant Distribution Planning, however, the interaction of activities, the determination of spaces by area and the general distribution of the installation are presented, to conclude with the design of the new installation.

I. Justification

The company under study has presented problems with its inputs, which have reached the total loss of raw material, as in the case of lamps, since, due to their characteristics, a sudden movement or inadequate storage can damage them, which represents a shortage and a cost, up to the delay on the part of the suppliers when access to the company is difficult, which generates a delay for the execution of the contract.

However, a location is sought that allows quick and safe access to the company's facilities, by any supplier and client, optimizing the handling of raw materials and supplies, thus allowing greater efficiency in carrying out projects and contracts, increasing its productivity and with it the possibilities of growth within the northern region of the State.

II. Methodology

SLP Method (Systematic Layout Planning), Systematic Plant Layout Planning

The SLP method (Systematic Layout Planning): Systematic Plant Layout Planning, is an organized way to carry out the planning of a layout and is made up of four phases, in a series of procedures and conventional symbols to identify, evaluate and visualize the elements and areas involved of planning.[4]

The SLP method (Systematic Layout Planning), consists of a pattern of procedures.[3]

Phase I: Location.
Phase II: General Distribution of Set.
Phase III: Detailed Distribution Plan.
Phase IV: Installation

Macrolocation Options

The alternatives for macrolocation are:

A. Sierra Norte de Puebla
B. Mixteca de Puebla
C. Serdán y Valles Centrales de Puebla

Thus, based on comparison, the option A. Sierra Norte de Puebla, presents greater advantages in terms of location and access, therefore, it is the alternative selected for the project.

Figure 1 Macrolocation of the new location

Microlocation Options

Determination of the precise point where the company will be built within the region.[2] Location alternatives in municipalities belonging to the Sierra Norte de Puebla.

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a. Street Allende, Suburb Agua Azul, Juan Galindo, Pue.
b. Street Insurgentes, Suburb Santa Catarina, Huauchinango, Pue.
c. Avenue 1° de Mayo, Cuautlita, Huauchinango, Pue.

Brown and Gibson Variation

Calculation of the Target Factor Location Measure (FO_i)

The assumed annual costs and the calculation of the FO_i.

	Workforce	Raw material	Transportation	Communications	Services	Total cost
Allende	71.5	145	42	10.6	2.54	271.6
Insurgentes	62.8	98	28	7.96	2.98	199.7
1° de Mayo	74.2	120	24	7.48	2.8	228.5

Table 1 Annual costs per location
Source: Self Made

$$FO_i = \left[COF_i \sum \frac{1}{COF_{in}}\right]^{-1} \quad (1)$$

$$FO_{Allende} = \left[271.64\left(\frac{1}{271.64} + \frac{1}{199.74} + \frac{1}{228.48}\right)\right]^{-1} = 0.281779952 \quad (2)$$

$$FO_{Insurgentes} = \left[199.74\left(\frac{1}{271.64} + \frac{1}{199.74} + \frac{1}{228.48}\right)\right]^{-1} = 0.383211706 \quad (3)$$

$$FO_{1° de Mayo} = \left[228.48\left(\frac{1}{271.64} + \frac{1}{199.74} + \frac{1}{228.48}\right)\right]^{-1} = 0.335008343 \quad (4)$$

Calculation of the Measurement of Location of the Subjective Factor (FS_i)

The result of the assignments are as follows, where 1 is assigned to the most relevant and 0 to the least important.

	Allende	Insurgentes	1° de Mayo	SUM
K1: Labor availability	0.5	0.8	0.7	2
K2: Demand	0.4	0.7	0.9	2
K3: Distances	0.2	0.6	0.9	1.7
K4: Access to services	0.5	0.8	0.7	2
K5: Security	0.4	0.5	0.8	1.7
SUM	2	3.4	4	

Table 2 Subjective factors by location
Source: Self Made

The analysis allows the elaboration of the index of relative importance W_j which is used to determine the hierarchical ordering R_{ij} of each subjective factor, in the manner indicated below.

	Allende	Insurgentes	1° de Mayo	SUM	$W_{Allende}$	$W_{Insurgentes}$	$W_{1° de Mayo}$
K1: Labor availability	0.5	0.8	0.7	2	0.25	0.4	0.35
K2: Demand	0.4	0.7	0.9	2	0.2	0.35	0.45
K3: Distances	0.2	0.6	0.9	2	0.11765	0.35294	0.52941
K4: Access to services	0.5	0.8	0.7	2	0.25	0.4	0.35
K5: Security	0.4	0.5	0.8	2	0.23529	0.29412	0.47059
SUM	2	3.4	4				
R_{K1}	0.25	0.23529	0.175				
R_{K2}	0.2	0.20588	0.225				
R_{K3}	0.1	0.17647	0.225				
R_{K4}	0.25	0.23529	0.175				
R_{K5}	0.2	0.14706	0.2				

Table 3 Hierarchical ordering of each objective factor by location
Source: Self Made

Substituting into the equation for FS_i the value of the measure of the subjective factor is obtained for each of the locations considered.

$$FS_i = \sum(R_{ij} \cdot W_j) \quad (5)$$

$$FS_{Allende} = 0.250 * 0.250 + 0.200 * 0.200 + 0.117 * 0.100 + 0.250 * 0.250 + 0.235 * 0.200 = 0.2238235 \quad (6)$$

$$FS_{Insurgentes} = 0.400 * 0.235 + 0.350 * 0.205 + 0.352 * 0.176 + 0.400 * 0.235 + 0.294 * 0.147 = 0.3658304 \quad (7)$$

$$FS_{1° de Mayo} = 0.350 * 0.175 + 0.450 * 0.225 + 0.529 * 0.225 + 0.350 * 0.175 + 0.470 * 0.200 = 0.4369853 \quad (8)$$

Calculation of the Location Preference Measure (MPL)

Once the objective values and the subjective values of location have been assessed in relative terms, the measure of location preference is calculated using the following formula:

$$MPL_i = k(FO_i) + (1-k)(FS_i) \quad (9)$$

Considering that the objective factors have a relative weight of 50%, and the subjective factors a relative weight of 50%.

$$MPL_{Allende} = (0.281779952 \times 0.5) + (0.2238235 \times 0.5) = 0.252802 \quad (10)$$

$$MPL_{Insurgentes} = (0.383211706 \times 0.5) + (0.3658304 \times 0.5) = 0.374521 \quad (11)$$

$$MPL_{1° de Mayo} = (0.335008343 \times 0.5) + (0.4369853 \times 0.5) = 0.385997 \quad (12)$$

Site Selection

The chosen alternative is the Avenida 1° de Mayo, Cuautlita, Huauchinango, Puebla, since it receives the highest location preference measure value.

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Figure 2 Microlocation of the new location/Satellite

Figure 3 Microlocation of the new location/Relief

Figure 4 Result: Microlocation/Perspective 1

Figure 5 Result: Microlocation/Perspective 2

Figure 6 Result: Microlocation/Perspective 3

Figure 7 Result: Microlocation/Perspective 4

Material handling

Selection of handling equipment: Raw material

	Suppliers		
Brand	**Fierp**	**Uline**	**Rubbermaid**
Type	Folding loading trolley, T. platform	Metal Platform Cart	Plastic Platform Cart
Characteristic	Steel sheet platform with non-slip PVC coating.	13 gauge 5 teel deck.	Removable and contoured handle for a better grip.
	Rubber lined edge that protects from bumps.	Durable red powder coat finish.	4 points to attach with straps.
	Foldable for easy storage.	Tubular 5 teel handle 1" (25 mm).	Steel-reinforced structural foam deck resists corrosion and denting.
	Abrasion, chemical and shock resistant polyurethane wheels.	Wheels of 6" rotate smoothly: 2 swivel, 2 rigid.	8" non-marking casters: 2 swivel, 2 rigid.
Cost	$1,425	$6,314	$16,918
Capacity	300 Kg	725 Kg	607 Kg
Dimensions	H*L*A	L*A	L*A
	85cm*90cm*61cm	152.4cm*76.2cm	152.4cm*76.2cm
Weight	13.3 Kg	46.26 Kg	39.91 Kg
Data sheet	https://www.truper.com/ficha_merca/ficha-print.php?code=49907	Not available	Not available
Email	Not available	servicioaclientes@uline.com	ventas@rubbermaidcomercialproducts.com
Website	https://www.truper.com/	https://es.uline.mx/	https://rubbermaidcomercialproducts.com/
Phone number	800-018-78737	800-295-5510	5544151340

Table 4 Suppliers: Platform Cart
Source: Self Made

The Selection of handling equipment: Raw Material, was made based on the comparison of suppliers, where the UNLINE brand was selected, with a Cart with a Metal Platform - 30 x 60".

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Figure 8 Metal Platform Cart - 30 x 60"

Management equipment selection: Inputs

Suppliers			
Brand	**Uline**	**Mikel´S**	**Surtek**
Type	Elevator Table	Elevator Table	Elevator Table
	Manual - Double Scissor	Non-slip	Hydraulics
Characteristic	Ergonomic table.	Up and down pedal.	Fast approach pedal.
	Hydraulic pedal raises the platform.	Two swivel wheels with locks.	Support with double scissors for greater security.
Cost	$16,346	$8,254	$12,450
Capacity	320 Kg	400 Kg	300 Kg
Dimensions	L*A	L*A	L*A
	92cm*50cm	78cm*48cm	100cm*90cm
	Lifting height: 140cm	Lifting height: 120cm	Lifting height: 100cm
Weight	101.1 Kg	58 Kg	65 Kg
Data sheet	Not available	Not available	Not available
Email	servicioaclientes@uline.com	Not available	Not available
Website	https://es.uline.mx/	https://www.mikels.com.mx/	https://www.urrea.com/grupoUrrea/productos/gusurtek
Phone number	800-295-5510	55 5361-8061	33 1479-1135

Table 5 Suppliers: Elevator Table
Source: Self Made

The result of the Selection of handling equipment: Inputs, gave MICKEL'S as the choice as supplier, with a Non-Slip Elevating Table.

Figure 9 Non-Slip Elevating Table

Supplier Selection: Test and Measurement Equipment

Suppliers		
Description	Marketing and rental of equipment for electrical measurements and tests.	
Company	Allectro	SRH Predictivo
Email	contacto@allectro.com	contacto@srhpredictivo.com
Phone number	55-5601-6213	55-1849-3791
Quotation	Apply	Apply
Billing	Apply	Apply
Delivery time and conditions	Excellent	Excellent

Table 6 Suppliers: Test and Measurement Equipment
Source: Self Made

However, the result of the Supplier Selection: Test and Measurement Equipment, were two: Allectro and Predictive SRH, companies dedicated to the commercialization and rental of equipment for electrical measurements and tests, fully qualified suppliers, depending on the requirements and needs of measurement and evaluation.

Equipment Selection: Shelves

Suppliers			
Brand	Grainger mexico	Servinox	Uline
Type	Boltless Metal Shelving	Smooth Type Shelf in Stainless Steel	Organizer with Shelves
Characteristic	Steel boltless shelf with chipboard cover.	Smooth shelf with four shelves.	Powder-coated steel frame, will not rust or corrode.
	Open accessibility from all four sides.	Manufactured in Stainless Steel Cal.20.	6 spaces to organize.
	Foldable for easy storage.	Greater organization and space.	Shelves adjust in 1" increments.
	5 Shelves.	High strength and durability stainless steel.	
Cost	$7,280	$6,012	$4,300
Capacity	2700 Kg	1700 Kg	900 Kg
Dimensions	H*L*A	H*L*A	H*L*A
	36"*72"*18"	45cm*90cm*180cm	36"*12"*40"
Weight	30 Kg	20 Kg	20 kg
Data sheet	https://www.grainger.com.mx/producto/GRAINGER-APPROVED-Anaquel-sin-Pernos-Tipo-B%C3%A1sico	Not available	https://es.uline.mx/Product/Detail/H-2510
Email	Not available	ventas@servinox.com.mx	servicioaclientes@uline.com
Website	https://www.grainger.com.mx/	https://www.servinox.com.mx/	https://es.uline.mx/
Phone number	800 800 80 80	(33)1580-9989	800-295-5510

Table 7 Suppliers: Shelves
Source: Self Made

The result of the Selection of Shelves for the company was the Metal Shelf without Bolts, from GRAINGER MEXICO.

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Figure 10 Boltless Metal Shelf

Equipment Selection: Drawers

Suppliers			
Brand	**Plastic containers mexico**	**Uline**	**Taner**
Type	Drawer Box No. 9	Plastic Stackable Bins 2pz	Plastic Drawer
Characteristic	Box made of high density polyethylene.	Organize small pieces in less space.	Easy access to small parts and accessories.
	Stackable up to 6 boxes with product.	Ideal for work tables and assembly areas.	Moisture resistant.
	Smooth internal surfaces, for easier cleaning.	Reinforced walls for stable stacking.	Effective alternative to order and locate materials.
		Front, back and side handles for easy handling.	Reinforced walls for stable stacking, without movement.
Cost	$230	$630	$174
Capacity	40 Kg	35 Kg	20 Kg
Dimensions	H*L*A	H*L*A	H*L*A
	20cm*50cm*30cm	38cm*42cm*18cm	19cm*12cm*8cm
Weight	700 gr	1 Kg	700 gr
Data sheet	Not available	Not available	Not available
Email	ventas@contenedoresdeplasticomexico.com	servicioaclientes@uline.com	Not available
Website	https://www.contenedoresdeplasticomexico.com/	https://es.uline.mx/	https://taner.com.mx/
Phone number	(55) 8854 4350	800-295-5510	(55) 4333-0000

Table 8 Suppliers: Drawers
Source: Self Made

Result of the Selection of Drawers, it was the Drawer Box No. 9, of CONTENEDORES DE PLÁSTICO MÉXICO.

Figure 11 Drawer Box No. 9

Analysis

The company under study carries out the activities established for the fulfillment of projects, with a monthly average of 4 contracts, whether inside or outside the region, despite varying magnitude.

Path analysis

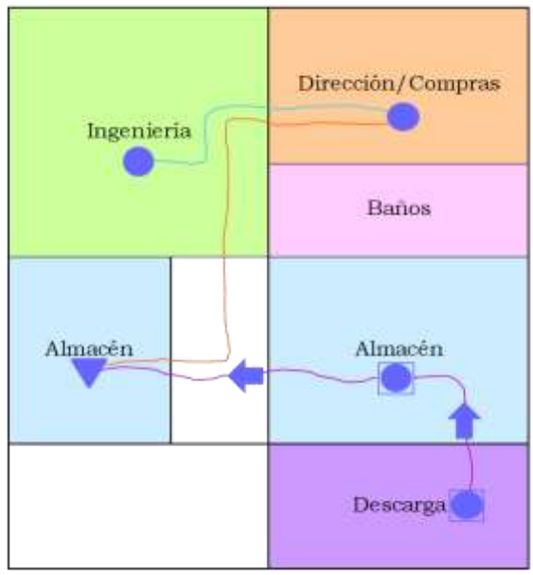


Figure 12 Route diagram integrating the process flow of the company under study
Source: Self made

Analysis of relationships between activities

Área	Descripción	m^2
Dirección	Área encargada de las especificaciones y cierre de contratos.	35
Ingeniería	Área responsable del diseño y los requerimientos del proyecto.	40.5
Compras	Cotización, condiciones de pago, seguimiento y condiciones de entrega de materia prima e insumos eléctricos.	25
Almacén	Manejo y almacenamiento de materia prima en insumos eléctricos.	238
Descarga	Área de carga y descarga de materia prima e insumos eléctricos.	168

Figure 13 Proximity relationship between the areas of the company under study
Source: Self made

Development of the Relational Diagram of Activities[1]

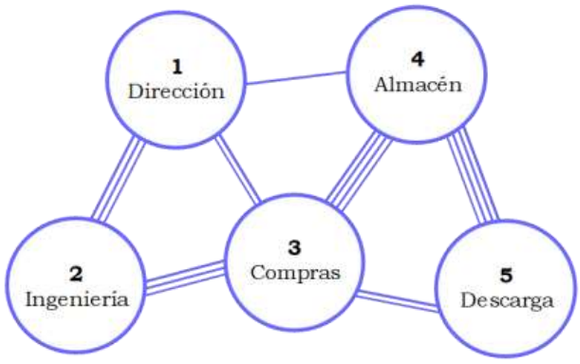


Figure 14 Relational diagram of activities of the company under study
Source: Self Made

Analysis of needs and availability of spaces

	Area	Dimensions (M)		Surface (M^2)
		Length	Width	
1	Dirección	7	5	35
2	Ingeniería	9	4.5	40.5
3	Compras	5	5	25
4	Almacén	17	14	238
5	Descarga	14	12	168
6	Sanitarios	5	4.5	22.5
7	Estacionamiento	12	7	84
8	Acera	12	2	24

Table 9 Needs and availability of space by area
Source: Self Made

Development of the Relational Diagram of Spaces[1]

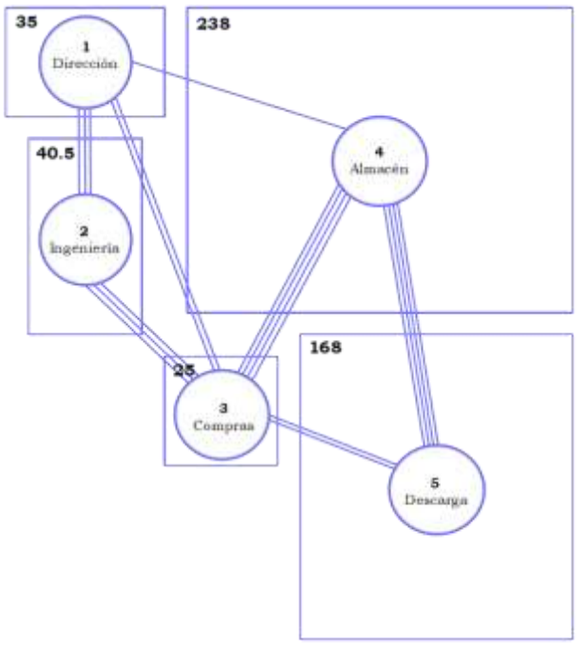


Figure 15 Proposal 1: Relational diagram of spaces with an indication of the area required for each activity
Source: Self Made

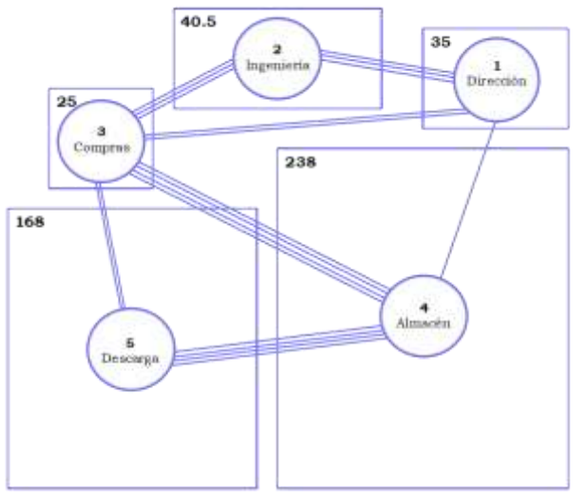


Figure 16 Proposal 2: Relational diagram of spaces with an indication of the area required for each activity
Source: Self Made

Evaluation of the alternatives of set distribution and selection of the best distribution

Based on the S.L.P. (Sistematic Layout Planning): Systematic Plant Layout Planning, the evaluation of the layout alternatives resulted in the selection of Proposal 1.

According to the selection of the proposal of the relational diagram of spaces with an indication of the area required for each activity, the layout of the installation is presented, generated in the AutoCAD software.

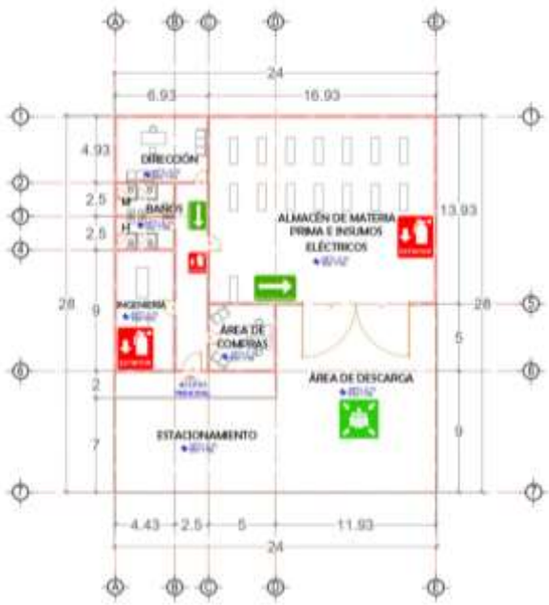


Figure 17 Result: Layout of the new installation of the company under study
Source: Self Made

Finally, it is presented as the final result of the application of the S.L.P. (Systematic Layout Planning): Systematic Plant Layout Planning, the render of the new installation of the company under study, modeling that gives a realistic perspective of the layout, prepared using SketchUp software.

Figure 18 Result: Aerial view of the installation

Figure 19 Engineering area

Figure 20 Direction

Figure 21 Sanitary

Figure 22 Warehouse area for raw materials and electrical supplies

Figure 23 Shopping area

III. Results

The diagnosis by means of an initial VSM for a complete visualization of the entire service carried out by the company under study, allowed determining the problem of the arrival of the suppliers at the address, as well as the delays of the raw material and electrical supplies.

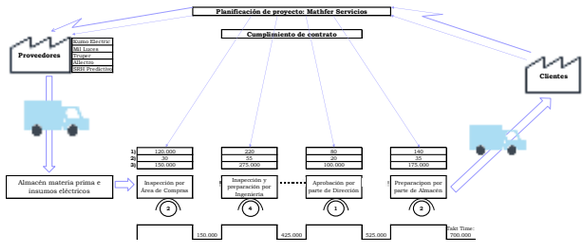


Figure 24 Initial VSM: Company under study
Source: Self Made

With the initial diagnosis it was possible to develop a design proposal for a new facility for the company under study in which, not only the monitoring and arrival of suppliers is faster and safer, but also achieves a reduction in inspection times. upon arrival of raw material and electrical supplies, as well as their preparation and departure for installation, which achieves total optimization of the company's resources in the service process. This is how the following future VSM shows the expected situation, already in the new installation.

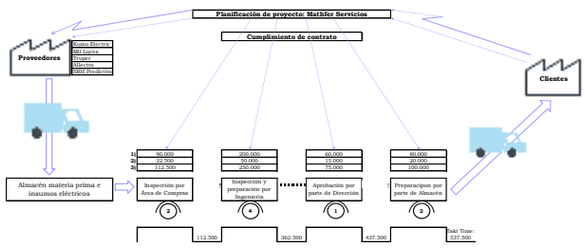
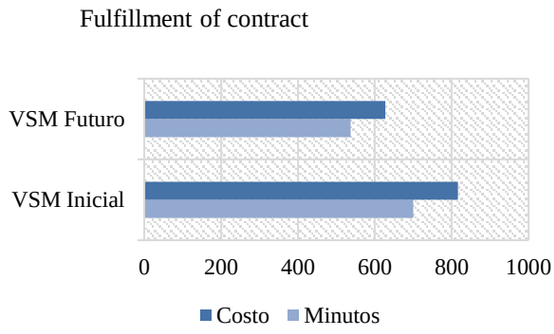
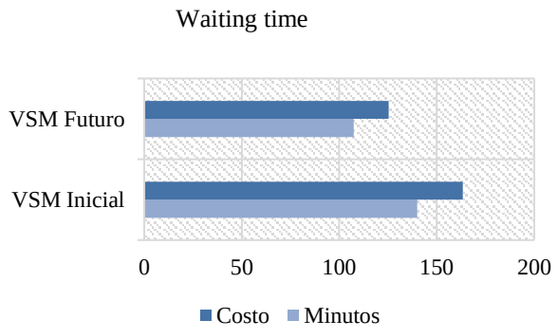


Figure 25 VSM Future: Company under study
Source: Self Made

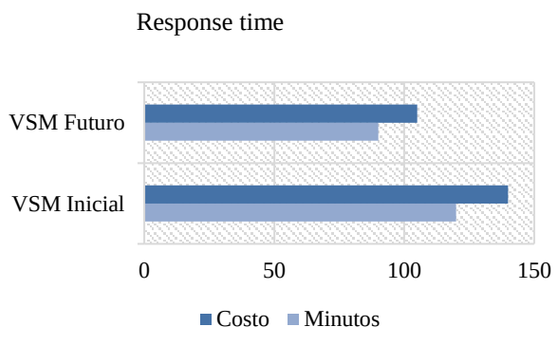
The comparisons of before and after the new installation of the company under study are presented, according to the initial VSM and future VSM.



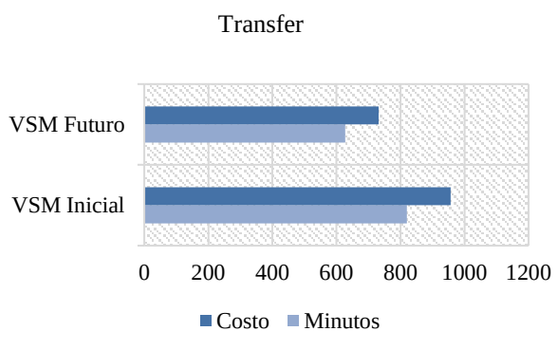
Graph 1 Compliance of contract
Source: Self Made



Graph 2 Wait time
Source: Self Made



Graph 3 Response time
Source: Self made



Graph 4. *Transfer*
Source: Self made

IV. Annexes

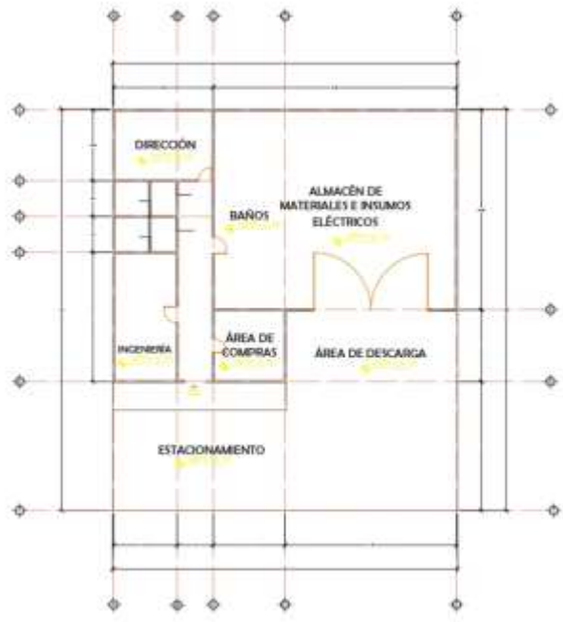


Figure 26 Layout without detailing the new installation

Figure 27 Render: Raw material management

Figure 28 Render: Warehouse internal perspective

V. Gratefulness

For the Industrial Engineering career of the Superior Technological Institute of Huauchinango for the facilities in the development of this project and the collegiate work of the Applied Technology Academic Body (ITESHUAU-CA-2).

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VI. Conclusions

Each of the specific objectives established in the project was carried out on time: the determination of a new location through macrolocation and microlocation, selection of the appropriate equipment for the proper handling of raw materials and electrical supplies, as well as the analysis and representation of the interaction of the activities of the company under study, the determination of spaces and general distribution, and finally the design and detailed presentation of the new installation. Thus, fulfilling the general objective of proposing the design of a new facility for the company under study, under the S.L.P. (Systematic Layout Planning): Systematic Plant Layout Planning. However, I want to emphasize that facility planning is not exclusive to the industrial sector but is also applicable to services.

VII. References

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