

Define

Measure

Explore

Design

Verify/Validate

Overall Equipment Effectiveness (OEE) Measurement Process Design



*BB PROJECT LEADER:
PATRICIA REYNOSO*

Project Charter

Project Charter

Define

Project Name:

Overall equipment effectiveness measurement process design.

Measure

Services/Processes Impacted:

54 Selected work centers in shop floor

Explore

Sponsor:

Ana C López

Design

Company/Site Location:

Pharmanufacture, Puebla México

Black Belt:

Patricia Reynoso

Verify/Validate

Core Team Members:

Patricia Flores
Luz Ma Gonzalez
Six Sigma Team (SST)

Project Description

Project Description:

Develop an Overall equipment effectiveness measurement system that efficiently, effectively and accurately measures the manufacturing processes and equipment efficiency.

Project Scope:

54 work centers in manufacturing area

**Define****Measure****Explore****Design****Verify/Validate****Business Results**

Business Results

Define

Measure

Explore

Design

Verify/Validate

- Measurement system that supports the quantification of failure breakdowns, changeover times and defects because of lack of equipment efficiency
- Way to measure the productivity of each manufacturing process.
- Basis for detecting opportunities and selecting belt projects.
- Operations support for lean environment

Project Goals



Project Goals

- **OEE (# of work centers into OEE system).**
 - Baseline 0.
 - Goal 54.
- **Trained people in OEE concepts.**
 - Baseline 0%.
 - Goal 100%.
- **SST walk completely integrated to OEE system.**

Define

Measure

Explore

Design

Verify/Validate



MGP Vision

Define

Measure

Explore

Design

Verify/Validate

- Gen 1 -OEE will be calculated from data recorded manually. Charts will be created also manually. Data will be Explored during SST walks.
- Gen 2 – OEE will be calculated automatically from data entered into a database. Charts are generated automatically from this database.
- Gen 3 - automated database system (real time). Each work center will be able to access the system to enter data on line.

VOC

VOC

Define

Measure

Explore

Design

Verify/Validate

- *Accuracy*
- *Model for business improvement*
- *Enabler to make decisions based on it*
- *Reliable*
- *Visual*
- *Timely updated*
- *Clear*

Customer Segmentation

Customers:

- *Internal – Supervisors, SST, Operators*
- *External - Performance assessment*
- *Stakeholders - Management*



Customer Segmentation

- Type of operation (solids, liquids and semisolids, parenterals)
- Area (bulk, packaging)
- Level (supervisor, operator, manager)
- Shifts

**Define****Measure****Explore****Design****Verify/Validate****Detail of CTQ's**

Detail of CTQ's

Define

Measure

Explore

Design

Verify/Validate

- Operators: ease to record data, metrics clear, measurement of their individual performance, feedback, actions taken timely
- Supervisor: reliable tool to measure people and equipment performance, visual, simple, clear
- SST: to have all relevant metrics updated in the work center so they can make decisions
- Management: Executive reports to know what problems are critical and need to be resourced and solved first, relevant and clear information for detecting and selecting belt projects.





DMEDVI

HOUSE OF QUALITY

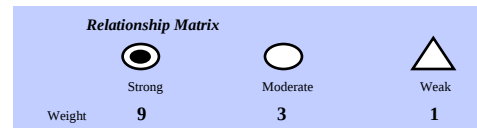
Define

Measure

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Verify/Validate



		Target Goals														Import
		↑	↑	↓	↓	↑	↑	↑	↑	↑	↓	↑	↑	↑		
		# of actions arose from the system	# of action completed On time	# of times info is not updated	# of mistakes found during aSST walk	% of work centers measured This way	Rate of comfort from operators collecting data	OEE improvement	Changeover time improvement	% attendance to SST walks	Average cycle time to Complete actions	\$\$\$ benefits generated From the system	Customer satisfaction index	# of people evaluated and recognized		
Relationship Matrix Strong Weight 9 Moderate 3 Weak 1																
Primary Want		Secondary Want														
Model for process improvement	Get new action plans for improvement	●	●			○		○	○			○	△		5	
	Have actions completed on time according to plan		●	△				○	○	●	●		○		4	
	Provide customized reports about committed actions and results		●	●				○	○	△					3	
	Day to day information Updated weekly by shift and area			●										○	4	
	Make the indicator results are accurate and reliable. Explain exceptions			○	●			●	●	○	●	●	●		3	
All manufacturing areas are involved	All work centers in the mnfg area should be part of the system	●				●	○					●	○	●	4	
	Customize the implementation according each work center needs				●	●	●	○	○	△		○	●		3	
It should be a support for the decision making process	Basis for the performance assessment for each individual						○	○	○					●	4	
	Basis for the TPM program design							●	●	○	●	●	●		4	
How Important		81	108	79	63	78	51	81	129	66	108	131	128	81		
Target		TBD	6 Sigma	ZERO	5 sigma	90%	4	30% this year	30% this year	100%	2 weeks	TBD	5	TBD		

CTQ Scorecard

CTQ Scorecard

Define

Measure

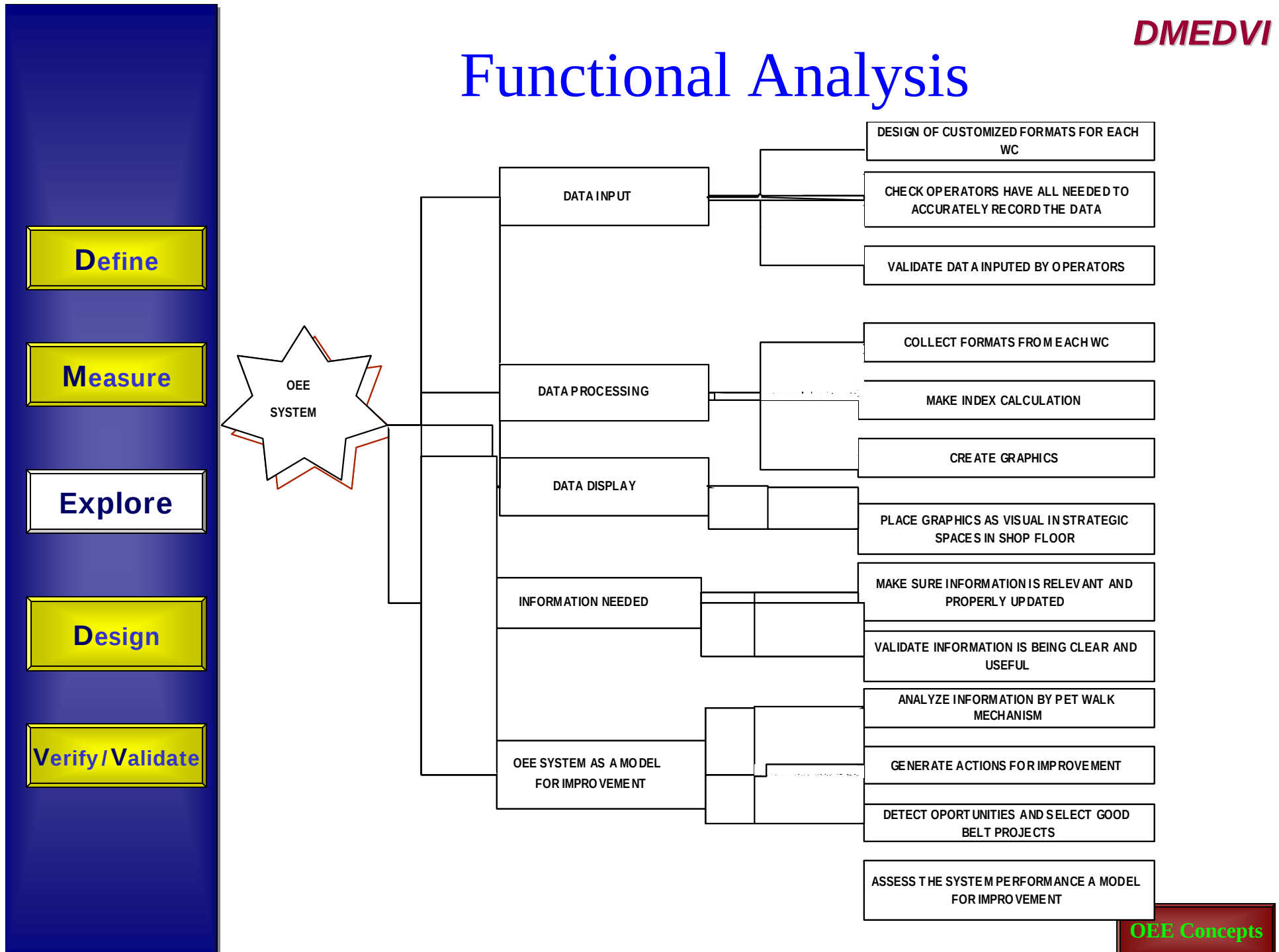
Explore

Design

Verify/Validate

System:		OEE SYSTEM DESIGN			
Project Leader		PATRICIA REYNOSO			
CTQ	Measure	Target/ Nominal	Upper Spec Limit	Lower Spec Limit	Sigma Target (ST)
Activities completed on time	Lagged activities	1			4.5
Accuracy of information	Errors	2			5.0
Avg Cycle time to complete actions	days	20	30	5	4.0
\$\$\$Benefits from improvements	\$\$\$	tbd			
Cust satisf index	Rank 1-5	5	5		5.0
% of WC integrated	%	100%			3.0

Functional Analysis



OEE Design Concepts

Concept 1 “Traveler documents”



Paper formats to capture information, input information manually to generate graphs.

Define

Measure

Explore

Design

Verify/Validate

Concept 2 “Black box”

Define

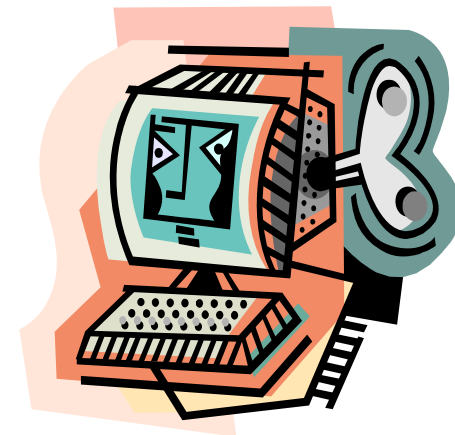
Measure

Explore

Design

Verify/Validate

Paper formats, input info in database what concentrates information and generates charts automatically, graphs are posted on workcenters walls



Concept 3 “Metrics network”

Define

Measure

Explore

Design

Verify/Validate

Data is inputted in an electronic terminal, automatic graphs generation, charts displayed in screens distributed in strategic places in shopfloor.



Concept 4 “Metrics on line”

- Electronic system where all equipments are monitored, all breakdowns, changeover time, etc are recorded automatically, data is centered in a database, graphs are displayed in monitor screen real time.



“Best Fit Concept Selection”

Define

Measure

Explore

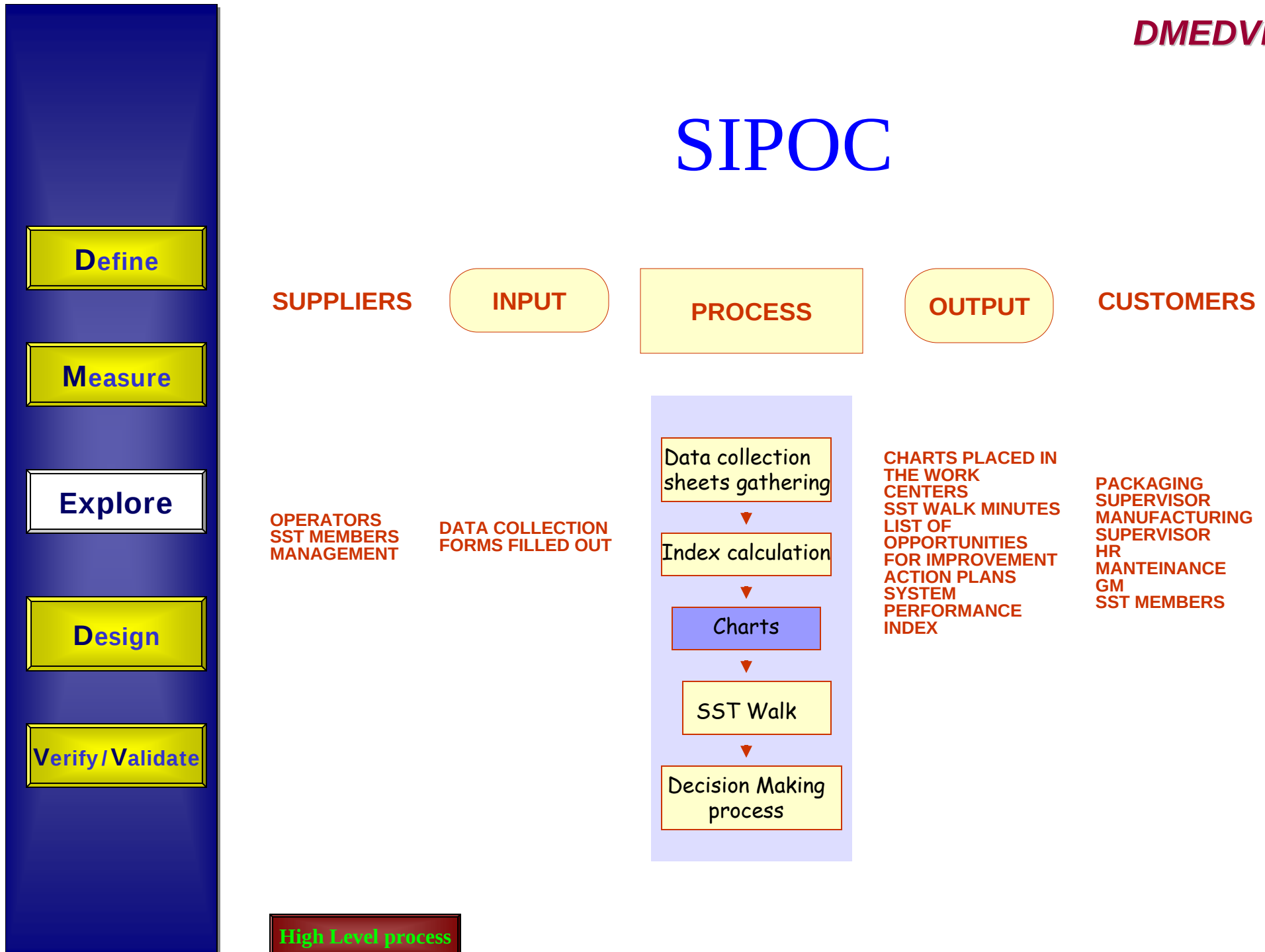
Design

Verify/Validate

Concept	Criteria and Weights					
	Cost/ benefit	Time to be implemented	Sigma	Operational ease	Operational cost	SUM
	3	4	5	3	5	
“Traveler Document”	27	32	30	21	35	145
“Black box”	21	24	35	24	35	139
“Metrics network”	15	16	40	27	40	138
“Metrics online”	9	8	45	27	40	129

Sipoc

SIPOC



High Level OEE process

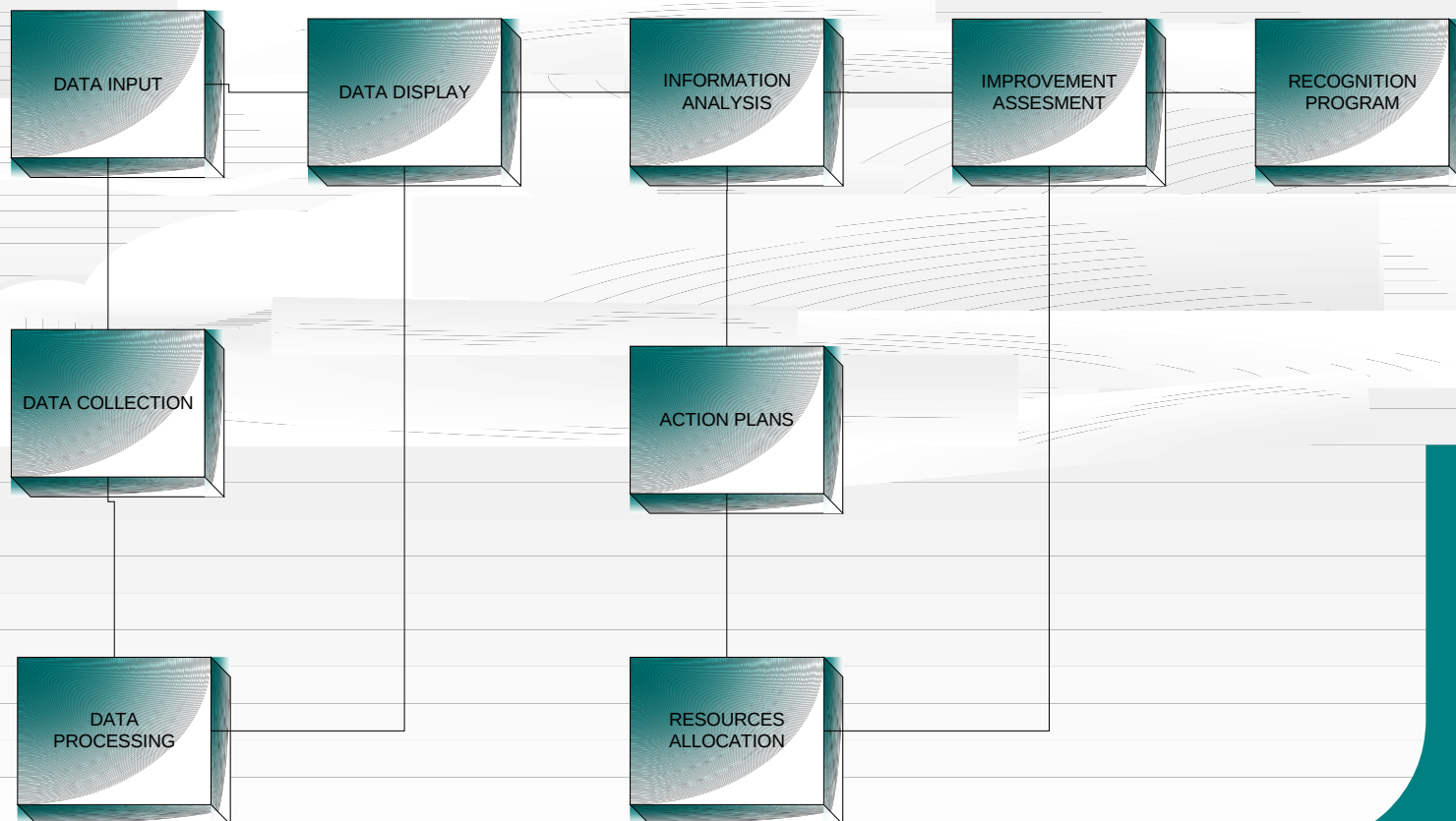
Define

Measure

Explore

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Verify/Validate



Evaluation and Gaps

EVALUATION OF CAPABILITY AND GAPS

CTQ SCORE CARD

System: OEE System						Date: 20-Feb-2002						
Project Leader: PATRICIA REYNOSO						Revision: 3						
CTQ	Measure	Target/ Nominal	Upper Spec Limit	Lower Spec Limit	Sigma Target (ST)	Mean	Std. Dev.	Yield	DPU (LT)	No. Opps.	DPMO (LT)	ed Sigma (ST)
Activities completed on time	Deleyed activities	1			4.5				1	500	2.00E+03	4.38
Accuracy of information	Errors	2			5.0				0.04	50	8.00E+02	4.66
Avg Cycle time to complete actions	days	20	30	5	4.0	18	3				7.14E+03	3.95
\$\$\$Benefits from improvement s	\$\$\$	tbd										
Cust satisf index	Rank 1-5	5	5		5.0	4.5	0.1				2.33E+02	5.00
% of WC integrated	%	95%			3.0			95.5%				3.20

FMEA

Define

Measure

Explore

Design

Verify/Validate

F M E A

Important issue to be analyzed as a big potential risk

Define

Measure

Explore

Design

Verify/Validate

Item/ Process Step	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Potential Cause(s) of Failure	Occurrence	Current Controls	Detection	RPN	Recommended Actions
Data Input	Wrong Information	Inaccurate results	8	Human Error	10	Scorekeeper review	8	640	Establish audits
Data Collection	out of time	Out of date data	7	Lack of supervision or unclear procedures	9	PET walk follow up	7	441	Collection of formats daily
Data display	Unclear	Lack of interest and reliability on metrics	7	No feedback from users of info	9	Metrics Feedback meeting	1	63	
Information analysis	Incomplete	Wrong decisions taken	8	Lack of training	9	PET help desk	5	360	Get PET trained
Action plans generation	Not linked to business results	Loss of benefits	6	Lack of involvement from management team	8	Improvement model assesment team meetings	6	288	
Resources allocation	Wrong resources allocation	Plans not implemented on time	8	Wrong definition of project scope	7	Improvement model assesment team meetings	6	336	
Improvement assesment	Inaccurate evaluation	management discouraged to support improvement initiatives	6	Lack of a clear procedure and ownership	7	Improvement model assesment team meetings	9	378	Supported and signed by finance dept

Design Elements

Define

Measure

Explore

Design

Verify/Validate



Service

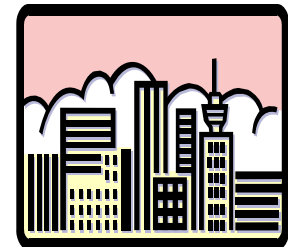
Information Systems

Human Systems

Facilities

Equipment

Materials



Detailed Design

Click on each box to go to Detailed Design Process

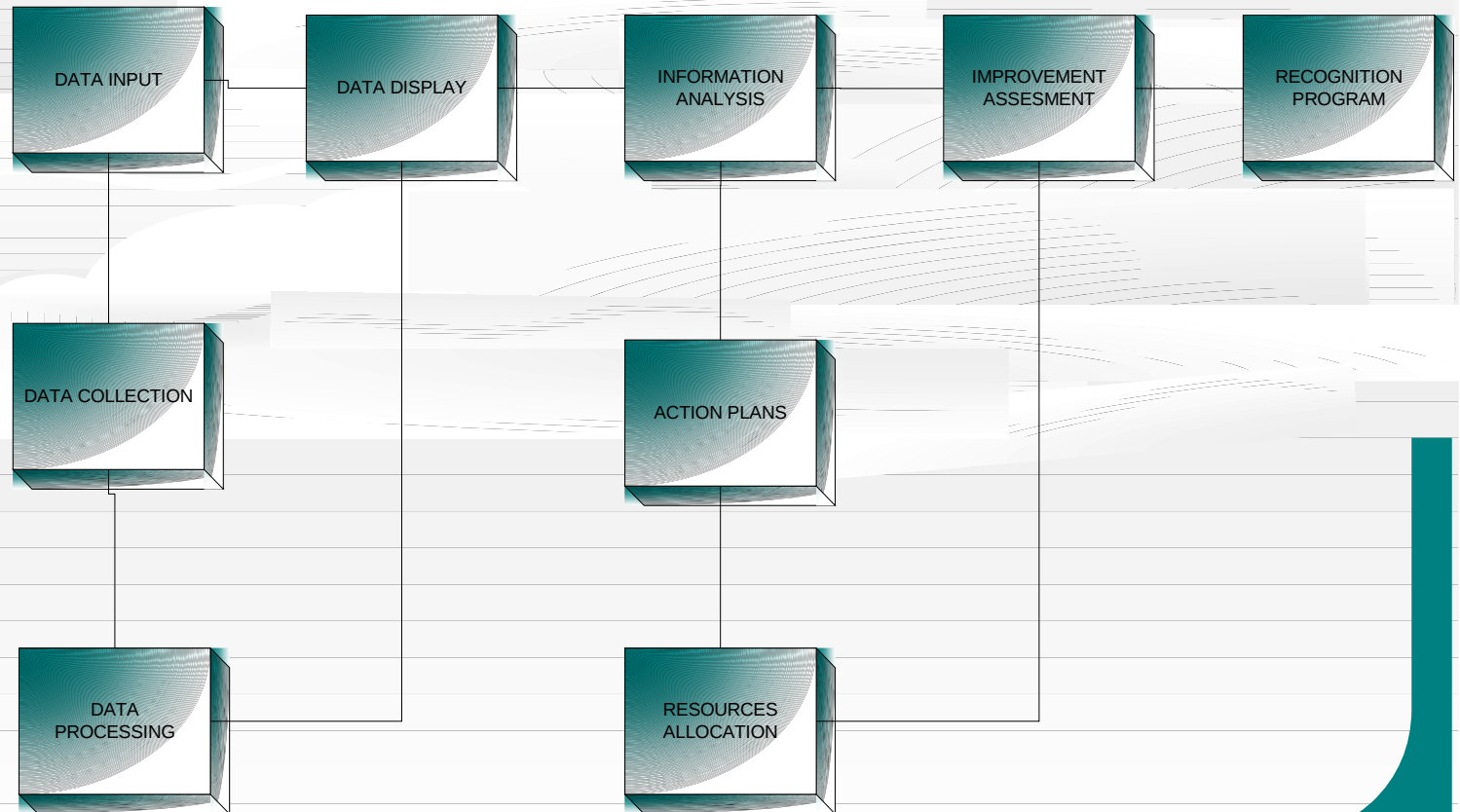
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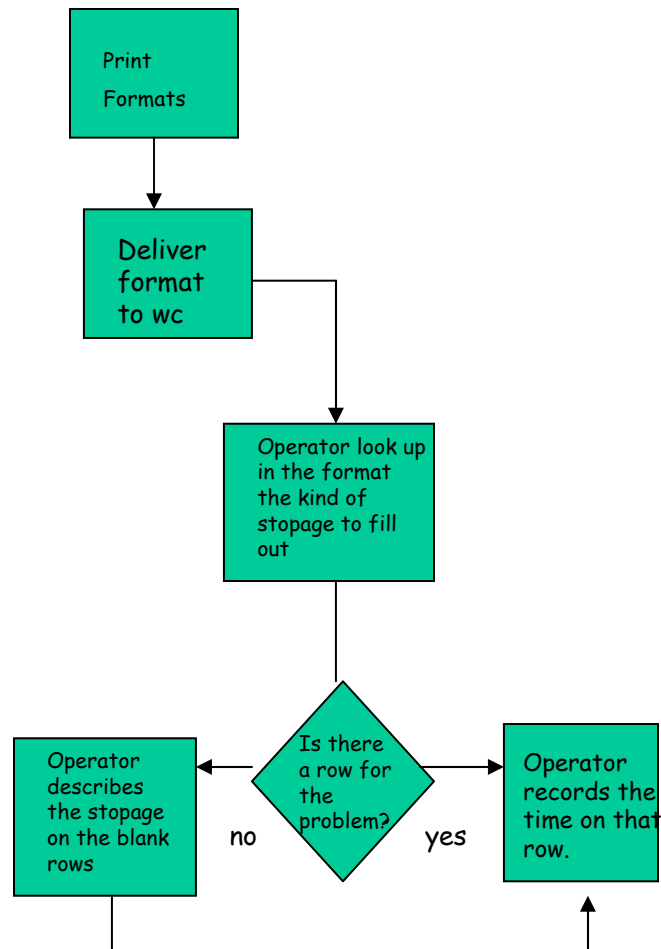
Measure

Explore

Design

Verify/Validate





Data Input	
Process/ Method	Info is recorded manually by operators
Information systems	Customized printed formats for each WC
Facilities/ sites	54 different WC
Human systems	2 people as scorekeepers All operators
Equipment & materials/ supplies.	Documents (formats) Chronometer

Define

Measure

Explore

Design

Verify/Validate

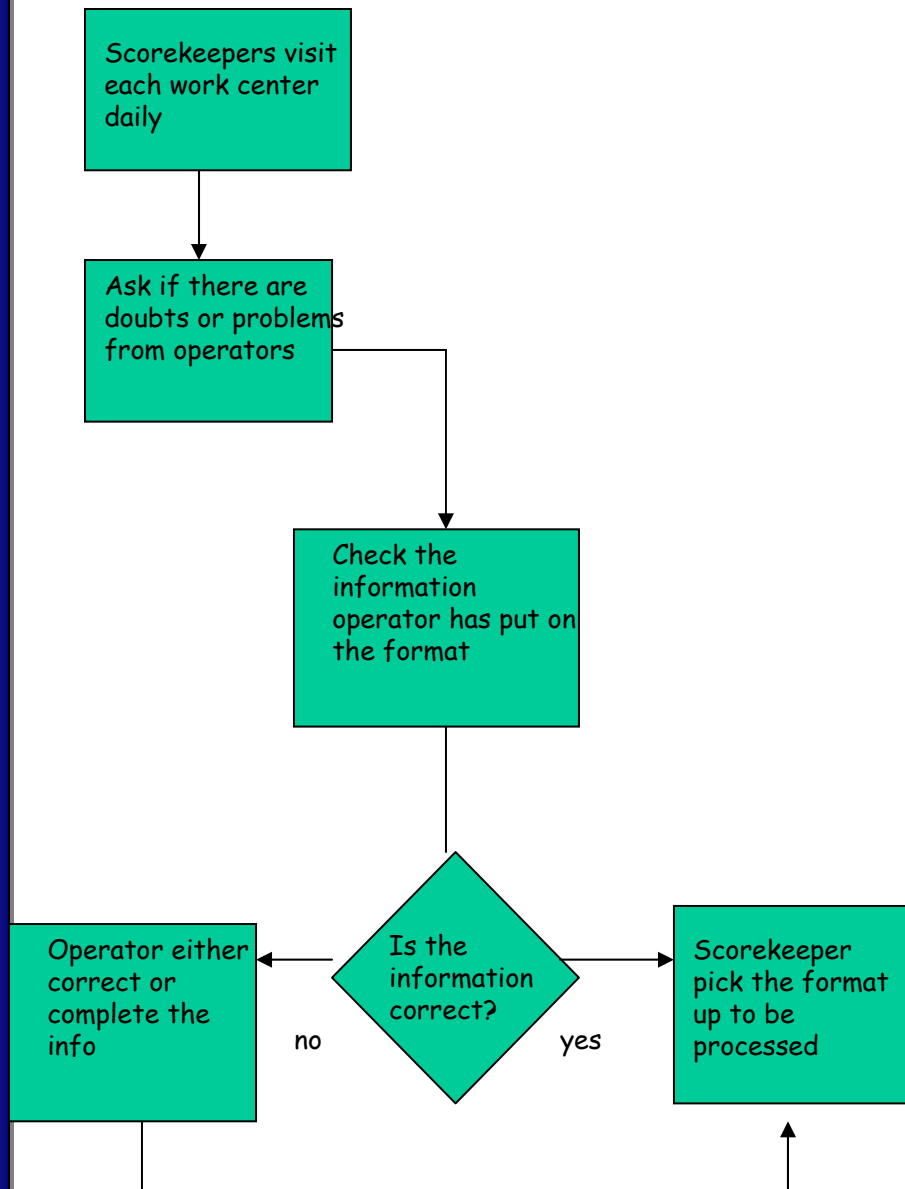
PAROS PLANEADOS

ENCARTONADORA NOACK
LINEA No. 13 CILAG

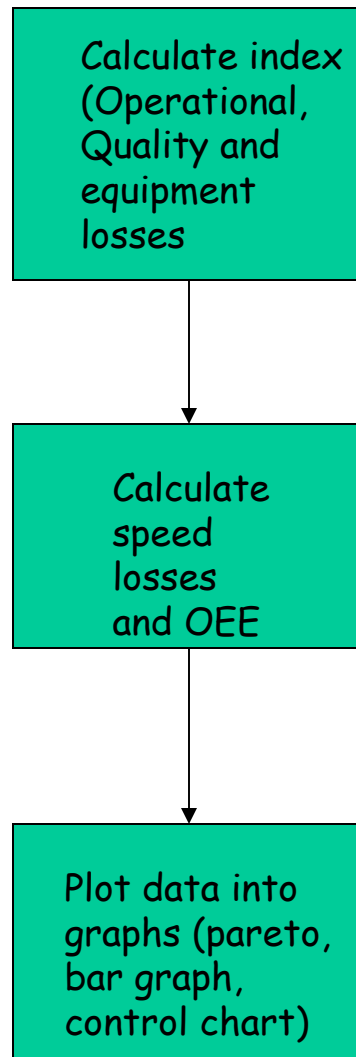
P. PLANEADOS	HORA INICIO	HORA TERMINO	P. PLANEADOS	HORA INICIO	HORA TERMINO	P. PLANEADOS	HORA INICIO	HORA TERMINO
Comida			Comida			Comida		
Cursos			Cursos			Cursos		
Desayuno de fin de mes			Desayuno de fin de mes			Desayuno de fin de mes		
Entrada de contratistas			Entrada de contratistas			Entrada de contratistas		
Entradas de planeación			Entradas de planeación			Entradas de planeación		
Exámenes			Exámenes			Exámenes		
TURNO:			TURNO:			TURNO:		
OPERADOR:			OPERADOR:			OPERADOR:		
FECHA:			FECHA:			FECHA:		
NOMBRE DEL PRODUCTO:	No. DE PERSONAS		NOMBRE DEL PRODUCTO:	No. DE PERSONAS		NOMBRE DEL PRODUCTO:	No. DE PERSONAS	
LOTE:	AVE DEL PRODUCTO	PZAS * TURNO	LOTE:	AVE DEL PRODUCTO	PZAS * TURNO	LOTE:	AVE DEL PRODUCTO	PZAS * TURNO
HORA INICIO	HORA TERMINO	TIEMPO	HORA INICIO	HORA TERMINO	TIEMPO	HORA INICIO	HORA TERMINO	TIEMPO
TIPO DE LIMPIEZA			TIPO DE LIMPIEZA			TIPO DE LIMPIEZA		
PAROS RELACIONADOS CON EL EQUIPO								
HORA INICIO	HORA TERMINO	TIEMPO	HORA INICIO	HORA TERMINO	TIEMPO	HORA INICIO	HORA TERMINO	TIEMPO

Customized data input format
for each WC

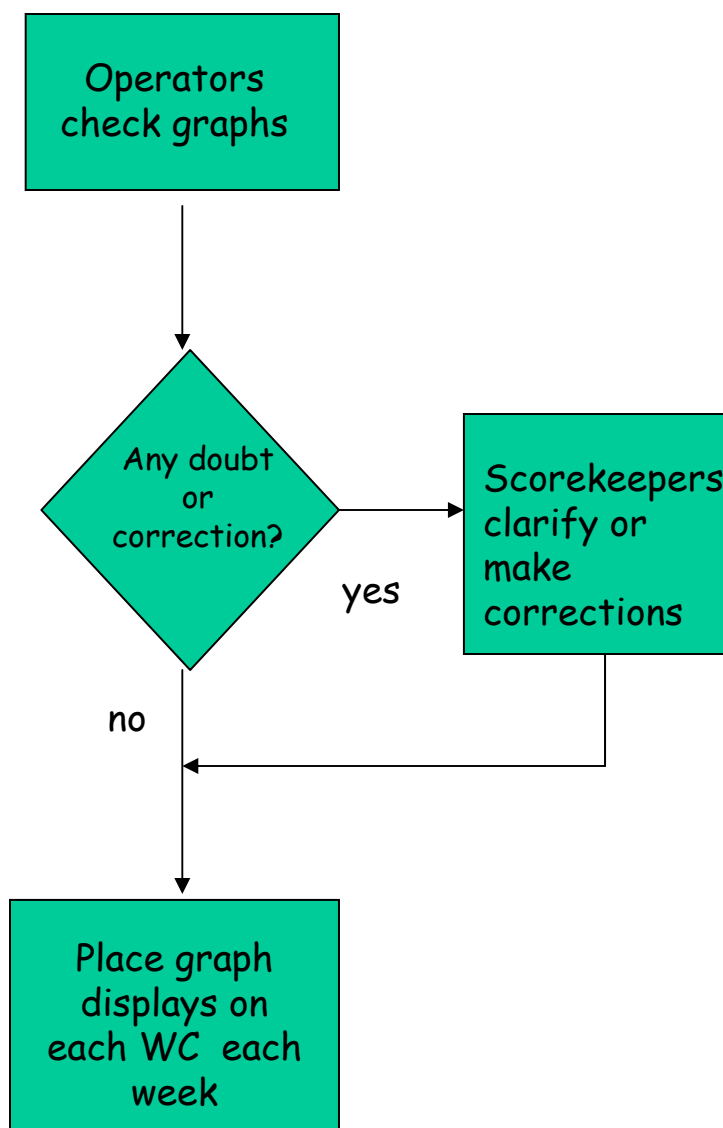
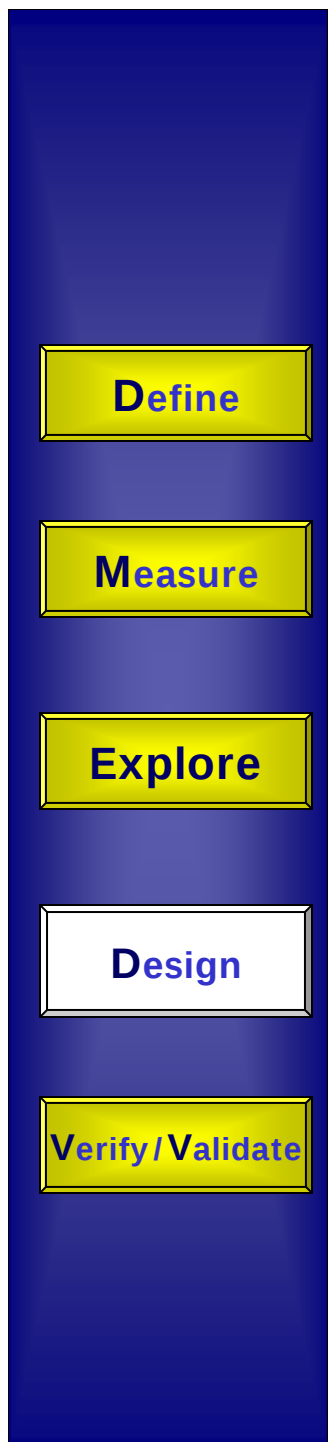
Process



Data Collection	
Process/ Method	Info is recorded manually by operators
Information systems	Customized printed formats for each WC
Facilities/ sites	54 different WC
Human systems	2 people as scorekeepers All operators
Equipment & materials/ supplies.	Documents (formats) Chronometer



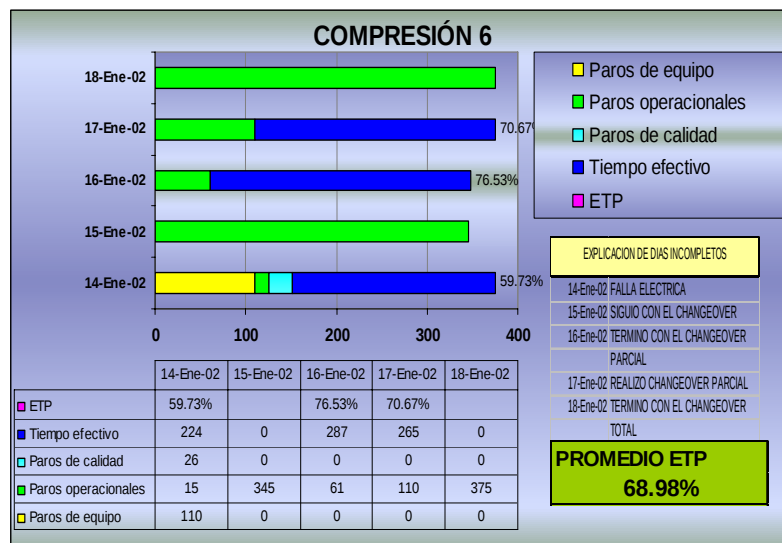
Data Processing	
Process/ Method	Info is processed and plotted by computer
Information systems	Excel, Minitab
Facilities/ sites	Work area allocated to the 2 scorekeepers in the shopfloor.
Human systems	2 people as scorekeepers
Equipment & materials/ supplies.	1 Color printer, 2 PC's in network, desk, chairs



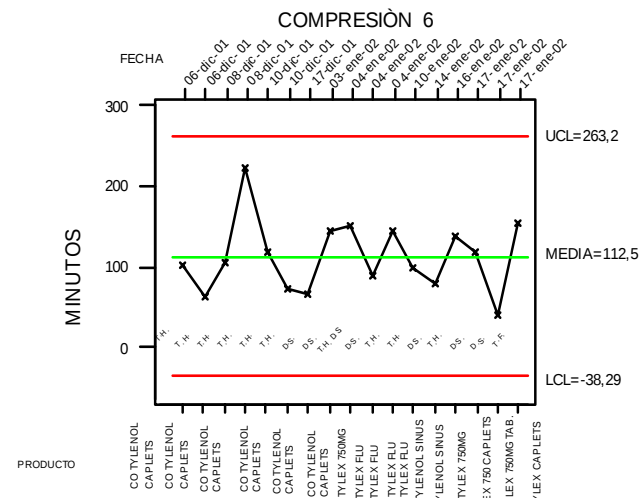
Data Display	
Process/ Method	Graphs are posted on the walls of each WC
Information systems	Paretos, bar graphs, control charts for OEE
Facilities/ sites	54 different WC
Human systems	2 people as scorekeepers All operators
Equipment & materials/ supplies.	Sheet covers, printers, boards

Major Metrics

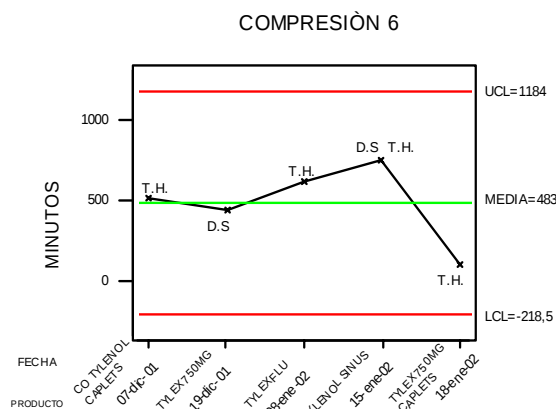
OEE INDEX



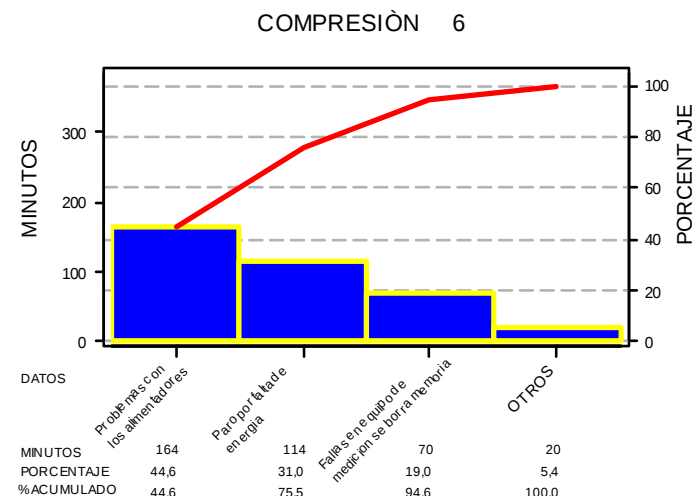
MINOR CHANGEOVER



MAJOR CHANGEOVER



EQUIPMENT STOPAGES



Define

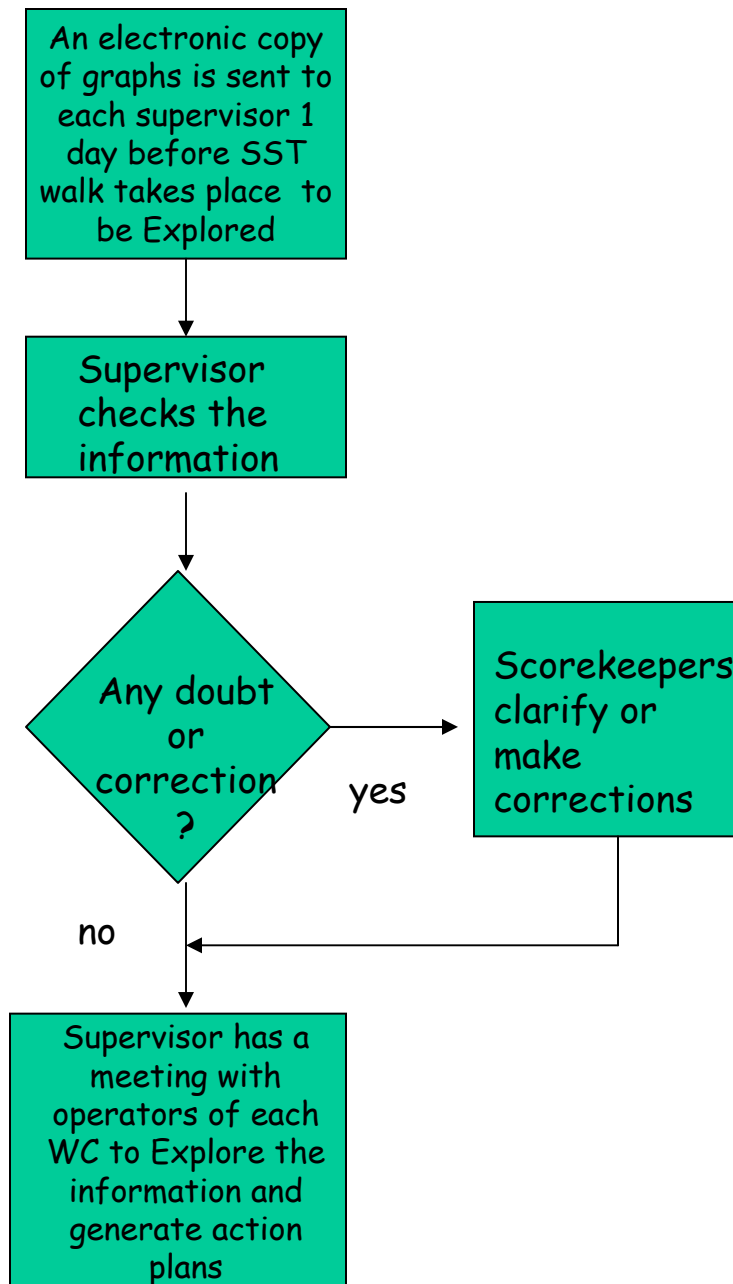
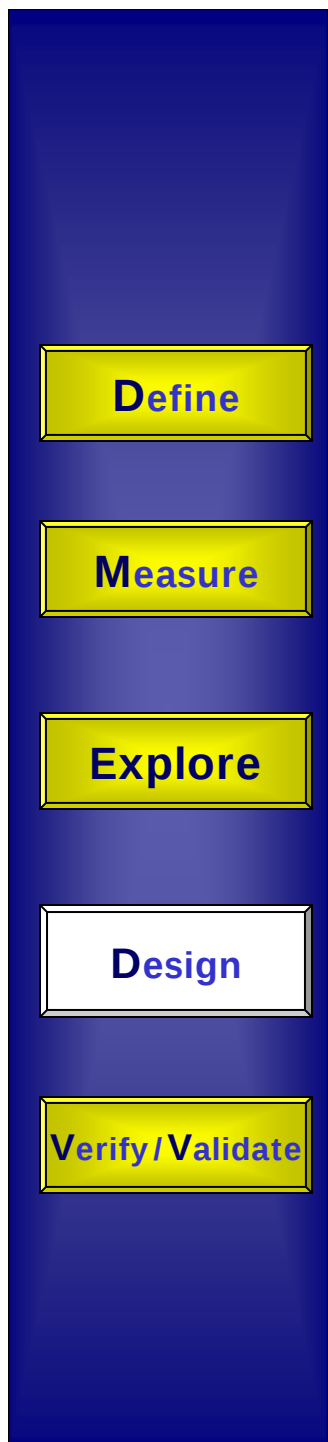
Measure

Explore

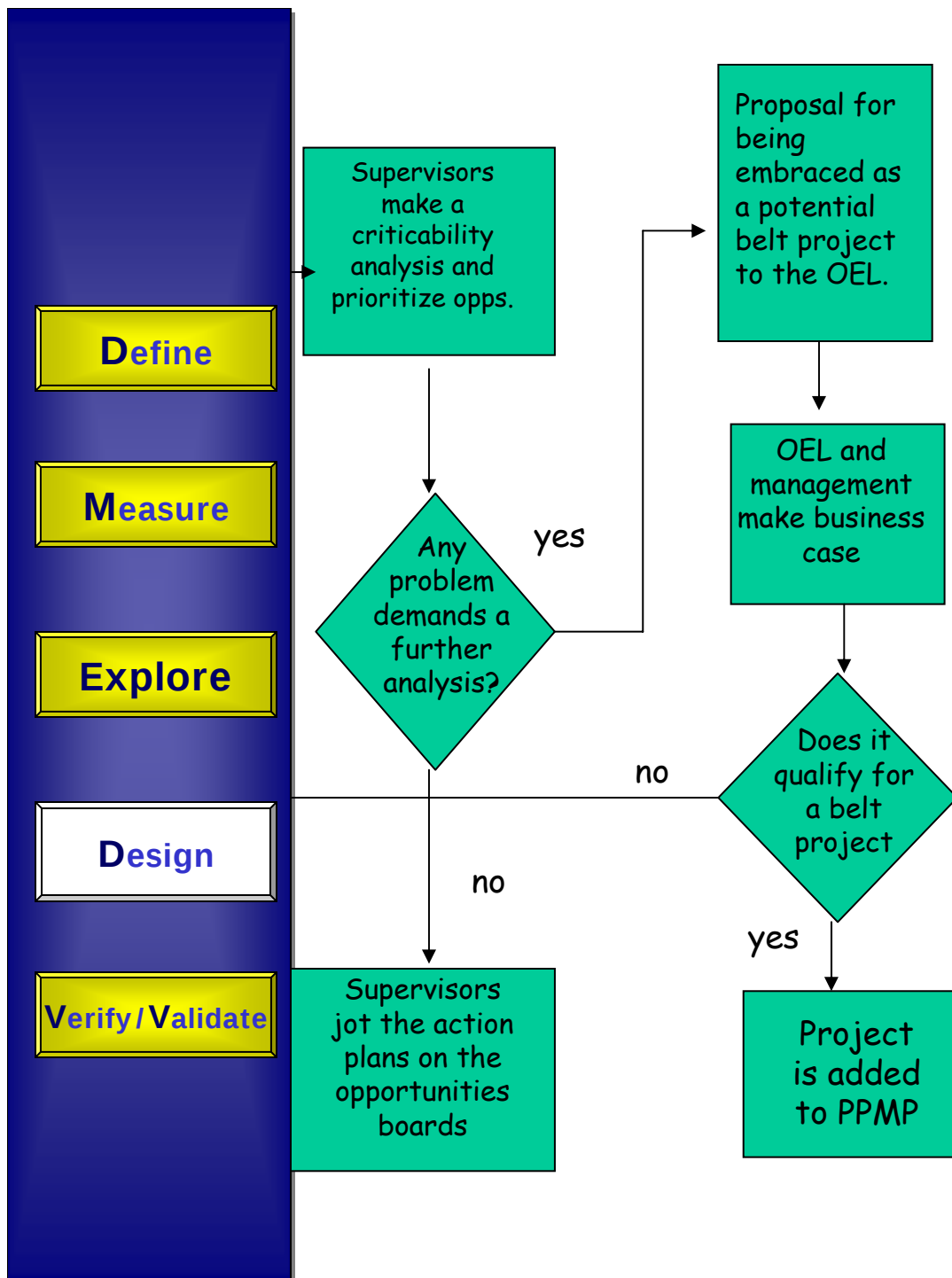
Design

Verify/Validate

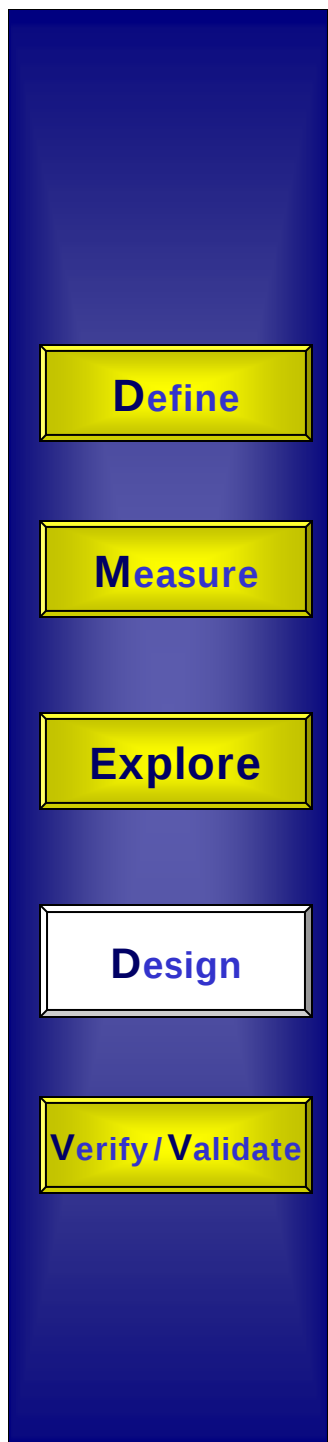
Process



Information Analysis	
Process/ Method	Work teams led by supervisor to analyse info
Information systems	Outlook, meetings
Facilities/ sites	54 different WC
Human systems	3 supervisors All operators
Equipment & materials/ supplies.	Electronic files via e-mail, computers, boards



Action Plans	
Process/ Method	Arose from info and criticability analysis
Information systems	Meetings, metrics,
Facilities/ sites	54 different WC
Human systems	Supervisors All operators
Equipment & materials/ supplies.	Boards, graphs, minutes



Minute with agreements is distributed to all SST members



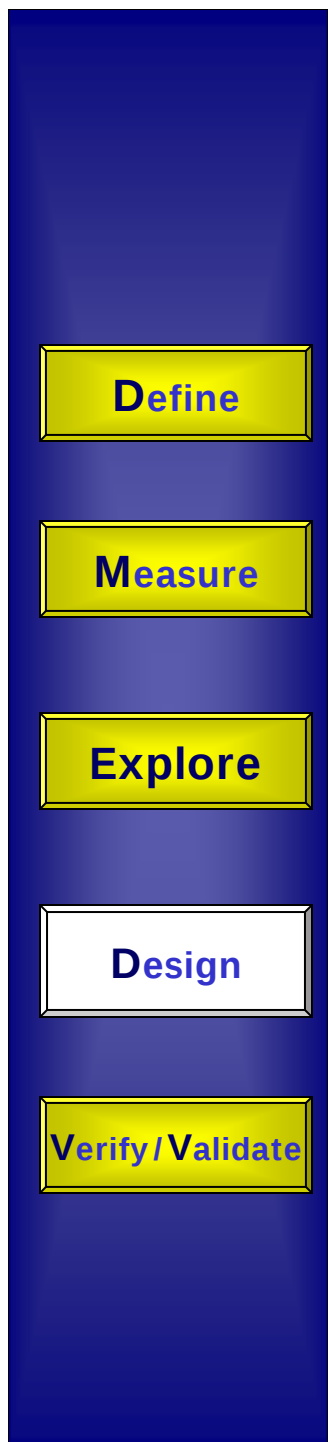
SST walk makes a follow up of the open opportunities and update the opportunities report.



Process Management team meeting evaluates improvements, accomplishments and gaps for the improvement process

Process

Improvement assesment	
Process/ Method	Team (comittee) for improvement evaluation Follow up by SST
Information systems	SST Minutes
Facilities/ sites	Meeting room each 2 weeks
Human systems	4 people conform PMT (Process Management team) also are part of SST
Equipment & materials/ supplies.	Formats for follow up, opportunities board,



SST walks through every work center and checks action plans on opps board



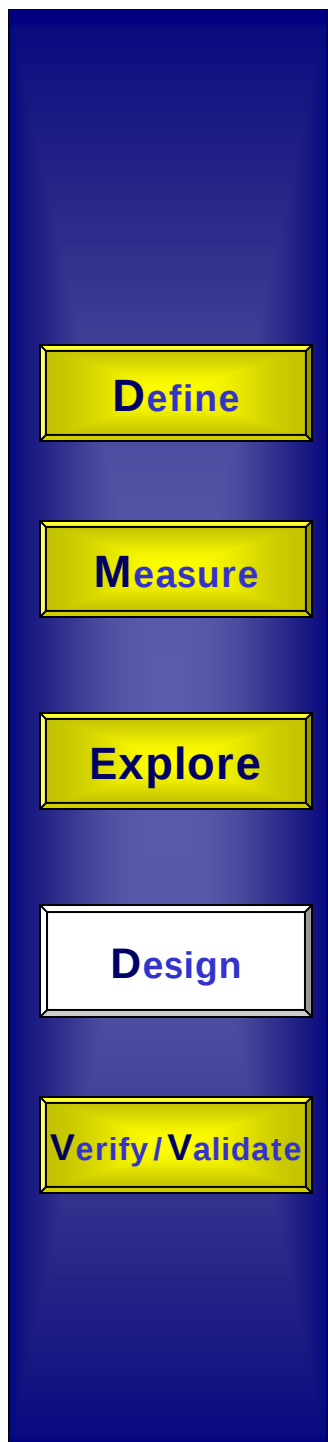
SST allocates resources and commits dates for completion



Commitments are recorded on the boards and a minute is written

Process

Resources allocation	
Process/ Method	SST allocates resources for actions needed accomplishment (twice a week)
Information systems	Opportunities boards, metrics in place
Facilities/ sites	54 different WC
Human systems	SST Action plans keeper
Equipment & materials/ supplies.	Formats for follow up, opportunities board,



Based on improvement assesment and sustainability of results, PMT determines candidates for recognition



Candidate nominations enter into the supply chain recognition process already defined

Process

Recognition	
Process/ Method	PMT nominates candidates approved by supervisors.
Information systems	Metrics, improvement assessments
Facilities/ sites	Meeting room once a month
Human systems	PMT (Process Management team), supervisors
Equipment & materials/ supplies.	Nomination formats, performance reports.

Process Management Team (PMT)

Define**Measure****Explore****Design****Verify/Validate**

- Mission
 - Make sure OEE system is effectively used as a model for improvement as impacts positively our business results by the use of tools such as six sigma, VSM, one right way, etc.
- Objective
 - Meet every 2 weeks in order to discuss OEE system performance metrics (ctq's) and to design strategies to overcome the gaps.
- Team members
 - Patricia Reynoso
 - Ignacio Gonzalez
 - Miguel Angel Lopez
 - Josaphat Martinez
 - Lucila Cabello

OEL (Team leader)

Production manager

Warehouse manager

Lean leader

Action plans keeper

**Critical Metrics**

Critical Metrics for Monitoring Performance

Define

Measure

Explore

Design

Verify/Validate

- # of actions arose from the system
- # of actions completed on time
- # of times info is not updated
- # of mistakes found in graphs
- Rate of confort from operators collecting data
- OEE improvement
- % of attendance to SST walks
- \$\$\$ Benefits generated from the system
- # of people recognized



Reporting Plan

Collecting data for monitoring major CTP's

OPORTUNIDADES QUE NO CUMPLERON, (FECHA COMPROMISO), QUEDA ABERTA CON FECHA REPROGRAMADAS															
OPORTUNIDADES QUE SE ESTÁ DANDO SEGUIMIENTO PARA CUMPLIR CON FECHA COMPROMISO															
OPORTUNIDADES CONCLUIDAS															
OPORTUNIDADES CON IMPORTANCIA ALTA (SE ESTARÁ MONITOREANDO POR MES DE ACUERDO AL # DE OPORTUNIDADES POR AREA)															
FECHA	AREA	PORTUNIDAD	COMENTARIOS ADICIONALES	QUIEN	CUANDO										
		FABRICACION JANSSEN													
3	17-Ene	A B	FAB Y LL	Capacitación de indicadores de depresión	INFORMAR AVANCE	JLG		16-Ene	12-Feb						
4		A	GRAN	STUGERON RETARD, CAMBIO A C/NARICA/N MICRONIZADA	SE CAMBIARA PROCESO	JLG/U		24-Ene	Febrero						
5		A	GRAN	Instalación de protector colector de polvos	CONECTAR	EN MAC / RN		01-Feb	23,24 FEB						
6		A	COMP	Reparación de limpiadores de tabletas	4 SEMANAS DE ENTREGA (19 MAR)	RIVER		24-Ene	19-Feb	19-Mar					
7	24-Ene	A	COMP 3	Fabricación de herramienta para BBCT tipo "Y" cortantes para almarras	ENTREGA EL PROY., RETRAZO 1 SEMANA 25 FEB	UF		31-Ene	16-Feb	24-Feb					
8	01-Sep	A	FABR	Area para montacargas	Se tiene que analizar cual sera el área del montacargas	JLG		03-May							
11	17-Ene	A	GRAN 2	Habilización de Escóvil	19 FEB CALIBRACION Y EL 25 FEB ARRANCA	JLG / UF		Febrero	12-Feb	26-Feb					
13	17-Ene	A	LL CAPS 1	Reducir los tiempos de changover	Se esta analizando la causa (tiempos altos.)	MIP EB		Pendientes							
14		A	DESARROL	Espacio para desarrollo (Granel)	Hay que planear un espacio para desarrollo	Febrero JLG									
15	Mar-41	A	PRODUC	Uniformes (personales) para producción	SE ENTREGON UNIFORMES 14 FEB Uniformes 19Feb	UF		24-Ene	25-Feb						
16	01-Sep	A	GRAN	Colocación de guardia al voltajeador de Glat	Instalación	RN		24-Ene	05-Mar						
17	01-Sep	A	FAB SOL	Colocación de guardia al clark	Se llevara a cabo una evaluación	ER/RN		24-Ene	05-Mar						
18	17-Ene	A	FAB SOL	LENTES DE SEGURIDAD GRADUADOS	SE RECIBE ARMADURAS Y SE ENTREGAN A DRA. PARA QUE LOS MANDE A GRADUAR	JAL		22-Ene	31-Ene	22-Feb					
19	17-Ene	A	FAB	BASE PIDESCARGA ESTATICA	SE EVALUARA	JAL/JLG		22-Feb							
21	17-Feb	A	AUTOCAL	INSTRUMENTOS DAÑADOS EN AUTOCALAVE	4 SEMANAS DE ENTREGA 21MAR	RIVER		12-Feb	15-Feb	21-Mar					
22	12-Feb	A	LL CAPS 1	IDENTIFICACION TUBERIAS COD DE COLORES	SE HARA PARA TODO FAB JANSSEN, FAB OLIG	JLG/UF		21-Feb	26-Feb						

[illegible]

Pilot Plan

Define

Measure

Explore

Design

Verify/Validate

- IWKA (Packaging machine)
- Two shifts included
- 1 month of data
- 12 people trained in OEE concepts
- Track performance of key metrics (attendance, # of opps., % completed on time, OEE improvement, etc.)

Pilot Performance

Pilot performance

DMEDVI

Define

Measure

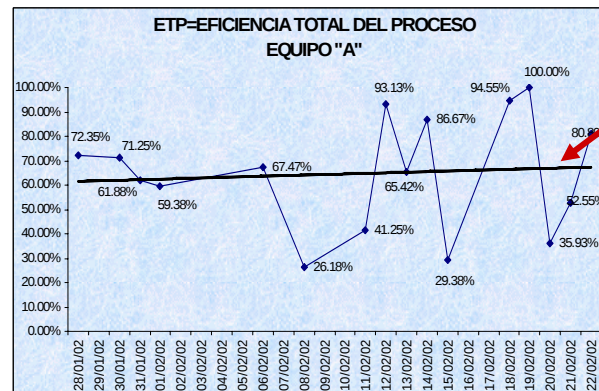
Explore

Design

Verify/Validate

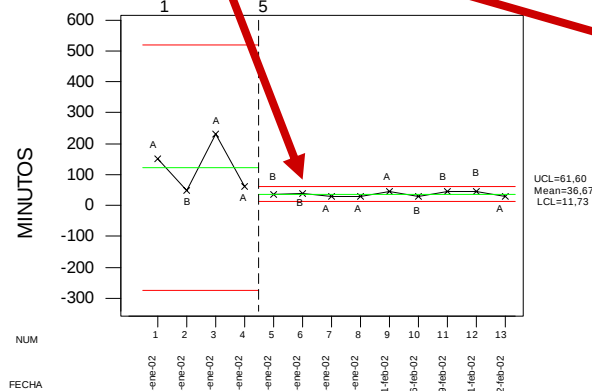
Variability
Reduction

OEE INDEX

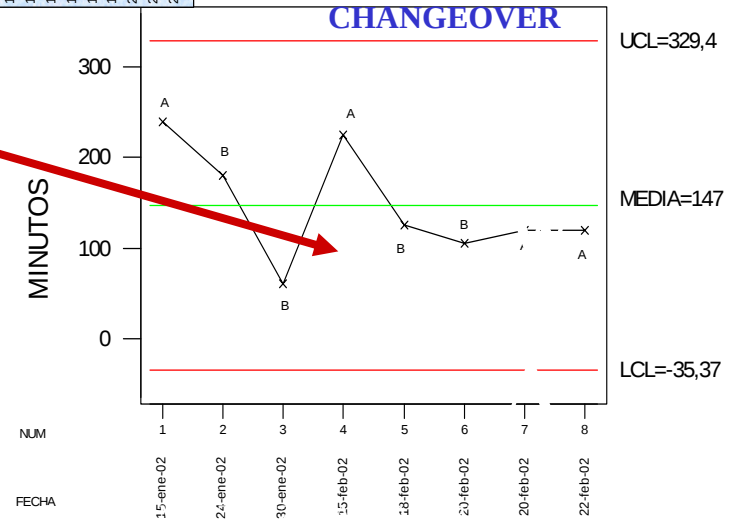


Increasing
trend

MINOR CHANGEOVER



MAJOR CHANGEOVER



Implementation Plan

Full Scale Implementation Plan

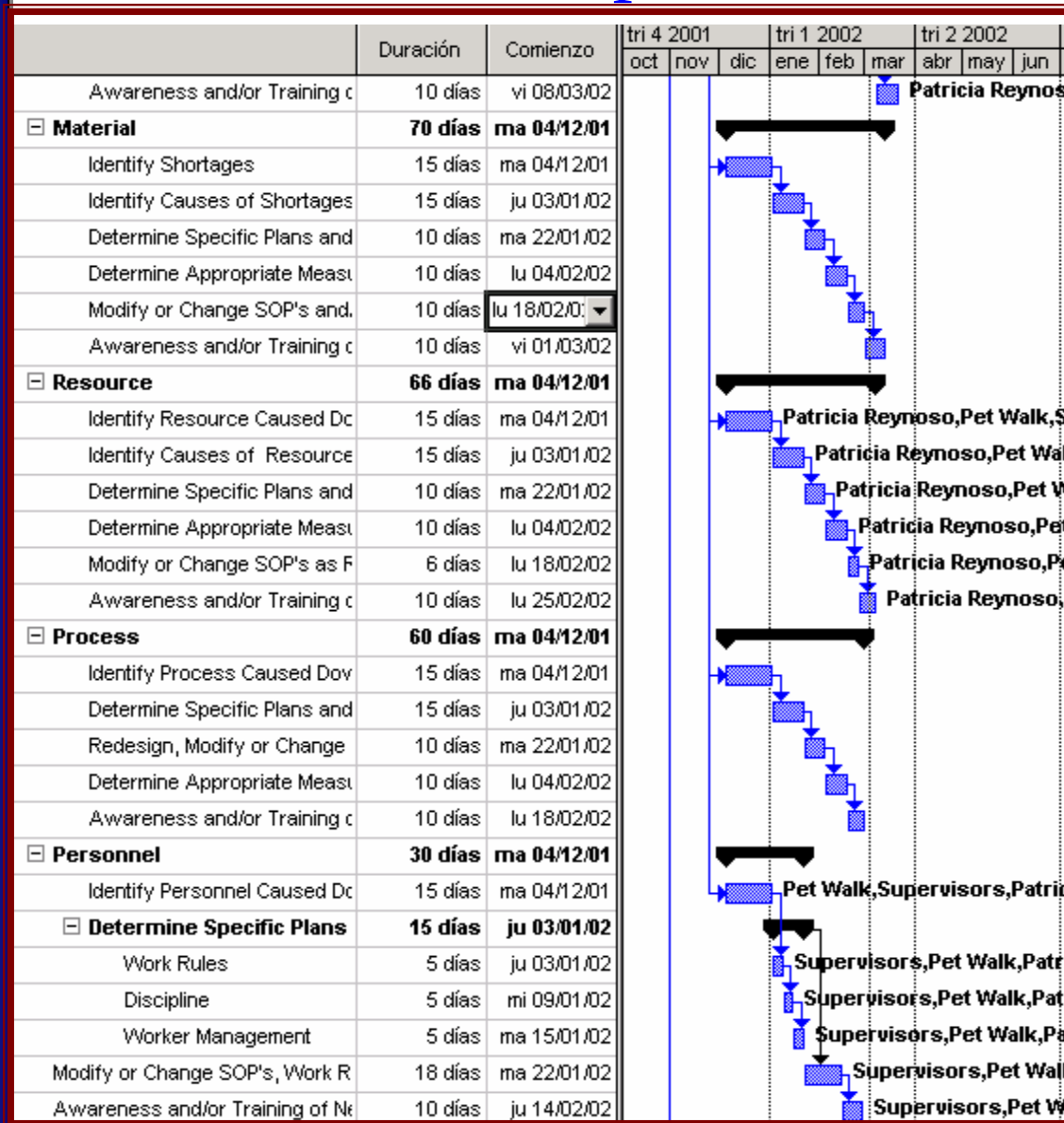
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Milestones

Change management	Dec 01
People training	Dec 01
Customized formats design	Jan 02
Resources allocation	Jan 02
All cells operating OEE system	Feb 02

Goals Achieved

Goals achieved

Define

Measure

Explore

Design

Verify/Validate

- **OEE (# of work centers into OEE system).**
 - Baseline 0.
 - Current 54 (100%)
- **Trained people in OEE concepts.**
 - Baseline 0%.
 - Current 100%.
- **SST walk completely integrated to OEE system.**
 - Current 100%.



Lessons Learned

Key Lessons Learned

Define**Measure****Explore****Design****Verify/Validate****Exit**

- Involvement of people in design as a “voice of the customer” exercise was crucial for the project success.
- There are no “Magic Solutions”. The key is to get consensus and agreement about the new process.
- Control management process, usually not taken into account, is necessary to get sustainable results.
- Pilot plan was very useful and valuable to refine the design and assure a good performance.

Main