Cátedra Nissan

-PROTHIUS-

Modelos de Organización en Obra y Empresa: Metodología para la selección y gestión de proyectos. Fase IV.

Rubén Rami

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Departamento de Organización de Empresas

Universidad Politécnica de Cataluña

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Cátedra Nissan
www.nissanchair.com
director@nissanchair.com

Fase 4. Propuesta soluciones

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Objetivo sesión

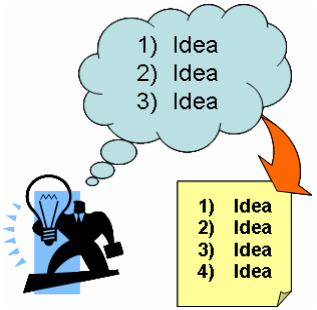
- Definir objetivo y expectativas de la fase 4: Propuesta soluciones
- Conocer herramientas más usuales en la fase 4
- Práctica con las herramientas

Fase 4: Propuesta Soluciones

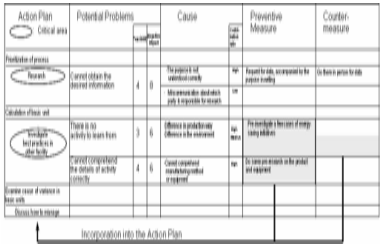
Objetivo	Identificar las soluciones para conseguir el 1er métrico, realizando una prueba, o “Trial” de confirmación (si es necesario)

Expectativas de esta fase:

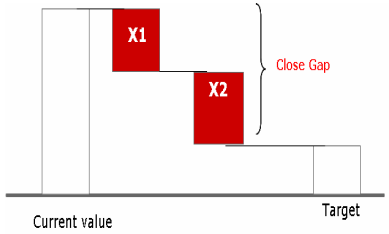
- Soluciones identificadas



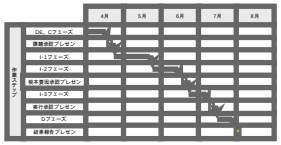
- Validar efecto (1er Métrico y financiero)
- Análisis de riesgo (soluciones y despliegue)

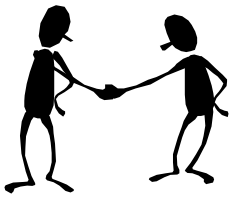


- Prueba de confirmación



- Acordar el plan de despliegue





Marcar prioridades en las soluciones mas efectivas para corregir la causa raíz

Fase 2

Entender la situación actual

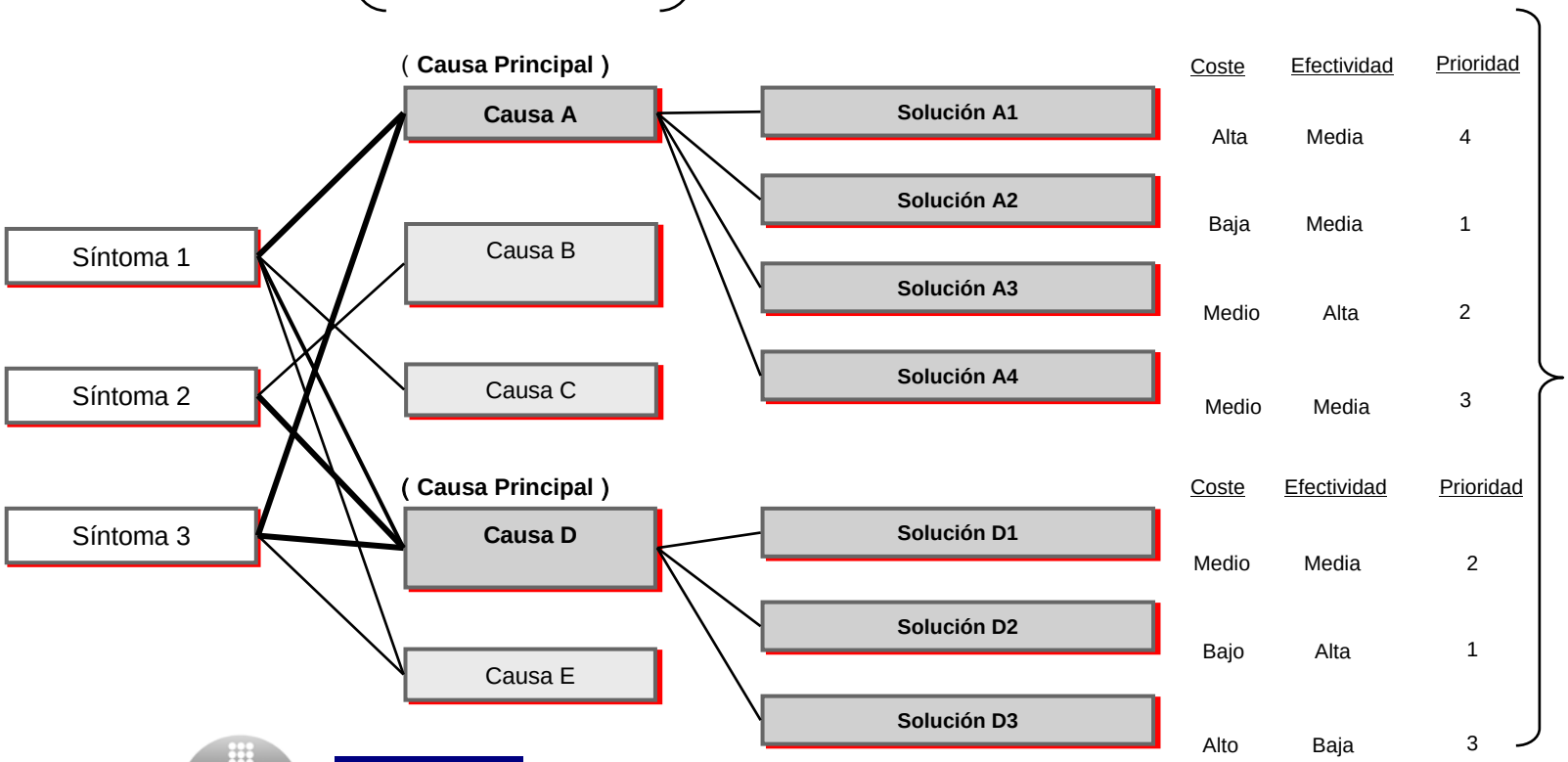
Fase 3

Identificar las causas y especificar la causa/s raíz

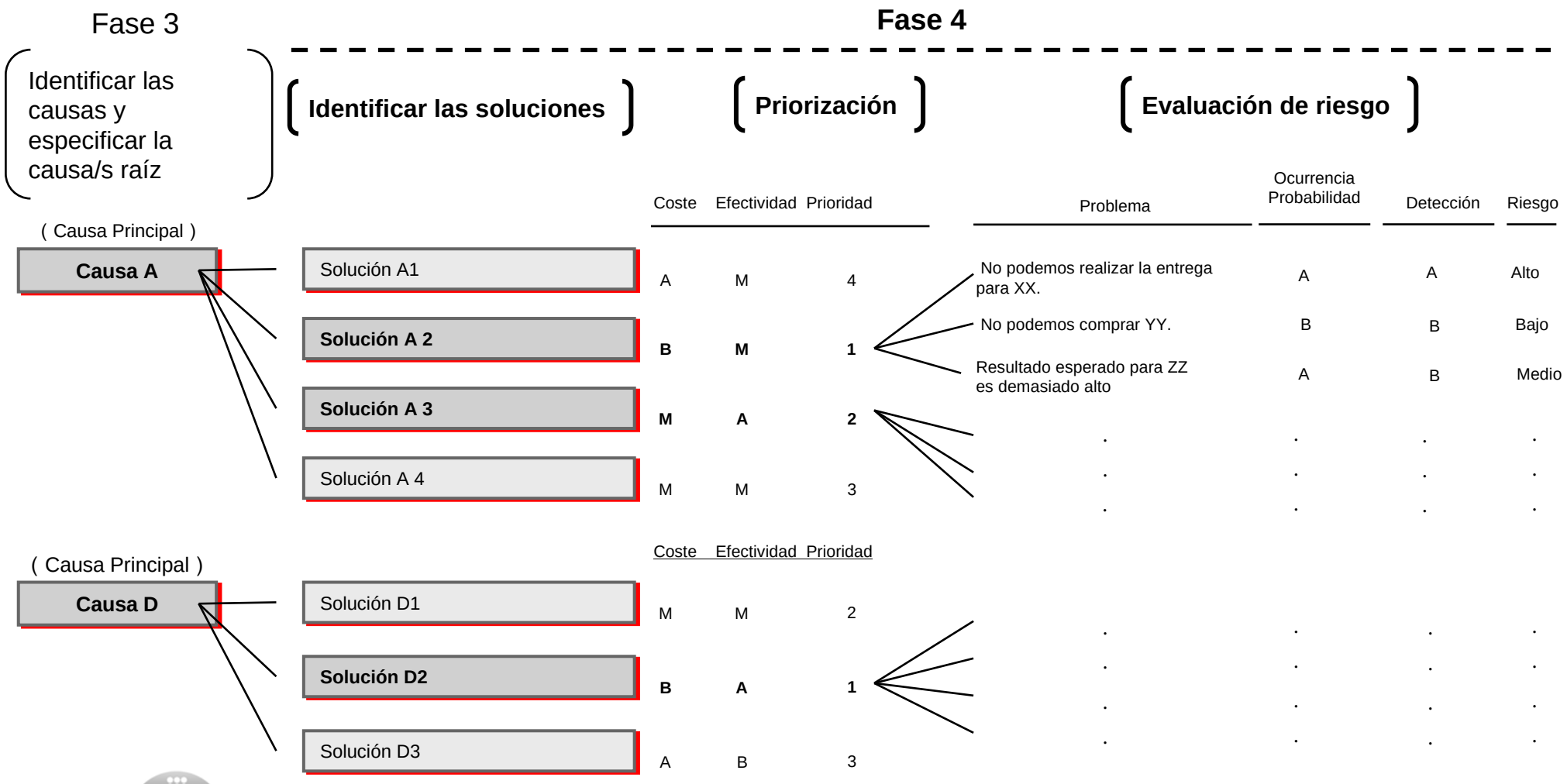
Fase 4

Identificar las soluciones

Priorización



Determinar el riesgo potencial para cada solución e identificar las acciones preventivas



Desarrollar un cronograma para validar con un “Trial” la efectividad de las medidas

Fase 4

Soluciones — **Desarrollar plan de implementación del “Trial”**

	Trial	Fecha	Resp.	Punto de control	Implementación definitiva
Solución A	Posible	1/Abril/06	J.Ramirez	Efecto Coste Ratio defectos Ratio entrega	15 / Mayo / 2006
Solución B	No posible		P.Juarez	Efecto Coste Precio etc…	
Solución C	Posible	10 a 15 Abril	C.Boga	Efecto Coste Ratio asistencia Horas trabajo . . .	1 / Junio / 2006

Conducir el “Trial” y evaluar resultados

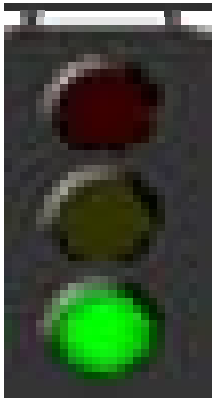
Objetivo

- Para confirmar si las soluciones adoptadas producen el efecto deseado (1er métrico), generan impacto negativo (2º métrico), o afectan a otros indicadores, que tendrán que ser medidos.

Puntos a Confirmar

Para la realización del “Trial” el equipo deberá confirmar los siguientes puntos con el responsable correspondiente de la función:

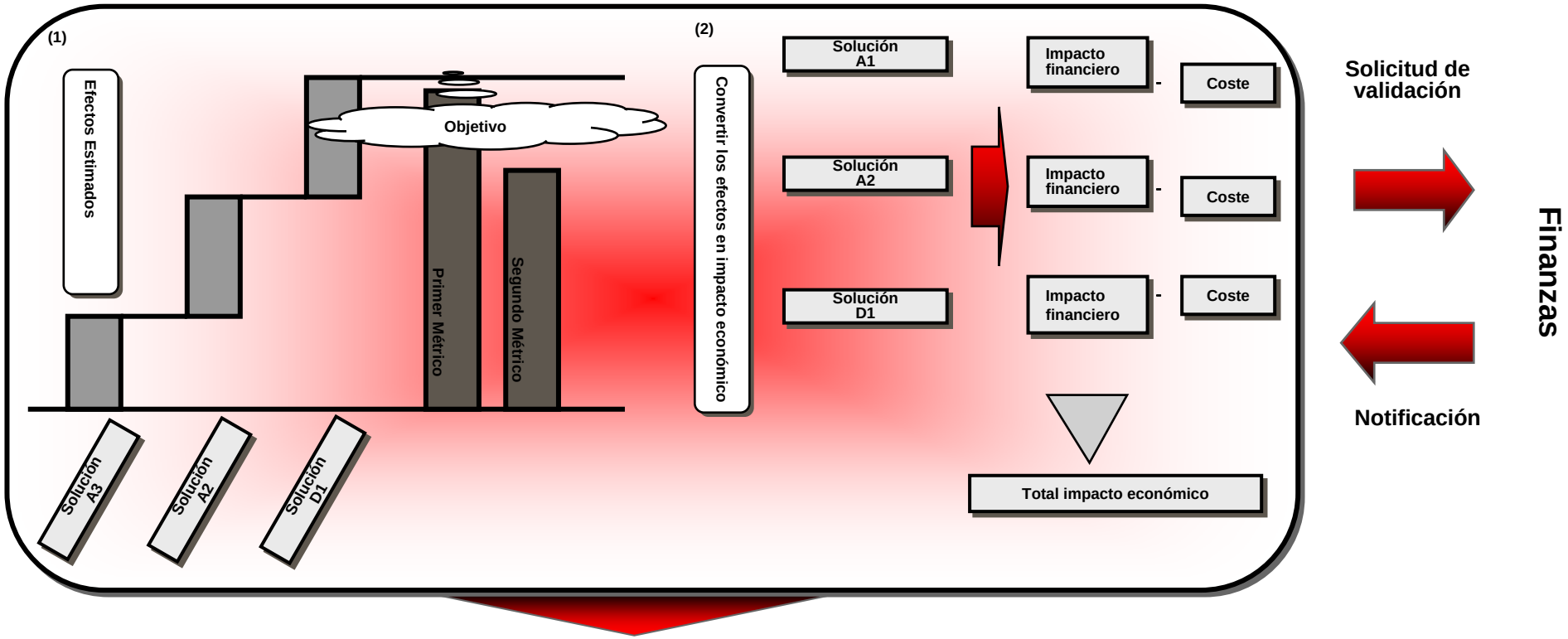
- Si la realización de la prueba se puede realizar o no
- Especificar las características del mismo: Cuando, donde y quien (personas y recursos necesarios así como los procesos afectados para su realización)
- Extensión del “Trial” para que sea representativo de la situación real.
- Como incorporar el feedback del mismo en el modelo de despliegue a gran escala.



Recomendación de realización de un “Trial”

- Cuando el ámbito es muy amplio
- Cuando la implementación definitiva es muy costosa
- Cuando el proceso es irreversible, una vez los cambios han sido realizados

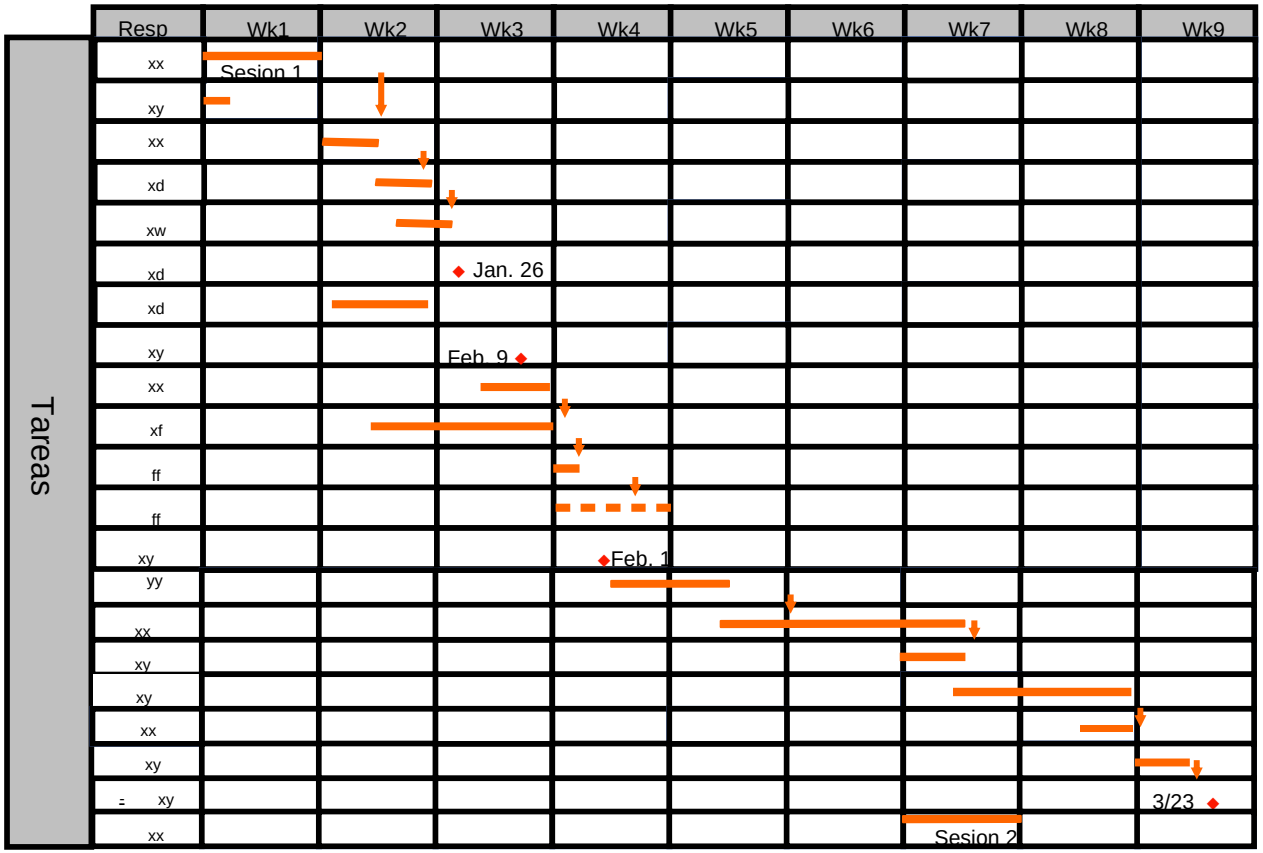
Decisión de Implementación de las Soluciones



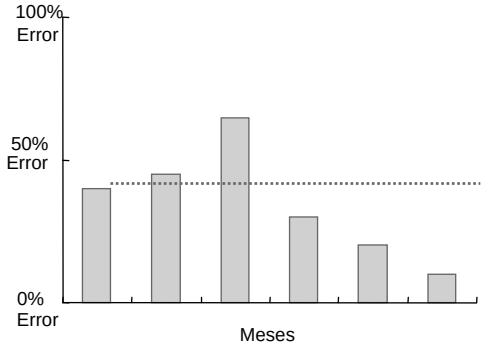
Decisión de implementación (Responsable compañía)

El responsable del proyecto deberá seguir y validar los efectos estimados durante la implementación

Desarrollo de un plan de acción para la implementación completa del proyecto



- Desarrollar un sistema de monitorización del plan de mejora



- Preveer la actitud de respuesta de la organización/es afectada y diseñar un plan de comunicaciones apropiado para vencer la resistencia al cambio

		Positions against the proposed means for implementation				
		Strongly Against it -2	Against it -1	Neither against nor For it 0	For it +1	Strongly For it +2
STAKEHOLDERS	Mr.., A GM, Sales					
	Mr., B GM , CS					
	Mr., C GM, Sales					
	Mr., D Director for Sales					
	Mr., E Manager, HR					
	Mr., F Account Executive for Dealerships					

Fase 4. Herramientas

BENCHMARKING

PRIORIZATION MATRIX

RISK ANALISYS

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Introducción al Benchmarking

- El Benchmarking es una herramienta utilizada para medir las prácticas y procesos de una organización, comparándolos con los de otras organizaciones, con el fin de identificar oportunidades de mejora.

- El Benchmarking puede realizarse entre diferentes departamentos o filiales de una misma compañía, dentro de la industria o fuera de la industria. Las comparaciones dentro de la compañía buscan el más alto desempeño o las mejores instalaciones. Las comparaciones dentro de la industria buscan a los líderes del mercado. Las comparaciones fuera de la industria buscan a las mejores prácticas globales.

- El Benchmarking, en la mayoría de los casos, se lleva a cabo en un ambiente de colaboración, lo que significa que las organizaciones incluidas en el estudio están de acuerdo en proporcionar información acerca de ellas a través de un cuestionario. Sin embargo el Benchmarking también puede llevarse a cabo sin colaboración, cuando se dispone de datos adecuados de una tercera parte.

Pasos para conducir el Benchmarking

Paso 1: Identificar las mediciones para el Benchmarking	Determinar que mediciones serán el benchmark. Pensar acerca de los procesos involucrados con la causa raíz, así como los productos y salidas de dichos procesos.
Paso 2: Identificar los objetivos para el Benchmarking	Decidir cuales organizaciones serán utilizadas como benchmark. Buscar compañías de clase mundial o líderes en un área funcional particular que le concierna
Paso 3: Determinar el método de recolección de datos	Evaluar varias fuentes disponibles de datos para identificar aquella que proporcione la información más exacta, comprensible y oportuna sobre una base continua
Paso 4: Determinar la brecha competitiva	Usar los datos que han sido recolectados para determinar en que medida el desempeño actual se aleja de la(s) organización(es) elegidas como benchmark
Paso 5: Proyectar el desempeño futuro	Asignar un valor financiero a la brecha competitiva y utilizarlo como parte del caso de negocio inicial para el cambio
Paso 6: Comunicar hallazgos	Utilizar los resultados de los pasos previos con el fin de mostrar que existe un problema u oportunidad y redefinir las expectativas de desempeño

Ejemplo de Benchmarking

Problema: **Los costos de embarque y gestión son demasiado altos debido a una distribución ineficiente del almacén**

Paso 1: Identificar las mediciones para el Benchmarking	Las mediciones apropiadas incluyen: líneas surtidas / persona / hora. Distancia promedio de movimiento por surtimiento
Paso 2: Identificar los objetivos para el Benchmarking	Las compañías ideales para benchmark tendrían un área similar de almacén (en metros cuadrados) y un número comparable de SKU´s
Paso 3: Determinar el método de recolección de datos	Las posibles fuentes de información pueden incluir el *Council of Logistics Management, Modem Distribution Management Magazine*, proveedores de equipo y software de almacén, etc.
Paso 4: Determinar la brecha competitiva	Comparar las líneas surtidas / persona / hora con alguna de las organizaciones seleccionadas para benchmarking
Paso 5: Proyectar el desempeño futuro	Multiplicar los costos de manejo actuales por la brecha competitiva (expresada en porcentaje) con el fin de obtener una estimación de los ahorros potenciales que pueden utilizarse en el caso de negocio
Paso 6: Comunicar hallazgos	Utilizar los resultados con el fin de mostrar que la distribución del almacén es ineficiente y que se justifica una acción correctiva

Tips para conducir un Benchmarking efectivo

Tips para el éxito

1. Cuando se identifiquen organizaciones contra las cuales hacer el Benchmarking, recordar enfocarse en procesos y objetivos, no en productos o mercados específicos. Una organización en una industria completamente diferente puede tener procesos muy similares a los suyos en el área funcional en que se conduce el Benchmarking

2. Sea cuidadoso en su búsqueda de datos para el benchmark. Algunas fuentes adecuadas incluyen:

   - Asociaciones y publicaciones industriales y profesionales
   - Organizaciones de Benchmarking
   - Contactos profesionales como clientes y proveedores
   - Información para inversionistas de competidores y reportes de analistas

3. Obtenga la aprobación del departamento legal antes de iniciar o participar en cualquier tipo de estudio de Benchmarking colaborativo fuera de la compañía

Tips para conducir un Benchmarking efectivo

Errores Comunes

1. Comparar peras con manzanas. Diferentes compañías pueden utilizar el mismo término para referirse a diferentes mediciones. Asegúrese que comprende claramente como han sido obtenidas y calculadas las mediciones antes de utilizarlas en el Benchmarking

   - Ejemplo: “Entregas a tiempo” pueden ser medidas de maneras muy diferentes de compañía a compañía

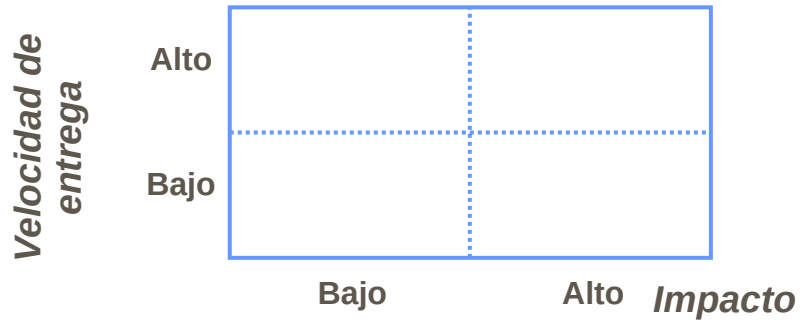
2. Asumir que todos los niveles de benchmark representan objetivos que pueden alcanzarse a través de la mejora del proceso. Las diferencias entre factores internos y externos que afecta a varias organizaciones pueden significar que su organización jamás alcanzará completamente los niveles de desempeño que otras presentan

Priorización :Matriz Pay-off

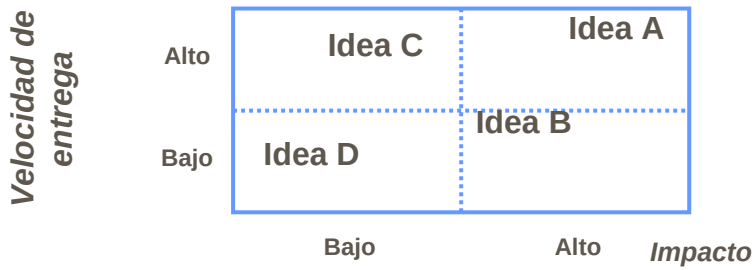
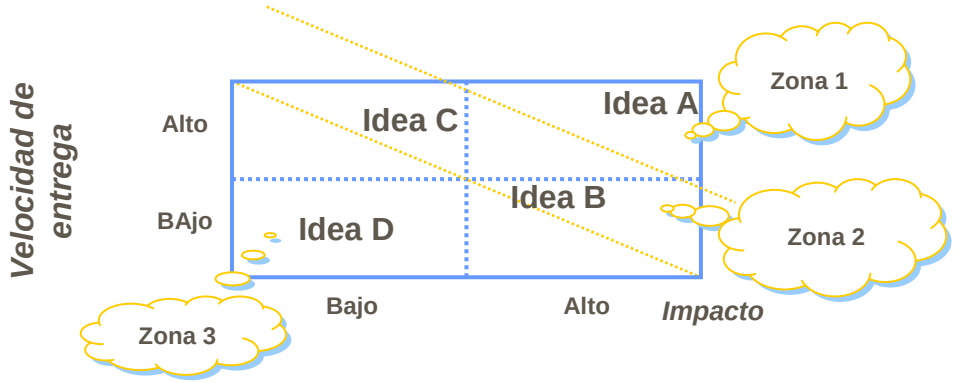
Para qué sirve?

- Prioriza las ideas en un corto periodo de tiempo a través de evaluar su rentabilidad midiendo en dos escalas.

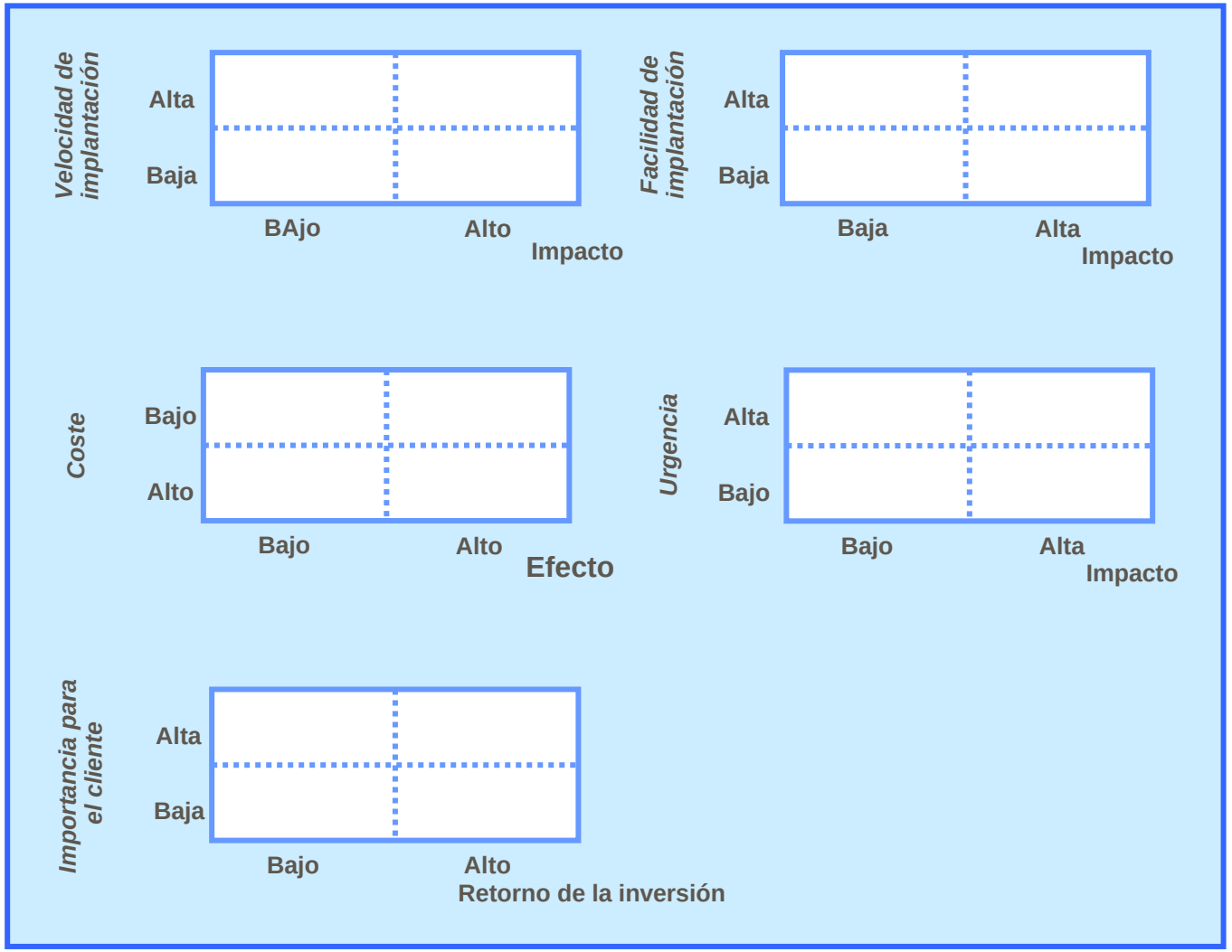
Pasos (1/2)

Pasos	Ejemplos
Paso 1 • Determinar las 2 escalas para evaluar las ideas • Chequear la bondad de estas escalas con el equipo	Ejemplos de escalas de evaluación: 1) Velocidad de entrega 2) Impacto
Paso 2 • Construir una matriz con las escalas de evaluación	

Pasos(2/2)

Pasos	Ejemplos
Paso 3 • Poner las ideas en la matriz a través de la discusión en equipo	
Paso 4 • Los factores con alta velocidad de entrega y alto impacto son definidos como de alta prioridad. (Zona 1 ➔ Zona 2)	

Ejemplos de Matriz



Priorización :PUGH Matrix

Para qué sirve?

- Evalúa y prioriza una lista de opciones, en función de una lista de criterios o características principales a las que se le relaciona con un peso específico.
- Es adecuado cuando es necesario una evaluación mas precisa que el caso anterior

Proceso :PUGH Matrix

- Paso 1: Selecciona los criterios para la comparación
- Paso 2: Selecciona las opciones a ser comparadas
- Paso 3: Construir una matriz con los criterios y las opciones. Evaluar cada elección contra los criterios. Para cada comparación el producto debería de evaluarse como mejor (numero +), igual (0) o peor (numero -)
- Paso 4: Calcula la puntuación total

Title	Priorizacion soluciones XXX

# Options	3
# Criteria	6

CTQ	Option 1	Option 2	Option 3
Criteria 1	1	0	-2
Criteria 2	2	0	-1
Criteria 3	0	1	2
Criteria 4	-1	1	2
Criteria 5	-2	1	0
Criteria 6	0	1	1
Total	0	4	2
Total +	3	4	5
Total -	-3	0	-3

Risk Analysis

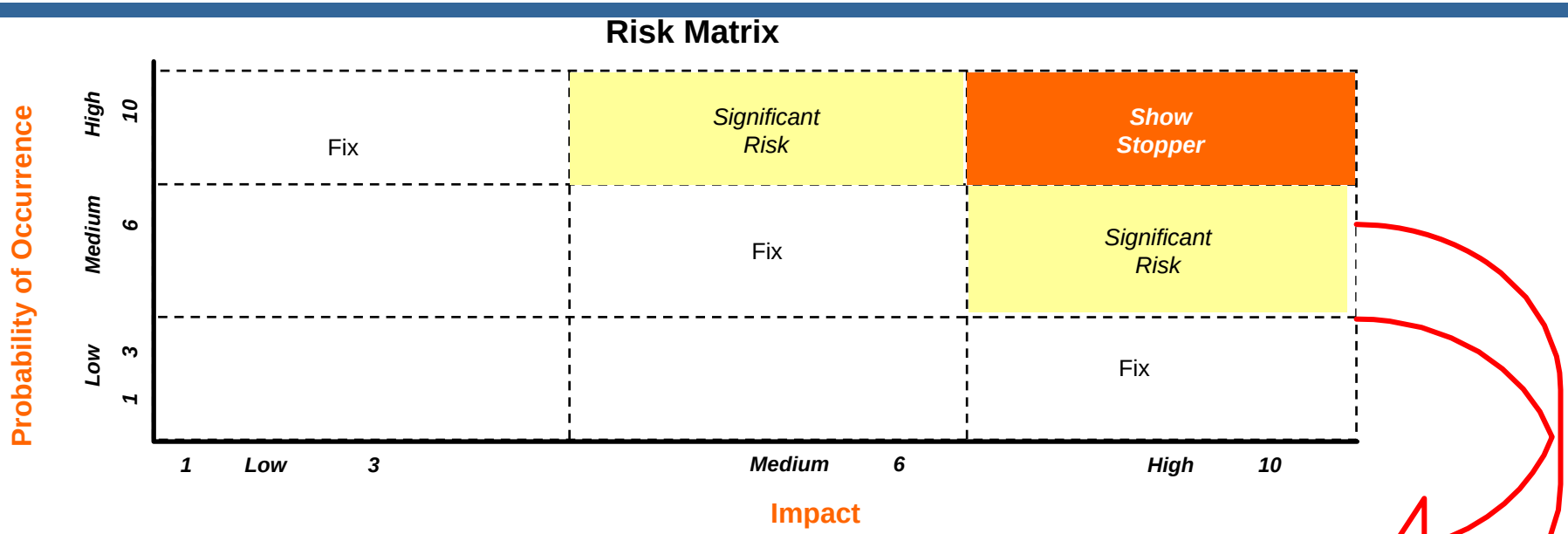
Purpose

- To identify potential problems and develop countermeasures for incorporation at the planning stage of each phase

Application

- Removal or mitigation of risks which could impact the quality, cost or lead time of a project
- Escalation to management for high level risks

One way to Represent and Share Risks



Item	Anticipated Issue	Probability	Impact	Cause	Contribution Ratio	Preventative Measures	Counter measures	Trigger points

Procedure for Conducting Risk Analysis

STEP	INSTRUCTION
Step 1: Include Risk Analysis into the project plan at each phase	• Plan for Risk Analysis with Crew and, if needed, with V-Leader - project risk at each phase - project definition risk at DE phase - improvement means risk at I3 phase - deployment plan risk at I3 phase - deployment execution at D phase
Step 2: For each phase and each type of risk, identify potential issues.	• Brainstorm potential issues with the V-crew; the question to ask is: What risks can result in project delays or poor result vs the target?
Step 3: Prioritize the potential issues	For each potential issue, rate : • The probability of occurrence (scale 1 to 10, 10 been almost certain) • The negative impact on achieving the target (scale 1 to 10, 10 being a show stopper for the project) • Plot them on a matrix or a table to decide which risk you want to remove.
Step 4: For high risks, analyse the causes	• Perform this step only if relevant (usually to be done for risk on solutions) • Assign a contribution ratio to each cause (e.g how much a given cause contributes to the risk) Based on the scale and rating.
Step 5: Develop preventative measures	• Develop preventative measures to prevent the risk from happening • Verify that the preventative measure is capable of lowering the impact rating down to below 3.0 level.
Step 6: Develop countermeasures to resolve the issue	• Perform this step only if it is not possible to have preventative action which removes the risk. The objective is to set up countermeasures if the risk occurs. • Identify what will trigger the countermeasure (i.e. how do we know we need to launch the countermeasure)
Step 7: Incorporate into action plans	• Incorporate both the preventative measures and the to do list of implementing the countermeasures into the action plan (project plan or deployment plan). • Report major risks to the to V-leader

Risk Analysis Example

Project outline: Cost management of energy consumption will be consolidated for central management by individual facility. In order to ensure on-time implementation of the action plans by the set due date, the project team conducted risk analysis for incorporation into the implementation plan.

Target: "To come up with how to go about company-wide energy cost management by April 1."

Action Plan ( ) : Critical area	Potential Problems	Feasibility	Negative impact	Cause	Contribution ratio	preventative Measure	Counter-measure
Prioritization of process							
Data-gathering	Cannot get the desired set of data	4	8	The purpose is not understood correctly	High	Request for data, accompanied by the purpose in writing	Go there in person for data
				The party who were asked for data had forgotten about it	Low		
Calculation of basic unit							
Investigate the best practices in other facility	There are no previous activities to learn from	3	6	Difference in production Way Difference in the environment	High Med	Pre-investigate a few cases of energy-saving initiatives (Occurrence possibility: 3 - 1)	Increase the # of facilities to investigate (Negative impact 6 - 4) (Advance notice is necessary.)
	Cannot comprehend the details of the activity correctly	4	6	Cannot comprehend manufacturing method or equipment	High	Do some pre-research on the product and equipment (Occurrence possibility:4-1)	See the initiative in action (Negative impact: 6-3)
Examine cause of variance in basic units							
Discuss how to manage							

Incorporate into the Action Plan

FMEA

- **FMEA is designed to prevent failures from occuring or from getting to internal and external customers.**

- **Therefore, FMEA is best suited for situations where failures might occur and the effects of those failures occurring are potentially serious.**

FMEA Steps

- 1.Fill in the header information
- 2.Fill in the process steps
- 3.For each process step, list requierements
- 4.For each requirement, list the failure mode
- 5.For each failure mode, list the effect of failure
- 6.For each effect of failure, estimate the severity
- 7.For each failure mode, list causes

FMEA Steps

- **8.For each cause of failure, estimate the likelihood of occurrence**
- **9.For each cause of failure, list the current process controls.**
- **10.Fore each process control, estimate the detection**
- **11.For each cause of failure, calculate the Risk Priority Number**
- **12.For high priority causes of failure and/or failure modes, develop recommended actions.**

FMEA Steps

- **13.For each recommended action, assign reponsibility and completion dates.**
- **14.For each recommended action, implement the action and note its effect**
- **15.For each implemented action, re- estimate the severity, occurrence and detection ranking and recalculate the RPN**

FMEA Step 1

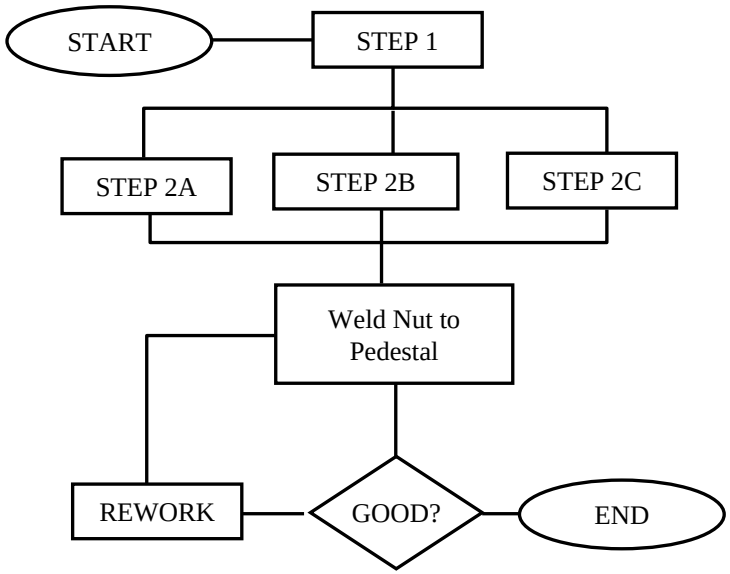
Fill in the header information

- **A) Describe the process**
- **B) Number the FMEA**
- **C) Identify the Pilot**
- **D) Identify page numbers**
- **E) List team members**
- **F) Name the preparer**
- **G) Enter the FMEA date**
- **H) Enter the revision data**
- **…..**

FMEA Step 2

Fill in the process steps

- Add all value added process steps from the process map to the FMEA form.



Process Step	Requirements
Weld Nut to Pedestal	

FMEA Step 3

For each process step, list requirements

Process Step Requirements
Weld Nut to Pedestal
Nut Present
Nut Welded Securely
Internal Threads in good condition

- Requirements can be specifications, if available, or statements of what the process step should accomplish

FMEA Step 5

For each failure mode, list the effect of failure

Process Step Requirements	Failure Mode Potential	Potential Effect(s) Of failure
Weld Nut to Pedestal		
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled
Internal Treads in Good condition	Internal threads damaged	Seat belt restraint is assembled, but threads are stripped. Assembly is weak

FMEA Tips about Step 5

For each failure mode, list the effect of failure

Tips about Step 5:

- List only “worst case” effects of failure (that´s all you need to estimate severity).
- Capture what actually happens when the failure mode occurs. Avoid general statements like, “ Part is rejected” or “Customer complaint”
- By being specific in this column, later steps (estimating severity & listing causes) will go much easier.

FMEA Step 6

For each effect of failure, estimate the severity

Process Step Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity
Weld Nut to Pedestal			
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6
Internal Treads in Good condition	Internal threads damaged	Seat belt restraint is assembled, but threads are stripped. Assembly is weak	9

FMEA Step 6 : AIAG Severity Guidelines

EFFECT	CRITERIA: SEVERITY OF EFFECT	RANKING
Hazardous-without warning	May endanger machine or assembly operator. Very high severity ranking when a potential failure mode affects safe vehicle opeation and/or non compliance with goverment regulation. çFauilure will occur without warning.	10
Hazardous-with warning	May endanger machine or assembly operator. Very high severity ranking when a potential failure mode affects safe vehicle opeation and/or non compliance with goverment regulation. çFauilure will occur with warning.	9
Very High	Major disruption to production line. 100 % of product may have to be scrapped. Vehicle/item inoperable, loss of primary function. Customer very dissatisfied.	8
High	Minor disruption to production line. Product may have to be sorted and a portion (less tahn 100 %) scrapped. Vehicle operable, but at a reduced level of performance. Customer dissatisfied	7
Moderable	Minor disruption to production line. A portion (less than 100 %) of the product may have to be scrapped (no sorting). Vehicle/item operable, but some comfort/convinience item(s) inoperable. Customers experience discomfort.	6
low	Minor disruption to production line. 100% of the product may have to be reworked. Vehicle/item opeable, but some comfort/convenience item(s) operable at reduced level of performance. Customer esperiences some dissatisaction	5
very low	Minor disruption to prodution line. The product may have to be sorted and a portion (less than 100%) reworked. Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by most customers	4
Minor	Minor distruption to production line. The produt may have to be sorted and a portion (less than 100%) reworked. Fit & Finish/Squeak & rattle item does not conform. Defect noticed by average customers	3
Very Minor	Minor disruption to prodution line. The product may have to be sorted and a portion (less than 100%) reworked. Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by discriminating customers	2
lowest	No effect	1

FMEA Tips about Step 6

For each effect of failure, estimate the severity

Tips about Step 6:

- The auto industry uses the AIAG guidelines as a standard. Controls division uses a 1 to 5 system.

- Whatever guidelines are used…..
  - Keep a copy with your FMEA
  - Always make the highest number most severe, the lowest least severe.

FMEA Step 7

For each failure mode, list causes.

Process Step Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure
Weld Nut to Pedestal				
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present
				Operator fails to load nut into welder
				Nut is loaded byt falls cut before weld cycle
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material
				WId strength variation is too large
				Variation in weld nut raw material
				Incorrect welder set-up

FMEA Tips about Step 7

For each failure mode, list causes

Tips about Step 7:

- Use Cause and Effect Diagrams for tough failure modes
- Sometimes hypothesis testing can be useful in demonstrating a cause is strong
- Try to verify that the listed causes are important to avoid too long a list of causes
- If you list causes everyone already knows about, you may not be able to reduce risk.

FMEA Step 8

For each cause of failure, estimate the likelihood of occurrence.

Process Step Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure	Occurrence
Weld Nut to Pedestal					
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present	8
				Operator fails to load nut into welder	2
				Nut is loaded byt falls cut before weld cycle	1
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material	2
				Wld strength variation is too large	6
				Variation in weld nut raw material	2
				Incorrect welder set-up	2

FMEA Step 8 : AIAG Occurrence guidelines

Probability of Failure	Possible Failure Rates	Cpk	Ranking
Very High : Failure almost inevitable	>1 in 2	< 0,33	10
	1 in 3	> 0,33	9
High : Generally associated with processes similar to previous processes that have often failed	1 in 8	> 0,51	8
	1 in 20	> 0,67	7
Moderate: Generally associated with processes similar to previous processes which have experienced occasional failures, but not in major proportions	1 in 80	> 0,83	6
	1 in 400	> 1,00	5
	1 in 2.000	> 1,17	4
Low : Isolated failures associated with similar processes	1 in 15.000	> 1,33	3
Very Low : Only isolated failures associated with almost identical processes	1 in 150.000	> 1,50	2
Remote : Failure is ulikely. No failures ever associated with almost identical processes	< 1 in 1.500.000	> 1,67	1

FMEA Tips about Step 8

For each cause of failure, estimate the likelihood of occurrence.

Tips about Step 8:

- The auto industry uses the AIAG as a standard. Controls Division uses as 1 to 5 system.

- Whatever guidelines are used…
  - Keep a copy with your FMEA
  - Always make the highest number most severe the lowest least severe.

FMEA Step 9

For each cause of failure, list the current process controls

Process Step Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure	Occurrence	Current Process Controls
Weld Nut to Pedestal						
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present	8	100 % Visual inspection by operator after cycle
				Operator fails to load nut into welder	2	100 % Visual inspection by operator after cycle
				Nut is loaded byt falls cut before weld cycle	1	100 % Visual inspection by operator after cycle
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material	2	Supplier certification & SPC information
				Wld strength variation is too large	6	Welder is calibrated every shift.
				Variation in weld nut raw material	2	Supplier certification & SPC information
				Incorrect welder set-up	2	1st piece weld strength

FMEA Tips about Step 9

For eahc cause of failure, list the current process controls

Tips about Step 9:

- Make sure you list the actual controls.
- Do not list “wannabe” controls.
- Be brutally honest, if there is no control, just say it.
- Frequently, there is no control for the cause of the failure mode; but there is a control to detect the failure mode itself.

FMEA Step 10

For each process control, estimate the detection.

Process Step / Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure	Occurrence	Current Process Controls	Detection
Weld Nut to Pedestal							
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present	8	100 % Visual inspection by operator after cycle	4
				Operator fails to load nut into welder	2	100 % Visual inspection by operator after cycle	4
				Nut is loaded byt falls cut before weld cycle	1	100 % Visual inspection by operator after cycle	4
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material	2	Supplier certification & SPC information	2
				Wld strength variation is too large	6	Welder is calibrated every shift.	5
				Variation in weld nut raw material	2	Supplier certification & SPC information	2
				Incorrect welder set-up	2	1st piece weld strength	2

FMEA Step 10 : AIAG Detection guidelines

Detection	Criteria : likelihood the existence of a defect will be detected by porcess controls before next of subsequent process, of before part of component leaves the manufacturing or assembly location	Ranking
Almost Impossible	No known control available to detect cause/mechanism of failure or the failure mode	10
Very Remote	Very remote likelihood current control will detect cause/mechanism of failure or the failure mode	9
Remote	Remote likelihood current control will detect cause/mechanism of failure or the failure mode	8
Very Low	Low likelihood current control will detect cause/mechanism of failure or the failure mode	7
Low	Low likelihood current control will detect cause/mechanism of failure or the failure mode	6
Moderate	Moderate likelihood current control will detect cause/mechanism of failure or the failure mode	5
Moderately High	Moderately High likelihood current control will detect cause/mechanism of failure or the failure mode	4
High	High likelihood current control will detect cause/mechanism of failure or the failure mode	3
Very High	Very High likelihood current control will detect cause/mechanism of failure or the failure mode	2
Almost Certain	Current control almost certain to detect cause/mechanism of failure or the failure mode. Reliable detection controls are known with similar processes	1

FMEA Step 11

For each cause of failure, calculate the Risk Priority Number

Process Step / Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure	Occurrence	Current Process Controls	Detection	RPN
Weld Nut to Pedestal								
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present	8	100 % Visual inspection by operator after cycle	4	160
				Operator fails to load nut into welder	2	100 % Visual inspection by operator after cycle	4	40
				Nut is loaded byt falls cut before weld cycle	1	100 % Visual inspection by operator after cycle	4	20
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material	2	Supplier certification & SPC information	2	24
				Wld strength variation is too large	6	Welder is calibrated every shift.	5	160
				Variation in weld nut raw material	2	Supplier certification & SPC information	2	24
				Incorrect welder set-up	2	1st piece weld strength	2	24

Risk Priority Number (RPN)

- The RPN number is calculated from the team´s estimates of Severity, Occurrence and Detection.
- RPN = S x O x D
- If you ar using 1-10 scale for Severtiy, Occurrence and Detection, the worst RPN = 1000 (10x10x10), while the best would be RPN = 1 (1x1x1)
- Use RPN numbers to prioritize failure modes and/or causes of failures in order to work on the highest priority issues.

FMEA Tips about Step 11

For each cause of failure, calculate the Risk Priority Number

Tips about Step 11:

- Any failure mode with a severity of 9 or 10 must be identified as high priority regardless of the RPN.
- Addressing the highest RPN is more important that setting an actual target.
- Teams are all different, so different teams will obtain different RPN´s.
- Use the high RPN to identify critical issues (failure modes, causes of failures, key process inputs.)

FMEA Step 12

For High priority causes of failure and/or failure modes, develop recommended actions

Process Step / Requirements	Failure Mode Potential	Potential Effect(s) Of failure	severity	Potential cause(s) Mechanism(s) fo Failure	Occurrence	Current Process Controls	Detection	RPN	Recommended Actions
Weld Nut to Pedestal									
Nut Present	Nut not present	Cannot assemble seat belt restraint to pedestal	5	Welded cylds without nut present	8	100 % Visual inspection by operator after cycle	4	160	Design, test &% Install a nut presence sensing circuit.
				Operator fails to load nut into welder	2	100 % Visual inspection by operator after cycle	4	40	See note
				Nut is loaded byt falls cut before weld cycle	1	100 % Visual inspection by operator after cycle	4	20	See note
Nut Welded Securely	Nut welded Insecurely	Bolt breaks weld nut loose when seat belt restraint is assembled	6	Variation inpedestal raw material	2	Supplier certification & SPC information	2	24	
				Wld strength variation is too large	6	Welder is calibrated every shift.	5	160	
				Variation in weld nut raw material	2	Supplier certification & SPC information	2	24	
				Incorrect welder set-up	2	1st piece weld strength	2	24	

Next Steps

FMEA Step 13

For each recommended action, assign responsibility and completion dates.

FMEA Step 14

For each recommended action, implement the action and note its affect.

FMEA Step 15

For each implemented action, re-estimate the severity, occurrence and detection rankings and recalculate the RPN.

FMEA Tips about Step 15

For each implemented action, re-estimate the severity, occurrence and detection rankings and recalculate the RPN

Tips about Step 15:

- Never recalculate an RPN without implementing an improvement ! Guessing is not allowed.
- Usually, it is difficult to reduce the severity of a failure mode. However, sometimes a failure mode can be eliminated.
- The most effective RPN reduction is reducing the likelihood of occurrence.
- The least effective RPN reduction is increasing inspection. Although, Poka-Yoke can reduce the detection ranking and reduce cost. !

Ejercicio 15

- **Matriz Priorización: Partiendo de las soluciones encontradas en el ejercicio 4 (process map) mejora proceso Burger Queen, marca un orden de preferencia.**
- **Decide los criterios y justifica los resultados**

Tiempo: 15 min (ejercicio) + 20 min (todas las presentaciones)

Ejercicio 16

- **AMFE: Realiza un análisis de riesgo, utilizando el formato AMFE teniendo en cuenta las soluciones propuestas en el ejercicio 8 (QFD), de diseño evento presentación vehículos a prensa**
- **Decide los modos de fallo, y define acciones preventivas/correctivas para los modos con riesgo mayor**

Tiempo: 30 min (ejercicio) + 50 min (todas las presentaciones)

Fase 4. Herramientas

SAMPLE SIZE

DOE
Departament
d'Organització
d'Empreses

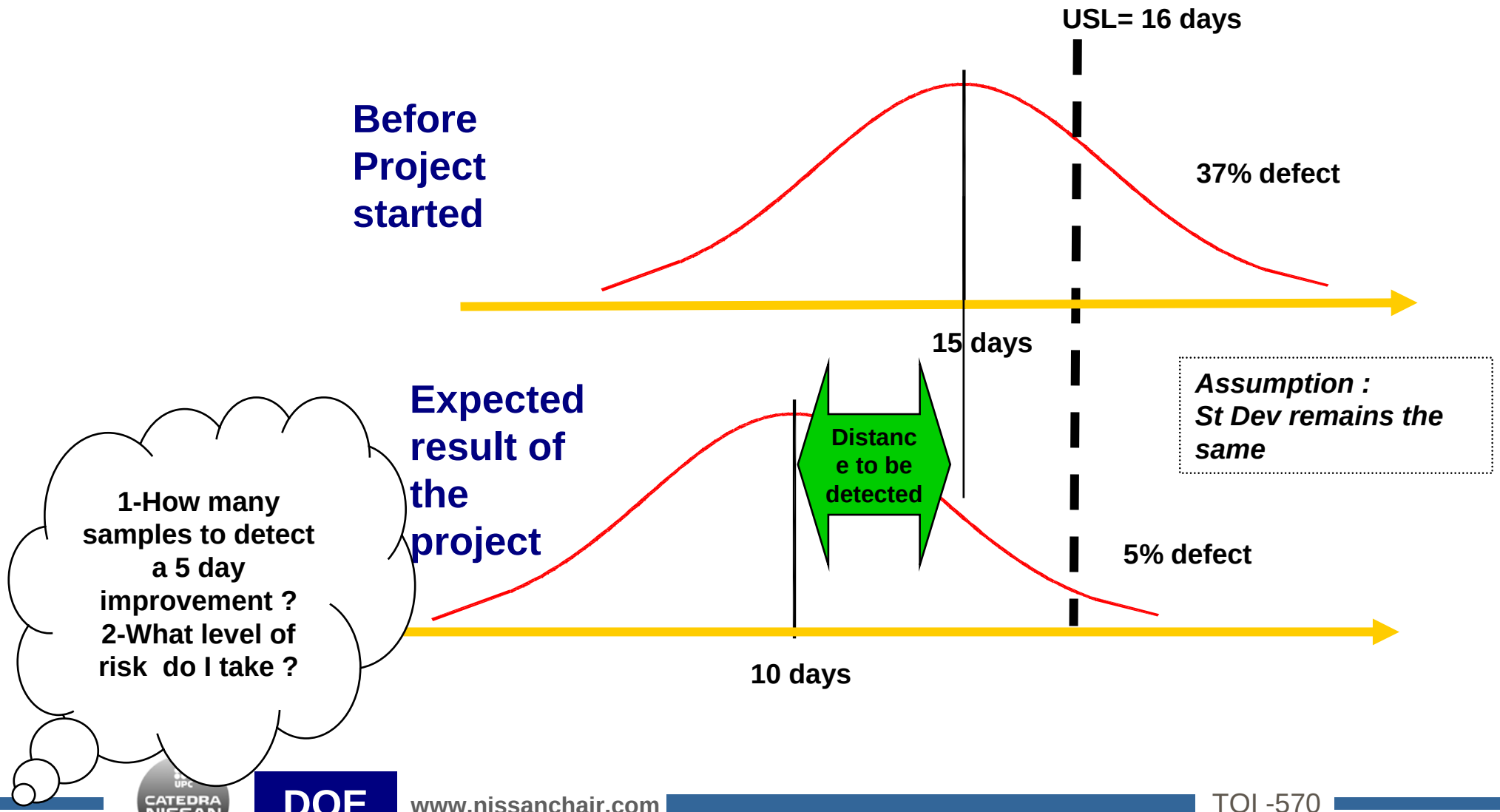
Execute a Trial / Sample size

- We saw in Phase 4 how Sample Size is a critical factor to evaluate accurately the mean and/or the standard deviation. We demonstrated that higher the Sample Size, higher the confidence in the calculated parameter (μ or σ).

- In this phase, the problematic is a little bit different as we would like to know, in advance, how many trials we need to guaranty a “given” improvement. In other words, I would like to know, for example :
  - How many customers should I ask to see a 0.5 satisfaction point improvement ?
  - How many cars should I build to confirm 5 sec. lead time saving ?
  - How many parts should I receive to guaranty a 10% improvement in defect rate ?
  - Etc…

- To calculate this Sample Size, we will need to know :
  - How much shift in mean value do we want to detect?
  - How much variance are there in the original population?
  - What will be the risk of error of the second kind at?

Execute a Trial / Sample size



Execute a Trial / Sample size

Let's be practical !

We will explore sample size calculation for 3 cases :

1) How many samples do we need to show a difference of mean versus a historical population ?

2) How many samples do we need to show a difference between two means ?

3) How many sample do we need to show a difference on proportions ?

Execute a Trial / Sample size

1. How many samples do we need to show a difference of mean versus a historical population ?
Application :

Original average to ship a product was 15 days, the standard deviation was 3 days ; with an upper spec limit of 16 days, the team computed a CPk of 0.11 (the defect rate being 37%).
The team worked to reduce this time and estimated that new average would be 10 days resulting in 5% defect rate.

Question, how many samples we will need to demonstrate the improvement ?

What do we need to consider ?

If we target a new mean of 10 days, the Null Hypothesis considers that the new population is not different from the original one, while the Alternative Hypothesis considers the new population is different.

•In this case, we want to make sure that the difference 10- 15= -5 is significantly lower than 0: We will test one side of the difference.

• As a common rule for such situation, let's take a risk a of 5% and a risk b of 10% (so a power of test of 90%)

Execute a Trial / Sample size

Stat/Power and Sample Size / 1 sample t

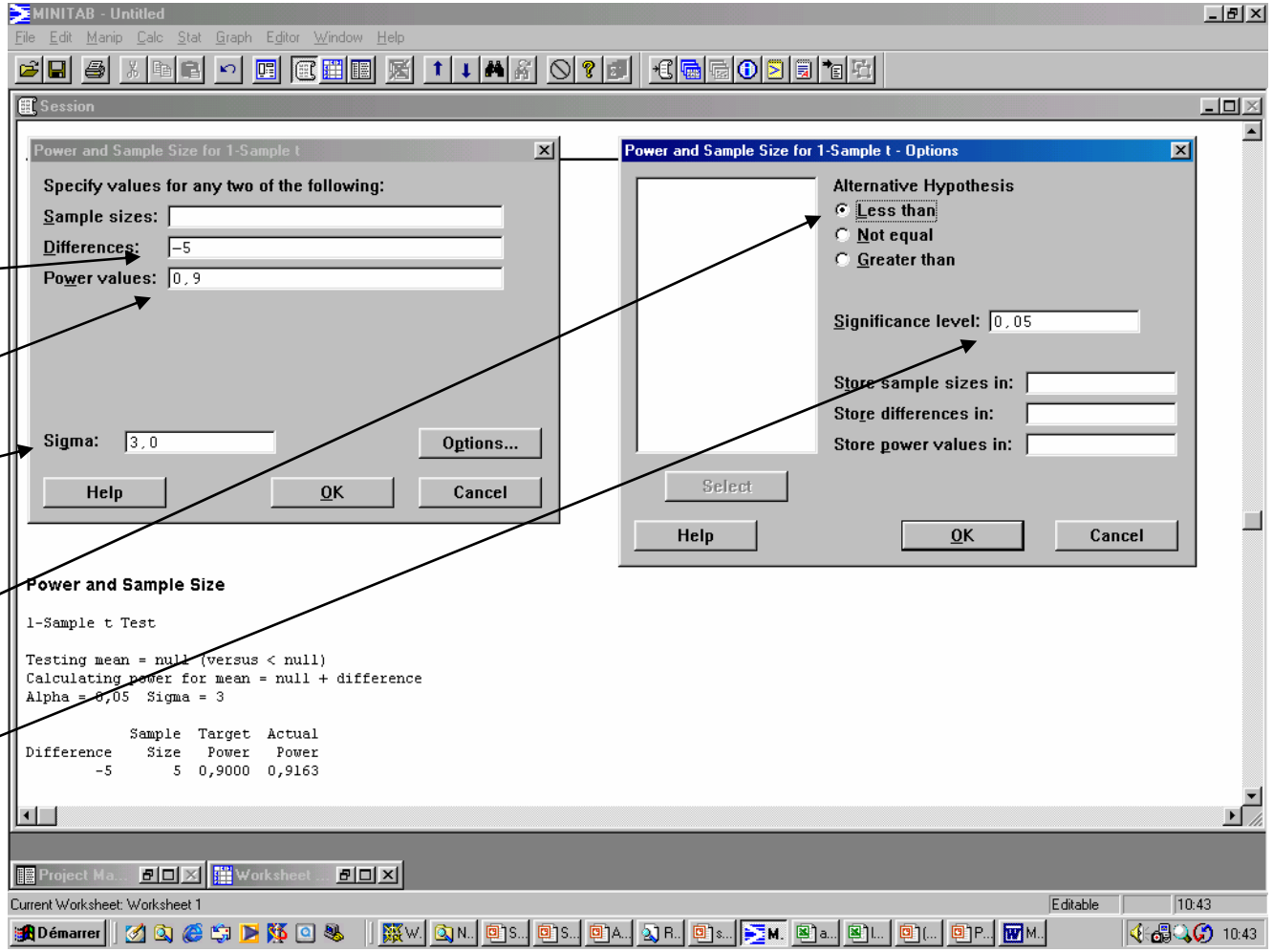
Difference = -5

b risk= 10% (power = 90%)

Standard deviation= 3

Option: Less than

a risk = 5%



Execute a Trial / Sample size

Power and Sample Size

```
1-Sample t Test

Testing mean = null (versus < null)
Calculating power for mean = null + difference
Alpha = 0,05  Sigma = 3

                Sample  Target  Actual
Difference        Size   Power   Power
        -5           5  0,9000  0,9163
```

With only 5 samples, we will be able to demonstrate a difference with the level of risk we selected and assuming the standard deviation remained at 3 days.

Practically, we will :

- collect those 5 samples
- calculate the new mean
- compare with the old one
- do a t-test to validate the difference.

Let's redo the test with risks of a=b=1%, how many samples do we need?
Let's suppose we are targeting a new mean of 13 days (i.e 25% defect rate), how many samples do we need?

Execute a Trial / Sample size

2. How many samples do we need to show a difference between two means ?

Application :

We want to compare delivery time of two suppliers, one claiming 15 days delivery time and the other 10 days *(standard deviation is assumed of 3 days for both).*

Question, how many samples do we need from each supplier to confirm the difference ?

What do we need to consider ?

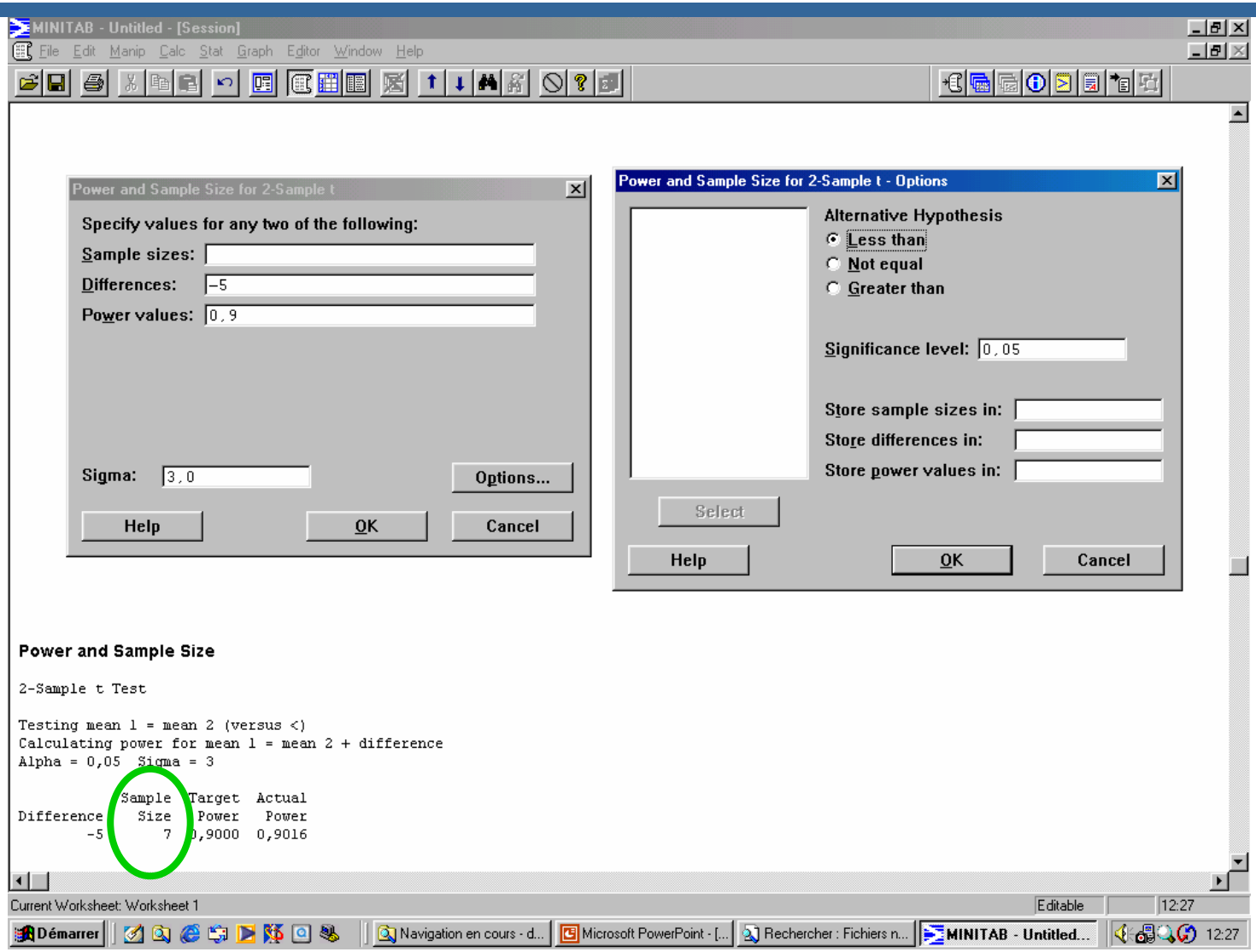
•In this case, we want to make sure that the difference 10- 15= -5 is significantly lower than 0: We will test one side of the difference, but we will use the 2 sample t calculation.

• As a common rule for such situation, let's take a risk a of 5% and a risk b of 10% (so a power of test of 90%)

Execute a Trial / Sample size

Stat/Power and Sample Size/ 2 sample t

We will need 7 samples from each supplier to be able to see a 5 day difference in their delivery time.



Execute a Trial / Sample size

3. How many sample do we need to show a difference on proportions ?

Application :

Back to our first example… Let's suppose we only have defect rate, we want to know how many sample we need to go from historical defect rate of 37% down to 5%.

Question, how many samples do we need to confirm this improvement ?

What do we need to consider ?

- **In this case, we will only need the historical % and the targeted %**
- **As a common rule for such situation, let's take a risk a of 5% and a risk b of 10% (so a power of test of 90%)**

Execute a Trial / Sample size

Stat/Power and Sample Size / 1 proportion

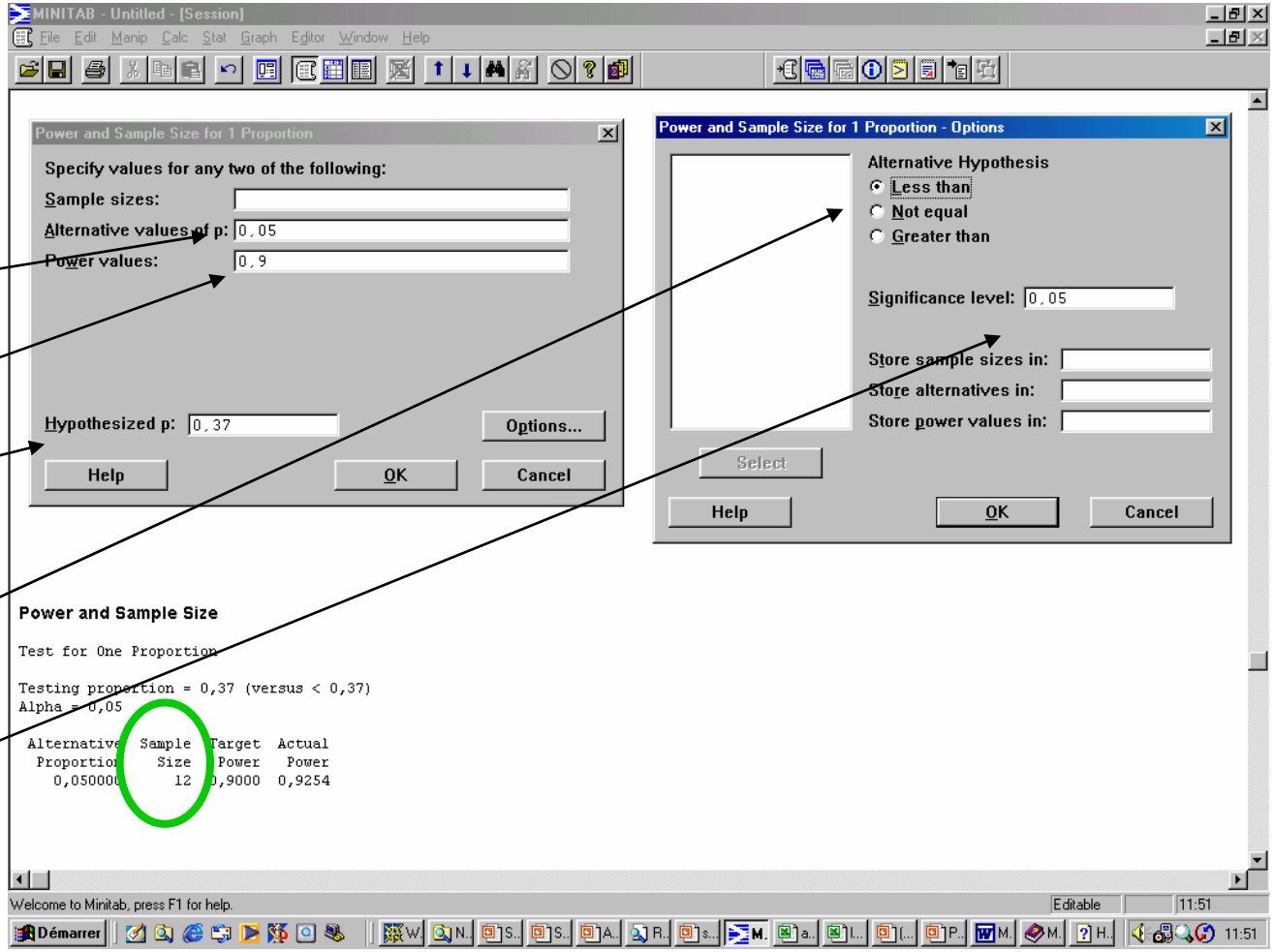
Targeted defect rate =5%

b risk= 10% (power = 90%)

Historical population = 37%

Option: Less than

a risk = 5%



Execute a Trial / Sample size

Power and Sample Size

Test for One Proportion

Testing proportion = 0,37 (versus < 0,37)
Alpha = 0,05

Alternative Proportion	Sample Size	Target Power	Actual Power
0,050000	12	0,9000	0,9254

We will need 12 samples to demonstrate a difference with the level of risk we took

versus 5 samples if we had continuous data

Let's redo the test with risks of a=b=1%, how many samples do we need?
Let's suppose we are targeting 25% defect rate, how many samples do we need?

Execute a Trial / Sample size

Sample size computation can be used to:

Forecast the number of samples you need to detect differences

1) **before deploying a project**
2) **Before launching a comparison (one tail or two tails)**
3) **Before performing an design of experiment**

Sample Size can also be used after you performed an analysis (t test, anova, proportion) if the p-value is to high in order to understand if there is really no difference or if b is too high to detect it (and then to know how many more samples you would need)

Limitations :

- **Difference of means supposes the original distributions are normal, if not you need more samples**
- **For test of the means, standard deviation is supposed to remain constant (if in fact you expect it to reduce , you will need less samples than computed)**
- **The new population is supposed to be stable (mean or proportion does not change over time)**
- **Minitab does not give sample size for changes in variances**