



# Solving complex and multidisciplinary problems in industrial context

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## Constant Ondo

- ▶ CEO of Exelop Switzerland
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- ▶ Lean Six Sigma Master Black Belt
- ▶ 20 years experiences in Projects/Programs & process optimization

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- ▶ CEO of Time To Innovate
- ▶ Master in Software Design
- ▶ 5 years at INSA de Strasbourg, working with Pr. Denis Cavallucci on IDM-TRIZ and STEPS development
- ▶ Member of TRIZ France Board

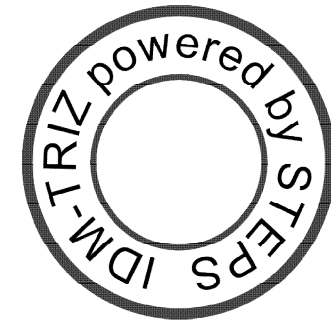


# Inventive Design Network

Training and Research  
about IDM-TRIZ



STEPS Software Edition



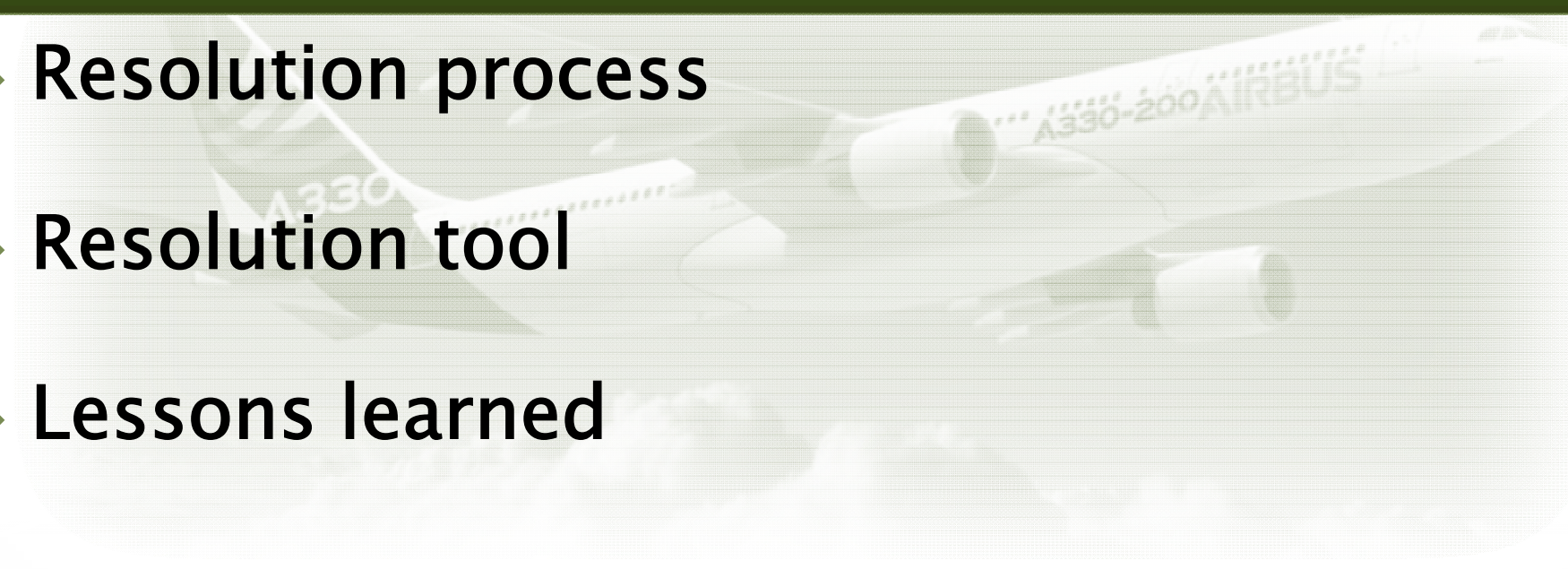
Supporting companies  
Help them to integrate IDM-TRIZ  
and STEPS



# Improving flight safety





- 
- ▶ Protecting the spinal column during crash
  - ▶ Resolution process
  - ▶ Resolution tool
  - ▶ Lessons learned



# During a crash heavy forces are at work on the human body

- ▶ To qualify for FAR 25 (Federal Aviation Regulation part 25)
- ▶ The column spine must be protected after a plan decelaration reaching 14g







# At 14G the spinal column must be saved



- ▶ Protecting the spinal column during crash
- ▶ Resolution process
- ▶ Resolution tool
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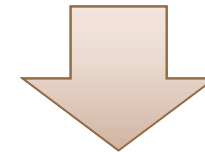




# Analysis of Initial Situation (AIS)

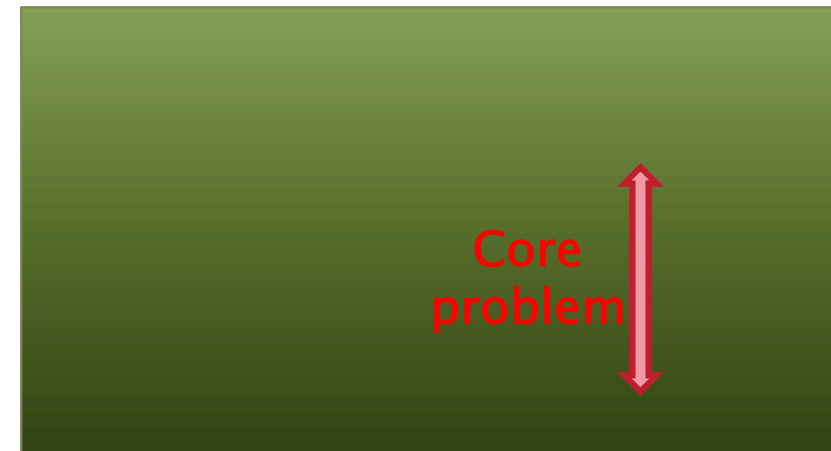


Different foam technologies have been tested. The result needed to be improved. Too much compromise on weight and cost.



It was required to :

1. Absorb kinetic energy
2. Reduce seat weight
3. Improve pilot comfort

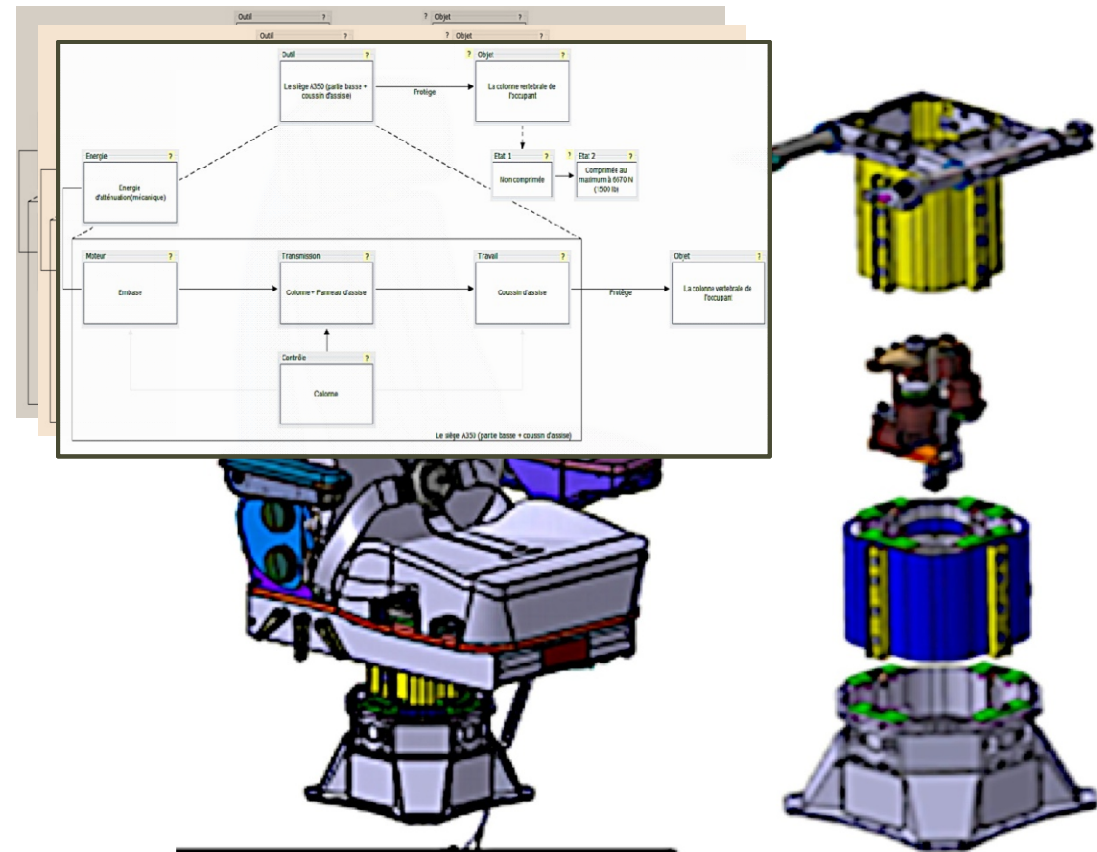




# Define the system, verify core problem (law 1)

## Objectives:

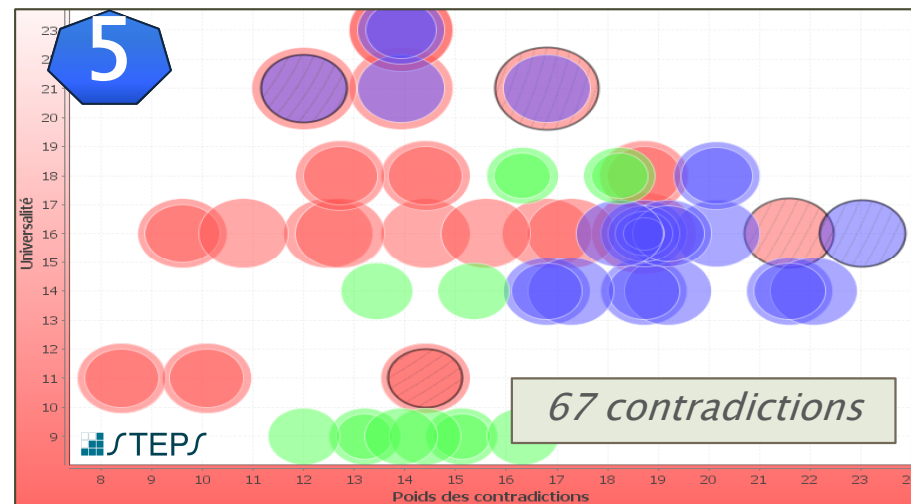
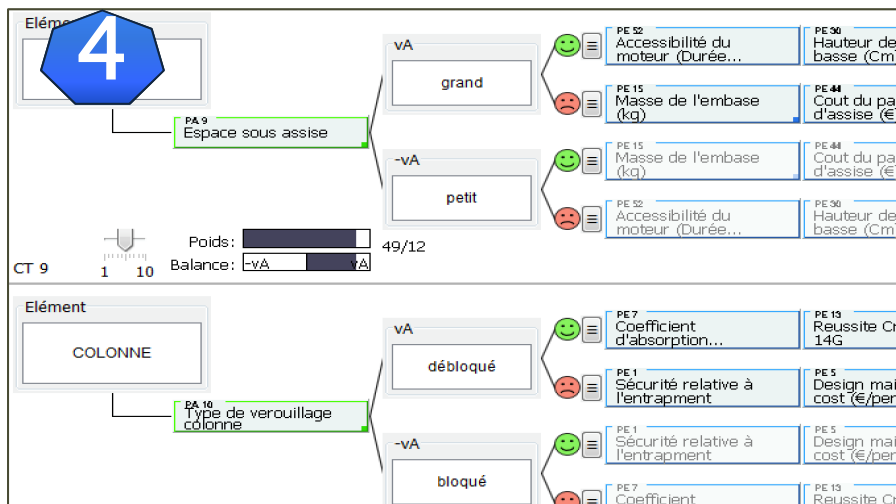
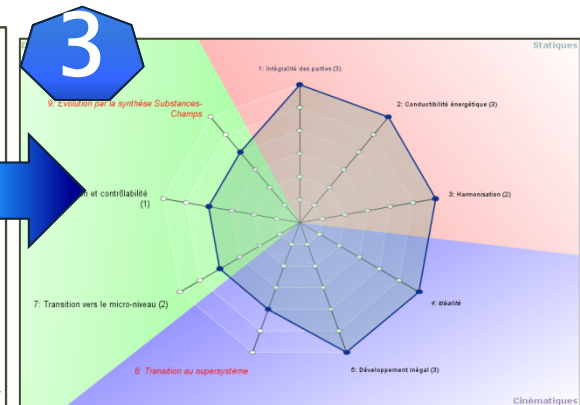
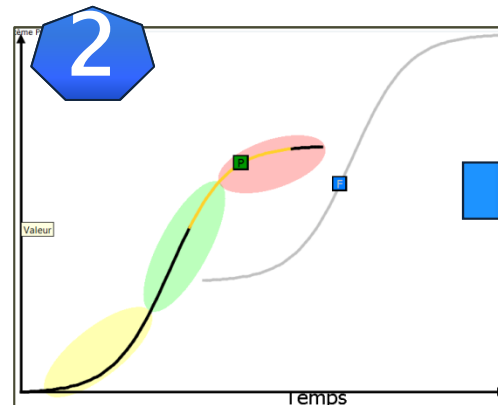
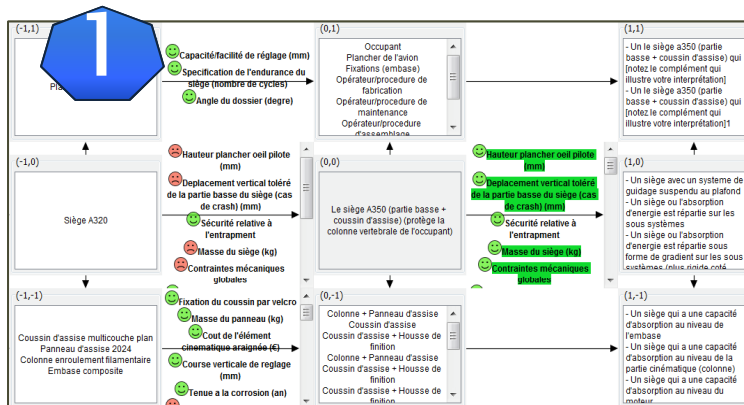
1. Verify the Main Useful function
2. Verify system completeness
3. Understand how different part should work



Assure that the system is well understood



# Generating the right contradictions



Translating laws and evolution hypothesis into measurable contradictions



# Solutioning through a step by step approach

**1**

Standards | Complément | Pointeurs d'effets

Choix des standards | Amélioration du choix

Standards

- 1.1 Construction et destruction des systèmes vépèles
- 1.1.1 Construction du vépèle
- 1.1.2 Vépèle complexe intérieur
- 1.1.3 Vépèle complexe extérieur
- 1.1.4 Vépèle basé sur l'environnement
- 1.1.5 Vépèle basé sur l'environnement avec
- 1.1.6 Régime minimal
- 1.1.7 Régime maximal
- 1.1.8 Régime maximal sélectif
- 1.2 destruction des vépèles
- 1.2.1 Elimination du lien nuisible par l'intr

Standard

1.1.1: Construction du vépèle

Les contraintes du problème permettent-elles l'introduction de substances et de champs supplémentaires ?

Si oui, éliminer l'effet nuisible de **Cousin d'assise** sur **La colonne** par la synthèse du vépèle en introduisant les éléments manquants.

Remarque : On est souvent amené à créer des vépèles dans les problèmes où nous devons effectuer des opérations avec des objets fins, fragiles ou faciles à déformer. Pendant la réalisation des opérations, on assemble l'objet avec une substance qui le rend dur et solide, puis on élimine cette substance par dissolution, par évaporation, etc.

**2**

Cout des système...

32. Facilité de réalisation

36. Complexité de l'appareil

37. Complexité de contrôle

Sélectionner

36: Effort de compres...

10. Force

11. Tension, pression

19. Énergie dépensée par l'objet mobile

Sélectionner

**Principes**

Pourcentage

Principes	Pourcentage
35	14.46%
2	9.64%
1	9.64%
37	9.64%
36	8.43%
26	8.43%
28	6.02%
19	6.02%
10	4.82%
15	4.82%
38	3.61%

**3**

solution

Effort grâce à un coussin d'assise

Effort grâce à un siège

Effort grâce au système

- 1.4 Absorber l'énergie par le système
- 1.5 Absorber l'énergie par le moteur
- 1.6 Utiliser le minimum de mousse
- 1.7 Absorber l'énergie par une em
- 1.8 Absorber l'énergie par un plat
- 1.9 Un siège avec un coussin d'ass
- 1.10 Un siège avec une colonne ta
- 1.11 Un siège avec une architectur
- 1.12 Siège ou on ajoute un absorbt
- 1.13 Siège avec un colonne a surc
- 1.14 Siège avec un moteur reversi
- 1.15 Limiter l'effort par un effacen
- 1.16 Limiter l'effort par un effacen
- 1.17 Limiter l'effort par glissement
- 1.18 Limiter l'effort grâce à un mo
- 1.19 Limiter l'effort grâce à une vit

Croquis

**Vertical crash absorption by vertical actuator:**

Vertical crash condition:

On pourrait aussi imaginer un moteur brushless qui réaliserait un freinage électrique TDC.

Ideal absorption for crash acceleration:

On pourrait imaginer un amortisseur qui aurait un glissement mécanique maîtrisé et résolu à partir d'une valeur donnée.

Vertical actuator shall absorb the dynamic pulse.

**4**

m-STEPS v1.1 Advanced

Etat Aide

Projet

Graphique des problèmes

Analyse du système

Résolution

Solution

Poids minimum des problèmes (P1):

Poids minimum des PEs (P2):

DP-1 Patrick Générer Importer

DP-2 Pierre Générer Importer


DP-3 Dominique Générer Importer

DP-4 Guillaume Générer Importer

Nouveau Utilitaire


Graph

# A complete paradigm shift

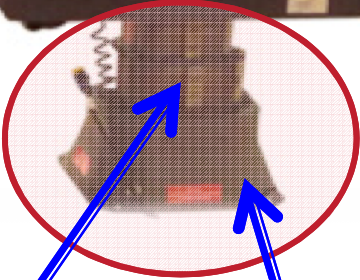


**Object**

1. Parts of the system were at different evolution stage
2. The foam was trying to integrate functions pertaining to other part of the system
3. The “Engine”, “Transmission” and the “Control” part of the system were not playing their role correctly



**Tool**



Transmission  
& Control

Engine

16 Solution Concepts, of which 3 were breakthrough candidates



# AGENDA

- ▶ Protecting the spinal column during crash
- ▶ Resolution process
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# Industrial problems can be complex

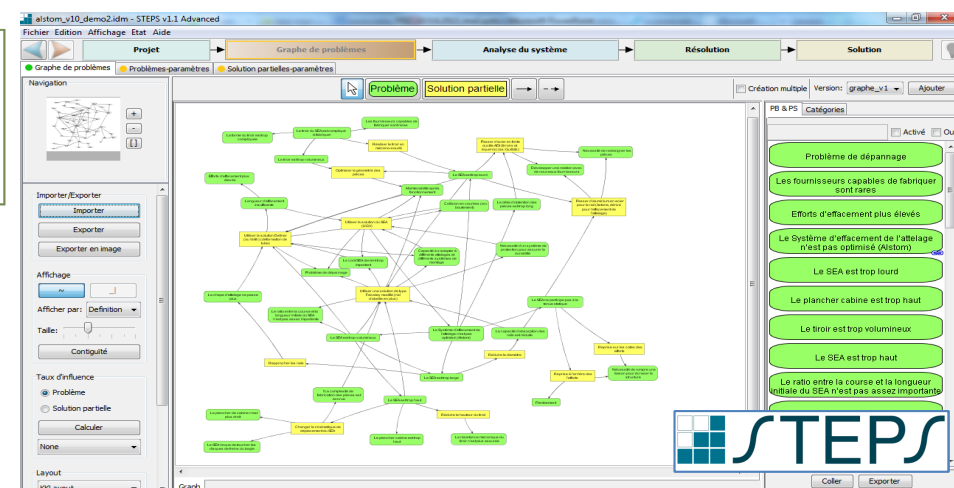
## They can also be :

- Multiple,
- Multidisciplinary,
- They are linked together,
- and some of them may have past resolution attempts (partial solutions)



Steps software helps easy capturing of complexity and translating it into tangible R&D or R&I scenarios

## Making IDM-TRIZ easy





# Complexity is governed by different conflicting parameters

## Parameters can be:

- Weight, Size, shape, field, etc.

## Problem resolution involve solving contradictions:

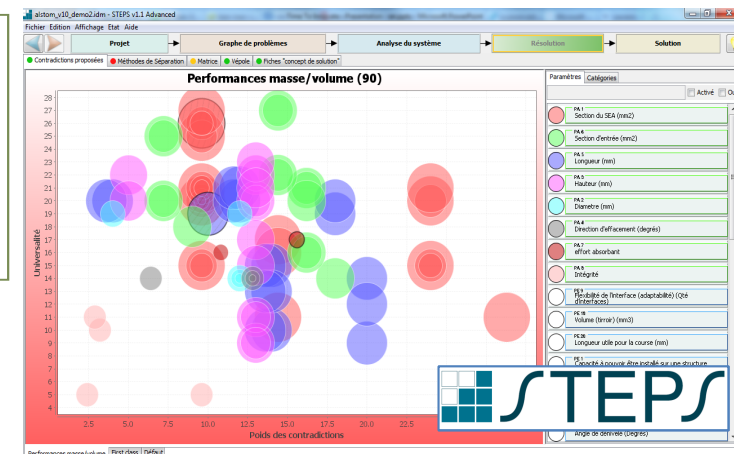
- Industrial problems come with multiple interlinked contradictions
- Selecting the right contradiction is crucial for efficient project management



## Steps software helps:

1. classify contradictions according to scenario.
2. Select the best contradiction to solve

## Making IDM-TRIZ easy



# Resolution can lead to many solution concepts *(unless you use ARIZ)*

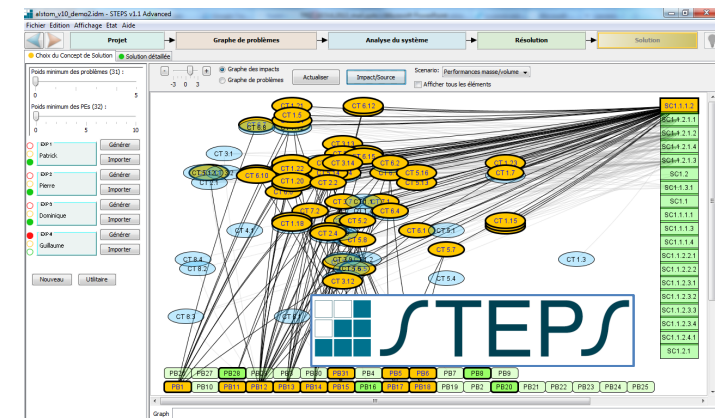
1. Working on all solution concepts may not be realistic nor cost effective.
2. Ability to select the best concept is a key success factor.
3. Selection must be as objective as possible and in line with company's strategy



## Steps software allows you to:


1. Measure impact a concept will have on the problem network
2. Select the most effective solution concept

## Making IDM-TRIZ easy





# AGENDA

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## METHODOLOGY

1. Analysis of initial situation is key for:
  - Bringing the Team together
  - Working on the right problem
2. Evolution hypothesis from MSA & LAWs need to be grouped according to system's parts
3. Building contradiction according to hypothesis is still challenging
4. Separation principles can be very effective

## PROCESS

1. Train
2. Right sizing the Pilote (scope & time)
3. Organise
4. Rollout

## TOOLS

1. Strong management support is needed
2. Sponsor's long term involvement required
3. Team selection can make a difference





# THANK YOU

## 대단히 감사합니다

