Management of Innovation
and
Process Systems Engineering

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Introduction : Concepts about Innovation

« Common shared definition »:

- Innovation is a process which allows any enterprise or system to obtain substantial advantages on a market by a significant evolution in its organization via new methods or tools, or by the deliverance on the market of a novel product, services …
Introduction : General concepts

Everybody has his or her own definition of innovation but there is agreement on the fact that:

- It is distinct from Creativity and Invention
- It is an end-to-end process whose objective is the generation of value
- It is not a sporadic act and leading organizations treat innovation as a systemic and systematic activity (PSE)
Introduction : General concepts

Thomas Davenport (1993): « Process Innovation: Reengineering work through information technology »

- Innovation = Adding a technology to drive process change
- Innovation = Human creativity during « reengineering »

Process Innovation = Process invention (creative act)
Introduction : General concepts

- Innovation is the end-to-end process by which improved, renewed, or replacement products, solutions and services are delivered in practice, generating new « top line » business value

- It should be driven by a comprehensive process engineering approach less reliant on unreliable, sporadic and ad-hoc creativity
Introduction: basic components for Innovation

- Business Process Reengineering (Invention)
  - Decades old/new techniques for re-inventing processes
  - Based on process management wisdom, creativity, common sense change management and rules of thumb
  - Example: Introduce a case worker, create a parallel activity, introduce a new system

Business Process Innovation

- Use of modern innovation methods to accelerate and systematize the generation of reengineering options
- Amplifies the creativity of practitioners to exhaustively explore re-design alternatives
- Knowledge management (problem solution) of process patterns
- Reliable and guided process to resolve contradictions in process design
Introduction : Business Process Management

- **1990 Business Process Reengineering (BPR):** process lateral thinking/Reengineering techniques

- **2000 Business Process management (BPMS):** Executable processes, direct path to implementation, management of the process lifecycle, process modeling languages

- **2005 Business Process innovation:** Exhaustive generation of re-design options- systematically solve problems in processes

- **200? Business Process realization:** Automatically realize ideal process models along selected innovation pathways

Process articulation and creativity→ Creativity/innovation in process technology→ Process methodological creativity and innovation
Introduction : basic components for Innovation

- Technologies (cross technologies)
- Strategy
- Marketing
- Law aspects (patents,…)
- Financial aspects
- Planification and Project management

To try to driven, anticipate or fit to the market needs
(ex: Iphone = Innovation = Cult object)
Presentation of a tool for problem solving improvement: application in Process Engineering

Introduction:

- To provide innovative solution for continuation
- To increase innovative conception/Design: creativity and Knowledge

Goal: To propose a Methodology with both parts
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Introduction:

Knowledge Capitalization:
- Reuse Past Experiences
- Method: Case Based Reasoning (affinity with human learning)
- Drawback: Incremental Innovation (low level)

Creativity / Innovation:
- Use of TRIZ tools to propose innovative Solutions
- Drawback: no learning and storage of the solving process

Aim: Synergy between CBR and TRIZ
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CBR Presentation:

- Artificial Intelligence Method
- Works of Schank (1982): Dynamic Memory (Human)

General Principle:

Similar Problems Have Similar Solutions
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CBR Presentation:

- **Central Notion:** CASE
  - Contextualised piece of knowledge representing an earlier experience

  Case (Problem, Solution, Comments)

- Stored in a Memory: Case Base
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CBR Description

Problem Space

Solution Space

- Case Base
- Stored problem
- Associated solution
- Target problem
- Proposed solution
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CBR Cycle: 5 R (Represent-Retrieve-Reuse-Revise-Retain)

- Target problem
- Represent
- Retrieve
- Reuse
- Revise
- Retain

Case base

New Case

Learned case

Validated Solution

Revised and tested Case

Solved Case

Revised and tested Case

Retrieved Case

New Case

Learned case

Introduction
CBR
TRIZ
Synergy
Example
Conclusion
Introduction

CBR

TRIZ

Synergy

Example

Conclusion

CBR Conclusion

Advantages:
- Produce Rapidly a solution: Accelerate Design
- Facility of use and maintenance
- Ability to learn and Manage a huge amount of information

Drawbacks:
- Specificity in one domain
- Solution with low level of innovation (based on past experiences)
- No retrieved solution if no similar problem faced before
Introduction

**CBR**

**TRIZ**

**Synergy**

**Example**

**Conclusion**

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**TRIZ**

- Innovation Situation Questionnaire: Problem Identification
- Contradiction: Problem Formulation
- Contradiction Matrix: Problem Resolution
- Ideal Final result: Problem Formulation and Criterion
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TRIZ Conclusion

Advantages:
- Eliminate barriers between domains: Accelerate Design
- Simulate Creativity of every person
- Reduce Time to produce a solution

Drawbacks:
- Good practice of the theory
- Redeployment of the whole process of Resolution (each time)
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Synergy Presentation

- Complementarity of both Methods
- Propose a Method and a Tool to accelerate Innovative Problem Solving/improvement

Triz brings:
- Systematic Proposition of innovative idea(s)
- A structure to index the memory

CBR brings:
- Simplicity to model and store knowledge
- Technique to accelerate problem research and comparison
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Synergy Presentation

Central Notion Case (Pb, Sol, Comments)

Pb represented with features:

- Two parameters in contradiction
- Problem location (system)
- Type of objectives: improvement, eradication, new functionality
- Goal to reach: expressed with one of the 39 parameters
- Resources
Synergy Presentation

Roles of the Contradiction Matrix

1) Structuration of the memory Base with indexation of case thanks to the contradiction formulation

2) Initial role if no retrieved case are found (proposed principles)
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Synergy Cycle

1. **Target Problem**
2. **Problem Description**
3. **IFR**
4. **Contradiction**
   - **Retrieve**
   - **Contradiction Matrix**
   - **Retrieve Case**
   - **Solved Case**
   - **Repair**
   - **Yes**
   - **No**
      - **Create**
      - **Learned Case**
      - **Associated Principles**
      - **Reuse**
      - **Proposed Solution**
      - **Interpretation**
Chemical Engineering Example

Chromatographic Separation:
Continuously separate a multi component mixture
Industrial interest (biotechnology, pharmaceutical...)

TMB process:
Liquid and solid in counter current flow
Liquid (mixture to separate) recycled in zone 1
Solid recycled from zone 1 to 4
2 inlets (eluent, feed), 2 outlets (Extract, Raffinate)
Chemical Engineering Example

Application of ISQ:

Drawback: circulation of the solid phase

Contradiction:

Reduce the circulation of the solid phase without decreasing the separation performance and increasing the operating cost.

Improved parameter: 33, convenience of use

Damaged parameter: 19, Energy spent by a moving object

Principles: 1 Segmentation, 13 Inverse, 24 Intermediary
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Chemical Engineering Example

** Principle 1: Segmentation **

Idea: separate the process in independent zone

** Principle 13: Inverse **

Sub-principle « make movable parts fixed and fixed parts movable »

Idea: Solid becomes static, inlets and outlets in a rotating way
Conclusion

- Synergy to systematically propose a solution
- Accelerate the proposition of solution thanks to the memory (contradiction indexation)
- Ability to learn (increase effectiveness)
- Creation of a tool
Perspectives

- Fitting TRIZ ontologies with Chemical Process Industry ones (design of micro process, green process...)

- Adding New functionalities
  * Adaptation
  * Multi contradictions Resolution (for the moment 2 contradictions on the same problem = two cases)
Management of Innovation and Process Systems Engineering

General conclusion:

- Process Design continuum: Routine  __________ Innovative

- Creativity/Improvement/innovation : a vital link
  (No success stories (blinded leaders): Ilford, Kodak, IBM,....)

- There is no age for Creativity and Innovation
  (Coco Chanel 71 year; Eiffel 57 year; Leonardo di Vinci....)
Presentation of a tool for problem-solving improvement: application in process engineering

Represent:

- Information on the problem
- Description of the target problem
- Representation: Features – Values pairs
- List of features used in the next step
Introduction

CBR

TRIZ

Synergy

Example

Conclusion

Retrieve:

- Retrieval from the case base of similar cases
- Two Steps:
  - Reduce the space of research in the case base (Indexing the base)
  - Research of the most similar Cases
- Similarity between the target and stored problems is measured with a function (depending of the type of features: words, numerical values...)

Presentation of a tool for problem solving improvement: application in process engineering
Presentation of a tool for problem solving improvement: application in process engineering

Reuse:

- Propose a solution to the target problem
- Starting point: retrieved solution of the most similar problem (previous step)
- Adaptation: gap between the target and retrieved problem, necessity to modify the retrieve solution
- Introduction of new knowledge for adaptation: rules...
Revise:

- The solution perhaps needs some adjustments to fit the target problem
- Resolve the discrepancy between the desired and the adapted solution: by simulation, optimization, real tests for example
Retain:

- Target Problem + Associated Solution = New Case
- Learning of this New Case
- Extension of the cover of the space and the CBR effectiveness
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