From TRIZ to Inventive Design Method (IDM): towards a formalization of Inventive Practices in R&D Departments

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Abstract

In today's methodological world, TRIZ has undoubtedly its place in the myriad of methods and tools useful for engineers in companies. Mostly dedicated for solving inventive problems, TRIZ is appreciated for its capacity to widen the scope of possible domains in which the solution is sought after. In that regards, it is often perceived by companies as a potential replacer of creativity techniques such as Brainstorming. We disagree with this statement in presenting TRIZ as, firstly, a theoretical framework for inventive thinking, second, as any theory, it aims to serve as a framework for developing new methods and tools useful in a certain context. Inventive Design Method (IDM) has been developed to re-structure and complete TRIZ body of knowledge with other theories like graph theory or Pugh's theory. The objective is to integrate companies' set of methods to pragmatically serve an innovation strategy with engineering tools open to invention. This advanced seminar is provided to describe, with concrete exercises, the main stages of IDM.

Extended Abstract

Our industry is currently undergoing a transformation that is guiding it from the quality era to that of innovation. This transformation necessarily involves changing design practices, the foundations of which currently rest on an optimization mentality. An innovation oriented approach would require that the bases of the design action contain other rules of invention where creativity and problem solving would have priority.

The methodology we discuss in this advanced tutorial (namely Inventive Design Method) is the result of 10 years of research at INSA Strasbourg (from [1] to [8]). It concerns the mapping of known information and the transformation of these pieces of information into a model that will facilitate a later problem solving stage.

IDM framework proposes four main phases to evolve from a fuzzy and multidisciplinary initial situation to a set of ranked inventive solution concepts. Here is a short description of theses phases:

Phase 1: Initial Situation Analysis: As stated in the introduction, this phase aims at investigating all the knowledge related to the study. This knowledge (tacit or explicit, coming from text documents of from experts' minds) is translated into a graphical model, mathematically exploitable, to facilitate decision-making.

Phase 2: Problems Mapping: Once the complete initial situation has been stated, a reduced set of problems must then be detailed by a set of contradictions. These contradictions represent bottlenecks in the evolution of the studied system. In this phase, we find sub-steps such as, poly-contradictions formulation, contradictions extraction and classification of the importance of contradictions in accordance with a specific scenario.

Phase 3: Solutions Concepts Synthesis: Each contradiction declared as a priority for the solving phase becomes an input point for the use of the different TRIZ techniques and tools. Each contradiction must be engaged in a solving process to be resolved without compromises. At the end of multiple solving stages, which can be successive or iterative, we can include the use of Altshuller's matrix associated with inventive principles, Substance-Field modelling associated with the system of Inventive Standards or even ARIZ-85C. Expectations regarding this phase are the generation of a limited number of solution concepts and the possibility of tracking their origin for the follow-up of the study.

Phase 4: Feedback between Solution Concepts and the Initial Situation: in this phase, we measure the impact of each solution concept with the problem graph elaborated in phase 1. This stage is built to estimate the hypothetical impact of each Solution Concept and choose that will be the subject of future developments.

A macro-representation of this process so as the information flow along the four phases is given figure 1.

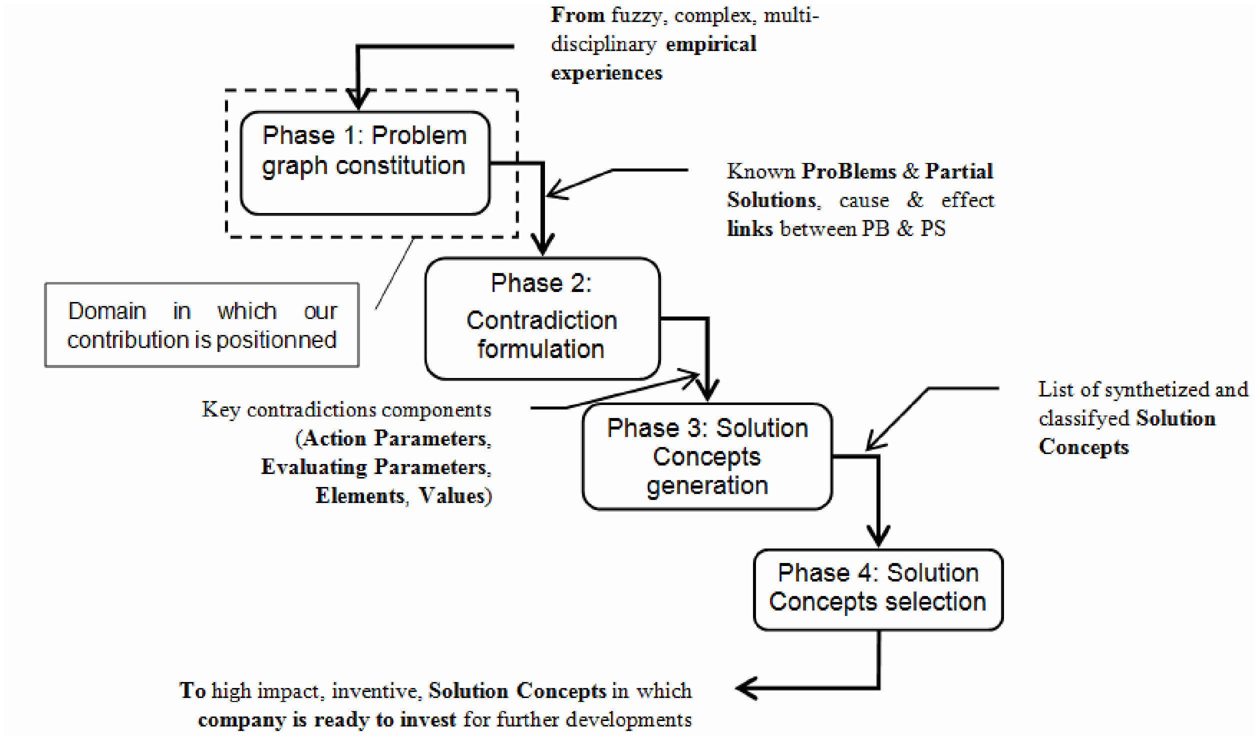

Figure 1: Macro representation of the four stages of Inventive Design Method

The session is divided as follows :

10:00-11:00: Introduction of the advanced tutorial, aims and scope, methodology and personal introduction. Brief description of paradigm shift in industrial era (from quality to innovation) and the necessity to address the challenge of designing in the era of innovation with new methods and tools.

11:00-12:00: From TRIZ to Inventive Design Methodology: TRIZ limitations, our proposal to overcome these limitations through a structured approach. Brief description of IDM's main stages.

Lunch break

13:00-14:00: Problem Graph construction and its derivation into Parameters.

14:00-15:00: From problem graph interpretation to a set of ranked contradictions.

Coffee break

15:30-16:30: Solving highly ranked contradictions in priority using TRIZ techniques and generating Solution Concepts. Then, using the ranked solution concepts to build an appropriate R&D strategy.

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[2] Zanni C., Cavallucci D. and Rousselot F. (2011) Use of formal ontologies as a foundation for inventive design studies, Computers in Industry, Volume 62, Issue 3, Pages 323-336 ISSN: 0166-3615, ELSEVIER.

[3] Cavallucci D., Rousselot F. and Zanni C., (2010); Initial situation analysis through problem graph, CIRP Journal of Manufacturing Science and Technology, Volume 2, Issue 4, 2010, Pages 310-317, ISSN: 1570-5838, ELSEVIER.

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[5] Cavallucci, D. and Khomenko, N. (2007); From TRIZ to OTSM-TRIZ: Addressing complexity challenges in inventive design; International Journal of Product Development (IJPD), Inderscience, Volume 4 - Issue 1/2 – 2007, ISSN: 1477-9056.

[6] Cavallucci, D., Weil R., (2001). "Integrating Altshuller's development laws for technical systems into the design process. Cirp Annals-Manufacturing Technology 50(1): 115-120, ELSEVIER.)

[7] Cavallucci D., Rousselot F. and Zanni C., (2009) Monitoring the impact of solution concepts within a given problematic, 3rd IFIP Working Conference, August 21-23 2009, Harbin, China.

[8] Cavallucci D., Rousselot F. and Zanni C., On contradiction clouds, 8th ETRIA's International TRIZ Future Conference (TFC2008), Nov. 5-7, Twente – The Netherland.