Chapter 8
From Creative Ideas Generation to Real World Solutions:
Analysis of the Initial Situation for Inventive Design

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ABSTRACT

The first stages of the creative inventive process are devoted to choosing the problem and redefining its conditions. Most of the time, the original statement of the problem is imprecise, and occasionally even incorrect. This is why it is necessary to have mechanisms to help structure the creative thinking of a set of experts during their analysis of the problem, by providing them a knowledge-based framework. This article presents the first stages of IDM (Inventive Design Methodology). IDM is a set of methodological tools whose main interest is the evolution of technical systems. The methodology proposes a dialectical analysis of the technical system, which focuses on the past, present, and future state of the artifacts, and the most likely transitions between them. This analysis also identifies the influences (positive or negative) that the changes done to certain elements in the system may have on other elements of the system. The use of these methodological tools provides the needed structuring framework to the experts’ creative idea generation.

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INTRODUCTION

When designers are engaged in a design process, one of the first tasks they face is the gathering of all potentially interesting information for understanding the initial situation. Its main objective is the drawing of a problem statement and the understanding of all future difficulties their design project will unavoidably face. If this crucial stage in the design process is neglected, there is a high risk that a project evolves towards poorly inventive outcomes since somewhere else; a similar task might have already been solved by another team. Another risk is to connect the design efforts with a goal of secondary importance and to miss a goal of primary importance. When designing in an inventive way, this issue is even more critical.

We will present here the first stages of IDM (Inventive Design Methodology) (Zanni et al., 2009). IDM is a set of methodological tools whose main interest is the evolution of technical systems. The methodology proposes a dialectical analysis of the technical system, which focuses on the past, present, and future state of the artefacts, and the most likely transitions between them. This analysis also identifies the influences that the changes done to certain elements in the system may have on other elements of the system. These influences may be satisfying or unsatisfying.

IDM is an extension to TRIZ (Altshuller, 1973, 1984), a Russian set of methodological tools for inventive design. While standard methods based on optimization try to find the best compromise between contradictory requirement, TRIZ advocates a more frontal approach: a set of tools are available to overcome the main contradictions. These contradictions should be highlighted during problem analysis, and TRIZ suggests different ways to solve or work around these contradictions, using a systematic methodology and building knowledge models of the evolving artefact. These generic models allow finding solutions by analogy with other areas, overcoming the psychological inertia that prevents new ideas to emerge from imagination.

A first phase in this analysis is the identification of all the parameters that are important for the evolution of the system (Cavallucci & Eltzer, 2009). The second step implies the construction of a model that allows the detection of the contradictions that hampers the evolution of the artefact.

The parameters may be of different kinds: action parameters, for which the designer can act on by changing or choosing their values; and evaluation parameters, used by the designers to verify that the artefact effectively meets some requirement.

For example, while designing a hammer, the “size of its handle” is an action parameter, the designer may make it “long” or “short”. On the other hand, “ease of handling” is an evaluation parameter; the designer might be interested in hammers that are easy to handle.

A contradiction expresses a mutual interaction of three parameters, such that if an action parameter AP tends to a value V, then an evaluation parameter EP1 changes from an unsatisfying value to a satisfying value and another evaluation parameter, EP2, changes from a satisfying value to an unsatisfying one. Nevertheless, if the action parameter AP tends to the opposite value of V, let us say $\bar{V}$, EP1 changes from a satisfying value to an unsatisfying value, and EP2 changes from an unsatisfying value to a satisfying value.

For example, if the hammer handle is long, the “hitting force” of the hammer is satisfying but its “ease of handling” is unsatisfying. However, if the hammer is small, the “hitting force” becomes unsatisfying and its “ease of handling”, satisfying.

When undertaking an inventive design study, there is a knowledge acquisition phase to specify the problem, by frequently reformulating it; until the whole set of the elements, characterizing the possible evolutions of the technical system under study, has been identified.

Initial knowledge acquisition is done by the construction of a network of problems / partial solutions. It lists the problems already encountered by the technical system and the partial solutions