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AN APPROACH TO SOLVE INVENTIVE PROBLEMS BASED ON THE SUBSTANCE-FIELD ANALYSIS AND SYSTEMS DYNAMICS

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ABSTRACT: *The Theory of Inventive Problem Solving (TRIZ) has their foundations on the knowledge extracted from the evolution of technical systems, scientific knowledge, and an effort to capitalize knowledge from several domains. Despite the TRIZ capacity to solve inventive problems, it lacks from three competencies: (1) TRIZ does not have a tool to observe the causality among the most important variables within an inventive problem; (2) It cannot follow the transformation of a system through time; (3) TRIZ cannot unveil the hidden relationships among different conflicts in a system to determine the right problem to solve and the most promising solving path. Nevertheless, there is a technical approach to explore the behavior of a system that can deal with the TRIZ drawbacks: The System Dynamics (SD) Modeling and Simulation Framework. This article demonstrates the feasibility to combine both approaches to produce a different problem-solving tool that can deal with inventive problems, particularly with problems modeled through a set of functions. The TRIZ tool that best deals with such kind of problems is the Substance-Field Modeling (SFM) tool. Once the user proposes a model, the next tool to use is a set of solving strategies (known as 76 Standard Solutions). These strategies suffer an adaptation process to propose at least one solving path. The combination of SFM and the SD approach is illustrated through a case study to discuss the advantage and limitation of a different solving framework.*

KEYWORDS: *Inventive Problems Modeling, System Dynamics Simulation, TRIZ, Substance-Field Analysis*

1 INTRODUCTION

The Theory of Inventive Problem Solving (TRIZ) is a useful tool for solving problems in three main classes: (1) situations model as a physical o technical contradiction; (2) when it is necessary to define the trends of evolution (ToE) of a system; and (3) when a problem involves the model of at least one function through the Substance-Field Analysis (SFA). The SFA is a TRIZ analytical tool for modeling problems related to existing technological systems. According to TRIZ, every system is created to perform at least one useful function (Altshuller 1999). The term useful does not refer to the concept of something beneficial or harmful, just to the fact that the system accomplishes their design purpose. The term 'substance' is used to describe an object of any level of complexity. A substance is used indistinctly to represent physical objects, systems or materials (Altshuller 1984).

The action or means of accomplishing it is called 'field.' According (Bultey et al. 2015) the term 'field' is not defined by its intention (set of formal attributes) but by its extension (set of formal objects: mechanical, chemical, thermal, electrical, gravitational and magnetic field). Further, the 'field' concept change from source to source (Altshuller 1984), (Salamatov 1999), and (Savransky 1998). A Substance-Field Model (SFM) is a graph used to describe a system or to formulate a problem as a function or as a set of functions. If the function depicts a problem where available knowledge cannot lead to a satisfactory solution, then the graph is linked to a set of generic rules called 76 standard solutions. A standard solution describes a solving path that can deal efficiently with the problem. To make a complete SFM are necessary two substances and a field or two fields and one substance. The construction of a SFM encompasses four steps: (1) Identify the components, (2) Construct the model, (3) Correlate the model with one of the 76 Standard Solutions, and (4) To develop at least one solution