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TRIZ FUTURE CONFERENCE

**Bridging Creativity in Science,
Entrepreneurship, Industry
and Education**

The 17th International Conference
of the European TRIZ Association

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FINLAND, LAPPEENRANTA

BOOK of ABSTRACTS

LAPPEENRANTA UNIVERSITY OF TECHNOLOGY, 2017

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Dear TRIZ Future 2017 Guests, dear Colleagues and Friends,

On behalf of the European TRIZ Association ETRIA and the ETRIA board it is a great pleasure for me to welcome you to the 17th TRIZ Future Conference TFC2017 in Lappeenranta. We hope to follow in the successful footsteps of the recent conferences in Wroclaw, Berlin, Lausanne/CERN, Paris, Dublin, Lisbon and others. If you have never been to our TFC conference, we offer you a warm welcome to the ETRIA community. I would like to express my sincere thanks to all contributors and speakers and in particular to the members of the organizing committee for their competent evaluation of the large number of submissions and for their careful preparation of the invited sessions. I wish you all interesting discussions and fruitful exchange of the latest advances in both science and practice over the coming conference days.

Yours sincerely,

The president for European TRIZ Association (ETRIA) Prof. Pavel Livotov

Tervetuloa,

Welcome to Finland's 100 anniversary year of 2017. On behalf of Lappeenranta University of Technology and School of Business and Management it is my pleasure to welcome you to Lappeenranta for the TRIZ Future Conference 2017 which is the 17th annual ETRIA conference. We are very excited to bring the TRIZ Future to Finland for the first time. The city of Lappeenranta is situated in eastern Finland, surrounded by lakes and forests. Lappeenranta, with a population of around 75 000, is known for lake Saimaa, lively events, fresh air and nature, and of course its sauna culture. Finland is one of the most innovative countries in the World. So, why should TRIZ Future 2017 not be the same?

The chair of TFC2017 local organizing committee Dr. Kalle Elfvingren

Dear TRIZ Future 2017 guest,

Welcome to LUT, welcome to the conference! Thank you for coming and thank you for contributing the conference program. Here are the numbers: we received 42 abstracts followed by 40 full text papers. The reviewing committees consisted of academia people with proven publishing record and practitioners: engineers, managers, consultants working with TRIZ and systematic creativity on products, technologies and services. The first evaluated the scientific rigor and academic value of contributions. The second focused on the applicability of the findings and the value of the contribution for the practice. 36 reports made it to the final program. We hope everyone will find something interesting, eye opening and useful among them. We want to use the chance to thank all the reviewers who invested their time and professionalism in the quality of the event.

Scientific committee chairs: Leonid Chechurin and Gaetano Cascini

05.10.2017
11:00-13:00
7343.2

Time	Title	Authors
11:00	From simulation to contradictions, different ways to formulate innovation directions	Sébastien Dubois Hicham Chibane Roland De Guio Ivana Rasovska
11:20	Method and Software for Finding Latent Problems Based on the Analysis of the Model of the Cause-Effect Structure of the Processes of the System	Alexander Kashkarov
11:40	Systematic Innovation in Process Engineering: Linking TRIZ and Process Intensification	Pavel Livotov Arun Prasad Chandra-Sekaran Richard Law Mas'Udah David Reay
12:00	How problems are solved in TRIZ literature: the need for alternative techniques to individuate the most suitable Inventive Principles	Yuri Borgianni, Francesco Saverio Frillici Federico Rotini
12:20	Multiscreen Analysis for Team Strategy Development	Tiziana Bertoncelli, Francesco Papini Kunal Goray Oliver Mayer
12:40	Innovative interaction design approach based on TRIZ separation principles and inventive principles	Xiaoguang Sun Rémy Houssin Jean Renaud Mickaël Gardoni Denis Cavallucci

From simulation to contradictions, different ways to formulate innovation directions

Authors: Sébastien Dubois, Hicham Chibane, Roland De Guio, Ivana Rasovska

Abstract

The main purpose of this paper is to show to what extent data used in design optimization process can be used to provide innovation directions and inputs to TRIZ methods. When looking for a new design, it is common to first try to optimize existing systems by experimental and numerical means. This approach requires building a model linking on the one hand, a set of Action Parameters and their range of possible values; and on the other hand, Evaluation Parameters that allow measuring the quality of a solution. Next, to evaluate the best potential solutions, the concept of dominance can be used to define the Pareto frontier, somehow the limits of the performances that can be reached with the built model of system. When none of the dominant points satisfies the objectives, it means that a redesign of the system is required and directions towards this new design needs to be elicited. Our hypothesis in this paper is that some directions can be formulated out of the analysis of experimental or simulation data, either by interpreting the influence of each parameter towards the reaching of the objectives, which is the classical routine way to do, or by identifying systems of contradictions from the data and thus propose another way to overcome the Pareto frontier.

Method and Software for Finding Latent Problems Based on the Analysis of the Model of the Cause-Effect Structure of the Processes of the System

Authors: Alexander Kashkarov

Abstract

The search for contradictions retarding system evolution and search for latent problems to be solved in reality are still kind of an art until nowadays. Cause-and-Effect Chain Analysis and Root Cause Analysis represent the most efficient tools for the search for root causes of observed disadvantages of any system. However, these tools enable one to identify only some causes of disadvantages because they are based on results of analysis of models that describe system behavior incompletely. To conduct any analysis on a highly qualitative level, to identify a multitude of causes of current disadvantages inherent to a system and majority of key problems, a researcher should use a model reflecting interrelations of system processes as a basis for his work. Principles of model building for system processes for the analysis of any system functioning are described in the paper. A case study has been prepared by the author. The model incorporates transformations of substance and energy flows, fields and forces, properties and states of substances. Such a model represents a cause-effect structure for system processes. Special software was developed by the author to make building and analysis of such model easier. Results of software testing for sixteen projects proved its efficiency – in addition to problems identified at earlier stages, the software enabled to identify new key problems and derive solutions for the latter. Application of proposed method with the use of new software contributes to a deeper insight into a system to be studied and furnishes an opportunity to identify non-obvious relations of processes and latent disadvantages inherent to a system. The proposed tool enables one to reduce labor consumption, to enhance efficiency and intensity of innovative activity.

Systematic Innovation in Process Engineering: Linking TRIZ and Process Intensification

Authors: Pavel Livotov, Arun Prasad Chandra Sekaran, Richard Law, Mas'Udah, David Reay

Abstract

Process Intensification (PI) as a part of knowledge-based engineering (KBE) can be defined as any significant technological development leading to more efficient and safer processes in chemical, petrochemical, and pharmaceutical industries. The PI databases of new technologies and equipment allow one to faster achieve the typical goals of innovation such as reduced energy and raw material consumption, increased process flexibility, safety and quality, and better environmental performance. However, some of these objectives are often contradictory in their realisation. In order to accelerate the implementation of PI technologies and solutions, the identified engineering contradictions can be eliminated with the help of the Theory of Inventive Problem-Solving (TRIZ), which is today considered as one of the most comprehensive invention methodologies. Both approaches - PI and TRIZ - were developed and are currently used independent of each other. Therefore, an attempt has been made to analyse how the various methods and technologies of PI can be linked to the components of TRIZ. The paper analyses the relationship of 155 PI technologies to TRIZ inventive principles, some inventive standards, and evolution patterns. It also outlines TRIZ inventive principles frequently used in PI, and identifies opportunities for enhancing systematic innovation in process engineering by applying complementary TRIZ and PI. The study also proposes additional 70 inventive TRIZ sub-principles for the problems frequently encountered in process engineering, resulting in the advanced set of 160 inventive operators, assigned to the 40 TRIZ inventive principles. Finally, the performed analysis of inventive principles used in 150 patent documents published in the last decade in the field of solid handling in the ceramic and pharmaceutical industries is discussed in the context of the findings. The presented research work belongs to the European project “Intensified by Design® platform for the intensification of processes involving solids handling” (IbD, <http://ibd-project.eu>), funded by the European Commission under the Horizon 2020 SPIRE programme.

How problems are solved in TRIZ literature: the need for alternative techniques to individuate the most suitable Inventive Principles

Authors: Yuri Borgianni, Francesco Saverio Frillici, Federico Rotini

Abstract

Many TRIZ critics (but also advocates) challenge its capability to individuate appropriate instruments for specific problems. Although each TRIZ user tends to prefer certain tools over others, Inventive Principles represent the most popular technique according to recent studies. Consequently, a more appropriate guidance to select the most promising ones for a given problem would result in a clear advantage for designers and supposedly for TRIZ popularity. The Contradiction Matrix is classically introduced to support this process, but its reliability is often questioned. In this framework, the authors have analysed a sample of problems solved by means of TRIZ and described in TRIZ-related literature. This choice was dictated by the need to pay attention to case studies really faced with TRIZ instead of being reconstructed from other examples, e.g. patents. The performed analysis has included 42 case studies from acknowledged TRIZ books and sources. Unfortunately, literature about problems solved with TRIZ is highly dispersed and the creation of a greater sample would have required considerable efforts. By the way, the authors believe that such a situation hinders the communication of TRIZ benefits. The analysis has led to the conclusions that follow. The Contradiction Matrix would have supported the determination of the described solutions in very few cases, namely 8, which confirms its limited reliability. A small number of Inventive Principles is capable of addressing the majority of the illustrated solutions; for instance, four of them are sufficient to solve almost 60% of the presented problems. Additional criteria have been used to classify conflicting parameters (more specifically a characterization in terms of Useful Functions, Undesired Effects and Resources), but their relationship with employed Inventive Principles seems quite random. The paper will open up a discussion about this presumable randomness of Inventive Principles and the possible measures to tackle the problem.

Multiscreen Analysis for Team Strategy Development

Authors: Tiziana Bertocelli, Francesco Papini, Kunal Goray, Oliver Mayer

Abstract

Nowadays corporate organizations normally hold a structure where discipline-based teams maintain a certain degree of homogeneity in skill set, still must respond to a very dynamic environment, in terms of technical and operational aspects and change of project scope in a short time. In such a scenario, the ability to formulate an effective development proposition for the team both with strong individual buy-in is critical. The scientific literature presents many examples of methods for group management, but most of them are focused on the best allocation of resources in the present time for a given set of project requirements. Only a TRIZ-enhanced version of the SWOT approach presents a method to improve organizations, products, services and processes and provides a detailed and complicated template for better resources management with a time development plan. Nevertheless, it demands an intensive effort to compile it and little focus is given to team resiliency, capability and growth. This paper presents a simplified Multi-Screen based approach successfully tested to identify a multi-year team development strategy for a technology team focusing on the energy sector. The workgroup is considered as the engineering system to analyse. In the nine-windows version the Multi-Screen approach proves its effectiveness paving the way to depict the overall landscape that shapes the technical skills the team is called to fulfil, the technologies to focus upon and consequently identified the needed development patterns at subsystem level, that is, for subgroups and individuals, in the spirit of TRIZ as a tool for personal creativity development, a research topic initiated by Altshuller himself. The modular structure allows to work in subgroups with different focus and offers a flexible tool for dedicated follow up sessions.

Innovative interaction design approach based on TRIZ separation principles and inventive principles

Authors: Xiaoguang Sun, Rémy Houssin, Jean Renaud, Mickaël Gardoni, Denis Cavallucci

Abstract

Under the pressure of the continuous requirements for high performance products, user experience attracts more and more attention. Consequently, designing interactive products is called for bringing usability and comfort to support people in their working. Traditionally, products are engineered as systems to perform a set of functions. They may show satisfactory performance from engineering perspective, however it often presents inadequate capability on user experience. To balance the weight between final product performance and user experience, this paper attempts to resolve this contradiction in design phase. On the basis of function definition and allocation (allocate to automation and human) studies, we categorize the detailed design into two classifications. One is design for automation function that involves an elaborate object, which can be composed with structural components, mechanisms, or control components. The other is design for ergonomics that denotes human intervention in the process of system operating, which can be described as identifying what kind of behaviour that human will generate. In order to estimate the final product performance and user experience, the separation principles and inventive principles from the TRIZ methodology are used to analyse the interactions between user's behaviour and product's behaviour. A case study is shown to illustrate the feasibility of proposed innovative design method in eliminating the contradiction between product performance and user experience. The proposed method contributes to detailed design phase, and the design object can be a complex machine, equipment, system, or simple product.

05.10.2017
11:00-13:00
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Time	Title	Authors
11:00	'Liberty vs. Love': The Principal Contradiction of Human Culture (2) The 'Liberty vs. Love' Contradiction and 'Ethics' at the Personal Level	Toru Nakagawa
11:20	The Study of Effectiveness of TRIZ Tools for Kaizen Activities in Japan and Developing Countries	Manabu Sawaguchi Heikan Izumi
11:40	The 40 Inventive Principles to conduct negotiations - Strategies and tactics to solve conflicts in communication	Claudia Hentschel
12:00	Is Anticipatory Failure Determination (AFD) effective for product reliability analysis? A comparison between AFD and Failure Mode and Effects Analysis (FMEA)	Renan Favarão Da Silva Marco Aurélio de-Carvalho
12:20	A Comparative Analysis of Praxiological Networks and Selected IDEF Models	Maksymilian Smolnik
12:40	TRIZ to support disruptive innovation of shared bikes in China	Jianguang Sun Kang Wang Zhonghang Bai Yu Wang Runhua Tan

'Liberty vs. Love': The Principal Contradiction of Human Culture

(2) The 'Liberty vs. Love' Contradiction and 'Ethics' at the Personal Level

Authors: Toru Nakagawa

Abstract

This is the second report of applying the TRIZ/CrePS Methodology to the social field. A basic hypothesis, found in the first report, is 'Liberty vs. Love' is the Principal Contradiction of Human Culture unsolved throughout the human history". The present study has investigated and extended it further. In short: Liberty is the First Principle of Human Culture, while Love is the Second. These Principles however contain various Contradictions, inside Liberty, inside Love, and between Liberty and Love. Both of these Principles are motivated by Ethics, which distinguishes Good from Bad deep inside the human heart. Thus the key to reduce/solve the 'Liberty vs. Love' Contradiction should be Ethics. However, Ethics is set and taught by society and evolving with history. Structural relationships of 'Liberty, Love, and Ethics' at the personal level are investigated.

The Study of Effectiveness of TRIZ Tools for Kaizen Activities in Japan and Developing Countries

Authors: Manabu Sawaguchi, Heikan Izumi

Abstract

TRIZ has been generally recognized as an effective methodology for creating innovative technological systems. However, such a strong belief might give TRIZ practitioners excessive expectations or discourage its beginners from practicing TRIZ. Therefore, this paper intends to verify that the basic concept of TRIZ and its inventive principles are very useful for solving problems even in production sites and communities, by paying attention to Kaizen activities in the field of daily life of people as well. This paper touches upon not only “Kaizen activities” born in Japan, but also “Jugaad innovation,” a kind of Indian type improvement activities. “Jugaad” is a colloquial Hindi word meaning an innovative solution, and “Jugaad innovation” means a unique product developed under the limited resources available in the communities where the average-level or poor people live. In fact, such improvement activities are widely seen not only in India but also in some of developing countries. This paper focuses on the several cases of “Kaizen (improvement)” and shows the results of case studies mainly from the standpoint of TRIZ’s inventive principles and functional analysis, to illustrate that the TRIZ approach is basically effective for not only the Japanese-style Kaizen activity, which can be defined as “Japanese-style Grass-Root Innovation (Js-GRI),” but also “Developing-Country-style’s (Dc-GRI)” including “Jugaad innovation”. Furthermore, the results of the survey on Quality recognition concerning social infrastructure-related products conducted in Japan and China are also analysed to indicate that the TRIZ thinking can be a key point in promoting collaboration between Js-GRI and Dc-GRI.

The 40 Inventive Principles to conduct negotiations - Strategies and tactics to solve conflicts in communication

Authors: Claudia Hentschel

Abstract

Communication is conflict and agreeing with another person or party within a negotiation sometimes looks as the ideal final result: not achievable, but serving as a guideline towards finding a common solution. Putting communication problems this “TRIZ-way” quickly raises the question, if the 40 Inventive Principles (IPs) could be applied – and if so, what the expectable solutions during a negotiation process would be. This contribution takes the 40 IPs of TRIZ and mirrors them with the contributions of three selected, contemporary communication experts and their most recent publications (R. B. Cialdini, M. Schraner and F. Schulz von Thun). What starts like a checklist for communication strategies and tactics becomes an evaluation of the universality of the 40 IPs: The often ventured guess in technics, that some IPs are more often to be applied than others, is confirmed for a non-technical field here.

Is Anticipatory Failure Determination (AFD) effective for product reliability analysis?

A comparison between AFD and Failure Mode and Effects Analysis (FMEA)

Authors: Renan Favarão Da Silva, Marco Aurélio de Carvalho

Abstract

Many product failures have premature origins in the development cycle. Potential failure identification methods are used to prevent such occurrences. With its advantages and drawbacks, the most widespread of such methods is Failure Mode and Effects Analysis (FMEA). There is also a TRIZ-originated tool for reliability analysis. It is known by such names as Diversionary Method, Diversionary Analysis, Subversion Analysis, Anticipatory Failure Identification, Anticipatory Failure Prediction and, most commonly, as Anticipatory Failure Determination (AFD). There are many claims concerning the effectiveness of AFD. However, few real cases are available and some AFD publications fall into the category of marketing materials. We looked into the literature and have found no previous attempt to systematically compare AFD with the current industry standard, which is FMEA. In this paper, we describe our comparison. We organized a short course on reliability for engineering students. In the short course, we taught both FMEA and AFD to the students. Students learned, applied the methods, and evaluated the results. Compared to FMEA, AFD was deemed best for new product development (59%), while 61% suggested FMEA for complex products. Although AFD has been rated as more robust (50%) and as efficient as FMEA, 60% of students considered FMEA more user friendly. In practical applications, AFD resulted in a better identification of failures and potential causes in 71% of the cases. These results show that AFD is indeed a sound reliability method that could be used as an alternative or an addition to FMEA.

A Comparative Analysis of Praxiological Networks and Selected IDEF Models

Authors: Maksymilian Smolnik

Abstract

The paper presents the results of a comparative analysis of praxiological networks and selected IDEF models. The typical praxiological networks formed from a number of praxiological chains and the Integration Definition (IDEF) models No. 0 and 3 were taken into consideration. Both of the ways of modelling were considered as the tools of design methodology and generally characterised in terms of their structures and selected assumptions related to their usage. The identification of inputs and outputs, subjects, objects and intermediaries of actions was carried out for the models. The selection of their elements and relations within them as well as the analysis of the problems associated with steering and realisation of processes were performed for them. Eventually, it was possible to describe the similarities and differences for both ways of modelling and to formulate recommendations on their usage. Finally, the possibility of the integration of these two ways of modelling was discussed.

TRIZ to support disruptive innovation of shared bikes in China

Authors: Jianguang Sun, Kang Wang, Zhonghang Bai, Yu Wang, Runhua Tan

Abstract

Since the end of 2016, shared bikes suddenly became popular in China. Shared bike is a typical disruptive innovation that conforms to the business model of the disruptive innovation, and its product development is also accord with the characteristics of disruptive innovative technology. But with the increase of the number of shared bikes, all kinds of bike brands are taking part in the fierce competition, so the second disruptive innovation becomes extremely urgent. In addition, due to the proliferation of shared bikes, which also brought a lot of problems. Based on the analysis of shared bikes innovation model, this paper uses 9 windows system for resource analysis and needs analysis. Based on the method of technical system decomposition, TRIZ and disruptive innovation theory are used to analyze its past and forecast its future development of technology opportunities.

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Time	Title	Authors
15:30	Levelized function cost: economical consideration for design concept evaluation	Mariia Kozlova Leonid Chechurin Nikolai Efimov-Soini
15:50	The method of the design improving by using the TRIZ function analysis and the trimming	Nikolai Efimov-Soini Leonid Chechurin
16:10	Optimization of morphological analysis through sensitivity analysis to support decision-making	Shqipe Buzuku Andrzej Kraslawski
16:30	A systematic literature review of TRIZ used in Eco-Design	Shqipe Buzuku Iuliia Shnai
16:50	Automation of conceptual design stage of framed buildings projects using TRIZ function modelling in BIM environment. A case study.	Ivan Renev Leonid Chechurin Elena Perlova
17:10	Quantifying and Leading Innovation with TRIZ within Competitiveness Strategies	Stelian Brad Emilia Brad

Levelized function cost: economical consideration for design concept evaluation

Authors: Mariia Kozlova, Leonid Chechurin, Nikolai Efimov-Soini

Abstract

Design concept selection lacks economic evaluation in the early stages of the design process. This paper introduces the levelized function cost concept for express design evaluation, adapted from the power generation sector. A single indicator represents all concept-related life-cycle costs per a unit of function produced, reflecting also the lifetime and productivity of the concept. Focusing on function cost, the indicator allows comparing fundamentally different designs, and handles function evaluation for different sets of objects. After a brief overview and comparison of potential indicators for economic assessment of design concepts this paper introduces the levelized function cost providing its derivation and definition, analyzes its sensitivity to the input variables, depicts the range of problems that can be addressed with the levelized function cost estimate, and finally illustrates its application in a flow meter design case.

The method of the design improving by using the TRIZ function analysis and the trimming

Authors: Nikolai Efimov-Soini, Leonid Chechurin

Abstract

This article is devoted to the design improving and the development by means of the TRIZ function analysis and the trimming. A new formal trimming method is presented in the paper. This one takes into account the importance of functions in the system, interactions between functions and relations between elements and functions. An addition change of the trimming paradigm is proposed. In the suggested approach the improvement of the system is completed by using the replacement of the function sets with other single function. As well, the suggested approach is illustrated by the industrial case study.

Optimization of morphological analysis through sensitivity analysis to support decision-making

Authors: Shqipe Buzuku, Andrzej Kraslawski

Abstract

Today's industry is constantly under the high pressure to increase competitive advantages and resource-efficiency. One of the main challenges for industrial project management is to optimize constantly factors like time, cost, quality, etc. To address this problem, several methods and tools exist focused on optimization. Morphological analysis is one of the methods most widely used in identification, formulation and structuring attractive opportunities or complex problems with the aim of seeking optimal solutions. When extended with cross consistency assessment, morphological analysis becomes an iterative method. The methodological foundation of the study is based on an iterative nature of the cross-consistency assessment as an opportunity to optimize it. One possibility to address this challenge is the use of sensitivity analysis to tackle the time limitation added with the need of iterations. The aim of this paper is to present a modeling approach for using morphological analysis and sensitivity analysis. Applying sensitivity analysis shows great potential of time reduction over the iteration process. The study addresses these priorities and presents two contributions: First, the study aims at recognizing the connection between the systems engineering requirements and project management activities, which incorporates multiple design dimensions and categories that can bring into light new co-creation opportunities and how their interests can be consolidated and optimized. Second, the research extends the application of creative design approach, specifically within a set of activities. The study recognizes and analyses the conflicts between the design activities and aims at creating alternative options and solutions to resolve these conflicts.

A systematic literature review of TRIZ used in Eco-Design

Authors: Shqipe Buzuku, Iuliia Shnai

Abstract

Creativity has emerged as a driving force to innovation processes and systems' design for the manufacturing industry of future generations. Despite the growing importance of value creation of innovation processes and strategies in general, companies are still faced with the challenge of measuring the outcome of innovation processes in particular. Many creative assessment methods for innovation can be identified from literature, such as TRIZ and morphological analysis. For example, researchers combine or integrate the technique of Theory Inventive of Problem Solving (TRIZ) with other methodologies such as Life Cycle Assessment (LCA) and Life Cycle Engineering (LCE), to help design engineers and practitioners to create, evaluate and select the best solution to meet the business objectives for eco-product and sustainable manufacturing. The integrated methods can solve main contradictory problems particularly engineering requirements from the concept of eco-design analysis to eco-product, sustainable manufacturing and application. Review work on the literature, specifically that on research and development of TRIZ, LCA, and LCE showed that said methodologies have been widely and successfully implemented in several practical applications. This review work provides an in-depth analysis of identifying and finding issues of strengths, weaknesses and outcomes of the TRIZ when combined with LCA, LCE, Eco-efficiency and other integrated methods for eco-product and sustainable manufacturing. The results show that using creativity assessment methods and eco-design methods facilitates decision-making process in early stage of conceptual design for sustainable manufacturing.

Automation of conceptual design stage of framed buildings projects using TRIZ function modelling in BIM environment. A case study

Authors: Ivan Renev, Leonid Chechurin, Elena Perlova

Abstract

In the article we present step-by-step automated TRIZ function analysis of a framed structural system. The analysis has been performed in BIM environment using Revit © software and tools for visual programming. The article includes an introduction and experimental model description and the main body consisting of Interaction and Function matrixes construction, functional diagram creation, ranking and trimming. The paper ends with conclusion and discussion.

Quantifying and Leading Innovation with TRIZ within Competitiveness Strategies

Authors: Stelian Brad, Emilia Brad

Abstract

The most prominent tool for analyzing the competitive advantage of organizations or larger ecosystems is the Porter's diamond. This paper investigates a systematic way to build up the Porter's diamond model, including the relationships between the building blocks – which was not yet treated in the current published papers. The framework is based on SWOT analysis, as well as on relationship and correlation matrices to show the connections between Porter's diamond blocks. With the methodology proposed in this paper new dimensions of the diamond are explicitly revealed. This creates a new space to identify conflicts and quantify critical issues within the strategy. TRIZ tackles the conflicts revealed by the links in the diamond and proposes generic directions to operationalize the strategy. The major finding of this research is that without a structured depiction and deployment of each diamond's block with the other blocks, many areas that require innovations and innovative projects can be easily omitted, making the strategy weaker. Findings in the paper are sustained by qualitative conclusions extracted from methodology application on an IT economic cluster. Results show that the proposed methodology brings advantages in defining a comprehensive analysis of the competitive environment, as well as in linking analysis with innovation. With the methodology proposed in this paper, information from the Porter's diamond can be used in a more effective way for building up a strategy for economic competitiveness.

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15:30	A comparison of two creativity methods for fostering participative innovation	Anna-Maija Nisula Aino Kianto
15:50	A framework of forecasting techniques as a checklist to minimize the likelihood of product design failures	Yuri Borgianni
16:10	Combining discrete event simulation, data analysis and TRIZ for fleet optimization	Sébastien Bach Roland De Guio Nathalie Gartiser
16:30	How to Generate Ideas Systematically from Function Analysis of an Inventive Problem	Min-Gyu Lee
16:50	Problem formulation of screw feeding system of fibrous materials using TRIZ	Marek Mysior Sebastian Koziółek Eugeniusz Rusiński
17:10	Forecasting of product and technology development using heuristic-systematic approach	Sebastian Koziółek Marek Mysior Bartosz Pryda Robert Smirnow Marek Robak

A comparison of two creativity methods for fostering participative innovation

Authors: Anna-Maija Nisula, Aino Kianto

Abstract

This paper examines and contrasts two methods that can be used for advancing participatory innovation in organizations: the Lateral thinking method and theatre improvisation method. While both of these methods are aimed at increasing creativity as a means of improving participative innovation, they differ on their conceptualizations of creativity, goals and processes. Utilization of the methods is illustrated by reporting on two creativity development workshops. The paper sheds light on methods for fostering creativity and participatory innovation, and highlights the collective nature of co-creation in participatory innovation.

A framework of forecasting techniques as a checklist to minimize the likelihood of product design failures

Authors: Yuri Borgianni

Abstract

TRIZ is intended to support, among the others, the forecasting of future versions of technical systems. In this sense, the Laws of Evolution of Technical Systems range among the most powerful methods to predict possible product development patterns. The violation of these laws supposedly represents a trigger of product flops, due to an unnatural evolution of systems. It can be argued that such an infringement mainly regards the structural level of the product, also because TRIZ is mainly concerned with the description of physical components and their interactions. As it is well acknowledged from the design field, structures are essential ontological domains of products, but other dimensions are likewise relevant. First, other fundamental characterizations are represented by the product behaviour and function, whose definition might however differ with respect to its conceptualization in TRIZ domain. Second, the individuation of a more abstract goal is attracting increasing attention as a means to denote the designer's intent and the purpose of the product in terms of human utility. By analysing lists of remarkable product failures, the author claims that reasons of fiascos cannot be fully explained by violation of TRIZ principles. Hence, other product ontological domains might be involved in unsuccessful product launches. To this aim, the paper proposes a framework comprising different forecasting and evolution models, which are sorted according to their reference to said ontological domains. For instance, dynamic Kano models are associated to the evolution of product requirements and functions. The claimed utility of the framework is the possibility of verifying whether any of the most reliable evolution patterns is infringed in new product development projects. Besides attempting to complement TRIZ body of knowledge with external models, the definition of the presented framework discloses the need for researching evolution of human needs more accurately.

Combining discrete event simulation, data analysis and TRIZ for fleet optimization

Authors: Sébastien Bach, Roland De Guio, Nathalie Gartiser

Abstract

Theory of inventive problem solving (TRIZ)-based methodologies enable solutions to multi-objective problems comprising two or more evaluation parameters to be found by defining the technical contradictions and setting the physical contradictions and the system of contradictions. However, most methodologies only address identification of the classical TRIZ system of contradictions. This paper proposes a method for identifying the generalized technical contradictions and their related generalized physical contradictions by using simulation data. A didactical example drawn from a real fleet cost reduction problem shows how to use them together with TRIZ methods and simulation means. The outputs of the proposed algorithms provide a minimum set of relevant technical and physical contradictions. Algorithms' time complexity allows addressing systems described with many variables.

How to Generate Ideas Systematically from Function Analysis of an Inventive Problem

Authors: Min-Gyu Lee

Abstract

In an inventive problem solving project based on TRIZ, the role of analysis methods like Function Analysis (FA) and Cause Effect Chain Analysis (CECA) is very important because they provide the big picture of the problem solving. Recently these two methods were improved to FA+ and CECA+ with better functionality and convenience and now they can guide the user further, down to semi-automatically generated solving directions. From the solving directions, the user can usually easily find the ideas for the solutions using simple methods like guided thinking, brainstorming, searching or using a few solving tools in TRIZ. But for more difficult problems the gap between helpful but broad solving directions and idea generation is too wide for the user to overcome. This research aims to help the users move even further down to finding the 'ideas'. The process is as follows: Due to the added features of FA+, the user can express and see the causal chain of actions in FA+ diagram. Select the promising unsatisfactory action, breakdown the action, draw a local CECA+ diagram or build an idea table to find the needed properties of action and substances including their needed dependence on space-time etc. With these information, finding the suitable substances (which is often very close to the detailed ideas for solution) is much easier. A case study shows how this method can be applied to a promising part of the FA+ diagram and guide the user toward new ideas step by step.

Problem formulation of screw feeding system of fibrous materials using TRIZ

Authors: Marek Mysior, Sebastian Koziółek, Eugeniusz Rusiński

Abstract

Current trends in organic waste processing are directed towards the use of new materials in thermochemical processes like torrefaction or pyrolysis. Currently known solutions on how to design a process installation are not fully applicable to the new type of materials being processed nowadays. The aim of this study was to describe set of potential problems that occur in the organic waste processing and to implement problem-solving approach using TRIZ to define potential solutions to them at the stage of conceptual design. The screw feeding system was defined as the system to be analyzed. One of the core problems defined was the blockage in material flow resulting from the morphology of the material. During the study, such TRIZ tools like Functional Analysis, 40 principles and Contradiction Matrix as well as System Operator were implemented to define the core problem and to generate solutions to this problem taking into consideration technological, economical, ecological and social aspects. The entire screw feeding system was also function-modelled and related to the entire torrefaction system showing its contribution to the process. Application of TRIZ at the stage of conceptual design makes it possible to define set of limitations in the design before the actual testing takes place. This allows to predict the behavior of the system being analyzed and thus to address the problems at earlier stage of the product development, reducing the use of resources in the design process

Forecasting of product and technology development using heuristic-systematic approach

Authors: Sebastian Koziółek, Marek Mysior, Bartosz Pryda, Robert Smirnow, Marek Robak

Abstract

One of key problems in industrial development relates to prediction of future needs of customers. Many companies create own development strategies based on intuition that rarely consider market development and changes in needs of customers. The aim of this study was to apply heuristic-systematic approach to perform forecasting of product and technology development on specific examples including Technological, Economical, Ecological and Social changes. Presented approach to forecasting is characterized by modelling of the system to be forecasted, data acquisition and analysis of relations between the system and its super system and subsystem. Specific tools like functional analysis, contradictions, system operator or S-curve analysis were implemented in the forecasting process. The precise definition of the forecasting problem is the first step of the process. This helps to define aim of the forecast and the expected, project-oriented outcome. Next, knowledge acquisition stage takes place followed by analysis of results and interaction between elements of the knowledge network. As a result, barriers and limitations in the product development significant in the future were defined. Based on the example of vehicle development it was concluded, that in nearest years the most significant development in this industry will relate to change of the drive energy source from gasoline to electricity. This is thus a direction that should be taken by research teams to adopt to the future market. As of today, technology related to electric vehicles does not meet the future requirements. It is necessary to solve problems related to energy storage. Application of this approach makes it possible to assess the development of specific products and technologies. This approach is applicable in all industries and services and helps to define the proper direction of development of products and technologies that will solve the future problems.

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Time	Title	Authors
11:00	Experimental validation of quantum-economic analysis (QEA) as a tool for new product development	Oleg Abramov Sergey Markosov Alexander Medvedev
11:20	Generating new product ideas with TRIZ-derived ‘voice of the product’ and quantum-economic analysis (QEA)	Oleg Abramov
11:40	Control design tools for intensified solids handling processes	Markku Ohenoja Marko Paavola
12:00	Can Altshuller’s matrix be skipped using CBR and Semantic Similarity reasoning?	Pei Zhang Sarrah Ghabri Denis Cavallucci Cecilia Zanni-merk
12:20	TRIZ to resolve socio-technical contradictions within the product usage integration in design	Remy Houssin Amadou Coulibaly Denis Cavallucci Jean Renaud
12:40	Identification of Secondary Problems of New Technologies in Process Engineering by Patent Analysis	Pavel Livotov Mas’udah Arailym Sarsenova Arun Prasad Chandra

Experimental validation of quantum-economic analysis (QEA) as a tool for new product development

Authors: Oleg Abramov, Sergey Markosov, Alexander Medvedev

Abstract

Quantum Economic Analysis (QEA®) was originally developed as a tool for business consulting. The key postulate of QEA is that, in order to make a business successful, the combined levels of development of (1) the company, (2) its product, and (3) the target market (further referred to as Combination) must fall within a set of “allowed” combinations (further referred to as Allowed Set). If a business’s Combination is not within the Allowed Set, it will unlikely be successful regardless of how good the company and the product are and how big the target market is. This approach allows business consultants to identify the right business strategy, and, for example, to recommend what changes to the company are needed in order to maximize the probability of business success by creating a Combination that falls within the Allowed Set. It has been suggested that QEA may be applicable not only in business consulting, but in technical TRIZ-consulting as well, albeit for a different purpose. In TRIZ-consulting, QEA may serve as a tool for new product development (NPD) that rejects unpromising ideas whose Combination does not fall within the Allowed Set. In this paper, the authors have tried to validate QEA’s Allowed Set experimentally by analyzing a pool of technical solutions for new products that were developed for different companies in actual TRIZ-consulting projects. For each solution the authors have identified (1) the combination of the company, product and target market levels of development, and (2) whether the new product was successfully commercialized. The results show that all commercially successful new products generally fell into QEA’s Allowed Set, which confirms that QEA may indeed be included in the arsenal of TRIZ-consulting tools.

Generating new product ideas with TRIZ-derived ‘voice of the product’ and quantum-economic analysis (QEA)

Authors: Oleg Abramov

Abstract

This paper addresses one of the biggest problems today in technical TRIZ-consulting and in TRIZ methodology: far too few ideas generated using TRIZ yield commercially successful products. One of the main reasons for this is that while voice of the customer (VOC) is the main input for generating and screening new product ideas, it, unfortunately, may not reflect customers’ wants and needs correctly. In order to address this issue, the author has proposed to supplement VOC with the more objective ‘voice of the product’ (VOP), which is derived using TRIZ tools, such as the Trends of Engineering Systems Evolution and Main Parameters of Value (MPV) analysis. Using VOP in combination with VOC meets customers’ wants and needs better than using VOC alone, thus increasing the chances for the new product’s commercial success. Practice shows, however, that even though the product ideas delivered by TRIZ-consultants fully meet customers’ wants and needs, TRIZ clients are often unable to commercialize these ideas. In this paper, the author proposes to engage Quantum Economic Analysis (QEA®) in the new product development (NPD) process as a screening tool to reject ideas that, although technically promising in terms of VOC and VOP, the client is unlikely to be able to commercialize. This will increase the success rate of TRIZ consultants and will make NPD more efficient. The paper includes a brief case study illustrating the importance of using QEA in NPD in general and TRIZ-consulting in particular.

Control design tools for intensified solids handling processes

Authors: Markku Ohenoja, Marko Paavola

Abstract

The Intensified-by-Design (IbD®) Project will create a holistic platform for facilitating process intensification design and optimisation in processes in which solids are an intrinsic part. TRIZ can be applied to generate new concepts for process intensification. For each concept, a new control system needs to be defined. Hence, the dynamics of the system need to be determined, the disturbances, manipulated and controlled variables need to be identified, and the utilization of novel measurement instruments, indirect measurements and advanced control strategies need to be evaluated. For these purposes, the IbD® Platform will incorporate a design step, where systematic procedure for variable selection is performed, available measurement devices are mapped, process identification is supported by design of experiments and model identification tools, and the control design is initialized by input-output selection and controllability analysis tools. As an output, the user of the platform is provided with a feasible set of manipulated and controlled variables, their pairing, and controllability measures already in the process design phase. With the documentation included in the platform, the user can find state of the art solutions for advanced process control, as well. This paper presents the essential functionalities embedded to control design step in IbD® platform to reach a feasible process design. With integrated process and control design supported by the platform, the performance of the intensified process will more likely meet its targets and design bottlenecks due to process control can be avoided.

Can Altshuller's matrix be skipped using CBR and Semantic Similarity reasoning?

Authors: Pei Zhang, Sarra Ghabri, Denis Cavallucci, Cecilia Zannimerk

Abstract

Inventive Design is a research field born on the basis that TRIZ body of knowledge was both promising and original, but also containing inconsistencies that only an in-depth scientific work achieved by a community of researchers could handle for its evolution. Amongst the techniques used by TRIZ community, Altshuller's Contradiction Matrix combined with the forty Inventive Principles that appears as a flagship for newcomers and observers. This rather old tool from Altshuller has undergone many researches and a large quantity of evolutions have been proposed for its rebuilding. Nevertheless, after several attempt of practices, two major drawbacks in its use still appears to engineers. The first one is when associating contradiction's parameters to one or several of the thirty-nine Generic Engineering Parameters, the second is to interpret the resulting Inventive Principles appearing in the cells of the Contradiction Matrix. These two potential reasons of inefficiencies are known to TRIZ world, but only few proposals have been made by researches in the community to cope with these drawbacks. This paper proposes to report about the use of Case-based Reasoning (CBR) associated to semantic similarity algorithms as a means to directly place users in front of a set of eligible solutions when trying to solve a contradiction, therefore avoiding the use of the Contradiction Matrix. Our research has now reached a milestone since we have developed an online web-application associated with a database and a case base for testing the inventive problem-solving environment with users and compare it with classical use of the matrix. We also summarize the architecture of our methodology and illustrate it with a case study.

TRIZ to resolve socio-technical contradictions within the product usage integration in design

Authors: Remy Houssin, Amadou Coulibaly, Denis Cavallucci, Jean Renaud

Abstract

Actually, product usage is done very late after the prototyping step in the design process. In these last steps, usage integration can cause contradictions between product performance and the respect of European directives and standards for product use. For instance, to fulfil the function “to cut” designers could propose many technical solutions like cutter, saw, laser, etc. As each technical solution is based on one type of energy (cutter is based on mechanical energy; saw is based on electromechanical energy; laser is based on thermic energy, etc.) this must be taken into account. Moreover, cutter has a cutting edge and laser have a high temperature, for safety reasons, user must not have access to these cutting edge or to high temperature area. Therefore, designers propose some protection equipment that may decrease visibility and accessibility. In our article in TRIZ FUTURE 2015, we proposed a method to identify the socio-technical contradictions engendered by the product usage integration in the early steps of the design process. In this paper, we propose TRIZ to help designers to resolve these socio-technical contradictions. Our proposition enables designers to find out the potential problems before prototyping step that may occur during the product usage phase and to resolve them thanks to TRIZ

Identification of Secondary Problems of New Technologies in Process Engineering by Patent Analysis

Authors: Pavel Livotov, Mas'udah, Arailym Sarsenova, Arun Prasad Chandra

Abstract

The implementation of new technologies in the production plants often causes negative side effects and consequential drawbacks. In this context, the prediction of the secondary problems and risks can be advantageously used for selecting best solutions for intensification of the processes, and helps to reduce additional investments and losses of time and production. However, the identification of secondary problems in new technologies is very time-consuming especially if only limited experience with new equipment is available in the industry. In this context, the proposed method puts primary emphasis on systematic and fast anticipation of the secondary problems using patent documents, which in the next step results in the extraction and prediction of possible engineering contradictions within novel technical systems. The paper introduces three ways to find secondary problems from the patent literature: a) direct knowledge-based identification of secondary problems in new technologies or equipment; b) identification of secondary problems of prototypes mentioned in patent citation trees; c) prediction of negative side effects using the correlation matrix for invention goals and secondary problems in a specific engineering domain. The method is illustrated by the analysis of innovative technologies and patents of the recent decade related to granulation process in pharmaceutical and ceramic industries. The research work presented in this paper belongs to the European project “Intensified by Design® platform for the intensification of processes involving solids handling” (IbD, <http://ibd-project.eu>), funded by the European Commission under Horizon 2020 SPIRE programme.

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Time	Title	Authors
11:00	TRIZ popularity, challenges and strategies to make it work in Finland	Behrooz Khademi Kalle Elfvingren Leonid Chechurin
11:20	Higher education classroom re-design via TRIZ: case study	Iuliia Shnai
11:40	Developing a method to aid engineers in finding solutions for functional problems	Nienke Nijenhuis
12:00	Trimming in the context of IT-services	Teemu Toivonen
12:20	Application of TRIZ Concepts to University Career Development Education	Kiyohisa Nishiyama Leleito Emanuel Nobuaki Sakai
12:40		

TRIZ popularity, challenges and strategies to make it work in Finland

Authors: Behrooz Khademi, Kalle Elfvingren, Leonid Chechurin

Abstract

Finnish government introduced new policies towards innovation in 2008 when the global financial crisis was growing. Finland has always been known as one of the top innovative countries worldwide. However, recent research shows that the output factors of innovation strategies regarding manufacturing and high-tech do not work well in Finland. Theory of Inventing Problem Solving (TRIZ) is one of the methods used in different industries to lead efforts towards radical innovations. There are arguments for and against the application of the method as well as how popular TRIZ is nowadays in industry. Both primary and secondary data were deployed to realize the level of popularity of TRIZ in Finland. Companies' challenges for management of innovation (particularly for application of regular TRIZ workshops) were extracted and the possible strategies to make TRIZ favored in Finland were suggested. The research conducted through an online survey by participating Finnish R&D and Innovation Managers. From the responses received, it was found out that many SMEs have no innovative activities and TRIZ was not a prominent method in large Finnish companies. The most important challenges for Finnish companies were the lack of motivation in employees and managers, the lack of basic knowledge about the method and the risk of information leakage by consultants. The most important strategies towards TRIZ dissemination were considered for different layers of the society. Finnish government and the big players in innovation system should contribute to higher innovation outcome by assigning more budget to universities for innovation-related courses such as TRIZ in master's degree programmes. Joint TRIZ seminars, where companies participate in its basic courses were found out to be interesting for participants. In addition, top-level managers and trainers in both universities and industries, should have new strategies in order to motivate the participants of the course and make it work more effectively.

Higher education classroom re-design via TRIZ: case study

Authors: Iuliia Shnai

Abstract

Current digital media influences traditional approaches in higher education. New educational standards are formed by modified and technology intensive methods. Therefore, inventions and improvement of teaching classrooms are inevitable for increasing education effectiveness. The aim of this paper is to create concepts of completely new or enhanced educational designs and methodologies using TRIZ. Theory of Inventive Problem Solving is a pack of idea generation tools, commonly applied for engineering. However, in this paper its value is recognized for ideation in general and applied to such social system as education. To achieve this aim the case-study was placed. The preliminary results provide conceptual models and ideas for new more effective knowledge, experience and attitude transfer forms. Each design is described in terms of Technological Pedagogical Content Knowledge (TPCK) model. TPCK is a basic framework for effective technology integration in teaching process. In addition, the real “Inventive thinking and TRIZ” course in Lappeenranta University and Technology was re-designed. The feedback system and video materials were developed and e-learning platform were adapted for the course. Overall, this work sheds light on the new blended and online learning standards and underlines the necessity and direction of inventing and improving in higher education.

Developing a method to aid engineers in finding solutions for functional problems

Authors: Nienke Nijenhuis

Abstract

Nature provides a nearly endless resource of evolved systems and incredible inventions: a great source of knowledge that is currently barely used in engineering design. In this paper, research is done how the theory of inventive problem solving (TRIZ) can aid engineers in finding solutions for functional descriptions of problems, using existing solutions from different disciplines; but most notably, how biology can be added to the (existing) set of solutions. One of the main questions is how to structure biological information using TRIZ. Engineers that use this method might find new, innovative, and possibly biomimetic solutions, often improving the eco-efficiency and multifunctionality of systems. Challenging problems in the development of this method are amongst others, the construction of a database system, quantifying and extracting biological phenomena, dealing with the hierarchical structure of natural systems, and the transfer of knowledge between biological and technical systems. It is suggested that using TRIZ' functional analysis as a basis for the database entries will aid in successfully integrating biomimetic solutions into the existing TRIZ method. To provide background information on the discussed subjects, the paper also includes an introduction to some methods and tools that deal with the automatic extraction and databasing of knowledge in the form of Physical Effects, the state-of-the-art of combining TRIZ, and a brief introduction of biomimetics and several TRIZ tools.

Trimming in the context of IT-services

Authors: Teemu Toivonen

Abstract

In an increasingly digital world IT-services are the corner stone of any credible strategy. This has led to large investments in developing new and adding features to old IT-services. Many companies emphasize time to market for new services and features. Getting new features into production is critical for staying ahead of competition and reacting to market changes and disruptions. This emphasis on speed often comes at a cost. Instead of investing time and effort into refactoring existing services new, features and services are often “glued” on top of existing solutions and processes. This in turn leads to increasingly complex services, IT-architecture, processes, code bases, etc. The increase in complexity leads to slower development times, increased development and maintenance costs and a worse user experience. TRIZ trimming questions have been successfully used together with functional models in traditional engineering domains to simplify systems. This article explores simplifying IT-services with trimming questions covering architecture, process, user interface and code simplification. The article presents how the different aspects of IT-services can be modeled so that the trimming questions can be effectively applied into practice and what changes can be made to the trimming questions to make them more effective. The article also cover facilitation techniques for modeling the aspects and applying the trimming questions into practice. The key findings are that TRIZ trimming questions are an effective way of simplifying IT-services, but the aspects of IT-services that are simplified (architecture, user interface...) need to be modeled in a way that is suitable for the trimming questions. Small modifications to the trimming questions also make them easier to apply into practice.

Application of TRIZ Concepts to University Career Development Education

Authors: Kiyohisa Nishiyama, Leleito Emanuel, Nobuaki Sakai

Abstract

Unpredictable globalizing society currently requires university students to design their own career as an independent individual. So, career development education, which is now also popular in Japan, should be customized assuming diversifying student back grounds. The educational activities tend to be talks lectured by business persons invited from leading companies. Special working culture in Japan is also a main lecture topic particularly for international students. Some lucky students may find clues applicable for their own career development from such lectures, but the other does not recognize the contents useful for their futures. This paper introduces an application of TRIZ to a university career development education under the assumption that all of the students will need to get over the sequence of problems, which are recognized as contradictions in TRIZ, on their career development. The authors used the TRIZ tools: “if then but statement”, “separation principles” and “40 inventive principles” in the lecture entitled “Introduction to Career Development Theory” aiming to demonstrate the process of problem definition and solving. The students firstly defined recognizable problems in their university lives with the “if-then-but statement”. Then they generated the solution ideas with other TRIZ tools. Most of all students proactively extracted problems and smoothly cooperated with their colleagues to generate solution ideas. We obtained positive feedbacks from the students and thus concluded that TRIZ is a practical tool for career development education

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