



HAL
open science

Systematic Innovation Partnerships with Artificial Intelligence and Information Technology

Robert Nowak, Jerzy Chrzęszcz, Stelian Brad

► **To cite this version:**

Robert Nowak, Jerzy Chrzęszcz, Stelian Brad. Systematic Innovation Partnerships with Artificial Intelligence and Information Technology. Springer International Publishing, AICT-655, 2022, IFIP Advances in Information and Communication Technology, 978-3-031-17287-8. 10.1007/978-3-031-17288-5 . hal-04449798

HAL Id: hal-04449798

<https://inria.hal.science/hal-04449798v1>

Submitted on 15 Feb 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Editor-in-Chief

Kai Rannenber, Goethe University Frankfurt, Germany

Editorial Board Members

TC 1 – Foundations of Computer Science

Luis Soares Barbosa , University of Minho, Braga, Portugal

TC 2 – Software: Theory and Practice

Michael Goedicke, University of Duisburg-Essen, Germany

TC 3 – Education

Arthur Tatnall , Victoria University, Melbourne, Australia

TC 5 – Information Technology Applications

Erich J. Neuhold, University of Vienna, Austria

TC 6 – Communication Systems

Burkhard Stiller, University of Zurich, Zürich, Switzerland


TC 7 – System Modeling and Optimization

Fredi Tröltzsch, TU Berlin, Germany

TC 8 – Information Systems

Jan Pries-Heje, Roskilde University, Denmark

TC 9 – ICT and Society

David Kreps , National University of Ireland, Galway, Ireland

TC 10 – Computer Systems Technology

Ricardo Reis , Federal University of Rio Grande do Sul, Porto Alegre, Brazil


TC 11 – Security and Privacy Protection in Information Processing Systems

Steven Furnell , Plymouth University, UK

TC 12 – Artificial Intelligence

Eunika Mercier-Laurent , University of Reims Champagne-Ardenne, Reims, France

TC 13 – Human-Computer Interaction

Marco Winckler , University of Nice Sophia Antipolis, France

TC 14 – Entertainment Computing

Rainer Malaka, University of Bremen, Germany

IFIP – The International Federation for Information Processing

IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

More information about this series at <https://link.springer.com/bookseries/6102>

Robert Nowak · Jerzy Chrząszcz ·
Stelian Brad (Eds.)

Systematic Innovation Partnerships with Artificial Intelligence and Information Technology

22nd International TRIZ Future Conference, TFC 2022
Warsaw, Poland, September 27–29, 2022
Proceedings

Editors

Robert Nowak 
Warsaw University of Technology
Warsaw, Poland

Jerzy Chrzęszcz 
Warsaw University of Technology
Warsaw, Poland

Stelian Brad 
Technical University of Cluj-Napoca
Cluj-Napoca, Romania

ISSN 1868-4238 ISSN 1868-422X (electronic)
IFIP Advances in Information and Communication Technology
ISBN 978-3-031-17287-8 ISBN 978-3-031-17288-5 (eBook)
<https://doi.org/10.1007/978-3-031-17288-5>

© IFIP International Federation for Information Processing 2022

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The Theory of Inventive Problem Solving (TRIZ) is popular creative thinking and systematic organizing knowledge methodology. It is a scientifically grounded and structured approach for forecasting the evolution of technological systems, and includes numerous tools and methods for product and process innovation, enabling an increase in creative and inventive productivity.

The European TRIZ Association (ETRIA) World Conference TRIZ Future (also known as the International TRIZ Future Conference, TFC) is traditionally a fundamental venue for disseminating information about TRIZ. TFC has reached its 22nd edition (TFC22) which took place in Warsaw, Poland, during September 27–29, 2022. The conference was organized at the Faculty of Electronics and Information Technology, Warsaw University of Technology, in Warsaw, Poland by the Artificial Intelligence Division. The conference motto is ‘Systematic Innovation partnerships with AI and IT’, which highlights the main idea of this event: to join TRIZ with Information Technology (IT) and Artificial Intelligence (AI).

Information Technology (IT) and Artificial Intelligence (AI) achieve many goals. It is worth noting that thoughtlessly comparing artificial intelligence to human intelligence may be a source of misunderstandings and confusion. Computers are only machines that, to some extent, should be viewed as fast-acting calculators that can only perform simple operations on binary numbers. Despite the huge successes, scope and scale of their applications, it is not without reason that computers are sometimes called ‘stupid automatons’. It is impossible for any program executed by a computer to become a unit autonomous enough to execute something other than its creator, a computer scientist, originally designed. The success of IT and AI is the success of the creativity of computer scientists, which now needs the support of TRIZ.

After disrupting the traditional format of the TFC 2020 and TFC 2021 conferences, TFC 2022 was provided in a hybrid form, which included seeing each other face-to-face as well as participating online.

Despite the focus on joining TRIZ and IT and AI, other topics typically linked with TRIZ and protagonists of previous TFC editions were still accepted. All 39 papers published in this book were at least triple peer-reviewed by several members of the Scientific Committee, and the authors had the chance to improve their papers based on these reviews before the final decision. The papers were presented during the TRIZ Future Conference 2022, a lively discussion followed the presentation.

August 2022

Robert Nowak
Jerzy Chrzęszcz
Stelian Brad

Organization

General Chair

Jerzy Chrząszcz Warsaw University of Technology, Poland

Scientific Chair

Robert Nowak Warsaw University of Technology, Poland

Program Committee

Stelian Brad Technical University of Cluj-Napoca, Romania
Denis Cavallucci INSA Strasbourg, France
Jerzy Chrząszcz Warsaw University of Technology, Poland
Sebastian Koziółek Wrocław University of Technology, Poland
Pavel Livotov Offenburger University, Germany
Robert Nowak Warsaw University of Technology, Poland
Tomasz Starecki Warsaw University of Technology, Poland
Paweł Wawrzyński Warsaw University of Technology, Poland
Cezary Zieliński Warsaw University of Technology, Poland

Scientific Committee

Rafał Biedrzycki Warsaw University of Technology, Poland
Robert Bembenik Warsaw University of Technology, Poland
Rachid Benmoussa Cadi Ayyad University, Marrakesh, Morocco
Yuri Borgianni Free University of Bozen-Bolzano, Italy
Hicham Chibane INSA Graduate School of Science and Technology of Strasbourg, France
Michał Chwesiuk Warsaw University of Technology, Poland
Marco De Carvalho Universidade Tecnológica Federal do Paraná, Brazil
Roland De Guio INSA Graduate School of Science and Technology of Strasbourg, France
Sébastien Dubois INSA Graduate School of Science and Technology of Strasbourg, France
Oleg Feyngenson International TRIZ Association, Korea
Lorenzo Fiorineschi University of Florence, Italy
Grzegorz Protaziuk Warsaw University of Technology, Poland
Tomasz Gambin Warsaw University of Technology, Poland
Piotr Gawrysiak Warsaw University of Technology, Poland
Hans-Gert Gräbe University of Leipzig, Germany
Maciej Grzenda Warsaw University of Technology, Poland

Claudia Hentschel	Hochschule für Technik und Wirtschaft Berlin, Germany
Mariusz Kaleta	Warsaw University of Technology, Poland
Włodzimierz Kasprzak	Warsaw University of Technology, Poland
Jacek Komorowski	Warsaw University of Technology, Poland
Maciej Ławryńczuk	Warsaw University of Technology, Poland
Lorenzo Maccioni	Free University of Bozen-Bolzano, Italy
Nicolas Maranzana	Ecole Nationale Supérieure d'Arts et Métiers Paris, France
Oliver Mayer	Bayern Innovativ GmbH, Germany
Jacek Misiurewicz	Warsaw University of Technology, Poland
Mieczysław Muraszekiewicz	Warsaw University of Technology, Poland
Toru Nakagawa	Osaka Gakuin University, Japan
Stephane Negny	Toulouse Graduate School of Chemical Materials and Industrial Engineering, France
Piotr Pałka	Warsaw University of Technology, Poland
Valeriy Prushinskiy	Samsung Electronics, Korea
Federico Rotini	University of Florence, Italy
Davide Russo	University of Bergamo, Italy
Dominik Ryżko	Warsaw University of Technology, Poland
Łukasz Skonieczny	Warsaw University of Technology, Poland
Fernando Solano-Donado	Warsaw University of Technology, Poland
Christian Spreafico	University of Bergamo, Italy
Christian Thurnes	Hochschule Kaiserslautern, Germany
Jarosław Turkiewicz	Warsaw University of Technology, Poland
Jacek Wytębowicz	Warsaw University of Technology, Poland

Organizing Committee

Urszula Adamiec	Warsaw University of Technology, Poland
Krystian Chachula	Warsaw University of Technology, Poland
Łukasz Chorchos	Warsaw University of Technology, Poland
Owais Khanday	Warsaw University of Technology, Poland
Gabriela Miączyńska	Warsaw University of Technology, Poland
Farhan Muhammad	Warsaw University of Technology, Poland
Katarzyna Nałęcz-Charkiewicz	Warsaw University of Technology, Poland
Łukasz Neumann	Warsaw University of Technology, Poland
Marek Sieczkowski	Warsaw University of Technology, Poland
Justyna Zgórzak	Warsaw University of Technology, Poland

Partners and Sponsors

Conference Partners

The European TRIZ Association

ETRIA

WWW.ETRIA.EU



**Faculty of Electronics
and Information
Technology**

WARSAW UNIVERSITY OF TECHNOLOGY



Silver Sponsor



PENTACOMP

Contents

New Perspectives of TRIZ

Mathematical Modelling and Formalization of TRIZ: Trimming for Product Design	3
<i>Chris Edward, Jane Labadin, and Narayanan Kulathuramaiyer</i>	
Improving the TRIZ Creative Engineering Methodology to Take into Account the Notion of the Value of the Idea	17
<i>Serge Tremblay and Mickaël Gardoni</i>	
VA++ - The Next Generation of Value Analysis in TRIZ	29
<i>Christian Iniotakis</i>	
Using MBSE for Conflict Managing TRIZ on a Systems Engineering Level	39
<i>Tim Julitz, Manuel Löwer, and Tim Katzwinkel</i>	
TRIZ-Based Approach in Co-creating Virtual Story-Maps	50
<i>Narayanan Kulathuramaiyer and Timothy George Mintu</i>	
Bridging Two Different Domains to Pair Their Inherent Problem-Solution Text Contents: Applications to Quantum Sensing and Biology	61
<i>Nicolas Douard, Ahmed Samet, George Giakos, and Denis Cavallucci</i>	
Inventive Design Solutions for the Complex Socio-technical Problems in Preserving Indigenous Symbolic Visual Communication.	70
<i>Chu Hiang Goh and Narayanan Kulathuramaiyer</i>	
Exploitation of Causal Relation for Automatic Extraction of Contradiction from a Domain-Restricted Patent Corpus	86
<i>Daria Berdyugina and Denis Cavallucci</i>	
Systems, Resources, and Systemic Development in TRIZ.	96
<i>Hans-Gert Gräbe</i>	
The Use of Publicly Available Image Search Engines to Find Solution Ideas Efficient Use of TRIZ Information Resources	109
<i>Jochen Wessner</i>	

Open Inventive Design Method (OIDM-Triz) Approach for the Modeling of Complex Systems and the Resolution of Multidisciplinary Contradictions. Application to the Exploration of Innovative Solutions to Deal with the Climate Change Impacts	121
<i>Amadou Coulibaly, Florence Rudolf, Murielle Ory, Denis Cavallucci, Lucas Bastian, and Julie Gobert</i>	
Market Impact Chain Analysis - MICA, New TRIZ Tool	135
<i>Jerzy Obojski</i>	
Modular Ideality for Systematic Segmentation	145
<i>Marek Mysior</i>	
Hypotheses Analysis as a Development of the System Operator Method Used in TRIZ	154
<i>Marek Mysior and Sebastian Koziol</i>	
AI in Systematic Innovation	
An Interactive Artificial Intelligence System for Inventive Problem-Solving	165
<i>Stelian Brad and Emil Ştetco</i>	
Inventive Principles Extraction in Inventive Design Using Artificial Intelligence Methods	178
<i>Masih Hanifi, Hicham Chibane, Remy Houssin, and Denis Cavallucci</i>	
AI Based Patent Analyzer for Suggesting Solutive Actions and Graphical Triggers During Problem Solving	187
<i>Davide Russo and David Gervasoni</i>	
Automated TRIZ Domain Mapping	198
<i>Guillaume Guarino and Denis Cavallucci</i>	
Systematic Innovations Supporting IT and AI	
Using NLP to Detect Tradeoffs in Employee Reviews	209
<i>Justus Schollmeyer</i>	
TRIZ-Based Approach in Capturing and Managing Indigenous Innovation and Knowledge.	220
<i>Timothy George Mintu, Narayanan Kulathuramaiyer, Franklin George, and John Phoa Chui Leong</i>	
The Potential of Creative Methods for IT Project Management	230
<i>Monika Woźniak and Anna Boratyńska-Sala</i>	

Modeling IT Systems in TRIZ	248
<i>Jerzy Chrzęszcz, Tiziana Bertoncelli, Barbara Gronauer, Oliver Mayer, and Horst Nähler</i>	
Modeling Software in TRIZ	261
<i>Horst Nähler, Barbara Gronauer, Tiziana Bertoncelli, Hartmut Beckmann, Jerzy Chrzęszcz, and Oliver Mayer</i>	
Integration of TRIZ Methodologies into the Digital Product Development Process	273
<i>Vasilii Kaliteevskii, Matvey Bryksin, and Leonid Chechurin</i>	
Lean and TRIZ for Improving the Maintenance Process	285
<i>El Ghalya Laaroussi, El Hassan Irhirane, and Badr Dakkak</i>	
Adoption of Artificial Intelligence in Romania: Innovative Policies to Overpass Vulnerabilities with TRIZ and Deep-Thinking Tools	296
<i>Marin Iuga and Stelian Brad</i>	
TRIZ Applications	
Analysis of Tools Used for Implementation of a Knowledge Base Based on an Ontology for a Service Robot in a Kitchen Environment	315
<i>Grzegorz Kuduk, Maciej Bekas, Barbara Węszowska, and Piotr Pałka</i>	
Combing TRIZ and LCA for a Better Awareness of the Sustainability of a Technical Solution	328
<i>Christian Spreafico, Davide Russo, and Daniele Landi</i>	
Eco-Design Pilot Improvement Based on TRIZ and ASIT Tools	340
<i>R. Benmoussa</i>	
Innovation Portfolio Management: How Can TRIZ Help?	352
<i>Nikhil Shree Phadnis</i>	
Development of an Ontology of Sustainable Eco-friendly Technologies and Products Based on the Inventive Principles of the TRIZ Theory (OntoSustIP) – Research Agenda	367
<i>Claudia Hentschel, Kai Hiltmann, Norbert Huber, Pavel Livotov, Horst T. Nähler, Christian M. Thurnes, and Agata M. Wichowska</i>	
Eco-Feasibility Study and Application of Natural Inventive Principles in Chemical Engineering Design	382
<i>Mas’udah, Pavel Livotov, Sandra Santosa, Arun Prasad Chandra Sekaran, Anang Takwanto, and Agata M. Pachulska</i>	

Focusing the First Phase – An Interdisciplinary Approach to Modeling an Interactive System on the Use-Case Indoor-Blind-Navigation 395
Ken Pierre Kleemann, Nadine Schumann, Veronika Heuten, and Hans-Gert Gräbe

Ideal Final Result for Agriculture: Striving for Sustainability 405
Valery Korotchenya

Analyzing the Role of Human Capital in Strengthening National Innovation System Through University-Industry Research Collaboration: A TRIZ-Based Approach 417
Abeda Muhammad Iqbal, Narayanan Kulathuramaiyer, Anan Shahid Khan, and Johari Abdullah

TRIZ-Based Remodeling of Body Enclosure for Corpse. 429
Ashley Edward Roy Soosay, Muhammad Hamdi Mahmood, Mohd Saiful Bahari, and Narayanan Kulathuramaiyer

TRIZ Education and Ecosystem

WTSP Report (5) Catalogs of TRIZ and Around-TRIZ Sites in the World: We Can Learn Full Scope of TRIZ-Related Works in the World. 443
Toru Nakagawa, Darrell Mann, Michael Orloff, Simon Dewulf, Simon Litvin, and Valeri Souchkov

TRIZ Training Within a Continuous Improvement (Kaizen) Event – Exploration and Evaluation. 458
Tony Tanoyo and Jennifer Harlim

TRIZ Training in Pandemic Time 470
Malgorzata Przymusiala

Author Index 479