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Edited by

V. Cruz Machado
Helena V. G. Navas
Universidade NOVA de Lisboa, Portugal

D. Daniel Sheu
Society of Systematic Innovation (SSI), Taiwan

Faculdade de Ciências e Tecnologia
Universidade NOVA de Lisboa

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Welcome to Lisbon

It is our pleasure to welcome you at the 7th International Conference on Systematic Innovation.

It is our objective to provide a forum for the discussion and dissemination of recent advances in the field of TRIZ Methodology, Knowledge-Based and Systematic Innovation.

The goal is to enable practitioners, researchers and scientists to exchange ideas on the these topics and to provide an international forum for exchanging new ideas and recent achievements by the TRIZ community and enabling further advances and collaboration with the industrial community.

We wish to express our sincere gratitude to the members of the organizing, scientific and technical committees.
The reviewers of the papers had a very important job, contributing significantly to the success of the conference.
We also wish to express our thanks to our invited speakers.
Very special thanks to our students, sponsors and to all who helped us with logistics, conference website, and publications.

Welcome to Portugal and Lisbon. We hope you all have a very happy and rewarding meeting.

V. Cruz Machado
Helena V. G. Navas

The 7th International Conference on Systematic Innovation

TRIZ, the “Theory of Inventive Problem Solving” is a living science and a practical methodology. In the last decades, research has proceeded in several stages. We are assisting to a growing interest on TRIZ especially within the industrial context. Large and small companies worldwide are using TRIZ at many levels to solve problems and to develop strategies for future technologies and products.

The 7th International Conference on Systematic Innovation - ICSI 2016 is organized by the New University of Lisbon and SSI – Society of Systematic Innovation.

ICSI 2016 is the sevenths international gathering of scientists and senior officials of companies interested in the topic of *TRIZ Methodology and Innovation* and its applications, scheduled for July 20-22, 2016 in Lisbon, Portugal. The first conference of this series was held in Hsinchu (Taiwan, in 2010), and the last one took place in Hong Kong in July 2015. These International Conferences on Systematic Innovation resulted from the belief that associated with *TRIZ and innovation* techniques have been making continuous and significant advances during the years. Important and dramatic improvements in systems and component design can be made by the use of the latest advances in Systematic Innovation.

The Conference aims at creating a forum to enable the interchange of research, practice, know-how and experience between industrial companies, research centers, educational organizations, academic institutions, and individuals on systematic innovation. Also we would like to leave words of acknowledgment for the members of the Scientific and the Technical Committees, to Selection Board members for the best project and the best paper, the Secretariat and all those who contributed to the success of the Conference.

The organizers of the International Conference on Systematic Innovation (ICSI) and Global Competition on Systematic Innovation (GCSI) are pleased to present the proceedings of the conference and the Program of Innovative Project Exhibition which includes 68 papers and 11 finalist innovation projects. Author and non-author participants from more than 15 countries will interact in the conference.

Whether the papers included in the proceedings are work-in-progress or finished products, the conference and proceedings offer the authors an opportunity to disseminate the results of their research and receive early feedback from colleagues, without the long waiting associated with publication in peer-reviewed journals. On the other hand, the presentations and the proceedings do not preclude the option of submitting the work in an extended and finished form for publication in any peer-reviewed journal. The organizers are indebted to a number of people who gave their time to make the conference a reality. The list of organizations and working team who have contributed tremendous amount of time and efforts to create this conference are acknowledged at the end of this program brochure. There are more contributors who are beyond the list.

We are confident that you will find the participation in this conference rewarding. If there is anything needing assistance, please feel free to let the attendant(s) at the service desk know. We are here to serve you.

D. Daniel Sheu

Society of Systematic Innovation

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Universidade NOVA de Lisboa

General Co-Chair of ICSI 2016

Helena V. G. Navas

Universidade NOVA de Lisboa

Program Chair of ICSI 2016

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All papers presented at the conference and included in these proceedings have been reviewed by the members of the scientific committee. The organization of the conference wants to thanks the members of this committee for their valuable and important contribution to make possible this conference.

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KEYNOTE PRESENTATIONS (abstracts)

Making TRIZ quick to learn & use, widely applied & popular!

Karen Gadd (Oxford Creativity, UK)

The TRIZ moment is here - TRIZ uniquely offers the world what it is currently demanding. The TRIZ community must seize this opportunity NOW to alert everyone to the power and range of TRIZ Capability. Together we need to get the message across that TRIZ should not be described as a tool, or put alongside trivial innovation techniques or assigned to some corporate creativity toy-box. Our best hope is to get individuals, teams and organisations up and running and using TRIZ fast so they see for themselves it completes all other toolkits and has its power for

- clear thinking
- solving the right problems
- intelligently directing future investment
- smart mobilisation of invaluable on-line knowledge,
- setting research for science and engineering in the right directions
- realising the Circular Economy and achieving real world-saving sustainability

In this keynote I offer the basic approaches which have delivered fast TRIZ successes in my 20 year TRIZ journey. I learned these as I encountered encouragement, enthusiasm and support as well as opposition, indifference, hit many dead ends and endured many disappointments. All of these eventually showed our team how to overcome the difficulties of embedding TRIZ into organisations, universities and business environments. Success in global companies, in many different industries, came from the output of one small TRIZ community which consistently made TRIZ work fast with pragmatic approaches keeping it straightforward and simple and yet rigorous, logical and algorithmic. Despite moving in the opposite direction of many other TRIZ providers we have not changed TRIZ, added or subtracted anything fundamental, but always revealed and shared TRIZ rules and logic with all the teams we worked with. We have delivered TRIZ in action on idea generation, new concepts and products, IP and patents, manufacturing, strategy, business practices, efficiency and cost saving even when tackling the most challenging, intractable and 'unsolvable' problems.
Although making TRIZ more popular is a big challenge – the answer is easy – just show that TRIZ always works, anyone can do it, that it is easy to learn and retain. The TRIZ we offer everyone we work with is adopted everywhere – often without further help from us. From our base in Oxford we succeed with TRIZ in all the environments we encounter – we are embedding TRIZ in large and small companies, in our local government, in Oxford University and our next goal is in schools. It has universal appeal and works in all communities not just engineers - including those whose output involves imagination, creativity and new design.
In my keynote address I will explain our fundamental approaches which deliver: -

- Good communication of 'How to immediately apply the TRIZ Tools & processes always in days (not weeks) of learning the pragmatic tools rather than the theory.
- Solving their own problems fast – we NEVER solve their problems for them (even when we can see the answers) & we have never failed to help teams
- TTT =Tiny TRIZ Tools – quick to learn and apply from the first hour of TRIZ
- Practical TRIZ Problem Solving - learning all TRIZ in simple algorithms and processes – and how to use them immediately on their own problems
- Demystifying TRIZ – with 9 Box approach to see it in context – and see all of it
- Happy teams – knowledge sharing is the heart of TRIZ – it begins with the people closest to you and extends to the whole worl.

Enriching Technology with Ideas from Biology: Systematic Methods for Cross-Domain Knowledge Transfer

Nikolay Bogatyrev (Bio TRIZ, UK)

Biomimetics is a relatively young branch of engineering, which take ideas for technology (and now even for management!) from living nature. Its ultimate aim is to make our life more in harmony with environment we are living in and depend on. A tremendous differences in the way that human economy and living nature function causes a lot of problems in our days. The main obstacle for spreading ideas of bio-inspired innovation is the absence of routine procedures which will guarantee the result. Currently there is no single systematic method for biomimetic design – inspiration, copying and analogical thinking do not give reliable predictable outcomes. Theoretical foundation and methodology for knowledge-transfer between biology and engineering will be presented at the talk. Presented methods and procedures for biomimetic design can potentially work for any cross-disciplinary challenges, making these projects profitable and attractive for business.

The Status and Prospects of Researches and Applications for Systematical Innovation in China

Run-Hua Tan (Hebei University of Technology, China)

The innovation processes in manufacturing enterprises are described in China. The challenges for innovation is that the processes are generally applied but high level innovations are difficult to emerge. The ideation in fuzzy front end, new working principles and new structures, new processes in the new product development are three kind of obstacles. The key step to overcome the obstacles is to introduce creation process into innovation process. We have developed a systematic innovative methods, C-TRIZ, as a knowledge system for creation processes. C-TRIZ is introduced for its four level structures. The implement process of C-TRIZ is also explained, which is a seven-step process model for training engineers for different industries. We have carried out more 60 classes in the past years. Some local governments have organized the local enterprises and their engineers to attend the classes. Government-university-enterprise system for innovation is then formed. In the future the C-TRIZ system will be improved and high level training system will be developed. The government-university-enterprise system will cover more and more regions in China.

SPECIAL INVITED SPEECHS

Innovation Value Chain and Research/Application Roadmap in Systematic Innovation

D. Daniel Sheu (National Tsing Hua University & the Society of Systematic Innovation, Taiwan)

Towards Open Innovation in Excellent Organizations

Hossein Safari (University of Tehran, Iran)

FORUM/PANEL DISCUSSION

Topic: Sustainability issues in systematic innovation

Forum Panellists:

- Diego Pacheco, Federal University of Rio Grande do Sul, Brazil

- Sajjad Nazidizaji, Universidade de Lisboa, Iran

- Hsin Rau, Chung Yuan Christian University, Taiwan

ABSTRACTS

ID 11: New Product Identification and Design through Supersystem Trimming

D. Daniel Sheu and Chia Lin Ho
Department of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan

Most TRIZ (Theory of Inventive Problem Solving) device trimming is used when components within a system are trimmed. This research proposes a novel trimming strategy and process for identifying new product concept by trimming and integrating various systems at supersystem using affinity index and dendrogram. The 9/12-window and Scenario Analysis processes were used to identify potential relevant systems to form a large “virtual” system. Then components of the virtual system are transformed into an integrated system. This integrated system is analyzed using a measurement of affinity, dendrograms, and the TRIZ trimming method. The measurement of affinity is proposed to calculate “tendency” or the ease of integration between components. The affinity relationship matrix is built to manifest the affinity between components in 6 different aspects. Dendrograms are then built to determine the best component set for integration through trimming. The final integrated system will have fewer components than the sum of the components within the original system while maintaining the same main functions. The contributions of the research include: (1) Proposing an integration process for multiple systems to be integrated into a more functional system yet with less-components; (2) Proposing a mathematical technique to assess the likelihood for integration of component groups, assisting users in identifying the priority for trimming. This will also make the trimming process

more objective instead of relying on human individual judgement. (3) Extending the traditional scope of TRIZ trimming from within system to super-system integration and merging.
Keywords: Dendrogram, Multi-system Integration, Systematic Innovation, Trimming, TRIZ.

ID 13: Parameter Manipulations: Unified strategies for Solving Physical Contradictions

D. Daniel Sheu, Rachel Yeh
Dept. of Industrial Engineering & Engineering Management, National Tsing Hua University, Hsinchu, Taiwan 300

Physical contradiction is at the heart of TRIZ contradiction problem solving. The essence of a physical contradiction is that for two objectives, we have two contradictory demands on the same parameter of the same system. As part one of the two-part Parameter Manipulation approach to solve physical contradiction, this paper proposes a systematic new method to solve physical contradictions using the parameter deployment and separation. By defining the Local System to include the components directly at the immediate relevant components of the physical contradiction, the proposed parameter deployment systematically deploys the two objectives and the contradictory parameter into their respective constituent parameters. The essence of parameter separation is to assign the two contradictory requirements, either at the objective level or at the contradictory parameter level, to be satisfied separately by separate constituent parameters or distinct value ranges of a constituent parameter. In this way, the contradiction can be avoided. An accompanying paper will describe the method of using Parameter Transfer to solve a physical contradiction by delegating the issue of satisfying one or both of the contradictory requirements to some parameters of a component seemingly irrelevant to the problem core. The contributions of this research include: 1) Establishing the concept of Parameter deployment and strategy of using it to solve physical contradictions systematically, 2) Addressing the problem at both objective level and the contradictory parameter level producing 6 strategies for solving physical contradictions, 3) Using parameter deployment to identify all possible combinations of separation methods to solve a physical contradiction, 4) Providing standard operational templates for problem-solving process, tool descriptions, and examples for ease of learning and applications, 5) Together with the Parameter Transfer to form a comprehensive 17 problem solving strategies in which all the disconnected existing methods are only parts of this unified theory of parameter manipulation.
Keywords: Physical contradiction, Parameter deployment, parameter Separation, Parameter transfer, TRIZ, Systematic Innovation.

ID 22: Mobius Ring for a Spin Top

Jyhjeng Deng[1*], Youn-Jan Lin[2], Jo-Peng Tsai[3]
[1*]Industrial Engineering and Management Department, Da-Yeh University
[2]Institute of Management, Minghsin University of Science and Technology, Taiwan
[3]Department of Food and Beverage Management, Far East University, Taiwan

A Mobius ring is devised for a spin top to enhance the amount of exercise, and it might be used as a rehabilitation equipment. The function analysis is used to evolve the new design of the spin top from its previous version which is a modern spin top running on two rings attached to a handle held by hand. The function analysis indicates that the handle can be eliminated by transferring its function to the rings. Furthermore, to enhance its maneuver challenge, the two rings are changed to a Mobius ring in which the ordinary Mobius ring is bent twice to make a two circle shape. That way, the Mobius ring is twisted to cause the top moves along the two circles so that it twists along the track. A prototype is developed and tested with certain possible revision on further design.

Keywords: Mobius ring, spin top, function analysis, rehabilitation, twist along the track.

ID 23: An image authentication scheme based on Sudoku

Tzu-Ching Chang, Tzung-Her Chen*
National Chiayi University, Taiwan

Image authentication is a technique used for integrity protection by embedding authentication information into the origin image to form the protected image. If any modification happened on the protected image, the extracted authentication information is used to demonstrate the tampered area happened. In this paper, an image authentication scheme based on Sudoku is proposed by expanding Sudoku to construct a related Sudoku matrix. It is well know that Sudoku has multiple solutions, and each is unique, such that this property is introduced to image authentication, it's difficult for attackers to cheat the user since he didn't know the exactly Sudoku. Image permutation is also applied in this paper to intensify the tamper detection quality. The experimental results show that the tampered area can be detected.
Keywords: image authentication, tampered detection, Sudoku, fragile watermarking

ID 24: Efficient clouding data sharing with signature aggregation

Hang-Yu Lin and Tzung-Her Chen*
National Chiayi University, Taiwan

While cloud computing allows users to store their documents and share the documents with others in the cloud, cloud providers should take the responsibility of data integrity. This paper proposed the clouding data sharing scheme with digital signature well-defined in academia and industrial, achieving the data integrity by signature aggregation. Due to the homomorphic property of signature, the large amount of signatures signed by an owner could be combined into a single signature. Thanks to this design, users download the clouding documents, without the need of the individual signatures of the documents downloaded. Furthermore, a user only needs to verify one signature.
Keywords: Cloud computing, data integrity, signature aggregation, data sharing

ID 26: A Study on the Economic Tool of Innovation

Su-Chen Huang
Department of Finance, Overseas Chinese University, Taiwan

Price elasticity is the most basic concept to be used in assessing the sensitivity of the variation of product's price to cause the corresponding change of quantity (demand quantity or supply quantity). No matter the supplier's price strategy or government's public policy making, its strategic effectiveness is usually highly related to price elasticity. Although price elasticity affects supplier's pricing strategy and the effectiveness of government's public policy, yet the requirement of supplier to analyze, under different supply (demand) price elasticity, the effect of price or other commercial strategies it has adopted, to general public who has not received professional economic analysis course, is very difficult. In order to solve enterprise's dilemma in decision making, a solution is proposed. First, through literature collection, the application of TRIZ and 9 screen diagram is understood, next, through literature collection, supply and demand price elasticity is summarized, database is built, finally, through the use of EXCEL software tool, acomplete set of "economic decision making system" is set up so that the supplier can put the known supply and demand price elasticity into economic model to make correct commercial strategy.
Keywords: Demand price elasticity; supply price elasticity; economy decision making tool; 9 screen diagram; TRIZ.

ID 27: The novel risk analysis requirements in ISO 9001:2015

Filipe Perdigão[(1)], Celeste Jacinto[(1)], Sandra Lopes[(2)], Ana S. Matos[(1)*]
[(1)] UNIDEMI – R&D Unit in Mechanical and Industrial Engineering, Faculty of Science and Technology, Universidade Nova de Lisboa, Portugal
[(2)] Lusosider-Aços Planos SA, Av da Siderurgia Nacional, 2840-075 Aldeia de Paio Pires, Portugal

Scope: The recent 2015 edition of ISO 9001 brings an innovative risk-thinking approach in its new section 6.1. Comparing with previous editions of the standard, the main innovation is the introduction of risk analysis and identification of opportunities within quality management processes.
Objective: The aim of this work is to show how the new requirements can be fulfilled by applying a preliminary analysis to a specific management process. It presents a case-study for future application to all other management processes that are covered by the companies' quality system. The full paper describes a practical application example.
Methods: Two methods were applied, the first was Failure Modes and Effects Analysis (FMEA/FMECA), and the second was Hazard and Operability Study (HAZOP). In the latter case, the authors used the designation QF-HAZOP to highlight the fact that this is a modified version of HAZOP, adapted for the analysis of Quality Functions.
Results: The work covered three vital management functions, including "Maintenance", "Human Resources" and "Sales". In this paper, the last one is thoroughly analyzed and discussed. The methods applied allowed identifying and scrutinizing 23 specific processes (functions) associated with around 60 risk factors (failure modes). After being categorized by risk level (or hierarchy of priorities), these risk factors provided a way for finding improvement opportunities.
Concluding remarks: This work shows that either FMEA/FMECA or the adapted QF-HAZOP constitute useful approaches to fulfill the new requirements of ISO 9001:2015 Quality Standard.
Keywords: FMEA/FMECA, QF-HAZOP, ISO 9001:2015, Risk analysis

ID 28: Developing a Kano-QFDE-TRIZ Model for Transforming Customer Requirements into Innovative Green Product

Yauwseph Tandiono, Hsin Rau*
Department of Industrial and Systems Engineering, Chung Yuan Christian University, Chungli, Taoyuan, Taiwan

In general, for every product, customer requirements are the ultimate judges. But in recent year, environmentally driven demands are rapidly becoming a very important aspect that need to be considered too. Consequently, in order to produce the world-ranking product, customer and environmental information must be grasped accurately and embodied in the portion of product specifications. However, in practice, just merely fulfilling the requirements is not enough to compete in the globalized market. Product developer must have the capability to transform the requirements into an innovative product. For this reason, it is important for business to have a robust, yet simple methodology to assist them in the product development process. Kano's model, QFDE (Quality Function Deployment for Environment) and theory of inventive problem solving (TRIZ) have been widely used to assist product development process. Their usage can separately solve only some of previously mentioned problems. Kano's model can distinguish important customer requirements which bring satisfaction to customer, QFDE can transform customer and environmental requirements into product specifications, and TRIZ can support innovative idea creation and solve technical problems; however, until now no method has been proposed to integrate these three tools in order to solve all of the previously mentioned problems. This paper focuses on the development of a new methodology using a multidisciplinary approach by integrating Kano's model, QFDE, and TRIZ to answer the previously mentioned problems. This methodology consists of a pre-analytical phase and five analytical phases. The pre-analytical phase starts to classify important customer and environmental requirements that have direct effects on the customer satisfaction. In analytical phases 1 and 2, the result from pre-analytical phase serves as an important factor to determine the important engineering metrics (EMs) and components, respectively. In analytical phase 3, the designers will obtain the combination of important engineering metrics and components by using the relational strength data. In analytical phase 4, the best improvement option that can fulfill customer and environmental requirements into product specifications can be obtained. In analytical phase 5, the chosen improvement set is further analyzed to reveal the possible technical problem. Then, using the contradiction matrix from the TRIZ tools, the designer can obtain the possible inventive principle. Each inventive principle is weighted based on the relational strength from each EM with the important components. The most effective technical innovation can be retrieved from the inventive principle with the biggest total weight. In this study, we have a technical innovation in desk lamp as an example to illustrate our methodology. The contribution of this study are as follows. It proposes a new way to integrate Kano's model, QFDE and TRIZ to precisely capture customer and environmental requirements and transform them into product specifications with a robust method to evaluate and select the best inventive principle to generate an innovative result.
Keywords: Environmentally Conscious Design, Kano's Model, Quality Function Deployment for Environment, Systematic Innovation, TRIZ.

ID 29: Using a TRIZ approach to Analyse Consumer Lighting to predict the future of service innovation for a Circular Economy

Merryn Haines-Gadd
University of Brighton & Oxford Creativity

The TRIZ 8 Trends of Evolution is a tried a tested method for assessing the development path of a product or invention, but how can these evolutionary steps be best applied to service innovation? With the world's population expecting to increase to 9 billion by 2050, the economy is predicted to quadruple, creating a greater demand for energy and natural resources. If consumption patterns remain the same and new methods are not introduced there will be a significant impact on the environment. Circular Economy is one solution to this problem, suggesting the radical re-thinking of how we deliver products and services to our consumers, moving us from a linear process to one that is regenerative by design. By shifting the mindset from traditional thinking around ownership and viewing products as providers of performance aims to encourage mutual investment between consumers and manufacturers in products' functions and efficiency over the whole lifecycle. Product Service Systems (PSS) provide a necessary framework to achieve this, and are a key component in a functioning Circular Economy. A theory born of academic research a (PSS) can be defined as convergence or combination of product and services within a system that fulfill a particular customer need or function. These types of business models provide attractive incentives to both companies and consumers recommended not only as a practice for mitigating idle capacity and wasteful patterns of use but also as a vehicle for value creation through continued engagement. Philips Lighting are pioneers in adopting and adapting Circular practice, initially with the implementation of 'light as a service' their Pay-Per-Lux model, developed collaboratively with RAU Architects in Netherlands in 2011 but have yet to fully explore this type of innovation from a business to consumer perspective. The lighting industry is currently under-going a systems shift; a light bulb, once a consumable, is now a long-life product. This is just one example of developments taking place across many other sectors; new technologies, such as the Internet of Things, are creating exciting opportunities for service innovation, challenging designers and researchers not only to be more mindful of lifecycle thinking and durability, but also prompting us to consider how this may influence the way we use and consume products in the future. This scoping study is part of an AHRC funded research collaboration between Philips Lighting and University of Brighton to explore the development of innovative design systems, tools and methods to assist in the transition towards a more Circular Economy. A TRIZ approach was used to firstly, map out the existing lighting systems to uncover the opportunities for innovation development within lighting products and secondly see how the Trends of Technical Evolution could be applied to develop new product developments and services. A 9-Box approach was adopted to ensure that multiple systems were considered: the sub-system - bulb; system - Luminaire and Super System - Connected lighting systems which were then mapped against all the trends to firstly demonstrate the current development. This study was conducted initially by the primary researcher and then validated by experts in the field of TRIZ, lighting design, and innovation processes.
Keywords: TRIZ, Lighting, Trends, Product Service Systems, Circular Economy

ID 33: Kando Story Understanding toward an Attractive Product in the Conceptual Design

Eisuke Saito, Ayano Sato, Shogo Kimura and Hiroshi Hasegawa
College of Systems Engineering and Science, Shibaura Institute of Technology, Japan

Making new ideas is the centerpiece of conceptual design activity. In this activity, to explore one big hit product, over 3,000 ideas are required. Moreover, successful companies provide the highest quality service, by which customers receive satisfaction through a Kando experience. Thus, customer satisfaction through their experience is necessary for greater success in business. Sato and Hasegawa have drawn focus to Kando requirement through Kando experience, and have proposed the Idea Creation Support System (ICSS) including the Kando Understanding Support Process through Word Of Mouth (WOM) communication effectiveness. Kando has been explained as "A mind moves through deep feelings about things" in the Kojien (the most famous Japanese dictionary, published by Iwanami). Sato and Hasegawa have defined Kando in detail using emotional design theory and the Attention Interest Desire Experience Enthusiasm Share (AIDEES) model for consumer behaviour understanding. Therefore, their proposal is that "Kando is generated by the interaction of the behavioural level and the reflective level, when a favourable experience, including a surprise, is greater than a past experience during the re-evaluation process". To gather Kando requirements in Kando understanding process, authors have generated pseudo WOM communication based on World Café methodology on ICSS, and the Kando requirements have been drawn through the Kando element, i.e., a reason of surprise, an element concerning surprise, and an element of past experience as the comparative target of surprised experience on World Café. Moreover, ICSS assessment system has been developed including quality assurance in order to create attractive product ideas—"Are we drawing the Kando requirement for attractive product idea right? " as the verification & "Are we creating the right attractive product idea which inspired Kando in you? " as the validation—based on a V-model with Verification & Validation (V&V). Because ICSS's Kando understanding support process depends heavily on the human mind and emotion. Especially, when its product idea is experienced, it is necessary to predict the implicit Kando story, made by a Kando element and a solution, whether to inspire Kando in advance. However, an accuracy and an easy quality assurance through the implicit Kando story is difficult, even the hybrid estimation method using SD analysis and fNIRS as a bioinstrumentation. In this paper, we propose a Kando story understanding for new ICSS of not expecting the implicit Kando story but drawing the explicit Kando story which can solve needs. World Café in the Kando story understanding process was organized within the following round steps. First, the theme of the discussion was "What is most story which inspired Kando until now?" In Round 1, participants explain their own Kando story using the Show Me Your Values and record an image, episode, and a keyword related to the explained Kando story using sticky notes. In Round 2 to 3, after moving a table, each table host introduces images, episodes, and keywords of the Kando stories obtained in the round, and these items are shared between all the members. Moreover, participants add the remembered and the noticed new things, and carry out the grouping of them. Then, the characteristics of the element which construct a Kando story is summarized through gathering round steps. In final session, Empathy Map is created using the elements summarized in the round 3, i.e., Kando elements and solutions. The theme of the mapping is "Considering the highest Kando story for inspiring this person." Finally, Kando story is written out by analyzing obtained Empathy Map. In this paper, we carried out the Kando story understanding for a bathtub cleaning problem. In order to carry out this problem, the 30 items' needs were extracted from the part-timer of the university co-op, mostly housewife, 42 persons. As a result of performing the Kando story understanding process to these needs, the example of Show Me Your Values in Round 1 and the example of Empathy Map For example, the idea "A thin film peels off when a bathtub wall, which consisted of thin film structures, became dirty" was obtained as the final outcomes by the idea creation through the Kando story understanding process. The Kando story of this idea became "One sheet's skin peeled off! Baby face! Be surprised at the bathtub was born again." Additionally, generated product ideas from three cases of ICSS, new ICSS with explicit Kando story understanding, and non-support thinking were compared. We discuss the results for improvement of Kando story understanding process.

ID 35： Constructing A Structured Innovative Product Design Process By The Integration of Category Classification and Knowledge Effects

Chun-Ming Yang*, Ching-Han Kao, Thu-Hua Liu, and Hsin-Chun Pei
Department of Industrial Design, Ming Chi University of Technology, Taiwan

Successful products are the foundation of any successful business, and the added sales may ensure the sustainability of a company, so product design and development is the foundation of any successful business. A consumer purchase products for their added functional and psychological values, thus the product design must take consumers' emotional needs into consideration; the products' added value also comes from innovation, thus the designers cannot afford being limited by their personal knowledge and experiences. Quick to market at reduced time and cost is the Nirvana of product design. This paper combines Kansei Engineering and the Knowledge Effects to propose a Structured Innovative Product Design Process. Specifically, the category classification of Kansei Engineering is applied to ensure the proper extraction of consumer emotional needs, and Knowledge Effects database of TRIZ is applied to enhance the designer's efficiency and effectiveness in converting these needs to design concepts. The applicability and operability of this proposed design process was tested in this study using graduate students enrolled in Industrial Design as well as an experienced industrial design practitioner. The results indicate that (1) all participants were able to develop satisfactory design concepts using the proposed design process without major difficulty; (2) the effects solutions generated with the help of Knowledge Effects database were rich in variety, which did help designers expand their horizon; (3) participants could easily follow the proposed design process without specific background in TRIZ or

Kansei Engineering; and (4) the general-purpose path map developed by the researchers could help further streamline the process.
Keywords: Category Classification, Knowledge Effects, Product Design and Development Process, TRIZ

ID 36: An Innovative Bio-Inspired Design System With Incorporation of Category Classification and Bio-Database

Chun-Ming Yang*, Ching-Han Kao, Thu-Hua Liu, and Ju-Ying Hung
Department of Industrial Design, Ming Chi University of Technology, Taiwan

Breakthroughs and inspirations in innovative product design and/or problem solving can often take cues from mimicking functions of living organisms and adopting some natural laws that people experience from their environments. However, most of these mimicking or imitating living organism's activities and behaviors are based on past experiences or to take some already-exist "best practices" at their face value and without a standard or systematic design process. Literature review show that previous bio-inspired design processes suffer from being ambiguous, lacking clear and specific procedural steps, lacking adequate databases for solution space, being overly complex, and not being able to provide an organized solution set. This paper proposes a systematic approach to the process of bio-inspired product design conception. An Innovative Bio-Inspired Design System (iBIDS) was constructed using NM (Nakayama Masakuzu) Method – Type T as the basic framework, complete with Category Classification, Biomimicry Taxonomy, and Structural Mapping as tools for implementation. These tools, as well as the framework, were selected to specifically target the aforementioned problems in existing design process in order to produce a feasible, effective, and efficient design process system. As the result of adding structure and appropriate tools to the bio-inspired design process, iBIDS is feasible, easy to use, can reduce process time, and can produce better results. It also opens up opportunities for designers or engineers to benefit from bio-inspired design itself.
Keywords: Biomimicry Taxonomy, Category Classification, NM Method – Type T, Structural Mapping Method

ID 37: Integration of ECQFD and TRIZ for sustainable product design model

Pei-Chun Tsai[1], Pei-Yi Huang[2] , Wan-Lin Hsieh[3*], Yang-Sheng Ou[4]
[123]Department of Industrial Engineering and Enterprise Information, Tunghai University, Taichung, Taiwan

Nowadays, the green-design concept has been implemented in new product development due to the growing consideration of environmental issue. However, it has always been a contradiction between environment-oriented or profit-oriented products. Therefore, this study aims to adopt the model of environmentally conscious quality function deployment (ECQFD) and the theory of inventive problem solving (TRIZ) for creating sustainable and innovative green-design product development process. The voice of the customer (VOC) divided into three dimension are cost, quality and environmental. ECQFD is utilized for transforming customer demand into engineering characteristics, so contradictions may be revealed during the modeling; meanwhile, TRIZ is taken as a tool for generating creativity to solve the contradictions. A case of household baking utensils has been used to examine the approach in this study.
Keywords: Environmentally conscious quality function deployment, Household baking utensils, TRIZ

ID 38: The Innovation Value Chain in Service Industry: the Evidence from Taiwanese hotel industry

Yu-Jie Chou[1], Wan-Lin Hsieh[2*]
[12]Department of Industrial Engineering and Enterprise Information, Tunghai University, Taichung, Taiwan

Nowadays, transportation are more advanced and well developed, and it shortens travelling. Therefore, people can travel from one place to another more easily and the tourism industry becomes blooming, causing more and more hotels developed. . In order to increase competitiveness, hotels try to innovate to attract more customers. This research adopts the model of innovation value chain to discuss relationship between various knowledge sources, innovation activities and firm performance in Taiwan's hotel industry. Innovation value chain (IVC) mainly consists of three parts: knowledge sourcing, innovation activities and firm performance. First, knowledge sourcing model describes various sources, such as suppliers, customers, competitors, universities and research institutions, from which organizations derive knowledge, meanwhile, further investigation on the different effect by foreign and domestic sources. Second, knowledge plays a key role in an organization's innovation activities such as service and marketing innovation. Third, service and marketing innovation lead an organization to greater performance and competitiveness. The survey is sent to all Taiwanese tourist hotel for verification. Statistical and econometric analyses are adopted in this study, to understand the relationships between various knowledge sources, innovation activities and firm performance.
Keywords: Innovation value chain, hotel industry, Taiwan

ID 39: Patent Analysis on Low Flow Detector and Unmeasured Flow Reducer

Jyhjeng Deng[1*], Jo-Peng Tsai[2], Youn-Jan Lin[3]
[1*]Industrial Engineering and Management Department, Da-Yeh University
[2]Department of Food and Beverage Management, Far East University, Taiwan
[3]Institute of Management, Minghsin University of Science and Technology, Taiwan

Patents WO2006/134593 and WO2004/025229 from Water Flow Tech and A.R.I. respectively will be discussed separately. These two patents tackle the measuring problem of low volume fluid flow which is an important issue for water supply companies. In the article, the function, way, result of these patents will be discussed in the extended abstracts. The result and function of these two patents are the same which are to minimize measurement errors with a conventional flow meter and to accumulate water and release it in a pulsating way at low volume flow, respectively. However, their ways are different. The way for WO2006/134593 is to use a magnetic valve, whereas for WO2004/025229, a pressure responsive sealing assembly is placed in a control chamber to control the fluid flow.
Keywords: Function, way, result, minimize measurement error, low volume fluid flow.

ID 40: Altice Labs – Building a Long Lasting Systematic Innovation Ecosystem

Monteiro, Ana Patrícia Marques da Fonseca; Carvalho, Pedro Luís Pires; Seixas, Nuno Alexandre Martins
Altice Labs, Portugal

Taking into account that innovation is “the act that endows existent resources (people and process) with a new capacity to create wealth” , it is now – more than ever before - absolutely mandatory to make sure that it is achieved through a consistent, systematic, day by day approach. Therefore, in this paper we will describe the historical evolution that was endured by this organization, which turned up being Altice Labs today. At its genesis it was first the GECA (Grupo Especial de Comutação Automática – Automatic Switching Task Force) which later became the CET – Centro de Estudos de Telecomunicações (Center for Studies in Telecommunications), which represented an – at the time typical - Research & Development (R&D) unit for a specific telecommunications’ operator. In this unit and throughout the times, the innovation process followed a typical path: Idea -> R&D -> Production -> Distribution -> Benefits, which was mainly performed in a closed and internal loop, ending up giving more and more strength to the “not invented here” syndrome. From this approach, and given that the organization started realizing some lack of interdisciplinary and inter-organizational feedback, it started, slowly but progressively, to open new points of contact and new sources of knowledge, mainly based on universities and other RDI centers, which are, by excellence, the major sources of exploratory innovation. In 1999, with CET becoming an independent company within the PT group – named PT Inovação, as it gained greater autonomy also in terms of innovation management, a different approach was put in place, with its main focus being the establishment of collaboration bridges with other entities, namely, external market, industrial and technological partners – all the industrial, scientific and technological system. Because of the competitive market characteristic and the competitors’ new capabilities, the “not invented here” approach was deemed insufficient, which led to specific strategic partnerships, which not only aimed at establishing technological interfaces but also the market interface. By monitoring and addressing these two interfaces (Market and Science/Technology) along with the realization that all the collected and generated knowledge should be organized and optimized, the organization understood that it needed to organize and grow its own resources’ competences and capabilities in order to achieve innovation. And it was based in that understanding that we arrived at the current state of innovation management system, built and grown on top of constant and permanent interactions with the 3 interfaces: Science/technology, organization and market. For each of these 3 interfaces, several players and stakeholders are identified and addressed, giving Altice Labs its much needed knowledge, skills and competences to achieve innovation. After presenting some of the historical steps, this paper will also address the difficulties that this transformational process brought, making it possible to evolve from a traditional to a more innovative organization. It will also be presented how this transformation affected everyone in the organization, from operational to management and support teams. Also, it will make clear that all this process was possible because of the involvement of everyone, making each one part of the transformation process and, ultimately, part of the innovation process. Finally, we would like to emphasize that the major difficulty in organizational innovation is not doing it once but rather doing it in a systematic and repeatable manner, something we would like to call “our Long Lasting Systematic Innovation Ecosystem”.
Keywords: innovation, systematic innovation, iterative process, team work.

ID 41: The unexpected contribution of design thinking to technology transfer activities

Sofia Dinis Esteves
Industrial Engineering Department, NOVA University of Lisbon

On a first sight, design thinking, which is defined as a method of meeting people’s needs and desires in a technologically feasible and strategically viable way (Brown, 2009), can be interpreted by having little or no application on a typical technology transfer process, where technology is on the spotlight and its the promoter of a market application and a new business opportunity. In other words, while the most common technology transfer processes are triggered by the development of a new technology that, after on, searches for available marketplaces where it generates value; design thinking methodology has

human problems or opportunities as the starting point to generate, develop and test ideas that will further be implemented in the most viable way. Thus, it is understandable that design thinking have been mostly applied to product and service development, not having had, theretofore, application to scientific and technical research or technology transfer activities. However, if we look closely to the main challenges on technology transfer and commercialisation we will find, among other issues, a lack of market knowledge and understanding which leaves a lot of technologies with no or few applications on the market place. This is considered to be a big problem because it reduces the potential return on investment derived from R&D activities that will struggle to turn on innovative products, processes or services with the so expected social-economic
benefit. Being design thinking a methodology which by essence masters on customers/users understanding, this method have a lot of potential to be applied on technology commercialisation activities and to soften some of the existing challenges.
On this paper we analyse each stage of technology commercialisation, and explore the main drivers of design thinking, in order to demonstrate all the possible applications of this human-centred methodology on technology commercialisation activities, as well as, comment on its benefits. Main findings show that the empathetic and explorative methodology of design thinking can be very helpful to unveil less obvious market applications, as well as, bring a better understanding on market dynamics, which will dictate the acceptance of a new technology.
Keywords: design thinking, technology commercialisation, technology transfer, value creation.

ID 42: Investor Groups' Perceptions of Ecosystem Builders in European Startup Ecosystems

André Águeda[1], Aneesh Zutshi[2], António Grilo[3], Virgílio Cruz-Machado[4]
UNIDEMI, Faculdade de Ciências e Tecnologia da Universidade NOVA de Lisboa, Portugal

Throughout recent history entrepreneurship has gradually become a vital element of modern societies. As highlighted by several researchers, SMEs and entrepreneurs play a crucial role in all economies, being inclusively hailed as the sole source of new net job growth over the last 28 years in the U.S.A. This escalation in the importance of entrepreneurship in the world economies has led governments to start shifting from traditional enterprise policies to growth-oriented enterprise policies, in order to promote the creation of favorable environments for business startups to thrive (Mason & Brown, 2014). While creating supportive framework conditions alone is insufficient to drive the promotion of entrepreneurship (Mason & Brown, 2014), nowadays it's possible to witness a conjugation of factors which, combined with appropriate approaches to the entrepreneurial ecosystem, explain today's entrepreneurial explosion on the global scene (Herrmann et al., 2015). According to Steve Blank (2013), there are four key factors which explain the current startup burst:
1) Startups can now be built for thousands, rather than millions of dollars;
2) Access to financing has decentralized from its clusters and expanded worldwide;
3) Entrepreneurship developed its own management science and tools;
4) Speed of consumer adoption of new technology has increased.
As a significant part of the global economic future lies on the performance of high-growth firms, society must be prepared to nurture entrepreneurs and support the growth of startups through their development stages. While several approaches to support new ventures have been attempted, most proved to be of limited effectiveness (Herrmann et al., 2015). Currently however, several researchers (Neck et al., 2004; Isenberg, 2011; Mason & Brown, 2014; Herrmann ate al., 2015) have to come recognize the importance of supporting entrepreneurial ecosystems as whole, in order to better provide support to entrepreneurs and startups. In the last few years Europe has been showing considerable commitment about promoting innovation and sustainable growth within its region, putting great efforts in developing supportive entrepreneurial ecosystems that encourage innovation, research and development, and entrepreneurship (European Commission). Such commitment can be verified by the implementation of supportive programs like Horizon 2020, which aim to encourage the development of new ideas and businesses through the providence of financial support to entrepreneurs and companies. Similarly to the funding, many other variables within an entrepreneurial ecosystem play equally crucial roles to the entrepreneurial success of a region. Being comprised by a diversity of actors, roles, and environmental factors that interact to determine the entrepreneurial performance of a region, entrepreneurial ecosystems are dynamic, and complex systems that need careful assessment by policy-makers, both at a micro and at a macro level, when developing regional initiatives dedicated to foster entrepreneurship. This paper aims to provide some insights about entrepreneurial ecosystems at a micro level, by focusing on two ecosystem actors which we regard as being extremely pertinent to the success of new ventures: ecosystem builders and investor groups. Focusing on the relationship between these two ecosystem actors, we aim to understand the interconnectivity between ecosystem builders and investor groups, and how they interact with each other to create value to the community. This study is based on a literature review to startup ecosystems and ecosystem actors, as well as on an empirical study to a population of 25 investor groups located in Portugal, U.K. and Germany.
Keywords: Entrepreneurship, Ecosystem Builders, Investor Groups, European Startup Ecosystems

ID 43: Using Systematic Innovation Techniques to find Solutions for the impact of Distance Education on Higher Education in Taiwan

Hsia, Tai-Chang[1*], Chen, Ya-Wei[2], Huang, Su-Chen[3]
[1,2*] Graduate Institute of Services and Technology Management, Chienkuo Technology University, Changhua, Taiwan, R.O.C.
[3]Department of Finance, Overseas Chinese University, Taichung, Taiwan, R.O.C

This study employs Michael E. Porter's Five Forces Model and TRIZ-based systematic innovation methodology to analyze the competitiveness of distance education in conventional education in Taiwan. First, this study discusses the competitiveness of Taiwan's distance education and conventional education industries based on Porter's Five Forces Model. Second, this study explores the influence of distance education on conventional education in Taiwan. Third, this study applies the TRIZ-based systematic innovation methodology to analyze the effect of distance education on conventional education in Taiwan and search for solutions. Finally, based on the solutions, this study incorporates distance education into conventional education to meet learners' needs and improve the competitiveness of Taiwan's distance education in higher education.
Keywords: Porter's Five Forces Model; conventional education; distance education; competitveness of industries

ID 44: Eco-Innovation and Knowledge Management: Towards Systematic Sustainable Innovation

Maria do Rosário Cabrita, Helena Carvalho, Virgínia Machado, Ana Paula Barroso, Virgílio Cruz-Machado
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Science and Technology, FCT, Universidade Nova de Lisboa, Lisboa, Portugal

In a Knowledge Economy (KE) competitiveness is strictly linked to the efficient acquisition and application of knowledge. Innovation is as a process wherein knowledge is acquired, shared and used to create new knowledge, which embodies products and services. When innovation aims to minimize the environmental impact of products/services, it is called eco-innovation. Although still a fuzzy concept, eco-innovation plays a central topic in integrating sustainability issues into economic process. Knowledge Management (KM) ensures that knowledge is used effectively and efficiently which makes KM a valuable tool for leveraging the eco-innovation potential of organizations. It is vital to identify KM practices that stimulate and leverage "green knowledge", which aims to improve organizations' eco-innovator performance. This green knowledge base intends to support the search for practices and strategies of sustainability and forms the foundation of greener performance trajectories. Today, environmental activities are increasingly seen as potential source of competitive advantage, and organizations are central to the solution of environmental problem because they play a key role in the innovation process. KM deals with the acquisition, development, distribution, utilization and retention of organizational knowledge to improve the operation effectiveness and competitive advantage of an organization. This paper seeks to outline the theoretical framework for systematic sustainable innovation, integrating two complementary areas of organizational knowledge: eco-innovation and KM. Based on the literature the concepts of eco-innovation and KM practices will be explored. In its approach, the paper points to the need of linking up the concept of eco-innovation to knowledge-based processes. We believe that this work contributes to building eco-innovation theory, providing the basis for discussion on systematic sustainable innovation.
Keywords: Eco-innovation, knowledge management, green knowledge, green performance.

ID 45: Group Decision Making on Evaluating the relative Importance of Disaster Rescue Mechanical Devices

*Wei-Fang Chen, Tsung-Yin Wang
Department of Mechanical Engineering, Far East University, Taiwan

Selection of the right disaster rescue mechanical devices has become a more important decision for the firefighters facing the diverse and choppy disaster scenarios. Moreover, the disaster rescue device has evolved due to adoption of new technology. Therefore, it is inevitable for firefighters to select or purchase the proper assistant tools to effectively and efficiently achieve their missions. This paper presents the procedures of a group decision making method for evaluating the relative importance of different disaster rescue mechanical devices for water region accidents, earthquake disasters and fire accidents. In this paper, we adopt the analytic hierarchy process (AHP) method to conduct this research. By way of consulting experts with abundant experience along with literature survey, a theoretical AHP model was established. Subjects of the AHP questionnaire in this paper were some senior firefighters in Xinshi District, Tainan City, Taiwan. This method proposed in this paper is generic and it can be modified for the selection of other disaster rescue mechanical devices for other regions based on the specific conditions. Also, it is hoped that the results of this research can provide a reference for the purchase or development of disaster rescue mechanical devices.
Keywords: Disaster Rescue Mechanical Equipment, Analytic Hierarchy Process (AHP), Multi-Criteria Decision Making (MCDM), Firefighter

ID 46: Systematic Mold Flow Analysis for Propeller Blade

*Wei-Fang Chen, Tsung-Yin Wang
Department of Mechanical Engineering, Far East University, Taiwan

Today's plastic products have been widely used in daily life, like the shell of the locomotive, car bumpers, lights, connectors, mobile phone housing, shell of LCD screen, and many plastic products. The above products are mostly completed by the

injection molding process products. However, in order to ensure the product a good quality, it is necessary to conduct a computer-assisted simulation prior to the following manufacturing process. In this paper, we adopt mold flow analysis software to systematically analyze a propeller blade product. A detailed process was used to illustrate the endeavors of this work. The result showed an effective improvement on deformation by way of adequate modifications of input parameters. Moreover, the production efficiency was also raised because of the reduced cooling time.
Keywords: Propeller Blades, Computer-Assisted Simulation, Mold Flow Analysis, Systematic Analysis.

ID 47: Integrating Systematic Innovation Method and Industry 4.0-based Concepts on the Problem Analysis and Opportunity Identification of Fastener Industry

Jo-Peng Tsai[1], Jyhjeng Deng[2], Youn-Jan Lin[3] and Terry Shih-Chuan Cheng[4,*]
[1] Department of Food and Beverage Management, Far East University, Taiwan
[2] Industrial Engineering and Management Department, Da-Yeh University, Taiwan
[3] Institute of Management, Minghsin University of Science and Technology, Taiwan
[4,*] Department of Mechanical Engineering, National Cheng Kung University, Taiwan

Screw manufacturing industry is an important industry in Taiwan. In 2015, Taiwan is one of the three largest fastener exporting countries in the world. The export quantity was 1.57 million metric tones. The exporting value was 2.8 billion US dollars. Many of the leading factories are capable of manufacturing massive quantities. However, as the global economic growth slows down recently, customers do not want to keep large inventory in the warehouse. As the batch quantity reduces, the production lines need to be adapted. Many problems will arise due to small batch quantity. In order to adapt to new order tends, we have to use Industry 4.0 concepts to quickly respond to the changing demands. As we solve the problems, we will find new business opportunities. In this paper, we use a systematic innovation approach to demonstrated how to find problems when applying Industry 4.0 concepts. Then we use TRIZ problem solving tools to solve the problems and suggests a new business model. The research processes in this paper are problem definition, Function Analysis and 40 inventive principles. In this paper, we showed systematic innovation approach of opportunity identification with a case study on a suggestion to new business model for tooling shops. The procedures we proposed in the paper can be used as general opportunity identification procedures. Therefore, it contributes a feasible reference method to search for a new business model in fastener industry or other industries.
Keywords: Systematic Innovation, Industry 4.0, Opportunity Identification, Fastener Industry.

ID 50: Understanding in what way TRIZ is used: a Portuguese reality

Anabela C. Alves[1], Celina P. Leão[1], Laura C. Maia[1], Helena V. G. Navas[2]
[1]ALGORITMI, Department of Production and Systems, School of Engineering, University of Minho, 4800-058 Guimarães, Portugal
[2]UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal

TRIZ is a methodology that promotes systematic innovation through its principles and tools. At the same time, it is a methodology that well-fitted with others methodologies already in many companies such as Lean Production. TRIZ support continuous improvement efforts of Lean companies by helping to design and develop nature-friendly products and saving resources (energy, raw material, water). Even so, few companies in Portugal know this methodology or are aware of its strength. With the Industry 4.0 at our doors, it is crucial to have the knowledge of this kind of methodologies. Additionally, it is compulsory for the new engineers to acquire competences on these. This paper objective, based on a content analysis (papers, case studies, projects, master dissertations and/or similar) that described works developed in Portugal, is to identify Portuguese reality of using TRZ methodology. The collected data will be coded into categories according to the type of work developed (academic or in an industrial environment), the company where the project was developed, the type of the approach to the problem (just using TRIZ or combining TRIZ and Lean), the TRIZ and/or Lean principles and tools used, the problem solved and/or project developed. Based on the results, the authors want to systematize the TRIZ use Portuguese reality and infer about the enablers and barriers to TRIZ use.
Keywords: Content analysis, Lean Production, Systematic innovation, TRIZ.

ID 51: Case Study of Relative Importance Perception on Firefighting Service Missions with AHP Method

Jo-Peng Tsai[1], San-Tsan Hung[1], Jyhjeng Deng[2], Tsung-Yin Wang[3], Youn-Jan Lin[4,*]
[1] Department of Food and Beverage Management, Far East University, Taiwan
[2] Industrial Engineering and Management Department, Da-Yeh University, Taiwan
[3] Department of Mechanical Engineering, Far East University, Taiwan
[4,*]Institute of Management, Minghsin University of Science and Technology, Taiwan

The firefighting service missions have become more complex and diverse due to the intense desire of citizenry in current democratic society. To realize the relative importance perceptions on firefighting service missions will be helpful for improve the service quality and raise the satisfactory degree for firefighting service units. Moreover, it is useful as a reference to allocate rational human and equipment resources for the administrative government units. In this paper, we presented the procedures of a multi-criteria decision making method for evaluating the relative importance perceptions of different firefighting service missions such as disaster rescue, emergent aid and care, guidance of fire accident prevention and miscellaneous citizen service. We adopt the analytic hierarchy process (AHP) method to conduct this research. We invite the heads of a subdivision district at Xinshi District, Tainan City, Taiwan as the subjects of the AHP questionnaire as they have the abundant service experience for the citizen's affairs. The research method and results in this paper provide a useful reference and base for administrative government units to allocate reasonable resources and for firefighting service unit to realize the citizen's perception on the diverse firefighting service missions.
Keywords: Firefighting Service Missions, Analytic Hierarchy Process (AHP), Service Quality, Resource Allocation.

ID 52: Causal Effect Perspective on Evaluation of the Best Innovative Business Model for Grilled Chicken Shops

Jo-Peng Tsai[1,*], Yu-Gang Chen[2], San-Tsan Hung[1], Ching-Fen Huang[2]
[1] Department of Food and Beverage Management, Far East University, Taiwan
[2] Department of Innovative Design & Entrepreneurship Management, Far East University, Taiwan

The research on developing innovative business models has become more important due to the severe competition of the food and beverage industry in Taiwan. However, at present there are few studies on this research domain. In this paper, three innovative business models for grilled chicken shops derived from morphological matrix and field research were used as three candidates for the selection of the best innovative business model for grilled chicken shops. We adopted analytic hierarchy analysis (AHP) method as the evaluation method. The evaluation criteria for selecting the best business model is based on a causal effect perspective including cannibalization for current neighbor shops, entry barrier of potential competitors and possibility of customer's return. This paper illustrates the procedures such as criteria selection, construction of AHP model, questionnaire design, survey for the experts' opinions and data analysis. The contribution of this paper is that it provides an innovative perspective and practical method to explore the entrepreneurship management of the new business model development.
Keywords: Business Model, Causal Effect Perspective, Entrepreneurship Management, Analytic Hierarchy Process (AHP).

ID 53: Use of Presumptions of Neuro Linguist Programming to Keep an Innovation Mindset

Shan-Yang Wang[1], Tzu-Chiang Chiang[2], Shwi-Chun Wang[3]
[1]Department of Computer Science & Information Engineering, Far-East University, Taiwan
[2]Department of Information Management, Tunghai University, Taiwan
[3]Department of Information Management, Fooyin University, Taiwan

The innovation process begins with the goal to create strategic advantage in the marketplace. To get an ideal product need lots of brain effort, and failure cause the innovators to feel frustration. TRIZ help people create good products, but it can not help people eliminate unpleasant feeling, however Neuro Linguist Programming can. In this paper, presumptions of Neuro Linguist Programming are introduced to help keep an innovation mindset. An innovation process with TRIZ and NLP can help innovators to create good products with pleasant mood, and get better results.
Keywords: NLP, Neuro Linguist Programming, TRIZ.

ID 54: A Method and the Process Model of Functionality Innovative Design for Product Development

Jiangnan, Liu[1*], Weijian, Lu[2]
HNU College of Mechanical and Vehicle Engineering, China

Facing fierce competition of the market, companies are increasingly interested in developing new products or increasing the functionality of their products to attract customers. For the designer, methodologies and tools play a central role in creating new functionality of the product. However, some of the accessible methods at the present either pay attention only to the voice of customers or focus on analyzing the important degree of customer requirements and product functions. Conversely, others rely solely on the way of thinking of designers. Most of available tools serve to determine which aspect of the product needs to be improved rather than how the designer can improve it. Even when motivated to design for a new function, the designers are unsure exactly how to proceed. In this paper, three approaches to functional design for new products were suggested. Based on KANO model, the approach guides designers to dig for customers' surprised and satisfied needs by analyzing the categories of customer requirements. Corresponding to these needs, the major function of the product are defined. The hands-on approach,

based on user experience design, leads designers to expand functionalities of the product by paying attention to the personal feelings and suggestions. Based on Benchmarking and Feature Transfer of modern TRIZ, the approach helps designers transfer functions from existed competing systems to the new system and refine the functions of the product. According to the hierarchy of function, a process model of product functional design was presented, which using these approaches to implement function innovation. The innovative design of a contest device demonstrated the usage reveals that the model has an orderly structural layer and leads function refinement step by step. This research proposes a generic method to develop functions of the product during design, which provide high efficient operating procedures and avoiding relying on random thoughts, intuition or personal experience.

Keywords: Function innovation · Feature transfer · KANO model · Process model

ID 55: Application of TRIZ on improving the protective shell of mobile phone

Pei-His Liu[1*], Chih-Min Cheng[2], Feng-Ling Lin[3]
Department of Industrial Engineering and Management ,National Chin-Yi University of Technology, Taiwan

On the basis of survey data from FIND of Institute for Information Industry in 2014, The viewing habits of people to watch video, has been transferred from TV to mobile devices. The survey pointed out that Taiwanese smartphone accounted for 58.7 percent of the population, collocation number up to 12.25 million people. And more than about half of these smart devices holder will watch video programs on the device. Therefore, The use of smart phones with headset market is in great demand. There are two reasons for using smart phones with headset : First, to avoid the influence of others , Second, to avoid interference to achieve a better sound. In this study, TRIZ systemic innovation theory and problem solving methods can be used to design a mobile phone protective shell with a headphone storage function. Headphone user can use it in the most convenient situations.
Keywords: mobil phone, headphone storage function, protective shell, TRIZ

ID 57: Resource and Energy Efficiency for Process Industries – the MAESTRI Project

Marco Antonio Medina Estrela; Eduardo João Silva
ISQ, Portugal

The MAESTRI project aims to contribute to the implementation of sustainability in European manufacturing and process industries, by providing a management system, in the form flexible and scalable platform, to promote and simplify the implementation of an innovative Efficiency Framework, the “Total Efficiency Framework”. The overall aim of the Total Efficiency Framework is to promote improvement culture within process industries by assisting decision-making process, supporting the development of improvement strategies and helping on the definition of priorities to improve the company's environmental and economic performance. Its development and validation will be achieved through its implementation in 4 real industrial settings across a variety of activity sectors. The Total Efficiency Framework concept will be based on four main pillars to overcome the current barriers and promote sustainable improvements: a) an effective Management System targeted for process and continuous improvement; b) Efficiency assessment tools to define improvement and optimisation strategies and support decision making process; c) integration with Industrial Symbiosis concept focusing material and energy exchange; d) a software Platform, based on “Internet of Things” concept, to simplify the concept implementation and ensure an integrated control of improvement process. Over a period of 4 years, the project aims to reach a wide range of relevant exploitable results, which can be mainly clustered into technological outputs, including eco-innovative products, processes and services tailored to industrial end-users; and structured solutions - involving technical, economical, legislative and policy solutions synergistically combined.
Keywords: Eco-efficiency, Industrial Symbiosis, Internet of Things, Management System, Total Efficiency Framework.

ID 59: The use of DFSS Tool / Design for Six Sigma in the Innovative Process of New Product Development: A Case Study

Sara Martins[1], Ana Dias[1], Helena Navas[2]
[1] ADEM, Departmental Area of Mechanical Engineering of Superior Institute of Engineering of Lisbon, Instituto Politécnico de Lisboa, Portugal
[2] UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade Nova de Lisboa, Portugal

The Six Sigma (SS) methodology is being widely used as a quality management model. Focusing on "Zero Defects" production, the tool that support New Products Development (NPD) used in the planning phases which precedes manufacturing is Design For Six Sigma (DFSS) methodology, suitable for production processes with SS requirement. There is a contradictory question regarding the differences and complementarities between DFSS tool and the SS methodology: to conclude about what is the best strategic decision by two companies, in which one uses the SS and the other uses the DFSS; else more, if it would be a competitor at a higher level with regard to the experience and knowledge, by using both. The case study indicates that given the

intrinsic characteristics of the company, common to other Portuguese Small, Medium Enterprises (SMEs), it is clear that the use of DFSS tool turns out to be the most effective, especially when the client is a big company.
Keywords: New Products Development; Six Sigma; Design for Six Sigma; Case Study

ID 60: The use of the theory of inventive problem solving (TRIZ) method in NPD processes: A Case Study

Nuno Guerreiro[1], Ana Dias[1], Helena Navas[2], Inês Pombo[3]
[1]ADEM, Departmental Area of Mechanical Engineering,Superior Institute of Engineering of Lisbon - ISEL, Instituto Politécnico de Lisboa, Portugal
[2]UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Tecnology, Universidade Nova de Lisboa, Portugal
[3]Sandometal – Metalomecânica e Ar Condicionado, S.A., Portugal

The theory of inventive problem solving or TRIZ is a modern innovative tool used to systematize the creative process decreasing the trial-and-error method. It's based on a large list of innovative principles and solutions that can be applied in new product (or process) development. This paper presents the methodology for the preparation of TRIZ in different fields that this can emerge applying the instrumental tools proposed for three levels of innovation according to Altshuller – the contradictions matrix, the substance - field method (S-Field) and the algorithm of inventive problems solving (ARIZ). This tool is also capable of interact with other innovative procedures like Axiomatic Project, that will be shown in this paper. The Axiomatic Project is a methodological tool that sintetizes tools decomposing in functional requirements and design parameters. For assembling the information is presented a case study of TRIZ application in the Sandometal's organizational process. This case study shows perfectly how TRIZ methodology can be applied and present good results on industrial companies inserted in markets increasingly demanding, dynamic and challenging, as they are nowadays.
Keywords: Axiomatic Design; Case Study; New Product Development; TRIZ.

ID 61: Case Studies in TRIZ: A Clothes Horse

Shan-Yang Wang[1], Tzu-Chiang Chiang[2], Shwi-Chun Wang[3]
[1]Department of Computer Science & Information Engineering, Far-East University, Taiwan
[2]Department of Information Management, Tunghai University, Taiwan
[3]Department of Information Management, Fooyin University, Taiwan

People are always busy in working from day to night. They do not have time to do regular work like putting clothes on clothes horse to dry it under sun. If a device can help people dry clothes automatically, it is very useful. In this paper, a climate-controlled clothes horse is introduced. It can automatically dry the clothes when sun is strong, and take clothes in when it is raining. TRIZ tools, including 40 inventive principles and contradiction matrix, help design the device. The product can save people time to let people do some more valuable work.
Keywords: Clothes Horse, TRIZ

ID 62: Applying Functional Analysis and Inventive Standards to Deal with Problem that Teacher poorly controls Students

Youn-Jan Lin[1], Jyhjeng Deng[2], Jo-Peng Tsai[3*]
There are rarely a paper about apply Functional Analysis and Inventive Standards to deal with a teaching problem that teacher poorly controls students in class. In this paper, we try to use TRIZ-based tools to deal with this problem. We use Functional Analysis and Inventive Standards to deal with this problem. Through the use of Functional Analysis and Binary Problems Ranking, we find the problem that the teacher poorly controls students is the most important problem in this case study. Then, we use Inventive Standards for Business and Management Applications method- Group 3, to improve poorly controllable effect of an interaction, and generated 4 ideas. Subsequently, we use multi-criteria decision matrix and estimating time to implement comparison and evaluation on these 4 ideas. Finally, we find the best idea is make students to do group discussion on case study and report the discussion result.
Keywords: Business and Management, Functional Analysis, Inventive Standards, Multi-Criteria Decision Matrix, Improving Poorly Controlled Students

ID 63: TRIZ and MACBETH in Chemical Process Engineering

Isabel Maria João,[a,b] João Miguel Silva[a,c]

[a] ISEL – Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa; [b] CEG-IST, Instituto Superior Técnico, Universidade de Lisboa; [c] CATHPRO-CQE, Instituto Superior Técnico, Universidade de Lisboa, Portugal

The Chemical Process Industry (CPI) is facing an increasing pressure to develop new or improved chemical processes. The major challenges experienced by CPI is related with sustainability namely economic, social and environmental issues reason why innovation in chemical process design is becoming more challenging. However innovative chemical process design needs the support of a systematic innovation approach to guide engineers in the creation of new or improved chemical processes. The objective of this work is to present an approach that integrates the theory of inventive problem solving (TRIZ) and a multicriteria decision aid method MACBETH for the selection of an innovative process among different process concepts. The objective is to establish a systematic innovation approach to assist engineers or decision makers through the idea generation method of TRIZ and the use of MACBETH to perform the selection of the best-generated concept. The selection of the best concept alternative under many criteria is a multicriteria decision problem which can be solved with MACBETH approach which is a multicriteria decision analysis approach that requires only qualitative judgements about differences of value to help an individual or a group to quantify the relative attractiveness of options. The use of an integrated approach in chemical process improvement may increase the efficiency of concept selection avoiding time waste. An illustration is presented in order to show the simplicity and applicability of the approach.
Keywords: Theory of inventive problem-solving (TRIZ), M-MACBETH, innovative process, chemical process engineering

ID 64: A Tool to Assign Weights to Customer Requirements in QFD for Service Industries

Isabel Maria João,[a,b] João Miguel Silva[a,c]
[a] ISEL – Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa; [b] CEG-IST, Instituto Superior Técnico, Universidade de Lisboa; [c] CATHPRO-CQE, Instituto Superior Técnico, Universidade de Lisboa, Portugal

Nowadays business cannot afford to waste its limited time, human resources, and money on services that customers do not want or need reason why modern quality systems move beyond eliminating poor service to maximize positive quality (e.g. enjoyable, luxurious, comfortable services) creating value. QFD focuses on delivering value by seeking out both spoken and unspoken needs and translating the customer requirements into actionable services and communicating these through the organization. Further, QFD allows customers to prioritize their needs and directs the organization in optimizing those features of the service that will bring the greatest competitive advantage. The problem of determining the value to assign to the weight of each customer requirement is particularly important in QFD. The traditional QFD methodology evaluates the importance of customer requirements applying methods of direct attribution of weights. Such procedure can become arbitrary in those situations where the customers are not able to give significant evaluation of their requirements and their preference system is not explicitly known. The results of this forcing can lead to a distortion of the design process and the development of products or services that do not match the customer needs and expectations. We propose a tool that makes use of a modelling approach based on an ordinal regression method with dummy variable regression in order to prioritize customers' needs that overcomes the problems of direct attribution of weights. The method also has the advantage of deriving the customers' requirements weights based on the shape of the value functions. The simplicity of the method as well as its advantages in the calculation of the customers´ prioritization of the requirements makes it a good candidate to use in combination with the QFD methodology. The straightforwardness of the modelling approach as well as the advantages of the method in the calculation of the customers' prioritization of the requirements is pointed out with an example of a service industry.
Keywords: Quality Function Deployment (QFD), ordinal regression, dummy variable regression, customer requirements

ID 65: Persistence of Innovative activities in the context of a moderate innovator

Joana Costa
DEGEIT - Universidade de Aveiro, Portugal

Innovation is a major determinant of firm performance. The competitive advantage of firms' is strongly connected to their ability to continuously innovate over long periods of time. The concept of persistence in innovation has been introduced since the early debate on cumulative creation. It underlines the influence of past and present innovations on future innovations, suggesting that there is a positive correlation between past and present innovations which, under the correct environment, transforms innovation into a routine. Thus, the analysis of persistence in innovation, its drivers and frameworks can improve our understanding of firms' dynamics, anticipate the effects of different policy actions, correct macroeconomic imbalances, help in designing the correct policies to boost R&D and, consequently, generate overall prosperity. This paper debates the persistence of innovation using a dynamic panel comprising 1099 firms operating in all economic sectors; firms are observed in three waves of the Portuguese part of the Community Innovation Survey (CIS), covering the time span from 2004 to 2010 (i.e., the CIS 6, the CIS 8 and the CIS 10). Innovation Persistence is analysed using the general concept of having performed any type of innovation during the period; furthermore, the concept is broken down into different types of innovation: product, service, process, organisational and marketing. Our first empirical approach to persistence uses transition probabilities, allowing for a simple understanding of the panel dynamic behaviour in each innovation type as well as the firms' trajectory. Despite its simplicity, this framework depicts the firm behaviour in each period, given its state in the previous period. The results vary substantially according to the innovation type in analysis: the proportion of firms declaring the achievement of either product or service

innovation is quite small compared to process, organisational or marketing innovations. The last period under observation included in the panel, 2008-2010, depicts a generalised fall in terms of innovation performance, perhaps caused by the economic crisis, although the difference is emphasised for product or service innovation. The empirical analysis continues with the estimation of two random effects probit models. The first model depicts a general panel, and the second model differentiates innovative behaviour in a time perspective (in both cases we control for firm-level characteristics and the use of public funds to perform innovative activities). The estimation of an alternative model discriminating past innovative behaviour (non-innovative, persistent, new or sporadic) is of particular interest as the persistence hypothesis fails to be corroborated in the general model for most of the innovation types, while the use of innovative behaviour sub-types produces different results. Former innovation options are, in most cases, found to be statistically significant in determining present innovative behaviour. However, the results vary according to the innovation type in analysis, which is of particular interest since as most of the existing studies only consider product innovation, and only a few consider organisational and process innovation as well. Moreover, our panel data allows analysing persistence of innovation in all economic sectors, filling a gap in the current empirical literature. While the existing literature mostly provides empirical evidence for industry, our results indicate that services and industry behave differently towards persistence, a feature that should be accounted for by policy makers when designing policies to boost R&D. In addition, persistence of innovation is generally empirically explored using the case of innovation leaders or followers, which may not apply to countries with poorer performances in terms of innovation. Studying the case of a moderate innovator may shed some light into the different conditions of firms and their attitude towards persistence, as well as the adoption of different policy actions to observe this heterogeneity. Our results, therefore, may add to the literature discussing firms' strategies towards persistency of innovation in the context of a moderate innovator. Finally, the perceived downturn in the innovative performance of firms over time, which is in line with the results presented for the Portuguese part of the Innobarometer, will allow drawing some policy recommendations, and required adjustments in terms of smart policy making.

Keywords: innovation persistence, product innovation, process innovation, marketing innovation, organizational innovation, service innovation

ID 66: The Servitization to Sustainable Product-Service Systems: a new perspective based in TRIZ

Diego Jesus Pacheco[1,2], Helena V. G. Navas[3], Carla ten Caten[1], Carlos Fernando Jung[1], Virgílio Cruz Machado[3]
[1]Federal University of Rio Grande do Sul – UFRGS, Brazil
[2]Centro Universitário Ritter dos Reis - UniRitter, Brazil
[3]UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Tecnology, Universidade Nova de Lisboa, Portugal

Many difficulties hinder the servitization. Companies must rethink business models and replace value of exchange by value in use, involving long term relations. The service transformation assumed that PSS may reduce the environmental impact and provide benefits for the PSS provider and the consumer in economic and social ways. However, sustainability is not an intrinsic characteristic of PSS. Still, recent studies have acknowledged that PSS business models in some cases can even have a negative effect on the environment while maintaining only economic benefits. In this sense, one alternative to mitigate these problems is the proposition of more effective methods and tools to sustain the service transition. Recently some researches has investigated and developing a promisor framework applying the TRIZ and its set tools in servitization process. TRIZ is an approach recognized by generation of radical innovations and have been applied aiming obtain more systemic, financial and sustainable results in servitization journey. TRIZ is a Russian acronym of Teoriya Resheniya Izobretatelskikh Zadatch, which means Theory of Inventive Problem Solving. Several news or adapted TRIZ tools has been proposed to generate a more sustainable servitization. For instance, a set of new TRIZ Inventive Principles (IPs) modified and oriented to services and an index system to explore similarities among PSS and to direct eco-innovations. Or still, the 26 reinterpreted IPs for eco-innovation in PSS. Nevertheles, although recent studies have highlighted several potential benefits of PSS, insights about how companies can adopt TRIZ in servitization is still very limited and remains as a relevant gap in this research field.. In this sense, the research questions proposed are: (i) what TRIZ tools are more appropriate to be applied in each step of servitization process? (ii) how TRIZ can be applied to obtain more sustainable Product-Service Systems? To develop the research and data collection, initially a systematic review of the literature was performed. The databases researched included Scopus, Ebsco, Emerald, Springer Link, Proquest and Scielo. The goal of this review was: (i) to identify the state of the art of researches about environmental innovation involving TRIZ in servitization and (ii) to identify the TRIZ tools more appropriate to be applied in each step of sustainable servitization process.

Keywords: Product-Service Systems. Servitization. TRIZ.

ID 67: A TRIZ based method for Product-Service Systems in SMEs

Diego Jesus Pacheco[1,2], Helena V. G. Navas[3], Carla ten Caten[1], Carlos Fernando Jung[1], Virgílio Cruz Machado[3]
[1]Federal University of Rio Grande do Sul – UFRGS, Brazil
[2]Centro Universitário Ritter dos Reis - UniRitter, Brazil
[3]UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Tecnology, Universidade Nova de Lisboa, Portugal

The servitisation of large companies has been largely studied by the scientific literature, but still little is known more specifically regarding SMEs (Dahmani et al. 2014). Still, a servitisation strategy could also appear as more risky since SMEs often have a mono-activity, and cannot counterbalance possible negative financial results with other more profitable activities. More generally, SMEs play a vital role in economic growth and employment. Large companies can afford to set-up a separate service organisation specialising in service provision, while SMEs might not reach the critical mass needed for a profitable service business. Therefore, considering the previous gaps and factors discussed, is possible conclude that the servitization towards to Product-Service Systems in SMEs remains as a critical managerial problem to researchers and practitioners. In this sense, the main objective of our research is to propose a TRIZ based method for hold the development of Product-Service Systems in SMEs. To develop the research and data collection, initially a systematic review of the literature was performed. In a second step, a survey was performed with 280 experts in TRIZ in order to define what tools are more appropriate to be applied in each step of servitization journey. To analyse the response, after the sample reliability to be validated by Cronbach's Alpha test, several statistical multivariate technics were applied to define the choice between step of servitization and the respective TRIZ tool (s). Based on these results, a proposed method to support the servitization was developed, a third stage, considering the criteria and steps defined in the design science research. The application of design science research can potentially reduce the existing gap between theory and practice because this method is not only oriented toward problem solving but also produces knowledge that can serve as a reference for the improvement of theories.
Keywords: Product-Service Systems. Servitization. SMEs. TRIZ

ID 68: Application of TRIZ Methodology to Collaborative Chains Construction

Helena V. G. Navas[a], António Abreu[b], Ana S. M. da E. Dias[b*]
[a]UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, Portugal
[b]Área Departamental de Engenharia Mecânica (ADEM), Instituto Superior de Engenharia de Lisboa (ISEL), Instituto Politécnico de Lisboa, Portugal

Nowadays, companies operate in markets exposed to the effects of globalization, the windows of opportunity for conducting business are becoming shorter in terms of time as well as the business environment is increasingly volatile. Thus, companies have to start learning to work together in certain areas or skills, to follow different paths other through the stimulation of inter-firm relationships giving rise to organizational models based on networks of collaboration between companies. It is understood by any one coalition collaborative chain among a set of various actors (individuals, organizations and companies) autonomous, geographically distributed and heterogeneous from an operational, cultural and sight of its objectives, which decide to establish collaborative relationships with each other, as process to achieve the objectives of common or compatible more efficiently. However, a major challenge with the knowledge that this area faces is related to the need to develop a general theory of collaborative networks. Providing a sufficiently consolidated theory that it is only possible to detect and characterize a set of principles and mechanisms that enable the sustainability of collaborative processes. Thus, the establishment of collaborative processes in response to a business opportunity should not follow an ad-hoc but instead must be supported by appropriate methodologies to support the process of analysis of technological and organizational systems, identify contradictions and problematic situations and process indicate the likely solution to the found problems. In this context, the Theory of Invention Problem Solving, better known by its acronym TRIZ, aims to aid in the detection of contradictions regarding systems and the generation of creative solutions which eliminate the contradictions found and get major improvements in technological and organizational systems. Moreover, the life cycle of products is becoming shorter time what causes the rate at which the processes occur in design and / or development of new products is increasingly rapid. Therefore, the search for excellence both in creating more efficient processes and in the development but also in design of products has become a critical factor for any organization. Innovation is crucial to increasing the efficiency of organizations, to improve competitiveness and profitability. The collaborative chains need to develop innovative solutions progressively with the aim of improved processes. Thus, support tools for analyzing the characteristics of cooperation between companies, such as the reasons for integrating businesses into the network, the choice of partners, organization and coordination of cooperation, cooperation in the circumstances , the results and implications are necessary for companies inside and outside the chain. In this area, the TRIZ methodology can also indicate some guidelines for managers of companies and their network since it allows to generate solutions to radical or based on the application of the latest scientific discoveries and experienced little change. The aim of this work is to contribute to greater agility and sustainability of the processes of formation of collaborative chains to meet business opportunities. Acting as identifying potential problems and generating creative solutions, the TRIZ methodology can assist in the creation and development of collaborative chains.
Keywords: collaborative chains, cooperative processes, innovation, TRIZ

ID 70: Setting Up an Innovation Lab in a Manufacturing Company

Paul Filmore
Plymouth University, UK

The focus on 'manufacturing' is an important distinction as for many companies primarily involved with fabricating engineering products, the management doesn't see the company as engineering-centric; in fact the managers are really even more

Marketing- or Sales- centric than manufacturing. The upshot of that is that for all of its talk about wanting to be (or at least saying the company is) innovative, the culture (as it is many similar companies) is not really comfortable with innovation. The highest value is placed on execution and predictability. So to have an innovation area is really a counter-cultural move, and that affects what the engineers can do and how the engineers need to innovate. This paper will thus address topics such as:

- A counter-cultural move toward innovation
- Hands-on innovation—the value of getting closer to the physical production and development of innovative ideas
- How to encourage people who have been hired for talents other than innovation to begin to participate in innovation. Project management skill is given such high value in the interviewing process that natural innovators are hardly ever hired.
- Is time-share innovation a practical possibility? Many companies talk about allocating say, 15% of an individual's time to projects that they want to work on, but that rarely happens in practice.
- Experiences are shared in setting up an innovation lab. After a period of time, experience has led some to really wonder if it can work.

Keywords: managing innovation, TRIZ

ID 71: Real Voice Of Customer (VOC) and the Rail Industry in the Gulf Region

[1]Jibran Walji, [2]Jabir Walji
[1]United Arab Emirates
[2]Ashghal, Qatar

New Railway and metro developments for the transport of passengers and goods top the list of six Gulf countries (Saudi Arabia, UAE, Qatar, Oman, Kuwait, Bahrain) transport projects with total investments exceeding US$100 billion. National railway projects in each of the GCC countries will integrate with the joint Gulf Cooperation Council (GCC) railway project, a 2200 km network that will link the six Gulf countries at a total cost of more than US$ 15.4 billion apart from the metro/ high speed and conventional rail. However none of these projects specially the city metro systems in Dubai and Doha have captured the Real Voice of the Customer in full, current and future. To capture the Real VOC is a difficult task, because very often the customer cannot assist us in deriving a new commercially viable solution or tell us what they want but a 'cheaper, better, faster' version of what they already use. This presentation will explore how Systematic Innovation Techniques assist mapping the Real VOC and thus would have allowed to evaluate BREAKTHROUGH unique opportunities for the Gulf Region, taking into account the context of the region for the last last 10 years in term of the highest GDP per population in the world, before the resent slide in oil prices since 2014 from approximately $150 per barrel in the hey days before 2014 to $40 per barrel in 2016.

ID 72: Applying Functional Analysis and Inventive Standards to Deal with Problem of Students Lacking Learning Motivation

Youn-Jan Lin[1*], Jo-Peng Tsai[2], Jyhjeng Deng[3]
[1*] Institute of Management, Minghsin University of Science and Technology, Taiwan
[2] Department of Food and Beverage Management, Far East University, Taiwan
[3] Industrial Engineering and Management Department, Da-Yeh University, Taiwan

There are rarely a paper about apply Functional Analysis and Inventive Standards to deal with a teaching problem. In this paper, we try to use TRIZ to deal with a problem about students lacking learning motivation in class. We use both Functional Analysis and Inventive Standards tools to deal with this problem. Through the use of Functional Analysis and Binary Problems Ranking, we find the problem, students lacking learning motivation is a second important problem in this case study. Then, we use Inventive Standards for Business and Management Applications method- Group 1, Improving insufficient (ineffective) effect of an interaction and generated 9 ideas, they provide many solutions to deal with the problem of Students lacking learning motivation.

Keywords: Business and Management, Functional Analysis, Inventive Standards, Improving insufficient learning motivation

ID 73: Innovative Leaders Competencies in Excellent Organizations

Hossein Safari, Mojtaba Mohammadnejhad Shorkaei, Fatemeh Mirzaeirabor
University of Tehran, Faculty of Management, Iran

Excellent organizations have leaders who shape the future and make it happen, and act as role model for institutionalizing values and ethics. Innovative leaders promote a culture which supports the generation of new ideas and new ways of thinking to encourage innovation and organizational development. In this paper, based on a research project, leader's competencies in excellent organization from EFQM and Malcom Baldrige model have been explored. These competencies include four category of human, function, change, and external environment, and shape the leader's excellent profile. In these profile, Innovation is a basic competency. Innovation for leaders in excellent organizations has different aspects such as creativity, idea generation, inspiration, team innovation, confidence making, and motivating. This competency has cause and effect relations with other

competencies such as people development, change management, networking, and inspiration. Indeed, it has a maturity path with three steps.
Keywords: Innovation, leadership, Excellent Organization, Profile, Competency.

ID 74: Lean Banking: Application of lean concepts and tools to the banking industry

Jéssica Xavier dos Santos, Maria do Rosário Cabrita
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Science and Technology, FCT, Universidade Nova de Lisboa, Lisboa, Portugal

In recent years and especially in the wake of the worldwide economic recession banks have been subject to growing external pressures which combined to its internal constraints led to structural changes and aroused several challenges with a negative impact on their activity. To thrive in the new business environment and ensure sustainable profitability in medium and long term, these firms are focusing on the persecution of new management strategies that provide more efficient and cost effective services without jeopardizing quality from the customer perspective. Cited as a holistic approach that aims to achieve operational excellence and create more value with fewer resources, lean management has been increasingly seen by banking services executives as a suitable solution to enhance competitive advantage and improve banking businesses performance. But in spite of its acclaimed success, especially when applied to manufacturing companies from where it stem from, the deployment of lean in a service enterprise still poses new challenges and obstacles that may even compromise its feasibility. The purpose of this paper is to discuss the application of lean principles to banking services, including its challenges, potential benefits and critical success factors. The methodology used was a case study research, in which is described and analyzed a lean approach in a real banking environment. The findings of this study shows the great potential of lean management as a mean to maximize banking processes'. However, and as stated in previous studies, in order to achieve a sustainable and lasting success, lean practices must be adjusted and become intrinsic to the firms' culture.
Keywords: Banking Industry, Lean Banking, Lean Management, Performance

ID 75: Innovation models at a glance: from a triple helix approach to the quintuple helix and the reshape of knowledge-based ecosystems

Alcino Pascoal, Maria do Rosário Cabrita
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, FCT-UNL, Universidade Nova de Lisboa, Lisboa – PORTUGAL

Ecosystem is a concept rooted on the research works of British scientist Arthur George Tansley, who was seeking to provide a meaningful interpretation about the interchange of materials among living organisms and between the former and the surrounding environment. This concept borrowed from Ecology was later adapted to the emerging innovation models, thus giving raise to the concept of knowledge ecosystem. These ecosystems are mostly promoted by knowledge-intensive institutions, such as Higher Education Institutions and/or affiliated partners (Research Organisations, Science Parks, Labs, etc.). The knowledge flow between all partners as well as the interactions with the environment (e.g. local community, climate, fauna and flora) are inducing new ways of doing business and likewise the emergence of alternative market niches. Innovation theorists examined these interactions, having generated increasingly complex structures along time. The triple helix model dates back to early nineties, being the cornerstone of such primary elaborations. The former was followed then by the quadruple helix model and shortly by the quintuple helix one. The later comprises five components, as follows: the original triple helix (governance, industry and academia), the civil society and also the natural environment. The addition of a fifth dimension to the innovation model considered is defensible «vis a vis» the need to integrate accordingly the aforementioned challenges, looking then to an all-inclusive model to better describe reality. Current framework is well-known, encompassing not only the issues related to the scarcity of natural resources, but also other issues which is the case of climate changes and its effects on society. This paper intends to analyse the fundamentals and components of a knowledge-base d ecosystem, the formal and the less-explicit interactions between all components, ending up with a discussion about the ways the inputs of natural environment within the ecosystem can influence the generation of new businesses and of new ventures.
Keywords: knowledge-based ecosystems, quintuple helix, innovation models, science parks.

ID 77: A Proposal to Systematic Innovation: Engineering and Financing Design

João Fradinho[1], João Patrício dos Santos[2], António Gonçalves-Coelho[1], António Mourão[1]
[1] UNIDEMI & DEMI, Universidade NOVA de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal
[2] Finance Setting, Avenida Dr. Mário Soares 35, Tagus Park, 2740-119 Porto Salvo, Portugal

The worldwide market of nowadays is volatile and increasingly calls for tangible and nontangible customized products. This is a remarkable challenge to companies, which must implement processes for generating new ideas that could fulfil the consumer´s aspirations, as well as more efficient internal processes. The need of continuous production of new ideas implies a fast decision-

making process to find what are the ideas that deserve to be explored. Such fast decision-making should take place in the conceptual design phase, and should consider both engineering and economic matters. TRIZ, “lateral thinking”, “thinking out of the box” or “case-based reasoning” are useful to find design solutions, but they lack the tools that are required to evaluate the goodness of those new designs. However, the new designs should be technically and economically sound, so that the idea makes the innovation come true. This paper presents a decision-making framework based on Axiomatic Design (AD). Specifically, the AD’s hierarchical decomposition and mapping between design domains will be used to systematically examine the engineering and the economic feasibility of innovative products.
Keywords: Axiomatic Design, Design Architecture, Engineering Design, Innovation.

ID 78: Multilevel triz contradiction in biomimetics

Davide Russo, Antonio Caputi
University of Bergamo, Italy

Over the last years there has been an increment of papers regarding both TRIZ and biomimicry. This works are mostly focused on thematic relating to the possibility to reproduce functions and structures of biological organisms, in order to solve specific technical problems. In this context, this paper concerns the study of technical and physical contradictions in the TRIZ methodology. Until this days, one of the most relevant issues in consulting biological systems databases, is that their use does not ensure a fast identification of contradiction and the way nature has overcome it. Contradictions were introduced to solve inventive problems, and in particular the technical ones. On the other hand, organisms in nature have to face problems that have a functional complexity that is higher compared to the normal technical activity. More in particular two features characterize biological systems: the hierarchical organization of biological structures, and the multi-level organization of the same. In complex biological systems there are contradictions also between different hierarchical levels but there are not efficient model of representation to highlight this crucial information. Some example s will be produce to explain nature multilevel complexity. This paper proposes a conceptual design framework, based on FBS, in order to describe high complexity systems as the natural ones. The main point is to characterize different levels of description using the relations which occur between the elements of the structure at different dimensional scales. This means that different topologies of the structures are identified at different levels. Moreover, elements linked on the basis of such topologies are also organized in a hierarchical scheme. Such framework allows to describe the biological structures in a functional way, taking in account the complexity introduced by the division of the scale levels, and the hierarchical organization of the elements of the structure itself. Moreover, this scheme summarizes the problem at different levels, so that it is possible to describe the given contradiction in many ways, reporting a larger range of parameters and physical effects, ideally increasing the number of the found solutions. The description of the same contradiction at many different scales is a powerful tool in order to support the designer’s activities, such as the analysis of biological systems, or the synthesis of bio inspired technical systems.
Keywords: biomimetics, design model, multilevel, triz, contradiction

ID 79: Systematic Innovation Applied in the Food Industry Packaging System

Teresa Leonor Martins Morgado[1,2], Joaquim Martinho[1]
Engineering Departmental Unit of Polytechnic Institute of Tomar, Portugal
Physics Center for Advanced Materials Engineering, Lisbon University – CeFEMA, UL

This paper presents the methodology used in the innovation and optimization of the format changes in packing process of food industry sector. In this context were studied three packing machines designated by Mariani D, Mariani E and Mariani F. The equipment’s Mariani D and E have a similar structure, but the most recent packing machine, Mariani F, has a different structure and therefore, served in this work, as base to uniform machines and processes of the factory packaging system. Nevertheless a comparative cost study of innovation on the three packing machines with and without uniform machines and packing processes are presented in this work. Changes in the packaging system format arise from the requirement to change the boxes of food products according to the market needs it is intended. Although the dimensions of all boxes is 3x4; the Portuguese market requests open boxes, some national and international markets due to the necessity cost reduction, request exhibitor boxes and other international markets due to movements, request closed boxes. After study and understand the factory packaging process and respective equipment’s was proceeded the data collection and was decided that to innovate the packaging system, three distinct zones of Mariani equipment’s needed intervention. The proposals were worked out in these three zones. It was used SolidWorks software as support tool to design the innovations in the machine structures. The comparative study of time spent before and after the innovations suggested by the authors, allowed concluded that there are: a reduction of about 90% of time spent in tool changes, an elimination of movements times, tools elimination, security conditions reinforcements, and the operations became accessible to all operators, thus eliminating the necessity of qualified technician. From cost analysis was concluded that the Pay Back submitted in either case is considered high, although it is limited to an estimate of the measurable aspects of the two proposals.
Keywords: Systematic Innovation, Lean, Continuous Improvement, SMED – Single Minute Exchange of Die.

ID 80: Beyond to texts of Innovation Management by using science metrics and text mining tools

Hossein Safari, Mohamamd Reza Sadeghi Moghadam, Mahsa soltani neshan, Mohsen Moradi-Moghadam
University of Tehran, Faculty of Management, Iran

Innovation is a new and critical concept in today's competitive world. Knowledge and innovation is the basis of excellence and competition among companies. Accordingly, it is also to understand innovation management, its related fields and application. Although Literature review is a good way to have comprehensive view on special field, it is time consuming. It also difficult to study many articles in different periods and present various analysis. Using scientometric and text mining tools help to realize what is over the texts. The most advantage of this method is not to intervene the personal view. All patterns and structures are obtained from texts independently. In this study, we collect more than 2,000 articles related to Innovation Management from 1990 to 2015 to map the knowledge structure of this field. Map of all relevant data represent by applying science map, then by analyzing the more frequent data we try to answer the following questions:1)what are the more relevant terms of innovation management? Which industries apply the concept of innovation management more? 3) What are the most widely used methods, tools and techniques in innovation management literature? 4) What is the innovation management research gaps? 5) What is the knowledge structure of innovation management knowledge?
Keywords: Innovation, Science Metrics, Text Mining.

ID 82: Innovation on the presentation by adopting the Innovation Principles for Business and Management

Chang-Chi Cheng[1], Ming-Young Jan[2], Li-Yuan Chen[3], Hao-Bo You[4], Chien-Ming Lee, Chin Lee[4]
[1]Department of Property Management, Chen-Hsin University of Science and Technology
[2]Department of Civil and Environmental Engineering, I-Shou University
[3]Department of Industrial Engineering, Chen-Hsin University of Science and Technology,
[4]Department of Property Management, Chen-Hsin University of Science and Technology

Generally speaking, typical format of most presentations are mostly in the form of “verbal follows slides”, that is, slides are normally shown on screen first, then verbal explanations come afterwards. In this case, presenters could simply read the content of the slides, and do not necessarily have to memorize all the details. Our first basic innovation is to reverse the order of the form for typical presentation, which becomes “slides follow verbal. In this case, the presenters must have considerable control over the content they’re presenting. They must be familiar with all details of the process of the presentation, including language, movement, interactions, next slide, and spot status, while without looking at the manuscript. Meanwhile, the audience must have an expectation on the appearance of the content of the next slide, therefore, the production of the presentation slides should focus on the nice appearance of concise text and numbers. Finally, to ensure the effective attraction of the audience's attention, many interaction techniques have been applied to the presentation, for example, with a duet report, match-up of the roles, responses to each other, negative ridicule and clapping hands, as well as the adoption of related cases (President Obama and the anger translators), etc., are placed in various sections of the presentation. Corresponding to these techniques applied, the innovation principles for business and management involved may include:
3-LOCAL QUALITY
22-BLESSING IN DISGUISE
25-SELF SERVICE
26- USE of COPIES and MODELS, and
29-FLOWS and FLEXIBILITY

ID 83: Innovation Impact Board

Cristina Barros
IPLEIRIA and SINMETRO

This paper aims to present a measurement tool, “The Innovation Impact Board”, designed to ensure the alignment of R&D + Innovation projects of new products, processes, services or business models with the vision of an organization and with its competitiveness critical factors. This tool wants to assess the speed, impact and penetration of the results of innovation projects into the market, usually the "Achilles heel" of innovative organizations. It is also designed to answer questions such as: How long did it took for the new product/process/technology or business model to hit the market? What’s the return on investment after one year of the innovation market entry? Which markets did the innovation reach and what’s its degree of penetration? The analysis of the KPIs (Key Performance Indicators) that integrate the “Innovation Impact Board” will certainly be important in the process of rethinking current business models replying to the following questions:
• Does the organization have the capacity to constantly analyse the market and create new opportunities?
• What’s the market value proposition of the innovation?
• Which markets are interested in this new value proposition? How does the organization create a client or customer relationship and makes them fall in love about this new idea? Which channels will be best to put the innovation on the market?

• What is the expected income and market share?
• What would be the impact of the innovation within the current business model and what kind of changes are needed to put it in place?
Keywords: Innovation, Tool, Impact, Market

ID 84: Technology Intelligence in the level of national Innovation ecosystem; concentrating on Fuel Cell Technology

Ahmad Jafarnejad Chaghooshi, Abbasali Karshenas, Reza Bazaziyan
Faculty of Management, University of Tehran, Iran

Policy makers at the national level and decision makers in firms generally needs to have appropriate and opportune information in various technological fields and innovation situations to make timely and effectively decisions. Lack of this information has irreparable consequences for organizations. The term “Technology Intelligence” is a generic solution for dealing with such a challenge. It is especially important in fields where technological development is rapid, and where changes are likely to occur more rapidly. The purpose of technology intelligence is to gain a technology based competitive advantage. This paper suggests a conceptual model for the development of technology intelligence in the national innovation ecosystem by using an empirical study in the fuel cell technology ecosystem. This model has six crucial items at its top level including performance and needed guidance, search and acquisition, processing, organizing and storing, analyzing, and documenting and disseminating. According to this model developing technology intelligence in the national innovation ecosystem can improve efficiency and increase wisdom in the ecosystem.
Keywords: Technology Intelligence System, Fuel Cell, Functional Architecture, Intelligence Needs.

ID 85: Applying TRIZ and Multi-Attribute Utility Theory to Develop Innovative Designs: A Case Study of Carbohydrate Detecting Device

Min-Feng Weng[1], Pi-Lien Chiu[2], Ming-Chuan Chiu[1]
[1]Department of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan
[2]Department of Product Design, Tung-Fang Design Institute, Taiwan

People with diabetes usually have metabolic problems because their own insulin is unable to operate effectively. Consequently, diabetics are required to control their blood glucose under diet management. The diabetics take proper dose of insulin to convert the carbohydrate levels according to their experience. However, most of the diabetics are not able to calculate the levels of carbohydrate correctly. Moreover, the currently measuring blood glucose apparatus is glucometer which might cause the risk of infection. Therefore, this research developed a new noninvasive carbohydrate detecting device which combines hyperspectral imaging and light field technique to identify the food ingredients along with their quantity. Theory of Inventive Problem Solving (TRIZ) is applied to generate the possible concepts and Multi-Attribute Utility Theory (MAUT) is utilized to select the best one. This research demonstrates a noninvasive detecting device to help diabetic control their blood glucose. In the future, this device can apply in weight control and food safety.
Keywords: Diabetic, Hyperpsectral Imaging, MAUT, TRIZ

ID 86: Innovation in the Manual Harvest Process – Application of Lean Philosophy and TRIZ Methodology

Luís M. G. Caro, Helena V. G. Navas, Virgílio A. Cruz Machado
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, Portugal

Given the competitiveness of national and international markets, it is essential to adopt new strategies and approaches to traditional management methods. In this perspective, this dissertation adopted the Lean philosophy and the theory of inventive problem solving, known as TRIZ, for the manual harvesting process of a wine company, Casa Ermelinda Freitas. In the current situation after the market’s recession, Portugal’s wine market has been standing out through the markets, mostly because of the wine technological development. However, this evolution has as its main focus on the making process and bottling of the final product, evolutionary situation which was not observed in the harvesting process. There are two possible ways for the grapes extraction, manual (option by traditional methods, developed over generations) or automated (requires an upfront investment to be possible). Portugal’s situation presents an old vineyard, with difficulties to implement the automated harvesting. Due to limitations of the automated harvesting, the study focused on identifying problems and improvement points of the manual process. This work aimed the problem solving and present improvement proposals. It was possible to develop a system based on manual harvesting, but with a higher level of mechanization, with some developed equipment. For this new equipment, new procedures have to be developed, which contribute for a waste reduction on the the harvesting process. The work was developed by the application of some techniques and analytical tools of the TRIZ methodology, particularly, the Ideality Matrix,

the Contradictions Matrix and the Substance-Field Analysis, also as the 5S, Visual Management and other tools of Lean philosophy. The applied improvements also led to the need of a reorganization on human and material resources. The proposed improvements led to an increase of the harvest productivity, also as a reduction of the operator's physical effort.
Keywords: Harvest Manual Process, Innovation, Lean, TRIZ.

ID 88: Construction of Interdisciplinary Maker Practice Platform

Li Shuangshou, Yang Jianxin
Fundamental Industry Training Center, Tsinghua University, Beijing, China

The innovation and entrepreneurship education have been more and more important in university curriculum system. Mass innovation spaces grow up in China to form a combination with maker community, maker, specialties and investment. Tsinghua iCenter ("i" for industry, interdisciplinary, innovation etc.) is promoting an interdisciplinary maker practice platform serving the innovation and entrepreneurship education, which is integrated into the university cultivation system to achieve inter-departmental fusion with traditional majors. The innovation environment, smart manufacturing platform and share mechanism have been constructed to form a comprehensive innovation and entrepreneurship service ecosystem. The minor of technological innovation and entrepreneurship has been started in collaboration with different schools and departments to bring technology, design and business together for exploring new education patterns (courses, projects and activities). The objectives of the platform are to build a multi-dimensional I&E training system for college students, summarize the experiences of courses and activities and form repeatable service pattern, provide maker teams more support conditions and improve the innovation and entrepreneurship ability of the students.

ID 89: From Value to Technological and Cultural Innovation – a holistic view of innovation

Manuel Fernandes
CAAM – Corporaste Academy for Advanced Management (by Gestão Total), Portugal

The aim of this theoretical paper is to introduce a holistic view of innovation and its interconnections to other phenomena, such as value and processes needed to create new value. The act of innovating coincides with that of value change. Value changes are creation or modification (addition or subtraction) of the value of a thing or solution (potentially a product), achieved by actions or events. There are four types of value in products (goods or services): (i) use value – or value as utility; (ii) economic value – or value as exchange; (iii) cultural value – or value as meaning and sign (in a collective context); and, (iv) perception value – or value as experience (at the individual level). The concept of value based innovation implies that any act of innovation creates or changes the value curve of a thing or solution, potentially represented by products (goods or services). The value curve of a product is defined by the performance of all its attributes. That performance reflects the effort applied by the producer of the product to innovate, and answers the level of demand for innovation by the market. This leads to four types of innovation based on the resulting value: (i) breakthrough innovation – creation of a new value curve, corresponding to a new product, defined by a stand alone value curve, not comparing to any existing product; (ii) adding value innovation – addition of some type of value to an existing product, placing its value curve above competing products' value curves; (iii) turning around innovation – reducing the performance of the attributes of a product, but turning it into a much cheaper solution comparing to other competing ones, placing the value curve of the product below the ones of competitors; and, (iv) differentiation innovation – changing the performance of some attributes of the product, playing with the value curve of the product in order to differentiate to the ones of competitors. All value phenomena (creation, generation, addition, improvement, consumption, destruction, and accumulation) happen in a context of human activities define by the resulting value form (tangible or intangible) and the process applied for the value materialization (simple or complex). The resulting four levels of human activities are: (i) ideation level – conceptualization and creation of ideas; (ii) technological level – transformation of any existing resource (material or non material) into a new thing or solution; (iii) cultural level – change of human behaviors, induced by or using a thing or solution; and, (iv) distribution level – making a thing or solution available for consumption to consumers. The journey from the ideation level to the distribution level can take one or two paths: through the technological level, or through the cultural level, or yet through both. The first corresponds to a process of technological innovation, and the second to a process of cultural innovation.
The technological innovation process is defined by the resulting value curve coming out of the innovation process (new vs. modified), and the applied creation process (procedural vs. loose), resulting into four types of technological innovation processes: (i) planned/structured process – this process is analytical, systematic, science based (fundamental and applied R&D), and develops new knowledge about natural systems by applying scientific laws (know why), based upon scientific knowledge and models, deductive by nature, and supported by collaboration within and between research units or entities, producing strong codified knowledge contents, highly abstract, but universal; (ii) targeted/objective driven process – answers specific needs of users, consumers or of the organization. This kind of innovation mostly fits in the non R&D based innovation class, focusing mainly on design innovation. The process of this type of innovation is symbolic (art-based), creating meaning, desire, aesthetic qualities, affect, symbols and images (know who), based on creative processes and supported by high interaction between teams and projects, requiring creativity, importance of interpretation, cultural knowledge, creating sign value and implying strong context specificity; (iii) adapted/ adopted process – relates to strategies of adoption and adaptation of innovations initiated and developed by others, based on the "imitation" of products (goods and services) attributes and of organizational processes. This kind of innovation mostly fits in the non R&D based innovation class, focusing mainly on

equipment and input-embodied innovation. This type of innovation process is synthetic, engineering-based, applying or combining existing knowledge in new ways (know how), based upon problem solving capabilities and custom production, therefore being inductive, and supported by interactive learning with customers and suppliers, producing partially codified knowledge and strong tacit components which are very context-specific; and, (iv) serendipitous/stochastic process – defined by stochastic results of focused or trial and error experiments, it is mostly based upon fundamental and applied R&D. This also fits in the R&D investment based innovation profile. The process of this type of innovation, like the planned/structured type, is analytical, science based, and developing new knowledge about natural systems by applying scientific laws, supported by collaboration within and between research units or entities, producing a strong codified knowledge content, highly abstract, but universal. The cultural innovation process is defined by the context in which behavior changes happen. This context is defined by the cultural individual orientation (materialistic view of life / self-enhancement vs. idealistic view of life / self transcendence), and by the cultural collective orientation (view towards the unknown / openness to change vs. view towards the known / conservation), resulting into four types of cultural innovation processes: (i) newel – generalized human behavior changes in large portions of the society induced by or using a new thing or solution based on new technology. New technological things and solutions induce new “created” behaviors/habits in relevant portions of the population, developing new meanings and signs. The impact of this type of innovation has a collective dimension as it creates standard behaviors at people’s group level, reflecting a high capability for collective creation and adoption. ; (ii) moral – generalized human behavior changes in large portions of the society induced by or using a thing or solution imposed by codes, rules and laws, or advocated by some preeminent opinion maker. New morals force new “adapted” behaviors in the large majority of a population. This type of innovation has a strong impact at the societal sphere, forcing behaviors at community level, but reflected in a moderate and slow capability for full collective adoption; (iii) beutel – restricted human behavior changes in a fringe or niche of the society induced by or using a thing or solution with some strong artistic or fashionable characteristics or attributes. New aesthetic trends reflected on products (goods and services) induce new “created” behaviors/habits in some small pockets of the population, developing new meanings and signs. This type of innovation mainly impacts the individual level, reflecting a very high capability for individual creation and adoption; and, (iv) gnosil – restricted human behavior changes in a fringe or niche of the society induced by or using a thing or solution caused by the acquisition of knowledge and information. New knowledge, resulting in new attitudes, forces new “adapted” behaviors in some small pockets of the population. The new knowledge refers to scientific findings that have impact on human life. The impact of this type of innovation is manifested at the personal (individual) level, reflected in a moderate and slow capability for vast individual adoption. The cultural changes in this archetype appear to be mostly induced by opinion makers and others in closed individual cycles. Examples of all types of value and innovation processes will be included in the presentation, in order to provide a clear understanding and bring a coherent and logical path model to comprehend innovation at all its different levels, therefore providing a holistic view of the innovation phenomenon, in order to support the analytical and decision processes.

Keywords: culture, innovation, technology, value.

ID 90: Applied Innovation by SMEs for RDI Certification Purposes

Manuel Fernandes
CAAM – Corporate Academy for Advanced Management (by Gestão Total), Portugal

This paper aims at bringing an inside country analysis of innovation (macro environment) down to the level of SMEs activities (micro environment) and their outputs to the economy. For that purpose, a study was been conducted based on the full population of certified SMEs accordingly to a RDI (research, development and innovation) standard in one EU country, using statistical data from Eurostat and other sources, complemented with an opinion study set on criteria established upon practical and theoretical models. The criteria were established upon current worldwide-accepted concepts (Oslo Manual) and new theoretical developments in the understanding of innovation on the creation and generation of value and technological and cultural innovation. A panel of experts from the fields of value management, innovation, economics, quality assurance and management systems auditing, performed an opinion study using the focus group methodology. The results show that most SMEs develop their innovation activities in the lowest level of difficulty in innovation and value creation and generation, applying the basic technological innovation processes and missing cultural innovation changes in society. Due to sample dimension and to the dispersion of activities performed by the enterprises in the sample, it was not possible to establish a correlation between economical activities and types of innovation. A closer analysis of innovation at the micro level (SMEs) gives insight to potential innovation and innovation management outputs and to new innovation strategies and policymaking. A better understanding of how innovation impacts value creation and generation, how the technological innovation process affects outputs, and how SMEs may take advantage of cultural innovation (behaviour changes in society and markets), may be drawn from the conclusions of the study.

Key Words: innovation, value, technological innovation, cultural innovation.

ID 92: Efficiency analysis of innovation: an an application to European Regions

Diogo Ribeiro[1], Rute Almeida[2], Celeste Varum[3], Joana Costa[4], Anabela Botelho[5]
[1,2,4] Universidade de Aveiro, DEGEIT
[3,5] Universidade de Aveiro, DEGEIT, GOVCOPP

European policy makers have widely recognized the importance of science, technology and innovation, and Member States are asked to make a major effort to invest more in R&D and other innovation related activities and to improve the efficiency of their innovative efforts. But the European Union is composed of countries which vary considerably in terms of innovative capacity and technological expertise. Indeed, the existence of significant gaps within Europe at innovation level is widely recognized. Enlargement further hastened heterogeneity within EU in terms of innovation capabilities and technological development. There is a wide variety of studies revealing the asymmetries in innovation performance across Europe. These studies use a variety of indicators, either individual measures or composite synthetic indicators. In this paper we use data envelopment analysis method (DEA) to estimate regions' positioning in terms of innovation efficiency according to an efficient frontier. From a methodological point of view, this innovative perspective allows considering simultaneously several indicators to evaluate performance, avoiding biased perspectives that may result from only looking at a single indicator of input or output. By using this nonparametric method we contribute to expand the analysis and knowledge about European regions innovative performance. This paper reports preliminary results from a wider study undergoing at the University of Aveiro. The work and results herein reported should be considered as work in progress.

ID 93: Innovation Convergence in the performance of the European Regions – Was the 2008 crisis a structural break?

Alexandre Hébil, Pedro Correia, Joana Costa, Celeste Varum, Anabela Botelho
Departamento de Economia, Gestão Engenharia Industrial e Turismo Universidade de Aveiro, Portugal

Since the signature of the peace treaties after the II World War the economic and political relations among the countries were intensified, European countries became allies targeting convergence and a common objective of sustainable growth. Innovation has become of increasing importance among members and the Governance is focused in boosting innovative practices as well as the establishment of relevant innovation networks to exploit the innovative spillovers. Consecutive enlargements of the European Union have grown the area of influence, which shapes the role model of the European firms and their productive chain. Globalisation is both the cause and the consequence of technological improvements that took place over the last decades. Technological progress boosted economic growth and development, markets are no longer able to be closed as progress is not an option, and firms can only decide rather being active or passive towards modernity. Goods and services are distributed worldwide, there is free movement of capital venture, and productive processes are diffused worldwide. Innovation is a capital tool to meet the requests of the modern world economic, political and social challenges. The cohesion of the European space will become unsustainable if policy actions do not promote the reduction of Regional asymmetries; European policy makers must pursuit all efforts to promote the approach among regions. It is therefore of major relevance to evaluate the policy measures implemented and their efficiency in terms of cohesion, to endeavour what is theoretically defined as catching-up. Using the accurate conceptual framework and methodology results will highlight the success of the existing policy actions. In the first section we will discuss the existing literature and revisit the conceptual issues in terms of convergence. The existing views will be critically compared and the connection between convergence, innovation, growth, convergence and cohesion. In the following section the empirical analysis will be implemented, using the beta-convergence model, allowing for the convergence estimations. The estimation results will allow a further discussion of the indicators, and shed some light to the policy failures, presenting some further recommendations.

ID 94: Proposal of the Instrument for Measuring Innovation level in the Industrial Energy Efficiency

Carmen Brum Rosa, Julio Cezar Mairesse Siluk
Federal University of Santa Catarina, Brazil

The intelligent and efficient use of electricity, and its treatment and control made responsibly and rationally, generate repercussions for business, the economy and society. In this sense, the energy management system constantly seeks innovations that aims to better use of electrical installations and equipment, reduce energy consumption and, consequently, increased productivity without affecting the safety and reduction of costs of electricity. Thus, this paper presents an instrument proposed to measure the level of innovation in industries that have an energy efficiency plan in their production processes. The instrument features 30 performance indicators grouped into 10 critical success factors fragmented into four points fundamentas view. The construction of the instrument was based on a survey on organizational innovation and industrial energy efficiency. With the implementation of this instrument is intended to generate a current diagnosis of the situation of the evaluated organizations, and support decisions of innovation managers in energy efficiency to get the best performance in the production of a service with the least expenditure of energy.
Keywords: Energy Efficiency, Organizational Innovation, Performance Indicators.

ID 95: Design Critique Differences with and without Substance-Field Analysis Method in Architectural Design Studio

Sajjad Nazidizaji, Ana Tomé, Francisco Regateiro
CERIS, DECivil, Instituto Superior Técnico, Universidade de Lisboa, Lisboa 1049-001, Portugal

Substance–field analysis (Su-field) method has been developed by TRIZ experts as a problem analysis tool and systematic problem solving method. Based on background analysis of design studio participants, architecture students rarely apply systematic problem solving methods in their design studio practice. Guided by the perspective of testing new approaches to the architectural design studio practices, this research aimed to establish a comparison between non-systematic design methods (currently followed) and systematic design methods borrowed from TRIZ methods, namely, Su-Field analysis method adapted to the design studio environment. With such purpose, 20 architecture students participated during two full days in a design studio held at the Azad Lahijan University, in Iran. The program included design problem finding, solution finding and peer and expert evaluation of the solutions. In the first day, students approach to design problems was freely developed, according to their experience and knowledge, in the second day Su-field analysis was followed. In both days, the task of participants was finding design problems concerning their university and finding solutions for them. In both cases, each proposed solution was evaluated by two peers and two experts, by weighted evaluation matrix. The results of the four evaluation panels were compared. Students considered Su-Field to be a useful tool, naturally absorbed into their design thinking. As to the authors best knowledge it is the first time that Su-Field analysis is applied to architecture design problems.
Keywords: Architecture, design studio, Substance-field, systematic methods.

ID 96: Joint Deployment of Lean and TRIZ Methodologies in Industrial Environment

José P. O. M. Bandeira, Helena V. G. Navas, Virgílio A. Cruz Machado
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, Portugal

TRIZ (Theory of Inventive Problem Solving) and Lean methodologies can alone be used to analyze and provide solutions to any system. Implementation of their techniques and methods can allow companies and industries to improve their processes and eliminate waste and find new solutions. Lean is a methodology which has spread around the world and is part of many companies strategy. The core principles of Lean are to maximize customer value and is a method of managing an organization with the objective of improving key indicators like productivity, efficiency and product quality. On the other hand, TRIZ as an inventing methodology and scientifically driven, is a powerful tool during the analytical stage. By proposing a combined use of Lean and TRIZ methodologies in industrial environment, a new approach can be adopted by companies in order to address issues detected in their processes.
Keywords: DMAIC, Ideality Matrix, Ishikawa Diagram, Lean, SIPOC,TRIZ.

ID 97: Evaluation of sustainable competitiveness through innovation

Nuno Cavaco
UNIDEMI, Department of Mechanical and Industrial Engineering, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, Portugal

Clients' continuous expectation increase and the need to be ahead of competitors, cause a huge pressure in companies and aggressiveness into markets. Due to this fact, companies' need to be in permanent change to gain competitiveness. One way to achieve this aim is through innovation. But the question is How? Where to innovate? Innovation at any cost? What kind of impacts should be expected? Is it possible to evaluate companies' innovation skills and stablish a relation with outcomes? This paper provides a model that contributes to competitive advantage creation through innovation integrating concerns about sustainability, based on the triple bottom line principles. Therefore, the model promotes innovation preserving a balance between economic, social and environmental results. The model is based on 7 competitiveness drivers, which include all key factors of a company, and allow the evaluation of companies' resources to be innovative, taking into account requirements structured in 8 proficiency levels. Additionally, the model allow the evaluation of the companies' competitive advantage, considering innovation indicators, related to each competitiveness driver. With this evaluation promotes another perspective of companies' innovation capability, as well as the identification of opportunities to improvements, concerning the areas where companies have lower scores regarding innovation resources and results. This model, in this perspective is an added value tool, once it allows a more focused approach about innovation priorities, taking into account that innovation cannot be just considered "product innovation" and the fact that there are a lot of other aspects in an organization that have influence on it.
Keywords: Strategic planning, competitiveness, sustainability, innovation, evaluation

ID 99: SECI, Ba and Network：Knowledge Creation Model in Taiwanese Independent Restaurant Sector

Wan-Lin Hsieh, Yi-Chih Wei
Department of Industrial Engineering and Enterprise Information, Tunghai University, Taichung, Taiwan

Many independent restaurants in Taiwan successfully reach the goal of sustainable development. However, most research focus on only chain restaurants but leave a research gap on these successful independent restaurants. Nine restaurants are from the north, center and south of Taiwan are chosen as cases in this research. The study adopts Nonaka's knowledge creation model to discuss how these independent restaurants create new knowledge at the initial stage of product innovation. Through the SECI process, Socialization, Externalization, Combination and Internalization, and the concept of four types of Ba in knowledge creation model, intra- and inter-organizational networking are discussed in this study. The research indicates that new knowledge could be more easily generated by close relationship with trust. Furthermore, socialized and externalized knowledge are usually generated via centralized network. When the inside and outside actors of organizations share the same vision, knowledge socialization and externalization will be impelled. The two-way relationship within customers, suppliers and related organizations not only triggers knowledge socialized but also helps out with externalized knowledge. The blooming development of the internet and mobile APPs enables knowledge externalization to be active in both Dialogue Ba and Cyber Ba. The last finding in this study is that the manager plays an important role in processing knowledge creation in independent restaurants, especially at the stage of knowledge socialization.
Keywords: SECI, Ba, product or service innovation, restaurant industry

ID 100: Lean Product Development Performance Measurement

Amir Hejazi and Nadia Bhuiyan
Contax Inc., Concordia University, Canada

In this paper, we develop a performance measurement model that can evaluate the effects of adopting lean in the engineering process. First, limitations of available work in the field of lean product development performance measurement were identified. Next, engineering effort was analyzed in order to identify hidden waste in engineering process and enable differentiating between value-added, non-value-added, and required non-value-added elements of engineering effort. Finally, a model was developed to measure lean performance in the engineering process. A lean engineering performance measurement model is developed that measures the performance effects of implementing lean initiatives in the engineering process. The implementation of model enabled performance measurement at different levels. It provided visibility on the waste hidden in the engineering process and quantified that waste. It evaluated the progress achieved towards fulfillment of lean goals such as waste elimination, lead time reduction, intellectual inventory reduction, and throughput improvement. New lean performance metrics are developed that account for the types of waste that are unique to the engineering process and had received no attention in the existing literature. Furthermore, performance metrics are properly linked and the model treats lean as a holistic system and quantitatively measures performance.
Keywords: product development, lean performance measurement, lean engineering, lean product development metrics, lean metrics, lean design.

LIST OF AUTHORS