The INCOSE Italia Conference on Systems Engineering (CIISE 2014)

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University of Rome "Tor Vergata",
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"Systems Engineering (SE) is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on holistically and concurrently understanding stakeholder needs, exploring opportunities, documenting requirements, and synthesizing, verifying, validating, and evolving solutions while considering the complete problem, from system concept exploration through system disposal.[1]

It is centered on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem: operations, performance, test, manufacturing, cost & schedule, training & support, and disposal. It integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from system concept exploration to production and operation. Systems Engineering considers both the business and the technical needs of the customers with the goal of providing a quality product that meets the user needs."[2]

CIISE14, the INCOSE Italia Conference on Systems Engineering, with its two day program, is the first full-fledged event of this type organized by the Italian Chapter of the International Council on Systems Engineering (INCOSE), and it is set to become a recurring event.

The conference program has been structured to address the main elements of INCOSE Mission: share, promote and advance the best of Systems Engineering. In particular, the program is characterized by three main elements: (i) an introductory Round-Table and a set of invited talks; (ii) three technical sessions (on Systems Engineering Methodologies, Model-Based Systems Engineering, Case Studies and Applications, respectively); (iii) Tutorials on Systems Engineering ("Mini-School").

The purpose of the introductory Round-Table, and of the set of Invited Talks from representatives of Administration, Defence, Academic, Research and Industrial organizations, was not only to highlight the strategic role that Systems Engineering can play in supporting the economic growth and competitiveness enhancement of Italy "country system" but also to encourage governmental and industrial support for research and educational programs that will improve the systems engineering process and its practice.

The aim of the three technical sessions, with a selection of peer-reviewed works, was to provide Systems Engineering professionals, researchers and organizations to share knowledge and exchange and compare experiences and, ultimately, to create new opportunities for future collaborations and synergies.

A further element, the Tutorials on Systems Engineering ("Mini-School"), had the purpose to provide a brief introduction to the main concepts of Systems Engineering, and, taking advantage of the Conference location in an University campus, to stimulate the interest of the students participating to the Conference.

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[1] SEBoK.2014. "Guide to the Systems Engineering Body of Knowledge" (SEBoK), http://www.sebokwiki.org/wiki/Systems_Engineering_Overview, accessed 06/10/2014

[2] INCOSE.2012. Systems Engineering Handbook, version 3.2.2. San Diego, CA, USA: International Council on Systems Engineering (INCOSE). INCOSE-TP-2003-002-03.2.

This Proceedings volume contains the thirteen full papers presented during the technical sessions and that has been selected through an anonymous peer-review process. Moreover, this volume contains the extended abstract of the three Tutorials on Systems Engineering given in the context of the "Mini-School", specifically: *"Introduction to Systems Engineering"* by Vincenzo Arrichiello, *"Modeling Approaches for the Design and Analysis of Complex Systems"* by Andrea D'Ambrogio and Lucio Tirone, and *"System Dependability Analysis: Main Issues and Possible Solutions"* by Alfredo Garro.

The paper *"Identifying the Smartness of a Mechatronic Coiler through the 'Systems Engineering'"* (by Eugenio Brusa and Ambra Calà) summarizes how the requirements related to the smartness of an industrial mechatronic system are defined. The approach aims at identifying the potential requirements related to any smart function that could improve the efficiency of the system, by simplifying its architecture, and that increase its operability. Particular attention is applied to the sequences of operation of the whole plant, to detect all the potential critical issues concerning the interfacing and the hierarchy of controls between the coiler and the steel making system.

An interesting Model-Based Systems Engineering approach is proposed by Eugenio Brusa, Sergio Chiesa, Ambra Calà, Francesco De Vita and Davide Ferretto in the paper *"Towards an effective interoperability of models within the 'Systems Engineering' applied to aeronautics"*. The proposal discusses the fascinating feature of the models 'inter–operability' which can be implemented among methods, models and numerical tools and investigates what are the needs coped with the interoperability. It points out the main limits of the functional models in terms of product design as well as the lack of information about functions and requirements typically present in the numerical models used for the system design, and then, provides a perspectives of interoperating the functional and numerical models, by using as a reference ezample the de–icing system as a critical subsystem of the whole aircraft system.

The paper *"How We Engineer Enterprise Systems"* by Mikhail Belov describes the methods developed and proved by practical usage to strengthen such capabilities and to engineer enterprise systems. Effectively managing the uncertainty and unknowns, clear translation customers' needs into requirements and further verification and validation them, as well as the preliminary estimation and the strong control of the full scope of project work such as timeline, resources and quality, are identified as the key consulting capabilities and discussed.

The paper *"System Models Simulation Process Management and Collaborative Multidisciplinary Optimization"* (by Matteo Nicolich and Giulio Cassio) shows how a collaborative and distributed execution framework is used to compose multiple simulation processes at component level to generate system models managing the complexity of running multidisciplinary design projects. Driving process, component and subsystem knowledge with system models, the framework allows a larger inference space for design, the ability to continually connect at the system level, and a basis for knowledge capture.

The paper *"Mastering Concept Exploration in Large Industrial Research Projects"* (by Simona Citrigno, Angelo Furfaro, Teresa Gallo, Alfredo Garro, Sabrina Graziano and Domenico Saccà) faces with concept exploration, requirement specification and analysis in the development life-cycle of complex systems by proposing a goal-oriented methodology for addressing both early and late requirement engineering phases which is lean, easy to master and apply and, at the same time, clear and rigorous.

The paper *"The Verification Process in the ASTRI Project: the Verification Control Document (VCD),* by Luca Stringhetti, Nicola La Palombara, R. Canestrari, O. Catalano, M. Fiorni, E. Giro, M.C. Maccarone, G. Pareschi, G. Tosti and S. Vercellone, proposes an interesting Verification Process in the context of the ASTRI Project.. The approach followed by the ASTRI project is to have all the information needed to report the verification process along all project stages in a single layer. The paper describes in details how the layer, is formed and how it will be used all along the verification process. The layer called Verification Control Document, is presented as a powerful tool to help the flow of the verification process as well as how to semi-automatically generate updated project documentation and progress report.

In *"MDM industrial applications in Systems Engineering Validation"* (by Carlo Leardi), the author discusses the MDM Multi Domain Matrices methodology, evolution of the original N2 matrices, which is highly both suitable to be applied in the Systems Architecture and Validation processes and constitute an efficient bridge between these two areas. In particular, this paper proposes some industrial applications of the DSM, Design Structure Matrices and MDMs in the liquid food industry and special attention is dedicated to combinations of graphical and algorithmic views of the systems.

In *"A Methodological Template for Model Driven Systems Engineering"* (by Paolo Bocciarelli, Andrea D'Ambrogio, Emiliano Caponi, Andrea Giglio and Emiliano Paglia), the authors illustrate a modeling approach based on the use of a meta-modeling architecture that focuses on the use of models as the primary artifacts of system development. The use of Model Driven Architecture, which allows to increase the level of automation when evolving models from the very abstract representation of a system down to the system implementation, are

employed, so as to make easier the analysis, development and testing activities by combining Model Driven Architecture concepts and standards with Model Based Systems Engineering.

The paper *"MBSE approach for the verification enhancement across the lifecycle of a space system"* (by Silvia Mazzini, Laura Baracchi, Stefano Puri, Mauro Pasquinelli, Diego Gerbaz, Joachim Fuchs, Valter Basso, Lorenzo Pace, Marco Lassalle and Juhani Viitaniemi) aims at showing the benefits of using model-based approaches to support the verification phases of Space Systems by discussing their main advantages on the ESA MARVELS study. The results aim to demonstrate that is it possible to perform a transition to a full model-based approach in the near term for the verification process, including re-use of elements from past projects, definition of new ways to support a more effective review process.

In *"How Model Based Systems Engineering streamlines the development of complex systems"* (by Enrico Mancin), the authors describes the best practice derived from the experiences gathered through the development of complex systems. They are based on the using of UML/SysML modeling language and paradigm, supporting the preparation, verification and validation of system requirements as well as the design of the system and the execution of models, for the realization of Model-Based Systems Engineering products.

The paper *"Interface Management in Concurrent Engineering Facilities for Systems and Service Systems Engineering: A Model-based Approach"* (by Daniele Gianni, Andrea D'Ambrogio, Volker Schaus, Andreas Gerndt, Marco Lisi and Pierluigi De Simone) illustrates the integration of the Interface Communication Modelling Language into the existing Model Based Systems Engineering methods for the Concurrent Engineering Facilities software framework VirSat, by identifying the business needs driving the use of MBIE approaches and showing example application scenarios.

The paper *"How Model-Based SE Makes Product/System Lifecycle Management Framework More Effective"* (by Carmelo Tommasi and Eugenio Vacca) faces with the Intellectual Property field that has to be taking into account for allowing a company to be more competitive and successful in today's increasingly knowledge-based economy. The author provides a general discussion on an effective management approach of intellectual properties from an Industrial point of view.

In *"Product Architecture Management - an approach to Product Life Cycle"*, which is an invited paper (by Gaetano Cutrona, Andrea Margini and Cesare Fantuzzi), the author presents a methodology, that is based on the application of Product Life Cycle principles aiming at the rationalization of the decisions made during the planning, analysis and implementation phases applied in a company producing machines for the food industry. The goal of the approach is to help designers and product architects to correlate the needs of projects stakeholders (requirements) with other needs related to the product strategy and roadmap in order to improve efficiency in terms of resource management, product variants and other aspects that affect the life cycle of the product.

Last but not least, the Organizing Committee would like to thank all the authors of the scientific contributions and demos, the reviewers, and the sponsors of *CIISE14* whose joint efforts allowed this event to become real and made possible to realize such successful initiative. We are very proud of it and we consider it an important achievement for the INCOSE Italian Chapter.

The CIISE14 Organizing Committee
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Biographies

Vincenzo Arrichiello holds a Laurea Degree in Engineering from the University of Genoa. He has practiced Systems Engineering for about 30 years, covering positions either in large companies (Defense Contractors) and engineering consulting Companies (as a co-owner), applying the systems approach across diverse industry fields (Aerospace& Defense, Robotics, Packaging) He was one of the founders of the Italia Chapter of INCOSE and is now serving as its President. From 2009 he is head of the Selex Academy, and directs the relevant Systems Engineering School . He teaches Systems Engineering courses in the Academy and in some University Masters.

Andrea D'Ambrogio is associate professor of computer science at the Dept. of Enterprise Engineering of the University of Roma "Tor Vergata" (Italy). He has formerly been assistant professor at University of Roma "Tor Vergata" and research associate at the Concurrent Engineering Research Center of the West Virginia University (USA). He is Director of the post-graduate Master degree in "Systems Engineering", established at the University of Roma "Tor Vergata". Andrea D'Ambrogio's research interests are in the software engineering field, specifically in the areas of engineering and validation of system performance and dependability, model-driven systems and software engineering, and distributed and web-based simulation. In such areas he has participated to several projects at both European and overseas level and has authored more than 90 journal/conference papers. He has served as member of the program committee of various international conferences, among which IEEE WETICE, ACM WOSP, ACM ICPE, SCS/ACM/IEEE TMS/DEVS, ACM PADS and SIMUTools. He has been general chair of SCS/ACM/IEEE TMS/DEVS 2014 and IEEE WETICE 2008. In 2010 he started the IEEE International Workshop on Collaborative Modeling and Simulation (CoMetS) and in 2011 the SCS/ACM/IEEE International Workshop on Model-driven Approaches for Simulation Engineering (Mod4Sim). He is member of the management committee of the ICT COST Action on "Multi-Paradigm Modelling for Cyber-Physical Systems" (MPM4CPS). Andrea D'Ambrogio is member of the editorial board of the IAENG International Journal of Computer Science (IJCS) and the International Journal of Software Architecture (IJSA). He makes scientific advisory work for various industries and national/international organizations, and is member of IEEE, IEEE Computer Society, ACM, SCS and INCOSE.

Alfredo Garro is an Associate Professor of Computing Systems at the Department of Informatics, Modeling, Electronics and Systems Engineering (DIMES) of the University of Calabria (Italy). He received the Laurea degree in Computer Engineering and the Ph.D. degree in Systems and Computer Engineering from the University of Calabria, in 2000 and 2005, respectively. From 1999 to 2001, he has been a researcher at CSELT, the Telecom Italia Group R&D Lab. From 2001 to 2003, he collaborates with the Institute of High Performance Computing and Networking of the Italian National Research Council (CNR). From January 2005 to December 2011, he has been an Assistant Professor of Computing Systems at the DIMES Department (formerly DEIS) of the University of Calabria. His main research interests include: systems and software engineering, reliability engineering, modeling and simulation. His list of publications contains about 80 papers published in international journals, books and proceedings of international and national conferences. He has been a member of the IEEE and IEEE Computer Society since 2005; he is a member of the IEEE Reliability Society and IEEE Aerospace and Electronic Systems Society. He is a member of the International Council on Systems Engineering (INCOSE). He has been elected for the 2014 in the SPACE Forum Planning and Review Panel (PRP) of the Simulation Interoperability Standards Organization (SISO). He is member of the Executive Committee of the MODRIO (Model Driven Physical Systems Operation) ITEA2 Project and the Technical Contact for his Institution in the Open Source Modelica Consortium (OSMC).

Carlo Leardi graduated 1989 in electronic engineering in Genova Italy. His professional background starts with quality assurance responsibility evolving in the last years to full verification, validation and testing commitment within complex systems development deployment projects in the following areas: automotive, freight railways and packaging industry. As a passion before and today as a full job, he is dealing with Quantitative Systems Engineering on a day-to-day application and coaching of a full range of statistical and simulation methodologies supporting the decisional process. He published several articles in Engineering and Systems Engineering journals and acts as teacher at Systems Engineering Masters. He is one of the founders and past-president of the INCOSE Italian Chapter.

Carlo Poloni is Professor of Mechanical Engineering at the University of Trieste and is the president of ESTECO spa. He received his "laurea in Mechanical Engineering" in 1987. In 1988 he worked in the space division of Aeritalia (italian aerospace company) and from 1989 to 1992 he worked for Sincrotrone Trieste where he was responsible for the mechanical design of critical components of the synchrotron light source. During this period he started to use evolutionary algorithms in design applications. From 1993 he joined Trieste University as a researcher and started to make Multidisciplinary Design Optimisation the key topic of his research. In 1999 ESTECO was founded as a spin off company to develop and maintain the industrial software modeFRONTIER that is today a widely used tool in many industrial sectors. He has published more than 100 papers in refereed journals and proceedings. He has consulted with various companies and international organisation including European Commision, EADS, BMW, Electrolux and the modeFRONTIER software is used by more than 300 companies world-wide like Toyota, Ferrari, Yamaha, Honda, Embraer, Petrobras. He is member of several professional associations like IEEE, ATI, NAFEMS and is board member of the Italian Chapter of INCOSE.

Andrea Tundis is Research Fellow at Department of Informatics, Modeling, Electronics and Systems Engineering (DIMES) of the University of Calabria (Italy). He received the Laurea Degree in Computer Engineering from the University of Calabria (Italy) in 2009, a Master title in Industrial Research from the same Institution in 2010, and, on February 2014, a Ph.D. Degree in Systems and Computer Engineering from the University of Calabria where he is currently a research fellow. His main research interests include the definition of model-based methods for the reliability and safety analysis of systems as well as models for the formalization and traceability of non-functional requirements. In the last year, he worked at the Programming Environment Laboratory (PELAB) at Linköping University (Sweden) on the extension of the Modelica language for the modeling of system properties in the context of the MODRIO (Model Driven Physical Systems Operation) ITEA2 Project.