Ramentor Oy

Contribution

Background, Experience and Knowledge

CONTENT

1   RAMENTOR'S RAMS AND ELMAS BACKGROUND

Since 1996 Professor Virtanen and his research team in Helsinki and Tampere Universities of Technology have produced simulation models and analysis tools for integrating the reliability, availability, maintainability and safety (RAMS) aspects into the complex systems' design and management processes. The research work was carried out together with various Finnish industrial companies, Finnish Defense Forces and Finnish funding agency for technology and innovation (Tekes). The participants represent manufacturers and users in metal, energy, pulp and paper, nuclear power, electronics industries. Their products and systems have to meet high safety and reliability demands.

The methods that were created during the research formed the foundation for the development of RAMS analysis software. The Competitive Reliability technology programme (carried out 1996 – 2000) of the [1] was the background for the research project (2001–2004), which was made in co-operation with Tampere University of Technology (TUT), Artekus Oy and several Finnish companies. Prototype versions of risk assessment software were the results of the project.

The development of RAMS design software tool that is applicable for industrial use was demanded by Tekes for funding the TUT's RAMS research projects. The RAM products development project (2003-2005) refined a commercial Event Logic Modeling and Analysis Software (ELMAS) [2] from the prototype versions. Instead of traditional FTA, the software uses a new method created for modelling and analysis of causes and consequences of failures [3]. Artekus Oy released also commercial versions of RAMalloc [4-5], StockOptim [6] and RAMoptim [7-8] software.

A new company Ramentor Oy continued the development of the approach with projects RAM Solutions and Efficiency (2006–2010). During 2008-2012, Ramentor participated in Prof. Virtanen's RAMS research project, which was a significant part of Tekes Digital Product Process (DPP) Technology Program. The goal of the DPP program was to enhance the efficiency of advanced ICT utilization in the product life cycle. Programme volume was 100 million euros of which approximately 40 million euros from Tekes and 60 million from Finnish process and technology industries. The focus of prof. Virtanen's research in DPP programme was to develop probabilistic methods for innovative product-service design and development, where information and communication technology (ICT) is integrated to products/assets, and intelligent maintenance systems (IMS) are applied to probabilistic risk assessment and life cycle management. During the projects Ramentor released a software named ELMAS 4, which combined the features of ELMAS and RAMoptim.

The latest version is ELMAS 4.9, which uses advanced FTA modelling technique [9]. It includes various extensions in the traditional FTA, and permits including user-defined procedure codes to support modelling of domain-specific features. This enables, for example, (i) combining FTA and FMEA analyses [10], (ii) including dynamic rules for backup power supply [11], (iii) defining exclusive stochastic consequences [12], and (iv) multi-state modelling of dynamic operation phases [13].

RAMS modeling and stochastic simulation of ELMAS software have been applied widely in the area of reliability engineering, risk assessment and maintenance optimization. Various problems have arisen from numerous industrial projects. Ramentor has provided solutions, which are based on sophisticated mathematical models and methods, as well as large computer-aided calculation and simulation schemes. In practice, each Ramentor's expert has accumulated at least 10 years of work experience in implementing industry-demanding RAMS projects as part of the development and application of ELMAS software.

2 RAMENTOR'S EXPERIENCE AND KNOWLEDGE

Initially all Ramentor's experts have participated in TUT's RAMS research. They have completed their masters theses and worked as TUT's researchers during the close co-operation between TUT and Ramentor. The theoretical background of RAMS methods and tools forms the basis of Ramentor's expertise in challenging industrial risk assessment applications. Application of the methods with the help of ELMAS tool bring significant added value to the RAMS design and decision-making process in different state of the assets life-cycle.

Since 2010 Ramentor's ELMAS Software has been the method for auditing technical plans and risk analyses of Posiva's facility for the encapsulation and final disposal of spent nuclear fuel. The systems of the facility were analyzed with the failure tolerance analysis approach that was developed by Ramentor. In 2015 Posiva announced that the Radiation and Nuclear Safety Authority of Finland (STUK) issued to the Finnish Ministry of Employment and the Economy its statement on the safety of Posiva's facility. STUK concludes in its statement that the criteria set forth in the Nuclear Energy Act are fulfilled and the final disposal facility can be built to be safe.

The European Organization for Nuclear Research (CERN) set the FCC study team to research industrially applied best-practices and tools for reliability and availability studies aiming at optimizing return of investment on the test stand. In 2014 Professor Virtanen together with TUT's researchers and Ramentor's experts entered the world-wide FCC study collaboration bringing in a deep experience in industry projects and well-proven tools to carry out RAMS studies in close collaboration with engineers and accelerator physicists. Since 2016 Ramentor has continued individually the R&D project, RAMS training program and industry cooperation development with CERN. In 2017 Ramentor received also the FCC study innovation award for the design work on an open and scalable modelling and simulation platform [14-15] to understand and optimize the reliability, availability and energy efficiency properties of the particle accelerator complex.

Other customer cases have included, for example, data center, paper and pulp mills, lifting equipment, tyre production process, district cooling and heating plants, maintenance outsourcing, veneer production, propulsion equipment, nuclear plant, power transmission lines, material handling solutions and telecommunication networks analyses. Projects have been made in design, realization and operation & maintenance stages to, for example, increase availability, decrease life-cycle costs, optimize maintenance plan, and assess the component criticalities.

Areas of Ramentor's expertise:

- Modeling and analysis of systems failure cause-consequence logic

- Specification and allocation of RAMS design requirements

- Analysis of design solution to fulfill requirements set for its RAMS performance

- Assessment of Systems' RAMS criticality RCM-positions

- Systems Fault tolerance analysis

- Application of Design Review in large scale investment projects

- Assessment of the suppliers capability to fulfill requirements set to the assets

- Design and Management of the assets' basic and extended Warranty contracts (length of period, terms, costs and risks)

- Optimization of the Systems' specific maintenance service program (CBM-TBM-CM) to achieve required availability and safety with minimum costs

- Design and Management suppliers service contracts (length of period, terms, costs and risks)
- Design and cost optimization of required maintenance resources and Spare parts stock
- Supply Chain Management
- Probabilistic Risk Assessment and Management in large scale investment project
- etc.

Basic knowledge of

- System Engineering
- RAMS design, engineering and management
- Probabilistic risk assessment and management
- Qualitative aspects of system analysis
- Event Logic Modelling and Analysis
- Quantification of basic events
- Quantitative aspects of system analysis
- Uncertainty Quantification
- Component importance
- etc.

Advanced knowledge of

- Data mining
- Discrete Mathematics
- Statistical data processing
- Multivariate regression analysis
- Counting processes (e.g. Homogenous and non-homogeneous processes)
- Probability and discrete math
- Stochastics processes
- Software algorithms
- etc.

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