European Safety and Reliability Association

Newsletter

http://www.esrahomepage.eu March 2017

Editorial

Terje Aven
ESRA Chairman
University of Stavanger, Norway

Dear ESRA Colleagues,

The major event this year is the ESREL 2017 conference in Portoroz, Slovenia 18-22 June. See http://esrel2017.org. The General Conference Chair is Marko Cepin, University of Ljubljana, Slovenia, and the Technical Programme Committee Chair is Radim Bris, Technical University of Ostrava, Czech Republic. They are doing a great job, and we all look forward to meet at the conference. The place looks spectacular.

ESRA currently has 27 technical committees (TCs), see http://esrahomepage.eu. A work has been conducted to establish updated contact lists for the TCs. The idea is that the TC Chairs can use these for communication purposes related to relevant activities. If you have not yet registered and would like to be informed about TC activities for your areas of interest, please contact the TC Chairs directly.

We also this year provide direct financial support to several initiatives proposed by our members in response to our annual call for project proposals. This year we got an exceptionally large number of applications, which made it clear that we need to develop some more detailed guidelines for how to select the projects to be supported. The topic will be addressed at the coming General Assembly Meeting during ESREL 2017.

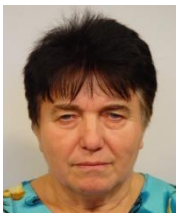
Among the initiatives supported can be mention a workshop on reliability technologies within the international conference on digital technologies in July in Zilina (Slovakia); a PhD school on Vulnerability, Risk and Resilience of Complex Systems and Critical Infrastructures, ECP, Paris; a Workshop on Reliability Assessment of Existing, Complex Civil Engineering Structures, TNO, the Netherlands; a Workshop on Virtual maintenance with focus on safety and reliability at Luleå Technical University, Sweden; a training course in November 2017 on advanced methods for reliability, availability, maintenance, diagnostics and prognostics of industrial equipment at the Politecnico di Milano, Italy; the 3rd Computational Reliability Engineering (CRE) Symposium for technical complex products, University of Wuppertal and University of Liverpool; and an international summer school in Poland (SSARS). Congratulations to all and good luck with the activities. We look forward to reading about these events in coming issues of the ESRA newsletter.

Also this year we will carry out an update of the ESRA memberships, and related payments. I hope that you have already ticked off for paid membership fee for 2017. Thanks.

Terje Aven
Chairman of ESRA

Feature Articles

Assessment of Risk Targeted to Complex Technological Facilities Safety



Dana Prochazkova
Czech Technical University in Prague, Czech Republic
prochazkova@fd.cvut.cz

The assessment of risk can be considered from the both, the theoretical view and the practical view. For security and development of humans it is important the risk assessment targeted to practical trade-off with risks; it goes on protection of human lives and health and other public assets that are necessary for humans (humans create the human space).

Complex technological facilities (hereafter only CTF) belong to the public assets because they ensure the humans live quality and at critical conditions they enable survival of humans. They represent multistage mutually overlapping open systems, i.e. the structure that we denote as the system of systems. Their makeup is limited area structure or network. Series of events from recent years connected with the CTF accidents and failures have been showed high importance of their safety.

To ensure the CTF safety it is necessary to consider the safety of whole complex, i.e. the integral safety. For this purpose it needs to work with an integral risk. The CTF integral risk is influenced by reality that CTF has a range of protected assets of different nature that are interfaced by internal links and couplings created by flows. Because the goals of assets are not the same, it is necessary to expect the conflicts. At several conditions (caused by occurrence of special disaster with size greater than design one – boundary value that assets and their interfaces withstand without greater losses and damages) the interfaces are the causes of another conflicts. Therefore, the CTF integral risk also depends on the hazards from disasters of all kinds (natural, technological, social, financial, economical, legal etc.) that can threatened it; the disasters affected not only the individual assets but also their links and couplings, which leads to the cascade failures.

For correct CTF risk assessment it is important to consider all disasters that can damage the CTF, and properly to determine the sizes of hazards connected with individual disasters. The risk connected with each disaster is probable size of losses, damages and harms on the CTF for hazard connected with the design disaster divided to one year. The crucial is the correct determination of hazard connected with the design disaster. **Both, the performed CTF safety reports audits and the inspections after the CTF accidents or failures, revealed that in evaluated cases**:

- Some possible disasters with potential to disrupt the CTF were not considered at risk determination directed to the CTF safety,
- Several faults in determination of correct value of hazard connected with design disaster were found (e.g. data from too short time interval on disaster, too limited knowledge).

From the practical reasons it is necessary to consider that the CTF risk connected with the given disaster does not represent only direct losses on assets but also and indirect ones; the indirect losses are caused by: delays or errors in response, cascades of failures caused by synergic and cumulative effects, which are caused by linkages and couplings among the assets; and by domino effects.

Due to the CTF structure their risk is the integral risk that is expressed by following formula:

$$R(H) = \left[\sum_{i=1}^{n} A_i(H) Z_i(H) + \sum_{i=1}^{n} \int_0^T \int F(H, A_i, P_i, O, t) \mathrm{d}S\mathrm{d}t\right] \cdot \tau^{-1}$$

where: $\boldsymbol{H}$ is the hazard connected with the considered disaster; $\boldsymbol{A_i}$ are the values of assets**, $i = 1,2, \ldots, n$** that are considered in connection with complex technological facility safety, where $\boldsymbol{n}$ is the number of monitored assets; $\boldsymbol{Z_i}$ are the vulnerabilities of assets taken under account, $\boldsymbol{i = 1,2, \ldots, n}$; $\boldsymbol{F}$ is the loss function; $\boldsymbol{P_i}$ is the occurrence probability of i-th asset damage – conditional probability; $\boldsymbol{O}$ is the vulnerability of safeguard measures; $\boldsymbol{S}$ is the size of followed territory / facility; $\boldsymbol{t}$ is the time that is measured from the origin of harmful phenomenon in facility; $\boldsymbol{T}$ is the time for which losses arise; and $\boldsymbol{\tau}$ is the return period for the given disaster.

Because the loss function $\boldsymbol{F}$ form is not known, we use for determination of total risk (i.e. the integral risk) the scheme given in Figure 1.

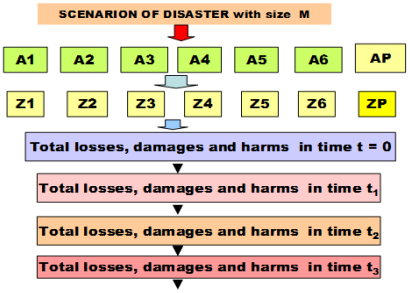


Figure 1. Flowchart for determining the risks for the strategic management of safety; A – assets and Z losses, damages and harms to the assets; Description: 1-the human lives and health, 2- human security, 3 - property, 4 - the public welfare, 5 - the environment, 6 - infrastructures and technologies, P – private

Onward the problem is complicated by reality that the world is in dynamic development, i.e. both, the CTF conditions and the risk sources are changing in time. Moreover, there is necessary to respect that the risk and safety are not complementary quantities – it holds that the risk reduction leads to safety increase but

at the same risk value the safety can increase if humans perform special measures or at their behaviour use special manners following from correct safety culture.

Therefore, at solution of practical tasks connected with both, the CTF safety and the CTF risk, ***it is necessary to consider that risks are normal and for the CTF safety it is necessary to apply*** not only the risk prevention measures and activities determined on the basis of correct intent and correct data and methods, but also:

- The safety culture by which the human behaviour in the CTF and its vicinity is targeted to safety,
- The tools that reduced losses and damages if some important disasters occur.

Therefore, it is necessary to prepare the qualified response for important risks realizations, such as:

- The risk management plans for both, the CTF and the CTF vicinity for all relevant risks,
- The continuity plans for survive of important CTF technological parts,
- Operational crisis plans for both, the CTF and its vicinity.

Risk matrices – mind your step

Nijs Jan Duijm
Technical University of Denmark, Department of Management Engineering
nidu@dtu.dk

The risk matrix is a popular tool in risk assessment. However, it has a few trap holes that one should keep in mind. This article summarizes a paper published in Safety Science (Duijm 2015), reviewing strengths and weaknesses of the risk matrix, and provides guidance on how the risk matrix should be used. A general conclusion can be drawn upfront: if all parties and stakeholders involved in a risk assessment agree on the use of quantified risk assessment, please forget about using risk matrices.

Risk can be expressed as a combination of the consequences of an event together with the associated likelihood of its occurrence. Many risk managers do not like numerical values for likelihood and consequence, but prefer discrete categories instead. The risk matrix facilitates assigning a discrete risk category to each combination of consequence and likelihood, i.e. it provides a mapping of consequence and likelihood to risk. This mapping may account for subjective or societal aspects of risk perception, such as major hazard aversion.

Some authors, notably (Cox Jr 2008) and (Levine 2012) define *Risk=probability×consequence* or a similar function. The essence of Cox' analysis is that the risk matrix shall replicate that definition of risk. Equal risk scores in the matrix shall correspond to equal values of the product of the cell's ordinates. We advocate that the risk mapping that appears through the coloring of the risk matrix is a *risk definition in its own right*. Expected loss (*probability or frequency* × *consequence*) is a meaningful risk metric, but it is not necessarily the basis for risk acceptance, so the risk matrix shall not necessarily reproduce expected loss.

We summarize some problematic issues when using or designing risk matrices:

- The naming and scaling of categories
- Aggregation and detail
- Ambiguity of the consequence definition

Scaling

The discrete consequence and likelihood categories are often identified by nominal, textual descriptions, such as "negligible", "serious", "catastrophic", and "almost impossible", "probable", "often". The meaning and ordering of the categories should be instantly clear to the reader. This is not trivial. One shall ensure that all stakeholders have the same understanding of the category. It is advisable that the nominal categories be linked to some quantifiable reference. Instead, or complementary to, using nominal categories, numerical ranges can be used to clarify the categories. ISO (ISO 2010) recommends to add this information if available.

The categories in a risk matrix can be almost equidistant, representing linear scaling, or they can differ by some multiplicative factor, representing a logarithmic scale. Linear scales are often found in the domain of project and financial risk. Logarithmic scales (with likelihood categories like 10^{-5}-10^{-4}, 10^{-4}-10^{-3}, etc.) are often found in safety risk studies. It may be hard to talk about "linear" or "logarithmic" scales when using textual category headings, although moving from "minor injury" to "major injury" and "fatality" by many will be perceived as a logarithmic scale.

Risk levels can be assigned to cells in the risk matrix in two ways, either by coloring using subjective arguments, or by numerical risk scores. Often the risk scores are the sums of the rank numbers assigned to the consequence and probability categories, as in Figure 2. When the categories are logarithmically scaled, this has the advantage that the diagonal bands and same risk scores represent (or are close to) equal expected loss.

		Consequence Categories			
		C1	C2	C3	C4
Likelihood Categories	F4	R5	R6	R7	R8
	F3	R4	R5	R6	R7
	F2	R3	R4	R5	R6
	F1	R2	R3	R4	R5

Figure 2. A 4x4 risk matrix with risk scores derived from the addition of the ordinal numbers of the likelihood and consequence category. Notice the identical risk scores along diagonals.

Aggregation

In this summary we only mention the problem of aggregation with respect to detail of the risk study. ISO (ISO 2010) states about this:

"Results will depend on the level of detail of the analysis, i.e. the more detailed the analysis, the higher the number of scenarios, each with a lower probability. This will underestimate the actual level of risk. The way in which scenarios are grouped together in describing risk should be consistent and defined at the start of the study."

Ambiguity

There are different practices for defining consequence endpoints. Three possibilities are observed in practice:

1. The consequence is represented by an event that has the *potential* to cause damage (worst case); the associated probability is the probability that the event (irrespective of the actual damage) occurs

2. The consequence is represented by the most likely or most *representative* damage; the associated probability is the probability that the event (irrespective of the actual damage) occurs;

3. The consequence is represented by a few alternative, discrete damage outcomes, each in another consequence category; the associated probabilities are the probabilities that each of those damages occur.

The main article (Duijm 2015) demonstrates that depending on the endpoint definition, the risk can change from "green" to "red", so care is needed. Although method 1 is not the recommended approach according to ISO (ISO 2010), it is often encountered and maybe quite well in line with the overall approximate nature of risk matrices, if the approach is used consistently.

Conclusion

We highlighted a few critical issues concerning the design and use of risk matrices. There have been earlier critical reviews of risk matrices (Cox Jr 2008; Flage and Røed 2012; Levine 2012), and some of the concerns in these reviews have been confirmed, while others are less critical in our view. Note that (ISO 2010) provides an excellent guidance on risk matrices, covering many, but not all, of the critical issues.

References

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Duijm, Nijs Jan. 2015. "Recommendations on the Use and Design of Risk Matrices." Safety Science 76. Elsevier Ltd: 21–31. doi:10.1016/j.ssci.2015.02.014.

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ISO. 2010. "IEC/ISO 31010:2009: Risk Management - Risk Assessment Techniques." Edited by I E C T C 56. Brussels: CENELEC.

Levine, E S. 2012. "Improving Risk Matrices: The Advantages of Logarithmically Scaled Axes." Journal of Risk Research 15 (2): 209–22.

PhD Degrees Completed

Contributions to improved risk assessments – To better reflect the strength of background knowledge

Christine Berner
University of Stavanger, Norway
Main supervisor: Associate Prof. Roger Flage
Co supervisors: Prof. Terje Aven & Associate Prof. Seth Guikema

Christine Berner recently defended her PhD thesis at the University of Stavanger, Norway. The research presented in the thesis is a contribution to the research project "Improved risk assessments – to better reflect the knowledge dimension and surprises", funded by the Research Council of Norway through the PETROMAKS II program. Her thesis aims to contribute with improvements to the scientific field of risk assessment and management. More concretely, providing practical guidance, with a solid scientific foundation, on how to better reflect and utilize the knowledge dimension when assessing and managing risk. A particular focus has been on the assumptions made in risk assessments. The thesis consists of five papers with their contributions briefly summarized in the following.

The first paper suggests a method for the systematic treatment of uncertain assumptions in quantitative risk assessments. The suggested method is based on defining different settings faced when making assumptions in a risk assessment, considering beliefs about assumption deviation, sensitivity of the risk index to changes in the assumption, and the overall strength of knowledge involved. The result is a set of recommended strategies that allow for balancing the need for uncertainty treatment with the resources spent.

The second paper builds on the first paper, in particular on the different settings faced when making assumptions in risk assessments; however, the focus here is on how decision-makers and/or risk managers can create risk management strategies based on critical assumptions identified in the risk assessment. The suggested risk management strategies are motivated by an approach known as Assumption Based Planning.

The joint aim of the two first papers is to provide risk analysts and decision-makers and/or risk managers with a practical and commonly founded method for treating and managing uncertain assumptions in risk assessments and during risk management.

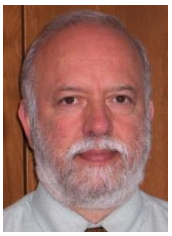
In the third paper the aim is to suggest how information from the risk assessment, in particular assumptions made but also other parts of the background knowledge of the risk assessment, can be presented to the decision-makers and/or risk managers

(or other relevant stakeholders). A main contribution of the third paper is the suggestion for how the risk analyst can visualize the strength of the background knowledge on which assumptions or risk indices are based.

The fourth paper focuses on two alternative approaches that can be used to represent uncertainty in quantitative risk assessments. The purpose of the paper is to compare a probability bound analysis with a traditional subjective probability approach for a particular case study. The paper illustrates the problem of balancing the need for analysis that provides clear recommendations based on stronger assumptions, against the provision of less clear recommendations based on weaker assumptions.

Lastly, in the fifth paper, we use a validated and verified model for the prediction of power outages as a result of hurricanes in the USA. By generating random hurricane tracks and altering the peak wind speeds of the simulated hurricanes, we identified hurricane scenarios with a surprisingly large number of power outages, as well as scenarios where a relatively low wind speed resulted in a surprisingly large number of power outages. These results indicate how models can be used to create awareness of, and possibly increase the knowledge related to, potentially surprising events with extreme impact.

RESS News



Carlos Guedes Soares
Editor-in-Chief RESS
Instituto Superior Técnico,
Universidade de Lisboa

The Reliability Engineering and System Safety (RESS) Journal has had a change of Associate Editor this year. Prof Joe Saleh gave a very dedicated contribution to the Journal during the last mandate, but he realised that the journal was taking much of the time he wanted to dedicate to research, so he has stepped down. In the meanwhile Prof. Mahesh Pandey from the University of Waterloo, in Canada took over this duty and we look forward to his enthusiastic contribution. This year the usual rotation of members of the Editorial Board was a bit more extensive than usual and we welcomed several new members: JM Bourinet, Radim Bris, Antoine Grall, William Oberkampf, Jinkiun Park, Rui Peng, Luca Podofillini and Shaomin Wu. Our thanks goes also to the contributions of the outgoing Editorial Board members.

RESS is continuing an active policy towards having special sections or issues on specific topics so as to present a more focused view on them.

Recently closed special sections, which will be shortly appearing on the web site are:

- Games and Decisions in Reliability and Risk
  Guest Editors: Refik Soyer and Suleyman Ozekici
- Reliability and Performance of Multi-State Systems
  Guest Editors: Gregory Levitin and Liudong Xing
- Maintenance Modelling
  Guest Editors: Shaomin Wu, Phuc Do

Presently the following special issues are **open to submissions**:

- Complex Systems RAMS Optimization: Methods and Applications
  Guest Editors: David W. Coit, Enrico Zio
- Impact of Prognostics and Health Management in Systems Reliability and Maintenance Planning
  Guest Editors: Joo Ho Choi and Ming Zuo

The **special issue of ESREL 2015** is finally open for submissions starting in April 2017:

- Foundations and Novel Domains for Human Reliability Analysis
  Guest Editors: Luca Podofillini and Ali Mosleh

ESRA News

Continuing education course: "Advanced methods for reliability, availability, maintainability, diagnostics and prognostics of industrial equipment"

Author: Francesco Di Maio

The 2016 professional one-week training course: "Advanced methods for reliability, availability, maintainability, diagnostics and prognostics of industrial equipment" took place at Politecnico di Milano, Milan (Italy) on November 21-24. The course was the XIX edition of the series. Its goal has been to provide the participants with the methodological competences and the computational tools necessary to tackle critical problems in the areas of reliability, availability, maintainability, diagnostics and prognostics. To this purpose, the course has presented proven methods to improve safety, increase efficiency, manage equipment aging and obsolescence, automate maintenance and reduce maintenance costs of industrial systems.

Since the beginning, the course has been officially supported by ESRA and since 2005 official scholarships have been offered. The 2016 edition of the course has been supported by ESRA with two

scholarships covering the registration fee. The 2016 scholarships have been offered to two Ph.D students, one of Univeristy of La Sapienza (Roma, Italy) and the other of Politecnico di Milano (Milano, Italy).

The first part of the course has been devoted to the presentation of advanced methods for the availability, reliability and maintainability analysis of complex systems and for the development of Prognostics and Health Management (PHM) and Condition Based Maintenance (CBM) approaches. In this respect, the basics of Monte Carlo Simulation, nonlinear regression and filter models (Auto Associative Kernel Regression, Wavelet transforms, Artificial Neural Networks, Echo State Networks, Particle filter) is illustrated. In the second part of the course, exercise sessions on Monte Carlo simulation, Artificial Neural Networks and Auto Associative Kernel Regression provide the participants with the opportunity of directly applying the methods to practical case studies. Finally, in the last part of the course, real applications of the advanced methods have been presented by the course organizers and participants. The applications range from Monte Carlo Simulation for availability analysis and condition-based maintenance management to regression and classification techniques for fault detection, classification and prognosis in different industrial sectors.

The 2017 edition of the course fill take place at Politecnico di Milano, Milan (Italy) on November 2017.

XVIII Dependability Conference (XVIII Congreso de Confiabilidad)

Organized by the Spanish Dependability Society (Asociación Española para la Calidad, AEC). Held 23 and 24 November in Madrid (Spain). The participants came from the industrial sector and from Universities and in the meeting the main discussion was about the challenge of applying the concept **Industry 4.0**, and the importance of dependability in this context. The application of this concept relays on the use of techniques such as big data, cloud monitoring and statistical analysis to improve industry competitiveness. In this way several tools to cope with this objective were presented.

Invited Lecture on “Advances in product qualification and supply chain responsibilities”

Author: Francesco Di Maio

On November 25, at Politecnico di Milano, an invited lecture has been held by Prof. Michael Pecht (Director and Chair Professor, Center for Advanced Life Cycle Engineering, University of Maryland, College Park, Maryland, USA) on the topic “Advances in product qualification and supply chain responsibilities”. The successful event has gathered more than 50 international researchers and professionals (engineers, maintenance professionals, facility managers and operators) as well as university students with an interest in Reliability, Availability and Maintainability (RAM) in various applications (transportation by air, land and sea, manufacturing, power production, …). The event was organized by Politecnico di Milano and supported by ARAMIS S.r.l, the Prognostics and System Health Management technical committee of ESRA, the Nuclear Industry technical committee of ESRA and the IEEE Reliability Society, Italy Chapter. The talk addressed the nowadays rapid products change, customer’s numerous choices and tremendous price pressure on suppliers, that are pressured to test quickly their products.

However, the traditional test and qualification standards were claimed not to be working. Over the past 10 years, there have been an increasingly large number of products that have passed qualification tests but have failed in the field. The resulting costs of these failures have been in the hundreds of millions of dollars for many companies. This lecture has overviewed why the current methods are inadequate, why the standards need to be replaced and how companies can qualify products in an accelerated manner to ensure acceptable reliability. Virtual qualification, accelerated testing, target application requirements, failure mechanisms and models, and prognostics-based qualification were discussed, with various examples. Responsibilities with the supply chain were also presented.

Past Safety and Reliability Events

2nd international "Computational Reliability Engineering (CRE)” Symposium

Dresden, Germany
27-28 October 2016

The annual Computational Reliability Engineering in Product Development and Manufacturing symposium was held in Dresden (Germany) on 27th and 28th October, 2016. The chair of Reliability Engineering and Risk Analytics (University of Wuppertal) of Univ.- Prof. Dr.-Ing. Stefan Bracke organised the symposium in cooperation with Babtec Informationssysteme GmbH and Meiji University from Tokyo. During the symposium all invited guests from the academic world and the industry discussed on recent topics regarding product reliability and high precision manufacturing of technical complex systems.

The goal of the symposium was the exchange of knowledge and experiences between the participants. The research community was represented by Meiji

University (Tokyo, Japan), University of Liverpool (United Kingdom), Leibniz University Hannover (Germany), University of Paderborn (Germany), Technical University of Cologne (Germany), Wroclaw University of Technology (Poland), Technical University Dresden (Germany), University of Siegen (Germany) and University of Wuppertal (Germany). Furthermore, the representatives of the following enterprises were attending the symposium: Siemens AG (Germany), Robert Bosch GmbH (Germany), Hager & Meisinger GmbH (Germany), Carl Zeiss SMT GmbH (Germany), FGW Group (Germany) and BABTEC Informationssysteme GmbH (Germany).

The first day of the CRE-symposium took place at VW´s "Gläserne Manufaktur" (The transparent Factory). Premium class vehicles VW phaeton and Continental Flying Spur of VW´s subsidiary Bentley were assembled in VW´s manufactory. Visitors could watch the precision of workmanship at every step of the assembly line from 2002 till 2016. After the stop of the production of VW phaeton models in Dresden, the transparent factory was converted to an exhibition of electromobility.

With a wonderful view into every floor of the assembly line and onto the entrance hall of the transparent factory directly under the roof, the reliability experts presented their recent findings concerning reliability and high precision techniques.

The presentations contained product as well as process driven approaches. The researchers from Meiji University introduced their concept considering reliability issues within the product life cycle design.

Concerning the product driven reliability analyses a wide product spectrum was discussed of nearly every phase of the product life cycle: lifetime performance and condition testing of shape memory alloy driven actuators during reliability validation (FGW), Time series analyses of anodes in the electrowinning process (BUW), the consideration of uncertainties using Mote Carlo Methods (Zeiss) and electromagnetic susceptibility tests in aerospace (Universität Siegen). TU Cologne presented the operating principle and the application area of hydroformed micotubes, a part of the microsystem manufacturing.

On the second day, the attendees took part in an external excursion visiting the centre of high precision watchmaking at Glashütte, Germany. The first manufactory was found in 1845 in this small Saxon town, 25km south of Dresden. The programme started with a guided tour through the German Watch Museum where more than 450 unique exhibits of Glashütte pocket watches, wristwatches, pendulum clocks and marine chronometers and their high precision development can be admired. Thereafter, the reliability experts had the opportunity to see the whole art of watchmaking – in terms of high precision manufacturing - during the guided plant tour of Glashütte Original. This watch manufactory designs and produces high class premium watches with a high proportion of authentic manual labour.

The next CRE-Symposium will be organised in October 2017 in London, United Kingdom, with, as usual, invited academic and industrial partners.

The organisers thank the official supporters: Babtec Informationssysteme GmbH from Wuppertal, Meiji University from Tokyo, University of Wuppertal and IAP GmbH from Cologne for the support and successful cooperation. Furthermore, the gratitude goes to Glashütte Original for the interesting guide and deep insights into the high manufacturing processes.

For further questions please contact:
Univ.-Prof. Dr.-Ing. Stefan Bracke
Chair of Reliability Engineering and Risk analytics
Faculty for Mechanical and Safety Engineering
University of Wuppertal
Internet: http://www.lzr.uni-wuppertal.de
Mail: bracke@uni-wuppertal.de

Figure 3. Participants at VW´s "Gläserne Manufaktur" (The transparent Factory)

The 14th International Probabilistic Workshop

Ghent, Belgium
5-7 December 2016

From 5 to 7 December 2016 the 14th International Probabilistic Workshop took place in Ghent. The International Probabilistic Workshop series is a rather small annual conference series with usually 50 to 100 participants and conference locations moving within Europe. The conference took already place in Austria, Belgium, Czech Republic, Germany, Poland, The Netherlands and U.K. The conference series strongly focuses on the presentation of the work of young researchers and therefore was several times supported by the ESRA.

Usually the conference does not feature parallel sessions. Due to this fact, the strong contribution by young scientists and the great variety of topics in the field of probabilistic and risk analysis, the conference enjoys a very open discussion culture.

This year the conference series returned for the first time to a former conference city. The distinguished organization and location, the beautiful city of Ghent and more then 30 very dedicated presenters created a very comfortable, creative and productive discussion atmosphere for the more than 50 participants during the sessions and in the breaks. The conference covered topics such as flexibility of structures, sensitivity analysis, fire safety, traffic and wind load, probabilistic description of various materials and constructions, imprecise probabilities, core damage frequencies, the presentation of some COST-projects and many others.

The conference was excellently organized and headed by Prof. Robby Caspeele from Ghent University. The papers of the conference are available in a Springer Book (14th International Probabilistic Workshop).

The next conference will be in Dresden on 27 to 29 September 2017. Further upcoming conferences will be in Austria (Vienna 2018), Scotland (Edinburgh 2019) and Portugal (2020).

Figure 4. Participants of IPW 2016

Figure 5. IPW 2016 Session

will also be an opportunity for researchers and practitioners, academics and engineers to meet, exchange ideas and gain insights from each other.

More than 600 abstract were received. More than 500 abstract were accepted. More than 450 papers were received. More than 400 papers are accepted and are going to be presented.

Invited plenary lectures will be given by 4 distinguished researchers:

- Dr. Stefan Hirschberg, Paul Scherrer Institut, Switzerland;
- Professor Enrique Lopez Droguett, Universidad de Chile, Chile;
- Professor Daniel Straub, Technische Universität München, Germany;
- Professor Antoine Rauzy, Norwegian University of Science and Technology, Norway.

Please register to the event: www.esrel2017.org

Organisers:
General Chair: Marko Čepin
General Co-Chair: Terje Aven
Steering Committee Chair: Enrico Zio
Program Committee Chair: Radim Briš

Conference Information and Contacts:
Conference website: **http://www.esrel2017.org**
Email: conference@esrel2017.org
Conference secretary phone: +386 1 620 82 35
General chair phone: +386 1 4768 243

Calendar of Safety and Reliability Events

27th International Conference on Safety and Reliability (ESREL2017)

Portorož, Slovenia
18-22 June 2017

The annual European Safety and Reliability Conference ESREL is an international conference under the auspices of the European Safety and Reliability Association (ESRA Website: esrahomepage.eu).

The 27th edition of the international conference, ESREL 2017, will provide a forum for presentation and discussion of scientific works covering theories and methods in the field of risk, safety and reliability, and their application to a wide range of industrial, civil and social sectors and problem areas. ESREL 2017

36th International Conference on Ocean, Offshore and Arctic Engineering (OMAE2017)
Symposium on Structures, Safety and Reliability

Trondheim, Norway
25-30 June 2017

Since 2003, the OMAE conference has more than tripled in size, with over 1,000 participants at OMAE 2015 in St. John's, Canada and over 900 in Busan, Korea. The annual OMAE conference is an international assembly of engineers, researchers, and students in the fields of ocean, offshore and arctic engineering.

The conference is organized by thematic area in 9 traditional Symposia, one of which deals with topics of Safety and Reliability as applied to this industrial domain. This Symposium typically has around 120 papers and thus is an interesting venue for reliability

specialists that want to develop applications in this industrial sector.

Call for papers - Authors should submit a title/abstract to begin the paper submission process. Draft manuscripts and final-paper submissions must conform to ASME publication guidelines.

Specific questions can be addressed to the **Symposium Coordinator** at:

c.guedes.soares@centec.tecnico.ulisboa.pt

Important dates:

- October 7, 2016 - Submission of Abstract Due Date
- January 9, 2017 - Submission of Full-Length Draft Paper for Review
- February 6, 2017 - Paper Reviews Completed
- February 13, 2017 - Author Notification of Required Revisions
- February 27, 2017 - Author Notification of Acceptance of Paper
- March 27, 2017 - Submission of Final Paper

Conference Website: **http://www.omae2017.com**

The International Conference on Information and Digital Technologies 2017 (IDT 2017)

Zilina, Slovakia
5-7 July 2017

The International Conference IDT'2017 is the annual event. The aim of the Conference is to bring together researches, developers, teachers from academy as well as industry working in all areas of digital technologies. Especially young researchers and postgraduate PhD students are greatly welcome to participate in this event. Beside the scientific field, several cultural and social events are planned for the enjoyment of the Conference attendees.

Each paper will be evaluated for acceptance by at least two peer reviewers. Furthermore, paid registration to the Conference is mandatory for paper acceptance (one registration per paper). We are going to add the publication of the full set of accepted papers IEEEXplore, Scopus and Web of Science.

Special events:

The two Workshops in framework of the conference will be organized:

- Int. Workshop on Biomedical Technologies
- Int. Workshop on Reliability Technologies

Important dates:

- March 13, 2017 – Full paper submission
- May 22, 2017 – Paper acceptance notification
- June 5, 2017 - Camera-ready papers
- June 19, 2017 - Final program

Conference website:
http://idt.fri.uniza.sk ; **http://idt.fri.uniza.sk/idt2017**

15th International Probabilistic Workshop (IPW)

Dresden, Germany
27-29 September 2017

The conference is intended for mechanical, civil and structural engineers and other professionals concerned with components, structures, systems or facilities that require the assessment of safety, risk and reliability. Participants could therefore be consultants, contractors, suppliers, owners, operators, insurance experts, authorities and those involved in research and teaching.

The 10th Dresdner Probabilistik Workshop will be hold in connection with the 15th International Probabilistic Workshop.

Key topics:
Safety, Risk, Probabilistic Computation, Reliability, Structural Safety, Mechanical Safety

Organisers:
Dr.-Ing. Matthias Voigt,
Prof. Dr.-Ing. Wolfgang Graf,
Prof. Dr.-Ing. habil. Ulrich Häußler-Combe,
Prof. Dr.-Ing. M. Beer,
Dr.-Ing. habil. Dirk Proske
Technische Universität Dresden,
Faculty of Mechanical Engineering & Faculty of Civil Engineering

Important dates:

- March 15, 2017 - Submission Abstract
- June 30, 2017 - Submission Final Paper

Event information and contacts:
Event website: **http://ipw15.probabilistic.info**
Dr.-Ing. Matthias Voigt
Technische Universität Dresden, Faculty of Mechanical Engineering, Institute for Fluid Mechanics
01062 Dresden, Germany
Tel. + 49 (351) 463-33962
Fax + 49 (351) 463-38182
E-mail: matthias.voigt@tu-dresden.de

ESRA Information

1. ESRA Membership

1.1 National Chapters

- French Chapter
- German Chapter
- Italian Chapter
- Polish Chapter
- Portuguese Chapter
- Spanish Chapter
- UK Chapter

1.2 Professional Associations

- The Safety and Reliability Society, UK
- Danish Society of Risk Assessment, Denmark
- SRE Scandinavia Reliability Engineers, Denmark
- ESReDA, France
- French Institute for Mastering Risk (IMdR-SdF), France
- VDI-Verein Deutscher Ingenieure (ESRA Germany), Germany
- The Netherlands Society for Risk Analysis and Reliability (NVRB), The Netherlands
- Polish Safety & Reliability Association, Poland
- Asociación Española para la Calidad, Spain

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- TAMROCK Voest Alpine, Austria
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- VTT Industrial Systems, Finland
- Bureau Veritas, France
- INRS, France
- Total, France
- Commissariat á l'Energie Atomique, France
- DNV, France
- Eurocopter Deutschland GMbH, Germany
- GRS, Germany
- SICURO, Greece
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- D'Appolonia, S.p.A, Italy
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- RINA, Italy
- TECSA, SpA, Italy
- TNO Defence Research, The Netherlands
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- SINTEF Industrial Management, Norway
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- CSIC, Spain
- HSE - Health & Safety Executive, UK
- Atkins Rails, UK
- W.S. Atkins, UK
- Railway Safety, UK
- Vega Systems, UK

1.4 Educational and Research Institutions

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- University of Natural Resources & Applied Life Sciences, Austria
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3. Standing Committees

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The aim of this committee is to establish the general policy and format for the ESREL Conferences, building on the experience of past conferences, and to support the preparation of ongoing conferences. The members are one leading organiser in each of the ESREL Conferences.

3.2 Publications Standing Committee

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This committee has the responsibility of interfacing with Publishers for the publication of Conference and Workshop proceedings, of interfacing with Reliability Engineering and System Safety, the ESRA Technical Journal, and of producing the ESRA Newsletter.

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ESRA is a non-profit international organization for the advance and application of safety and reliability technology in all areas of human endeavour. It is an "umbrella" organization with a membership consisting of national societies, industrial organizations and higher education institutions. The common interest is safety and reliability.
For more information about ESRA, visit our web page at http://www.esrahomepage.eu
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