European Safety and Reliability Association

Newsletter

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June 2009

EDITORIAL

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As you will have certainly noticed the ESRA Newsletter has had a difficult period in 2008, in which only one issue was published. Several factors must have contributed to this situation, although the increased pressure that people feel in their jobs will certainly have a reflection on the time they devote to other activities. It has indeed been difficult to obtain contributions to the Newsletter, which led to a reduced frequency of publication.

However I am happy to announce that we are in the recovering phase and in 2009 we are aiming to have two issues. This situation resulted from positive changes that have occurred in ESRA, in particular a increased activity and membership of the ESRA Technical Committees.

Initially these Committees were created to promote the respective area and some have organised specific workshops, while others have promoted the writing of review articles. However as time has passed and the ESREL Conferences became more established, it became obvious that with an annual frequency of Conferences, there was little room for workshops to be organised in between.

Thus, the Technical Committees were more directed towards supporting the Conferences and instead of promoting specific workshops they were asked to promote sessions in their specialist area at the ESREL Conferences. This involvement in the Conferences was also expanded by giving the Technical Committee a special role in the reviewing of the papers, organising sessions and chairing the sessions of their respective area.

The interaction between the Technical Committees and the ESREL Conferences had an important synergy because the need to have responsible persons for the review and organisation of papers in certain subject areas led to the creation of Technical Committees, which saw their number increasing from 8 in 2004 to 27 in 2009. This creation of more committees meant the involvement of a larger number of persons in the activity of ESRA, which is certainly a beneficial aspect.

The Newsletter lives from news and articles provided by national correspondents that will reflect national activities related with the subject area and also members of the Technical Committees that have been invited to contribute with feature articles. Indeed the Technical Committees have been challenged to have as an objective of contributing with at least one article per year to the Newsletter and the present increase of frequency of the Newsletter results from this increased contribution of the Technical Committees as will become apparent.

I have been a Co-Chair of the Technical Program Committee of last two ESREL Conferences and in this period an important effort was made to create new Technical Committees and to integrate them in the structure of the Conference. This has been an effort that has given very good results in some committees in which the activity is well streamlined and integrated with the Conference Programme preparation, but there is still some work to do in strengthening some subject areas and in creating new ones.

It is very important that there exists a good link between the ESRA structure and the ESREL Conference team to make sure that this effort is made simultaneously at the level of improving the Conference review process and also in consolidating

the Committees with the experience obtained in the preparation of each of the Conferences.

I hope that this process continues and that the committees will become an increasingly more important contributor to the Newsletter. However it is also important for the Newsletter to incorporate information about the National activities and in this respect I would like to bring the attention of the people responsible for the National professional associations to be active in providing input to the newsletter.

Concluding this Editorial I would like to recognise again that we are in a recovery process, showing an increased frequency of publication of the Newsletter, but we need more contributions to maintain and even increase this tendency

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CONTRIBUTIONS FROM ESRA TECHNICAL COMMITTEES

Deterioration and Maintenance Models for Components in Hydropower Plants

Thomas Welte,
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NTNU and SINTEF, Trondheim

A doctoral thesis on deterioration and maintenance modelling has been presented at the Norwegian University of Science and Technology (NTNU), Department of Production and Quality Engineering, Trondheim, Norway, in June 2008. The thesis and some of the attached papers can be found on: http://urn.kb.se/resolve?urn=urn:nbn:no:ntnu:diva-2205

The objective of the work has been to provide a general deterioration and maintenance model for components in hydropower plants. The model may serve as basis for maintenance planning and maintenance optimization. It may also help to answer questions, such as:

- What is the probability of failure in a given time interval?
- How often should inspections be carried out?
- Is it better to carry out a maintenance action now or in *x* years?
- Is it advisable to postpone the action?
- What are the costs if the action is postponed?
- If we can choose between alternatives A and B: Which alternative should be performed first?

Since practically all technical systems are subject to deterioration, a failure is often the consequence of excessive deterioration. Inspections and maintenance are undertaken to uncover deterioration and to prevent failures and damage. The improvement and the optimization of maintenance has great potential for cost savings. Thus, systematic approaches and mathematical models are required to quantify the influence of maintenance decisions on reliability and costs.

The thesis presents a general maintenance and deterioration model for different components and failure modes. The model was designed to utilize existing methods and perspectives in the Norwegian electricity industry. The model is based on a deterioration model consisting of a semi-Markov process with discrete state space. The deterioration model was built on an existing state definition established by the industry. A numerical procedure is presented for calculation of failure probability and operational costs as a function of different maintenance strategies. The thesis presents examples where the model is used in reliability analysis, maintenance scheduling and inspection interval optimization. A Bayesian approach for parameter estimation is suggested. Both expert judgement and condition monitoring may be used as sources of information for the parameter estimation. Recommendations on how to carry out expert judgement are given. The thesis also discusses two other popular models; a Markov process that is frequently applied to modelling maintenance of components in electric power systems and a maintenance model that treats the deterioration as a gamma process. Differences and similarities between the models are described and advantages and disadvantages are discussed.

In some cases, there is the need for a more specialized deterioration model. One example is presented in this thesis where the influence of different operating conditions on the life of Francis turbines is analysed by a deterministic crack growth model, which is based on the empirical Paris' law.

The PhD position has been part of the research projects "Maintenance and refurbishment in hydropower" and "Value adding maintenance in power production". The projects were commissioned by the Norwegian Electricity Industry Association (EBL), and the research has been carried out at SINTEF Energy Research, Department of Energy Systems. The PhD work was conducted in close collaboration with the research activities at SINTEF. In addition, there has been a collaboration with the power companies and equipment manufacturers that attended in the research projects. Objectives of the projects were to establish best practice maintenance strategies for hydropower plant operators and to develop and test tools and solutions that can contribute to profitability in the hydropower business.

FEATURE ARTICLE

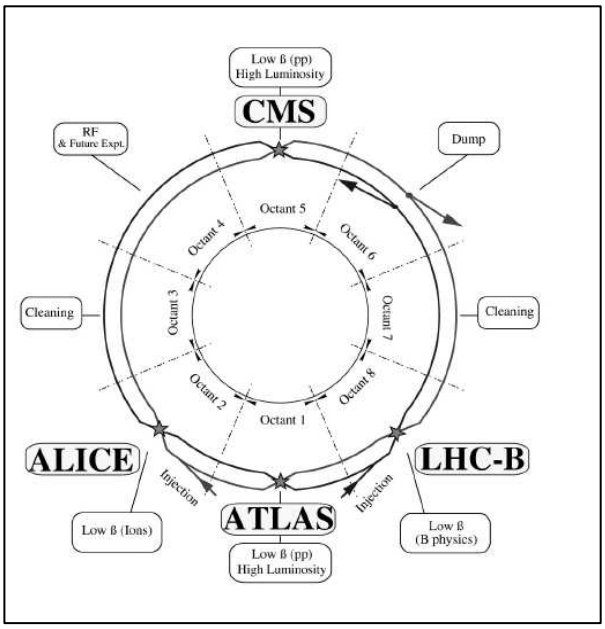
Applications of Probabilistic Safety Assessment to CERN LHC: a Case Study

Roberto Filippini
Laboratory for Energy Systems Analysis, PSI, Switzerland

Introduction

Experimental facilities, like accelerators and research reactors, are complex and expensive assembly of sophisticated technologies. Very often, their operation is associated to a risk, which can be quantified in term of environment contamination, fatal deaths or just money losses. In this case, risk management (i.e. quantification and consequent risk reduction) is not a trivial issue, especially because these applications are not in an easily recognizable domain of safety critical systems.

The CERN Large Hadron Collider (LHC) is the largest experimental collider worldwide. It is an assembly of novel and very diverse technologies: superconducting magnets, cryogenic and vacuum systems, and electronics for beam controls.



In order to run experiments in the LHC, it is very important to have a stable beam but also to minimize potential risks that may occur during operation. At the nominal beam energy (7 TeV) consequences of a failure (i.e. beam loss) can be destructive. The recent accident, a few weeks after the successful first-beam day in September 2008, has demonstrated that the risk cannot be underestimated [1].

Figure 1: The LHC schematic and the TCDQ (Courtesy by CERN)

Safety of the machine is therefore more than an issue, and since the very early stage guided the design of the LHC. Safety features are implemented in the LHC machine protection system. This system monitors the status of several quantities and prevents errors-anomalies to develop into potentially destructive failure scenarios during operation with the beam. Because of the instability of the beam in case of failures, active prevention is not enough and is added to passive elements to guarantee an additional protection. Among these elements, there is the Target Collimator Dump Quadrupole (TCDQ).

Two Target Collimator Dump Quadrupole (TCDQ) systems are installed at point IR6 (octant 6) of the Large Hadron Collider (LHC) accelerator ring, one per beam, see Figure 1. Each system contains a mobile active dilution block particularly to protect a quadrupole magnet and the downstream LHC machine elements from damage in case of an asynchronous beam dump. In CERN LHC jargon, an asynchronous beam dump is the consequence of the LHC Beam Dump System (LBDS) failure to switch on within the 3µs particle free energy gap [2]. The time stamp of this event is every 90 µs, which is the beam revolution frequency in the 27 km LHC ring.
This study estimates the risk that the TCDQ is not in the configuration required to protect the LHC machine elements at the instant of an asynchronous beam dump. A Probabilistic Safety Analysis (PSA) approach is applied and its results are interpreted in the framework of IEC 61508 safety standard ([3], [4]).

TCDQ functioning principles

The TCDQ system is controlled and supervised by a Programmable Logic Controller (PLC) ([5], [6]). The PLC generates the inputs to the two DC motors which move the absorber block in and out of the beam vacuum chamber. The position of each block is calculated ac-cording to the actual beam position and size, which depend on the beam energy. The LHC operational phase determines the configuration to operate: 1) during the ramping phase (about 30

minutes) the beam energy changes and the TCDQ has to adjust its position, 2) at injection (450GeV) and during the colliding phase at top energy (7TeV) beam energy does not change and TCDQ holds the position. The TCDQ operation is supervised and errors in the positioning, which cause a misconfiguration, are detected and generate an interlock (ILK). The local Beam Interlock Controller (BIC) manages the ILKs from the TCDQ PLC and issues a beam dump request to abort operation.

During operation, the operator in the control room may manually adjust the position of the block. After the beam dump, before the new fill, the TCDQ is moved back to the initial injection position. This is considered as an implicit check of most of functionality.

Risk assessment and PSA

Probabilistic Safety Assessment (PSA) is the set of methods used to analyze and quantify the safety of nuclear power plants. Its scenario perspective and decomposition of functional failures into basic events provide a compelling toolbox for analyzing other complex systems. The PSA methodology [4] is applied here to calculate the probability the TCDQ is not configured to protect the LHC elements. The TCDQ failure by misconfiguration is modeled with a fault tree.

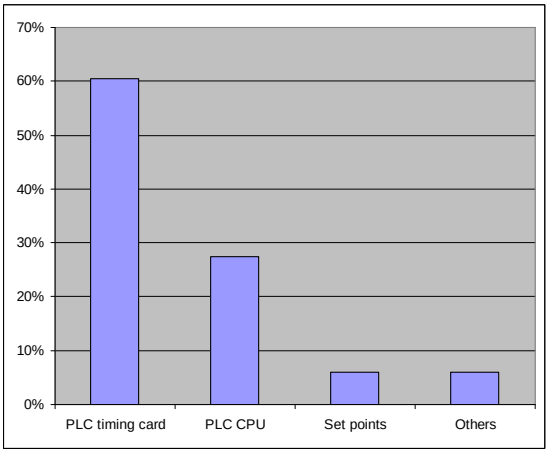


Figure 2: Contributors to TCDQ unavailability

The risk is the frequency of asynchronous beam dumps, which is about one per year (0.8/y, [2]), and the consequences that are estimated to be catastrophic (>3 months downtime, very expensive repair). This determines the safety integrity level (SIL) of the TCDQ in order to reduce the risk [3]. Data for the analysis are in part collected from previous reliability studies [2].

Results

The analysis is done for an operation scenario of 400 beam fills, 10 hours each, during which the TCDQ is assumed to hold position 78% of time, and to track the beam the remaining 22%. This returns an average probability of failure of 3.64 E-05 for two TCDQs. Two major assumptions underlying this value are: 1) inputs to operate TCDQ are correct and 2) the system is operated only in automatic mode with no manual adjustment of TCDQ position. With these assumptions the TCDQs satisfy SIL4 [4].

The analysis is completed by some insights concerning the dominant contributions. These are shown in Figure 2 with the relative percent fraction. The most important ones are briefly outlined:

1. Failure of PLC timing card to transmit the start signal to the PLC at the LHC start of ramp (60%): possible measure is to acknowledge the start signal by the PLC and verify the PLC state is consistent with LHC phase.
2. Failure of PLC CPU that affects both TCDQ controls and supervision (28%). A possible measure is to implement controls and supervision in two separated PLC.
3. Another 10% contribution is dominated by the failure of the interlock functions. This can be reduced by checking the interlock functions at regular time intervals.

It is important to remark that manual operations of TCDQ are not in the scope. For sake of completeness, a sensitivity analysis has calculated their potential impact to the TCDQ probability of being not properly configured. Just as order of magnitude, at an assumed rate of one intervention/10 fills, the TCDQ would drop to SIL2 [1E-03, 1E-02].

Conclusions

The PSA of the Target Collimator Dump Quadrupole (TCDQ) collimator system recently performed for CERN's Large Hadron Collider (LHC) show that the novelty of such studies lies in the adaptations required. In this respect, this work is the last of a series of works that demonstrate PSA is a valid methodology when applied to fields diverse from nuclear, for example [7].

The safety study of the TCDQ systems returns a low probability for the TCDQ failure in case of asynchronous beam dump, corresponding to a safety level of SIL4. Possible modifications were found to address the specific system weaknesses identified by the PSA; in particular the single points of failure can be eliminated. These recommendations are currently under review of the designer, and some of these will be likely implemented.

While the risk associated with automatic TCDQ operation was found to be low, a sensitivity analysis shows that the risk may increase significantly when TCDQ is manually operated. An analysis of the manual adjustment tasks, procedures and human performance conditions are suggested in order to confirm the effectiveness of the defences currently in place and possible improvements.

This study goes to complete a big picture of safety assessment of the LHC machine protection system,

which has been addressed for a number of its most critical components. The attention of CERN to these aspects is constant, and confirms that sensitivity to safety is becoming relevant also for big experimental facilities.

Acknowledgements

The author is grateful to Dr. V. Dang of Paul Scherrer Institute, Dr. J. Uythoven and his staff at CERN for the fruitful collaboration.

References

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[2] R. Filippini, J. Uythoven, Update and Summary of the Dependability Assessment of the LHC Beam Dumping System, EPAC, Edinburgh, UK, 26 - 30 Jun 2006.

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[7] L. Podofillini, V.N. Dang, K. Thomsen, Scoping-level Probabilistic Safety Assessment of a complex experimental facility: Challenges and first results from the application to a neutron source facility (MEGAPIE), Nuclear Engineering and Design, 2008, pp 2726-2738.

PHD DEGREES COMPLETED

Reliability analysis and cost modelling of degrading systems

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Main Supervisor: Prof. Uday Kumar, Luleå Univ. of Technology, Sweden

Main Examiner/Opponent: Prof. Kurt Petersen, Lünd University, Lund, Sweden

The thesis discusses the application of reliability analysis and cost modelling techniques to support the decision-making process in operation and maintenance activities and demonstrates its usefulness in real life. Many times it is not possible to implement design changes due to complexities and cost considerations, as in the case of railway infrastructures, etc. In such situations operational reliability is assured through effective maintenance actions. Knowledge of the technical condition of components is important to achieve the optimal maintenance policy in order to minimize the total system risk. The present research work also demonstrates an application of reliability analysis to improve system reliability based on design changes. The objective is achieved using cost-benefit analysis in combination with failure data and root cause analysis. The analysis of failure data with the different cost elements involved in the operation and maintenance of the complex systems is presented as a basis for choosing between alternative designs.

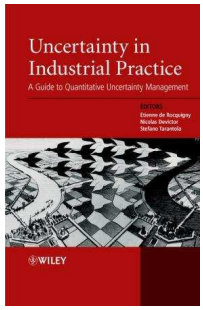
Furthermore, an optimization model has been developed to estimate the optimum inspection frequency required at the minimum maintenance cost based on the technical condition of the component. The consequences of not choosing the right distribution have also been discussed in the thesis. The concept of the virtual failure state has been introduced to estimate the failure distribution of highly critical components. The factors influencing the degradation process have been identified and studied in detail.

The thesis deals with case studies from rail infrastructure, oil & gas industry and manufacturing industry. Such a study is useful for reliability analysis of the degrading systems/components for making maintenance decisions or for initiating measures for changes in the design.

BOOK REVIEW

UNCERTAINTY IN INDUSTRIAL PRACTICE: A Guide to Quantitative Uncertainty Management

Edited by: *Etienne De Rocquigny (EDF)*
Nicolas Devictor (CEA)
Stefano Tarantola (JRC)



This book is the product of the ESReDA *Uncertainty Analysis* project group composed of a large panel of industrial research branches: Electricité de France - EDF R&D, Commissariat a l'Energie Atomique – Nuclear Energy Directorate (CEA), European Aeronautic Defence

and Space Company – Innovation Works (EADS-IW), Hispano-Suiza, SAFRAN Group, Joint Research Centre of the European Commission (JRC ISPRA and Petten), University of Duisburg-Essen, and the Delft University of Technology.

The book is dedicated to the better understanding of the industrial constraints and best practices associated with the study of uncertainty. It is concerned with the quantification of uncertainties in the presence of data, model(s) and knowledge about the problem, and aims to make a technical contribution to decision-making processes. It illustrates the optimal trade-offs between literature-referenced methodologies and the simplified approaches often inevitable in practice, owing to data, time or budget limitations, or simply to the current formulation of regulations and the cultural habits of technical decision-makers.

The book comprises ten case studies, chosen to reflect a broad spectrum of situations and issues encountered in practice, both cross-industry (covering various branches, such as power generation, oil, space and aeronautics, mechanical industries and civil structures, and various positions in the industrial cycle, from upstream research to in-service or sales support) and cross-discipline (including structural safety, metrology, environmental control, robust design, sensitivity analysis, etc). Their maturity varies from pioneering efforts in industrial R&D divisions (low) to incorporation in operational processes on a plant (in-service). They are the real source of thought throughout the book. A common methodological framework, generic to all case studies, has been derived from them, instead of being imposed as a prior theoretical setting. The real novelty of the book may therefore lie in its ambition to draft from practice a generic approach.

The focus of the book is on quantitative uncertainty. Recommendations and examples in this book focus primarily on industrial situations in which there is enough modelling expertise, knowledge and/or data to support the use of quantitative modelling of risk and uncertainty, with probabilistic or mixed probabilistic/non-probabilistic tools.

SAFETY AND RELIABILITY EVENTS

Joint ESREL 2008 and 17th SRA-Europe Conference

Sebastián Martorell, Universidad de Valencia, Spain

The 19th European Safety and Reliability Conference, ESREL 2008, was held in Valencia, Spain, between 22 and 25 September 2008. This year the Conference stemmed from a European initiative merging the ESRA (European Safety and Reliability Association) and SRA-Europe (Society for Risk Analysis – Europe) annual conferences into the major safety, reliability and risk analysis conference in Europe during 2008. This was the second joint ESREL (European Safety and Reliability) and SRA-Europe Conference after the 2000 event held in Edinburgh, Scotland. This Joint Conference confirmed the expectations insofar as the technical programme and number of participants is concerned. All presentations were of high quality and very relevant to current academic and industrial trends. These presentations have been published as a four volume set of Conference Proceedings: *Safety, Reliability and Risk Analysis: Theory, Methods and Applications – Martorell et al. (eds) © 2009 Taylor & Francis Group, London, ISBN 978-0-415-48513-5.*

ESREL is an annual conference series promoted by the European Safety and Reliability Association. The conference dates back to 1989, but was not referred to as an ESREL conference before 1992. The Conference has become well established in the international community, attracting a good mix of academics and industry participants that present and discuss subjects of interest and application across various industries in the fields of Safety and Reliability. SRA-Europe was founded in 1987, as a section of SRA international founded in 1981, to develop a special focus on risk related issues in Europe. SRA-E emphasizes the European dimension in the promotion of interdisciplinary approaches of risk analysis in science. This was the 17th edition of its annual conference that takes place in various countries in Europe.

The Conference Programme was a result of the enthusiasm and efforts of the many authors (376) who have contribute with their papers, special session organizers, technical programme committee members (101), technical area coordinators (34), conference webmaster, local organising committee (11) and the conference secretariat and technical support (14) at the Universidad Politécnica de Valencia. All these initiatives and efforts are gratefully acknowledged.
The scientific scope of the Conference embraced the thematic areas of:

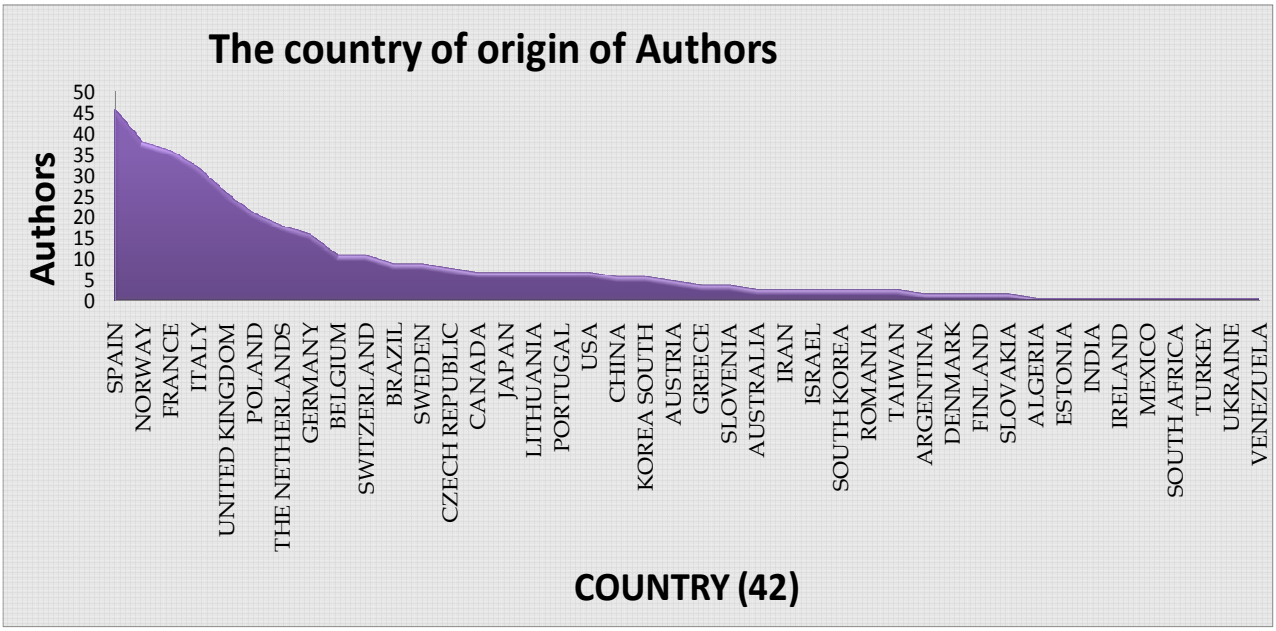
- Accident and Incident Investigation
- Crisis and Emergency Management
- Decision Support Systems and Software Tools for Safety and Reliability
- Dynamic Reliability
- Fault Identification and Diagnostics
- Human Factors
- Integrated Risk Management and Risk-Informed Decision-making
- Legislative dimensions of risk management
- Maintenance Modelling and Optimisation
- Monte Carlo Methods in System Safety and Reliability
- Occupational Safety
- Organizational Learning
- Reliability and Safety Data Collection and Analysis

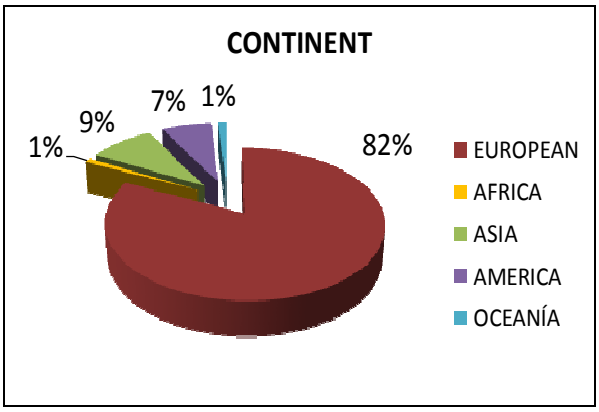
- Risk and Evidence Based Policy Making
- Risk and Hazard Analysis
- Risk Control in Complex Environments
- Risk Perception and Communication
- Safety Culture
- Safety Management Systems
- Software Reliability
- Stakeholder and public involvement in risk governance
- Structural Reliability and Design Codes
- System Reliability Analysis
- Uncertainty and Sensitivity Analysis

and the following industrial and service sectors:

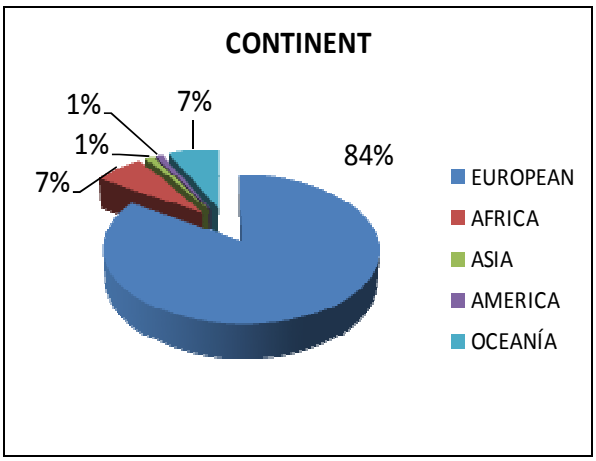
- Aeronautics and Aerospace
- Automotive Engineering
- Biotechnology and Food Industry
- Chemical Process Industry
- Civil Engineering
- Critical Infrastructures
- Electrical and Electronic Engineering
- Energy Production and Distribution
- Health and Medicine
- Information Technology & Telecommunications
- Insurance and Finance
- Manufacturing
- Natural Hazards
- Nuclear Engineering
- Offshore Oil and Gas
- Policy Decisions
- Public Planning
- Security and Protection
- Surface Transportation (road and train)
- Waterborne Transportation

The Technical Programme consisted of 425 papers from prestigious researchers coming from all over the world resulting from approximately 800 submitted abstracts, which were presented in nine parallel sessions. It consisted also of 2 poster sessions including 27 poster presentation and 4 plenary talks. The country of origin of authors and co-authors was widespread. The Authors distribution is shown in the figure below.



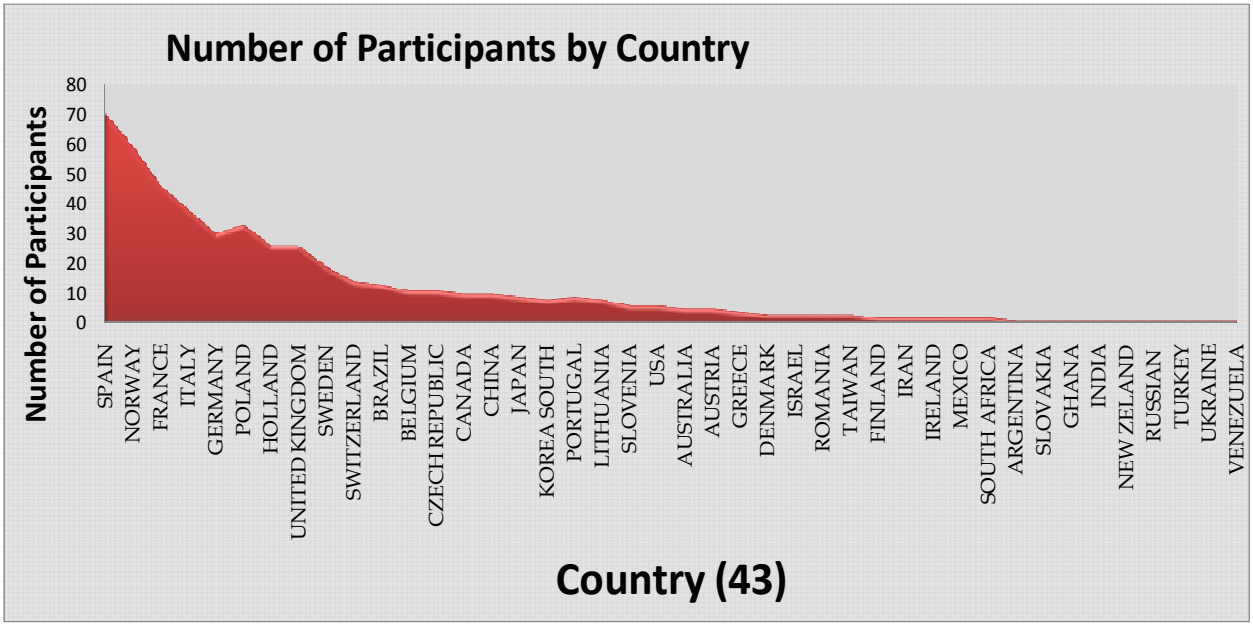


Of the around 500 participants who attended the Conference, 53 % were drawn from Academia, 25% from industry and 22 % from other institutions such as governmental services, national research laboratories, etc. Almost 17 % of participants were no authors, which shows the relevance of the Conference. Approximately 16% of participants were PhD students, which shows that there is a new generation of researchers coming up. The Conference was principally attended by participants from Europe, but also from other continents all over the world. The country distribution of participants is shown in the figure below.



The host of the Conference was the Universidad Politécnica de Valencia (UPV), under the high patronage of the Ministerio de Educación y Ciencia (DPI2007-29009-E), Generalitat Valenciana (AORG/2007/091 and AORG/2008/135) and Ajuntament de Valencia. Thanks also to the support of our sponsors Iberdrola, PMM Institute for Learning, Tekniker, Asociación Española para la Calidad (Comité de Fiabilidad), CEANI and Universidad de Las Palmas de Gran Canaria.

It was a great pleasure to have the opportunity to co-operate with you all during the Conference, both at the planning stage and during the Conference in September. We hope you all enjoyed the programme and the Conference.



First joint meeting SMAI/ MAS-IMdR

Benoîte de Saporta, IMB, Université de Bordeaux & INRIA Bordeaux Sud-Ouest CQFD

Christian Paroissin, IPRA-LMA, Université de Pau et des Pays de l'Adour

The first joint meeting SMAI/MAS-IMdR on Applied Mathematics and Dependability was held at the University of Pau on February 6th 2009. It was attended by 48 participants, 14 from the industry and 34 academics (14 of them being PhD students). The video of all the presentations is available on-line : <http://cratice.univ-pau.fr/live/uppa-vod/SMAI>, and summaries are also available on the conference web-page <http://www.math.u-bordeaux1.fr/JMASF09/>.

The Société de Mathématiques Appliquées et Industrielles (SMAI) is the French Society for Applied and Industrial Mathematics. The goal of the Society is to contribute to the development of applied mathematics through research, industrial applications, publications, education and the training of researchers and engineers. This learned society has individual, institutional and corporate members (university or industrial labs, companies, etc), researchers and specialists in applied mathematics (scientific computing, numerical analysis, partial differential equations, optimization and control, applied probability, statistics, financial mathematics, image and signal processing, life modelling, ...). The Society organizes regular and occasional events. There exists four thematic groups composing the SMAI. Among them, the GT-MAS is devoted to statistical and stochastic modelling.

The day opened by a presentation of the SMAI and more especially of the thematic group GT-MAS by Jean-François Delmas (ENPC), the head of GT-MAS. Then the French Institute for Risk Management (IMdR), http://www.imdr.eu/v2/extranet/index.php?page=accueil) was presented by Christiane Cocozza-Thivent (University of Marne-la-Vallée) as one of the

vice-presidents. Then five talks were given by engineers or researchers. The meeting was chaired by Yves Dutuit (University of Bordeaux).

The first talk was given by Catherine Duveau from SNECMA/SAFRAN. She spoke about statistical analysis and decision help for motor safety. Based on regulamentary constraints that rule navigability of planes, she presented the experiment feedback available and some examples of applied statistical analysis and their limits.

The second talk was given by Olivier Gaudoin from INPG (Grenoble) about simultaneous modelling of aging and maintenance efficiency of repairable systems. The theoretical developments were applied to real data provided by EDF R&D. The software MARS was developed in collaboration with this company.

The third talk was given by Antoine Grall from UTT (Troyes). He spoke about coupling condition based maintenance and on-line detection for systems which are degrading continuously and monitored through inspections. After modelling the degradation phenomena with a gamma process, he proposed adaptive inspection/maintenance policies.

The fourth talk was given by Jaromir Antoch from Charles University (Prague, Czech Republic) on the evaluation of the occurrence probability of accident clusters using scan statistics. This is a joint work with Julie Berthon (Thalès Avionics). Two approaches are considered for evaluating the probability to observe a cluster of a given length: the first one is based on Monte Carlo simulation (either direct, or based on a Petri net) and the second one on Markov chains.

The fifth and last talk was given by Jean-Paul Signoret from TOTAL (Pau) about methods and tools in the field of dependability. He reviewed the different commonly used approaches for solving problems in this domain, pointing out the assets and the often overlooked limits of each method aspiring to better care from practitioners and new tractable models from theorists.

A second edition should be held in 2010 or 2011 probably in Grenoble.

CALENDAR OF SAFETY AND RELIABILITY EVENTS

ESREL 2009
European Safety and Reliability Conference
Prague, 7-10 September 2009

Prague has been selected as the venue for upcoming ESREL 2009. Prague, the capital city of the Czech Republic, lies in the heart of Europe and ranks amongst the most impressive historical cities in the world.
Details will be included on the conference web page www.esrel2009.org.

3rd International Conference on Hydrogen Safety (ICHS)
Ajaccio, 16-18 September 2009

Information about this event can be con-sulted on the Conference website at:
http://conference.ing.unipi.it/ichs2009/

10th International Conference on Structural Safety and Reliability (ICOSSAR)
Osaka, 13-17 September, 2009

Information about this event can be con-sulted on the Conference website at:
http://www.sc.kutc.kansai-u.ac.jp/icossar2009/

18th SRA-Europe Meeting
Karlstad, 28 June - 1 July 2009,

Information about this event can be con-sulted on the Conference website at:
www.sraeurope.org

13th International Symposium on Loss Prevention and Safety Promotion in the Process Industries
Brugge, 6-9 June 2010

Information about this event can be consulted on the Conference website at:
www.lossprevention2010.com

International Railway Safety Conference (IRSC) 2009
Båstad, 28-30 September 2009

The Swedish National Rail Administration will be hosting 19th Int. Railway Safety Conference.

The IRSC provides a forum for an in-depth exchange of experience and lessons for improving rail safety and is exclusively devoted to rail safety issues. Participants are senior people with responsibility in rail safety management and mostly include industry representatives, safety regulators, investigation agencies and rail unions.

The conference will provide simultaneous translation for English, German, French and Japanese languages.

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web site: http://www.intlrailsafety.com/

Marine Traffic Engineering Conference 2009

Malmö, 19-21 October 2009

The Marine Traffic Engineering Conference 09 in field of maritime science - with strong relations to safety and reliability issues will be hosted by Sweden October 19-21, 2009 at Malmö. This is 13th conference so the level is quite high and its significance is as well good.

Some of the topics are: safety and reliability of transportation systems; safety management systems in transportation; risk assessment in transportation systems; safety of navigation and shipping; marine navigation; pilot navigation ; ice navigation.

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Tenth Conference on Probabilistic Safety Assessment and Management (PSAM 10)

Washington (Seattle), 7-11 June 2010

This meeting will focus on the improvement of performance and safety of complex technological systems, economics, and environment - emphasizing the breadth of PSA applications including methodologies, technologies, and industries. In addition to a compelling technical program we will provide meeting attendees with the opportunity to enjoy the attractions of Seattle and the natural beauty of the Pacific Northwest coastal area.

Prospective meeting attendees are encouraged to submit an abstract by September 18, 2009 by following the instructions and forms that are provided at the following conference web site: http://www.psam10.org.

Important Dates:

Submission of Abstracts: May 18 - 15 Sep 2009
Notification to Authors: 16 Nov 2009
Full Paper Submission: 15 Feb 2010
Pre-Conference Workshop: 05-06 Jun 2010

ESRA INFORMATION

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1.1 National Chapters

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

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

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- INRS, France
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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.org.
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