



European Safety and Reliability Association

Newsletter

<http://www.esrahomepage.org>

June 2003

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FEATURES

“DYRECT PRODUCT”

Céline Kermisch and Pierre-Etienne Labeau

For some years, more and more research efforts on dynamic reliability (also called probabilistic dynamics) have been conducted. The term dynamic emphasizes the fact that many engineering systems behave dynamically, i.e. their response to an initial perturbation evolves over time as system components interact with each other and with the physical process. A major problem in some safety or even availability studies of industrial systems consists precisely in taking into account, in a realistic way, the dynamic interactions between the physical process and the nominal or dysfunctional behaviour of the plant. Indeed, in such systems, the evolution of the accidental or operational scenarios arises from the interaction between the occurrences of two types of events: those associated to the deterministic evolution of the continuous process variables on one hand, and those related to the solicitations or failures of the system components on the other hand, the latter usually presenting a stochastic nature.

Dynamic reliability methods are capable of handling explicitly these interactions in the delineation of operational or accidental scenarios. In principle, they constitute a more realistic model of systems for the purpose of availability or reliability analysis. There is therefore a strong motivation for improving methods for dynamic system analysis.

However, despite their potential for greater correctness, dynamic reliability methods had a limited

penetration in the area of industrial applications. One of the reasons for this situation is the heavy theoretical background of dynamic reliability techniques. Therefore, a study conducted last year by C. Kermisch and Prof. P.-E. Labeau at the Université Libre de Bruxelles (Belgium) aimed a.o. to translate this knowledge in a less academic and more practical language that would be more accessible to industrials. This work was initiated by the ISdF and supported by Air Liquide, CEA, EDF, IRSN, PSA Peugeot Citroën and TotalFinaElf.

In this work, the dynamic reliability modelling was introduced step-by-step starting from simple illustrations. A state of art of the dynamic reliability methods (graphical data representation tools as well as simulation techniques) was made. The methods found in the literature were compared in order to determine which ones could be useful in the industrial applications.

After a detailed investigation, Petri Nets and Monte Carlo Simulation were selected as the most powerful techniques in view of industrial applications. It was therefore decided to apply these methods to a real, but simplified, industrial process: a Steam Methane Reformer (SMR). A first step was made in this study: the SMR unit was represented by Petri Nets.

As the interest of the industrial circles concerning dynamic reliability is continually growing, a new project, titled DYRECT PRODUCT (Dynamic Reliability for Continuous Technological PROcesses subject to Discrete Unexpected Configuration Transitions), is being initiated. The proposed work is divided in three parts.

1. The first step consists in completing the dynamic reliability treatment of the simplified SMR problem. A simplified dynamic model for this industrial process will be defined. This model will be coupled with the Petri Nets that have already been built. This will allow us to display the possible problems due to the interfacing between both parts (discrete and continuous evolutions of the process i.e. Petri Nets and code).
2. Then, specific aspects of the use of Monte Carlo methods in dynamic reliability will be examined in details. The following topics will be investigated:
 - Theoretical bases of direct, component- (or event-) based simulation in dynamic reliability
 - Specific issues related to common cause failures in direct simulation
 - Comparison between the performances of the direct and system-based approaches in the frame of dynamic reliability
 - Efficient algorithms for availability calculations in dynamic reliability
 - Efficiency of existing algorithms for the treatment of uncertainties.

3. Finally, the treatment of uncertainties in dynamic reliability will be analyzed, according to two axes:
 - Effects of parametric uncertainties in industrial reliability studies on the scenario identification process
 - Analysis of the impact of these uncertainties on the solution techniques of dynamic reliability problems.

This research project is funded by the subscriptions of interested partners: 8000 Euros (industrial subscription) or 2000 Euros (academic subscription).

The project should be supported by the same partners as the previous one: Air Liquide, CEA, EDF, IRSN, PSA Peugeot Citroën and TotalFinaElf, but it is still open to new partners.

A more detailed work description is also available on request. If you have any further question, please contact:

C. Kermisch (ckermisc@ulb.ac.be) or P.-E. Labeau (pelabeau@ulb.ac.be), we will be pleased to answer you.

LOOKING BACK AT ESREL 2003

P.H. (Paul) Waarts, Chair ESREL 2003

Looking back at ESREL 2003, I think everything went quite well. In Maastricht there was a warm atmosphere. 350 participants enjoyed a good program with excellent keynote speakers and very good presentations in the parallel sessions.

The only drawback was the good weather. Not everybody wished to stay in the conference centre. The good weather invited many participants to take a stroll through the city of Maastricht. Also the companies present at the exhibition were not always pleased with the low number of presence.



Figure 1: Didier Plastique with the opening act.

The conference started at Sunday, June 15th with an ice-break party. Actually it started earlier with a pre-

conference summer school (workshop). There were 9 workshops from basic to advanced level, the basic workshops were meant to bring everybody at the same level, so that they could better understand the presentations during the conference. The advanced workshops gave people the opportunity to discuss more thoroughly and to focus the scientific needs.

During the official start of the conference we added a new element to the conference. Prof. Plastic explained the risks and safety of rubber balloons. He brought it in a very visual manner, and gradually changed into a circus act.

Afterwards, two keynote speakers kicked off with:

- George Apostolakis (MIT): Risk-Informed Decision Making
- Henry Wynn (Warwick University): Where are we with risk

And later on:

- Joseph Fragola (SAIC): Emerging Failure Phenomena in Complex Systems
- Pieter Polet (AEGON): The ups and downs of PPP in loss prevention and financial risks management
- Ton Vrouwenvelder (TNO/Delft University): Uncertainty analysis for flood defence systems in the Netherlands
- Ben Ale (RIVM/Delft University): Living with Risk: A Management Question



Figure 2: Reception at the town hall, speech of the Major of Maastricht

I think we had a good mixture of science and pleasure. During the daytime there were keynote speakers and six parallel sessions. Every evening a social event was held: at Sunday the ice breaking party; at Monday the reception at the Major of Maastricht in the old town hall (with the choir of St. Cecilia van Sweakhuijsen) and Tuesday the official conference dinner in the limestone caves in the North of Maastricht.

The conference closed with a new element in the ESREL conferences: the conference awards: for the best paper, the best young scientist, best poster and an award for the best joke on safety and reliability. The jury had a very difficult time with this new idea (very many presentations had to be visited, and with 6 parallel sessions this was not easy for the 5 members of the jury). Prof. Roger Cooke (Delft University) handed out the awards. Not all award winner were

present during the closing session, so I will give a summary here:

- Best Young Author: M. Jagtman (Delft University).
- Best poster: V. Safonov (VNIIGAZ): Risk analysis of Black Sea underwater passage of Russia-Turkey trunk gas pipeline system
- Best presented paper: D. Proske (TU Dresden): Risk to old bridges due to ship impact on German inland waterways
- Best joke(s): Mr. L. Allford (EPSC) and R. Denning (ministry of Defence, UK)

Now the Conference has ended I am looking forward to the next ESREL 2004 conference in Berlin, and I hope we will enjoy it as much as the previous one.



Figure 3: Best paper award presented by Prof. Roger Cooke

REVIEWS

ESRA on the WWW

Please visit our pages and send your feedback to the Webmaster. The ESRA-homepage is available at <http://www.esrahomepage.org/>

Book review

Petri Nets for Reliability Modeling (in the Fields of Engineering Safety and Dependability)

Winfried G. Schneeweiss ; LiLoLe Verlag GmbH, Hagen, Germany, 1999, ISBN 3-934447-00-7.

This book is a nice introduction to Petri nets (PN), stressing the modelling viewpoint. Its presentation is tutorial rather than theoretical and is a good example of how PNs can be used in dependability field. This monograph is clearly written and well structured. It includes many illustrative examples and exercises with their detailed solutions. This makes it more attractive for practitioners and students. The author, who has a long experience in teaching reliability engineering, has organised his book in 13 well-balanced chapters and two appendices. The author presents in the preface some interesting viewpoints.

First, he reminds us that, in spite of numerous papers, theses and books already published on Petri nets, they are still not widely used in dependability field, though they are one of the best graphical tools for reliability modelling. Second, he claims reliability engineers are able to helpfully handle PNs, even if they have not a deep knowledge of the related theory. Third, he states several important (from a theoretical viewpoint) properties of PNs, such as "conservation", "liveness", are not relevant for availability, reliability and production purposes. In the same way, the author is right when he writes that the term stochastic Petri net should encompass any randomness in a PN.

In the introductory chapter and the second one, a preliminary description and the basics of PNs are given in a concise and clear manner. In this first part, one can appreciate the high modelling power of PNs, which has equally recourse to auxiliary places or to inhibit arcs to model some priority constraints. Some special aspects of PNs with reliability modelling are presented in chapter 3, in particular the fact that PNs encompass fault trees and state graphs, and then can model them.

There is no doubt that the three following chapters make up the core of the book, because chapter 4 deals with the non-repairable systems while repairable systems are the topic of chapters 5 and 6.

The modelling of systems without redundancy is shown first by means of a non-repairable n-out-of-n: G module. Then systems with successively cold and hot standby are presented with several didactic examples, which illustrate different modelling options offered by PNs. The basic aspects of repairable systems are treated in chapter 5 which is strongly maintenance oriented. It is also shown, in this chapter, "that for a systematic embedding of places for "system up" an "system down" respectively, the success tree and the fault tree, i.e., their PNs, are indispensable". This is the author's viewpoint, but a question arises: is this systematic embedding option relevant in the case of real-size systems? An answer will be given in chapter 10. Chapter 6 is devoted to the repairable systems with advanced aspects of maintenance including limited maintenance, preventive maintenance, repair priorities and more complex cases. It is a key-chapter of the book, which will interest all the dependability engineers.

The cost/benefit aspects are often and unfortunately omitted in the books centred on systems dependability. This is why chapter 7 is worth reading. The treated examples clearly illustrate the discrete option (one token for one unit of profit) retained by the author to model this kind of problem. Another option lies in the computing of sojourn times in the places which correspond to working and failed states of the modelled system, but it is out of the scope of this book.

The author defines "timeliness" and treats it in chapter 8 on the basis of several simple examples.

Phased missions are a theme often studied in reliability field by means of boolean (e.g fault tree) or Markovian approach. Chapter 9 gives a new insight into this topic including phased repairs, via PN modelling.

The remainder of this book concerns successively the design of large PNs (chapter 10), some comments on the PN theory (chapter 11), some information on tools for PNs applications (chapter 12), and comments on limits of the presented modelling approach (chapter 13). As the previous ones, these chapters are also worth reading because all the subjects treated inside interest both engineers and students. However one can regret that no practical information is given on the way to obtain or to estimate (if Monte-Carlo simulation is used) the main indicators of system performances, i.e, its reliability, its instantaneous and average availability and related mean times (MTTF, MUT, MDT,...). Moreover, some specific aspects of PNs modelling, such as messages emitted or received by transitions and transitions with memory, are not mentioned. The above omissions are certainly intentional and can be explained by the fact that this book is devoted to PNs modelling and not to their exploitation.

Overall, this is a fine and well-structured book that deserves the attention of people concerned by the oriented dependability modelling of systems. Thus, it can be used with benefit as textbook in engineering universities and technical institutes.

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International journal *Risk Decision and Policy*

Editor: Enrico Zio, Polytechnic of Milan, Italy
email: rdp@polimi.it

Founding Editor: Paul Anand
The Open University, UK

The international journal Risk, Decision and Policy publishes research work concerned with the study and application of methods for the analysis, assessment, management, harmonization, and regulation of risk in its various forms: technological, environmental, financial and societal. The journal considers practical case studies of risk assessment and applications of descriptive, prescriptive and normative decision making in a wide variety of areas. It publishes also articles on human and organizational factors, on cognitive science and on foundations of decision-making under uncertainty, including choice and game theory.

Contributions are expected from risk engineers, decision makers and regulators as well as from psychologists, sociologists, political scientists, mathematicians and financial managers. The Journal

publishes also commissioned reviews, with peer commentary of topical problems concerning risk.

A Special institutional subscription rate is available for members of the European Safety and Reliability Association (ESRA)

For more information, look at the ESRA web site: <http://mar.ist.utl.pt/safereynet/meetings.asp> or at the publisher web site: www.taylorandfrancis.com

SAFERELNET Workshop on Acceptable Safety Levels

The Workshop on Acceptable Safety Levels took place on 19th May 2003, in Copenhagen. Over 40 representatives attended the workshop hosted by COWI.

The objective of the workshop was to discuss approaches to establish these acceptable levels including present practice, appropriate safety differentiation, economic considerations, aspects of risk perception and normative rules.

Contributions in the following topics were presented:

- Review of Risk Criteria in the EU, V.M. Trbojevic – EQE International, UK
- Criteria for Determining Consistent and Acceptable Risk Levels Based on the ALARP Principle, A. Francis, M. Gardiner, M. McCallum – Advantica Technologies Ltd., UK
- Three Mutually Compatible Risk Acceptability Criteria, Niels Lind – University of Waterloo, Canada
- The Statistical Value of Life or the Life Quality Index as a Basis for Setting Acceptability Limits, R. Rackwitz - RCP, Germany
- Target Reliability Levels and Probabilistic Assessment of Fatigue Reliability for Documentation of Remaining Service Life of Ageing Offshore Structures, Ole Tom Vårdal - Aker, Norway
- Optimal Design of Civil Engineering Structures, Oliver Kübler & Michael H. Faber – ETHZ, Switzerland
- An Attempt to Unify Risk Criteria in the EU, V.M. Trbojevic – EQE International, UK

SAFERELNET Workshop on Integration of Risk and Reliability

The Workshop was organised in Copenhagen 21st. May 2003 to present and discuss the approaches for the integration of Quantitative Risk Analysis (QRA), Structural Reliability Analysis (SRA) and Human & Organisational Factor Analysis (H&OFA). The objective of the workshop was to discuss this issue

and identify approaches for the effective integration of these techniques.

Contributions in the form of presentations or discussions were presented on the following topics:

- Key issues for the integration of Quantitative Risk Analysis and Structural Reliability Analysis, N.K. Shetty and A. Hessami - Atkins, United Kingdom
- H & O Factors in Risk and Reliability Assessment, Mauro Pedrali – D'Appolonia, Italy
- Human and Management Factors in Probabilistic Risk Analysis: A Review I, M. Faber – ETHZ, Switzerland, E. Kragh - COWI, Denmark
- Human and Management Factors in Probabilistic Risk Analysis: A Review II, H.B. Andersen, I. Kozine – RISØ, Denmark
- Examples of methods for integration: Semi-quantitative method with Safety Barrier Diagrams. E. Kragh – COWI, Denmark
- Introduction to Bayesian Probabilistic Nets. Technical risk assessment of decommissioning options using Bayesian Probabilistic Nets, I. Kroon – COWI, Denmark
- A Practical Example of Integration of Risk and Reliability Techniques in the Nuclear Industry, Elod Holló – VEIKI, Hungary

SAFETY AND RELIABILITY EVENTS

Seminars and Conferences

June 14-18, 2004

PSAM 7 and ESREL'2004

International Conference on Probabilistic Safety Assessment and Management (PSAM 7 and ESREL'2004) will be arranged at Hotel Inter-Continental, Berlin, Germany.

For the second time, after the pleasant experience of 1996, this conference represents the joint meeting of two successful conferences which are held regularly. This joint conference will be the major international event in 2004 for the presentation and discussion of innovative methodologies and practical applications of probabilistic and risk-informed approaches to safety as well as reliability. These approaches are aimed at the optimisation of the design and operation of technological systems and processes from the safety and economic points of view.

Important Dates

- Call for Papers January 15, 2003

- Submission of Abstracts May 15, 2003
- Notification to Authors September 20, 2003
- Full Paper Submission December 10, 2003
- Conference June 14-18, 2004

General Chair

Cornelia Spitzer

E-mail spitzer@tuev-mannheim.de

For further detailed information related to the conference, visit the PSAM 7 – ESREL'04 home page at <http://www.psam7.org>.

June 20-25, 2004

OMAE 2004

Join your colleagues at **OMAE 2004**, an international conference that promotes technological progress and international cooperation in ocean, offshore and arctic engineering. OMAE is the setting for engineers, managers, technicians, researchers, academia and students from around the globe to discuss technology developments and their applications.

Following on the tradition of excellence of previous OMAE conferences, more than 400 technical papers are planned for presentation at the conference in seven symposia:

- Offshore Technology
- Safety and Reliability
- Materials Technology
- Pipeline Technology
- Ocean Space Utilization
- Ocean Engineering
- Polar and Arctic Sciences and Technology

Also, industry workshops, special sessions and keynote lectures will be included in the technical program. National and international oil companies are expected to sponsor and participate in the conference.

OMAE is also a good place to interact and network with top people from around the world in the ocean, offshore and arctic engineering fields. This networking can present great opportunities for you and your company.

The Ocean, Offshore and Arctic Engineering (OOAE) Division of ASME International and the University of British Columbia are sponsoring the conference.

Workshops

30th and 31st October 2003, London

SAFERELNET Workshops

A number of Workshops on topics of interest to several Work Packages will take place in conjunction

with the next SAFERELNET Thematic Network Meeting.

The main objective of the Workshops is to promote the understanding of the approaches to be adopted for the integrated formulations to be promoted in the project.

The workshops will take place in London at “The Institution of Structural Engineers” on 30th and 31st October 2003. The following Workshops are planned:

Workshop on Inspection Planning

This workshop aims at presenting and discussing the first deliverable of WP 7 on Risk Based Inspection Planning. The report concentrates in aspects of structures as for equipment the variable of most interest is not the probability of failure but its availability.

Workshop on Maintenance Planning

This workshop aims at discussing the basic concepts about dependability and maintenance in various industries. This discussion has the objective of converging to a relatively consistent view of how risk based maintenance planning should be dealt with within the scope of SAFERELNET Thematic Network

Workshop on Risk Management

This workshop is aimed at establishing the current state of Safety Management practice in safety related industries (Nuclear, Aviation, Chemical and Land Transport) and arrive at a position on the proposed draft or alternative approaches to this task for SAFERELNET.

Agenda

Thursday, 30th October

10:30-13:00	Workshop on Inspection Planning
13:00-14:00	Lunch
14:00-15:30	Workshop on Maintenance Planning
15:30-16:00	Coffee Break
16:00-17:30	Workshop on Maintenance Planning

Friday, 31st October

09:00-10:30	Workshop on Risk Management
10:30-11:00	Coffee Break
11:00-12:30	Workshop on Risk Management
12:30-13:30	Lunch

Registration

Please choose the Online Registration option at the following web address to register:

<http://mar.ist.utl.pt/saferelnet/meetings.asp>

For any queries, please contact Fátima Pina (fatima@mar.ist.utl.pt).

ESRA INFORMATION

1 Membership

1.1 Professional Associations

- The Safety and Reliability Society, UK
- The Institute of Quality Assurance, UK
- The Danish Society of Risk Assessment
- Institut de Sûreté de Fonctionnement, France
- ESRA Austria
- ESRA Germany
- VEIKI Hungary
- The 3 ASI, Italy
- ESRA Norway
- SRE Scandinavia
- The Netherlands Society for Risk Analysis and Reliability (NVRB)
- ESRA Poland
- Asociación Española para la Calidad, Spain
- ESReDA

1.2 Companies

- AEA Technology, UK
- RAILTRACK UK
- W.S. Atkins Safety and Reliability, UK
- RMRI Ltd. UK
- Health & Safety Executive, UK
- Transgás - Gás Natural, Portugal
- Companhia Portuguesa de Produção Eléctrica, Portugal
- Caminhos de Ferro Portugueses, Portugal
- Adtranz, Portugal
- IDICT, Portugal
- Direcção de Navios, Ministério da Defesa Nacional, Portugal
- Bureau Veritas, France
- TECSA, SpA, Italy
- Tecnopolis Csata Novus Ortus, Italy
- Registro Italiano Navale, Italy
- Safetec Nordic AS, Norway
- OFP Arsenal, Austria
- FZ Seibersdorf, Austria
- Palfinger Krantechnik GmbH, Austria
- VAB, Austria
- RiskAudit, France
- Commissariat à l'Énergie Atomique, France
- EdF, France
- INRS, France
- Elf Aquitaine Production, France
- VTT, Finland
- Forschungszentrum Jülich GmbH, Germany
- GRS, Germany
- Finnish Institute of Occupational Health
- TNO Defence Research, The Netherlands
- COWI Consult

1.3 Educational Institutions:

- University of Surrey, UK
- University of Bradford, UK
- City University London, UK
- Loughborough University of Technology, UK
- Università Degli Studi di Pisa, Italy

- Università Degli Studi di Pavia, Italy
- Politecnico di Milano, Italy
- Politecnico di Torino, Italy
- Delft University of Technology, the Netherlands
- Technical University of Gdansk, Poland
- University of Gdynia, Poland
- Central Mining Institute, Poland
- Universität Dresden, Germany
- TU Muenchen, Germany
- University of Wuppertal, Germany
- The Institute of Nuclear Technology 'Demokritus' Greece
- Instituto Superior Técnico, Portugal
- ITEC, Portugal
- Universidade de Coimbra, Portugal
- Université Libre de Bruxelles, Belgium
- Université de Bordeaux, France
- Lulea University, Sweden
- University of Innsbruck, Austria
- Universidad Politécnica de Madrid, Spain
- Universidad Politécnica de Valencia, Spain
- Universidad D. Carlos III de Madrid, Spain
- Consejo Superior de Investigaciones Científicas, IMAFF, Spain
- Institute of Fundamental Technological Research, Poland
- Université de Technologie de Troyes, France
- Politecnico di Torino, Italy
- University of Wrocław, Poland
- NTNU, Norway

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3 Management Board

The Management Board is composed of the ESRA Officers plus one member from each country, elected by the direct members that constitute the National Chapters.

3.1 Conference Standing Committee

This committee aims at establishing 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

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.

4 Technical Committees

4.1 Offshore Safety

Chairman: B. Leira, NTNU, Norway
E-mail: Bernt.Leira@marin.ntnu

4.1.1 WG on Quantified Risk Assessment

Chairman: V. Trbojevic, EQE International Ltd, UK.
E-mail: yvt@eqe.co.uk

4.1.2 WG on Structural Reliability

Chairman: B. Leira, NTNU, Norway
E-mail: Bernt.Leira@marin.ntnu

4.2 Safety of Maritime Transportation

Chairman: C. Guedes Soares, IST, Portugal.
E-mail: guedess@mar.ist.utl.pt

4.3 Reliability of Mechanical Components

Chairman: G.I. Schuëller, University of Innsbruck
E-mail: G.I.Schueller@uibk.ac.at

4.4 Uncertainty and Sensitivity Analysis

Chairman: A. Saltelli, JRC, ISPRA, Italy
E-mail: andrea.saltelli@jrc.it

4.5 Human Factors

Chairman: E. Fadier, INRS, France
E-mail: fadier@inrs.fr

4.6 Risk Management

Chairman: I. Watson, UK
tel: +44 1925 763760

4.6.1 WG on Computer Aided Risk Management

Chairman: Dr. P. Kafka, GRS, Germany
E-mail: kaf@grs.de

4.7 Monte-Carlo Simulation

Chairman: P.E. Labeau, Univ. Libre De Bruxelles, Be
E-mail: pelabeau@ulb.ac.be

4.8 Systems Dependability

Chairman: Yves Dutuit
E-mail: dutuit@hse.iuta.u-bordeaux.fr

4.9 Maintenance

Chairman: Enrico Zio
E-mail: enrico.zio@polimi.it



ESRA is a non-profit international association for the advance and application of safety and reliability technology in all areas of human endeavour. It is an "umbrella" organisation with a membership consisting of; national professional societies, industrial organisations and higher education institutions. The common interest is safety and reliability.

For more information about ESRA, look at our web-page at <http://www.esrahomepage.org>.

For application for membership of ESRA, please contact the general secretary, Palle Christensen, E-mail: palle.christensen@risoe.dk.

Please submit information to the ESRA Newsletter to the editors: Stein Haugen, sh@safetec.no or Snorre Sklet, Snorre.Sklet@indman.sintef.no