ESReDA

European Safety, Reliability & Data Association

Newsletter

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Some considerations on the European Directive on Resilience of Critical Entities 2022/2557

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During the ESReDA 56th seminar, I was inspired by several speakers and discussions during breaks and dinners. In searching for a framework to combine these 'building blocks in safety thinking', particularly with the EU Directive on Resilience of Critical Entities 2022/2557 could be of interest.

This Directive focuses on significant disruptive effects during crucial congestion in integrated systems. These new systems are based on characteristics as an 24/7 accessible open network organization with a high energy density, while sensitive and vulnerable for congestion and disruptions. These systems contain 'serendipities', defined as: discovering by accident something that has not been observed before.

To cope with safety critical disruptions, a prospective approach is indispensable, based on a mixed use of gas and electricity, the latter generated by both wind and solar sources. It became clear that a transition in the balance between gas and wind/solar energy requires a fundamental shift in scientific paradigms regarding safety and risk. Such disruptions are defined in their operating environment with notions such as 'system of systems' 'networks', 'socio-technical systems' and are supposedly submitted to chaotic system states, defined in the Cynefin model. Incorporating the operational environment in a more encompassing problem definition enlarges the 'unit of analysis' as defined by David Woods beyond the level of the direct man-machine-interface scope. Such an expansion of the analytic scope shifts the focus from the event to the system and simultaneously enlarges the problem solution spaces to a LCA scope and all levels of the system.

This shift introduces a reflection on three issues:

- how to identify and explore unacceptable and irreversible vulnerabilities and disruptions that emerge from transitions while avoiding serendipities?
- Are present analytic tools and techniques valid and applicable in adequately foreseeing unacceptable and irreversible phenomena of such new systems?
- Do they provide adequate elimination or mitigation strategies of discrete disruptions?

In answering these questions, several principles of problem-solving strategies have to be taken into account:

- Are the problem definitions evidence and case based?
- Are they based on inherent physical characteristics of the system?
- What are the chain interdependencies?
- Do they cope with new single hazards and multiple hazard exposure?
- Do they cope with higher system vulnerabilities?
- Are higher hazard exposure phenomena taken into account?
- Are extremes and slow system dynamics taken into account?
- Are all pertinent system values represented in coping with the disruptions?

Such a shift in scientific paradigms in safety R and D highlights the implicit change in schools of thinking about safety and risk identification, perception and appreciation. In an 'old school of safety thinking' causes are predominantly representing probabilistic approaches in case-based inquiries to establish 'acceptable' or 'inacceptable' risk levels due to single or multiple occurrences, accidents and incidents. Consequences are expressed from a single disciplinary perspective of mechanical, chemical or biological

hazard. In the shift towards a 'new school of thinking', the 'cause-consequence relationship' has proven its limitations in coping with complexity and dynamics of socio-technical systems. During the presentations and discussions, a new phrasing of 'safety and risk' emerged, to be described as: the criticality of rescue, recovery and resilience capabilities during the chain of events in the life cycle of networks, particularly with respect to their congested configuration and limit state loads. Such criticalities manifest themselves in systems that can be characterized as Volatile, Uncertain, Complex and Ambiguous (VUCA) and characterized as a specific category of High Energy Density system (HED) with a 'never dying' nature of 24/7 availability. In addition to Transport, Infrastructure and Logistics (TIL) systems, a new group of Energy Transition Networks is added to this category of systems. Consequently, discrepancies with intended, designed performance may occur as serendipities: unforeseen, uncontrollable, undesirable and unpredictable as either profitable or disastrous. The range of uncertainty in their performance has become too wide to exclusively cope with during operations, a LCA approach is indispensable. The devastating and irreversible consequences of sudden energy releases resulting in loss of lives and properties are socially unacceptable. Several occurrences have indicated the vulnerability of complex dynamic systems with tight couplings and logistic network interdependencies. The grounding of a Very Large Container Carrier in shallow waters (Ever Given in the Suez Canal 2021) demonstrated the gridlock consequences of tight logistic coupling and Just-In-Time management. The 30-minute delay of a single flight (KL 1956) from Athens to Amsterdam on 15 November 2024 caused the disconnection of 17 (!) transfer flights to their final destination for the majority of passengers to airports all across Europe due to the time critical optimization in the Hub and Spoke logistic concept. These disruptions created considerable waste of resources and reduced scarcely available capacity. In the first case, the recovery to restore to optimal performance took months, while in the second case, the recovery took minutes up to hours in a time critical situation. This brings the 'resilience' of the system in the focus of diagnosing these occurrences as relevant to the criticality of the overall system because of its performance.

Major differences between the 'old' school of safety thinking and the 'new' school are:

- The identification of 'hazard' has shifted from physical consequences to disruptions.
- A system approach replaces specific event-oriented approaches, preferring organizational learning over precaution and prevention
- A forensic phase in the diagnostic process to establish facts and consensus on the course of events is deleted from the diagnostic toolbox in favor of learning from success and managerial process optimization.

To cope with such differences, it requires a shift in operator mental models: rather than compliance with regulations, operators are assumed to be comprehensive, capable of diagnosing problems, adapting and acting accordingly, expressing their problem-solving capability. The ultimate goal of this new operator mental model is to cope with disruptions. Their 'resilience' capability is aiming at restoring the former system state as stable and controllable, maintaining the required system configuration.

This new mental model raises an interesting question about the nature of a 'disruption'. Is disruption a threat or an opportunity? Does it facilitate change in the system which enables a revitalization of its performance given the change in operating conditions? Is such a change achievable in the operating environment or does it require design adaptations?

This brings up some questions:

- is there a role for the system integrator or system architect?
- Is 'disruption' also an opportunity rather than fighting disruptions by increased 'resilience'?

Increasing resilience in VUCA and HED systems requires a broad orientation on intervention options that are beyond conventional frames of reference such as Operational Excellence and other optimization procedures. Such an orientation covers early warnings, indicating potential oscillation and interferences of system parameters towards disaster, involvement of feedback from all stakeholders, considering 'multi'-aspects, -actors and -factors, democratic participation taking into account value driven logic and emotional reasoning from various perspectives and closing value chains to a Triple Zero concept – No accidents, No waste, No emissions-.

In short: introducing resilience requires early diagnosis of VUCA and HED systems, preferably in their early phases of design and development. In turn, this requires a paradigm shift in data collection and processing. With the growth of complexity and dynamics in systems, the modelling of such systems and the acquisition of sufficient data to facilitate system diagnosis has increased. Mathematical modelling and statistical processing have reached their limits in size and scope of the modelling and data collection in adequately representing reality and offering manageable solution spaces. This has raised questions about data language, data reliability, performance indicators and their validity beyond the level of

numerically coded statistics of past performance. A new need emerges for semantic layers for safety data in information acquisition at both a societal value level and operational performance level, coping with a LCA scope from design to the aftermath and recovery from occurrences. Graph representations, visualization, simulation, influence diagrams, serious gaming and virtual reality approaches have demonstrated serious opportunities that should be explored further to integrate safety in this new information paradigm.

During the seminar, to adhere to 'resilience' as an opportunity for safety enhancement crystallized. Several building blocks were presented, enabling a dialectic synthesis between 'old' and 'new' schools of safety thinking. We are back where we started 25 years ago as an ESReDA project group: start with reliable information. The safety circle is closed in coping with critical entities without creating disasters. The EU Directive facilitates navigation of a safety-oriented journey through a proactive solution landscape that is wider and richer than the occurrence domain which triggered the start of the journey 25 years ago.

EU Project Firelogue Webinar on:

Analyzing current trends in integrated wildfire risk management and critical infrastructure dynamics

By Dr Nikolaos Kalapodis and Dr Georgios Sakkas
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As part of the Firelogue project Webinar series, the Working Group Infrastructure (led by KEMEA – Dr Nikolaos Kalapodis and Dr Georgios Sakkas) prepared and hosted a webinar entitled "Analyzing current trends in integrated wildfire risk management and critical infrastructure dynamics. Forecasting Future Challenges and Opportunities for Resilience". The webinar was held on July 3, 2024, and a total of 213 people registered for the webinar, reflecting a remarkable interest in the topic. Of the registrants, 144 actively participated in the webinar and took part in insightful discussions and exchanges.

The Webinar featured presentations from EU-CIP, ELGO-DIMITRA -Institute of Mediterranean Forest Ecosystems (IMFE), ESRI - the world leader in GIS platforms, and the European Commission Joint Research Centre (JRC) focusing on the interplay between wildfires and critical infrastructure.

Dr. Emilia Gugliandolo, coordinator of the EU-CIP project, described in her presentation the objectives of the project, which is to improve the resilience of critical infrastructure against man-made and natural threats, including wildfires. The project involves 20 partners and focuses on data analysis and evidence-based policymaking in the field of Critical Infrastructure Protection (CIP). Its main objectives are to establish a pan-European knowledge network, improve analytical capabilities and support innovation. By addressing the multifaceted challenges of wildfires and fostering collaboration among stakeholders, EU-CIP aims to create a comprehensive approach to infrastructure protection and risk management.

Dr. Miltiadis Athanasiou (IMFE) categorizes infrastructure into hard (such as roads and power grids) and soft (such as education programs and emergency services) and highlights the interconnectedness of wildfires and these infrastructures. He discusses the dual impact of wildfires, which can both damage and be exacerbated by critical systems such as telecommunications. To mitigate wildfire risks, he emphasizes the importance of managing forest fuels through methods such as greenbelt creation and maintaining fuel breaks by utilizing various fuel treatment methods like mechanical treatments, grazing, and prescribed burning, with policymakers playing a key role in these efforts. Educating citizens about safety and evacuation is critical, as is improving citizen warning systems. Community preparedness and recognition of fire-resistant structures are essential to building resilience. He advocates learning from past experiences, strengthening forest services, and involving local stakeholders in wildfire management. Finally, he notes that the use of technology can streamline administrative tasks, allowing for more effective wildfire management during difficult seasons.

The ESRI presentation (Mike Cox & Anthony Schultz) highlighted the importance of geospatial tools for risk mitigation and impact reduction in the Wildland Urban Interface. Geospatial components are essential for public safety operations, enabling effective data collection and analysis during incidents like wildfires. By integrating various data sets, stakeholders can better understand incident impacts and enhance response strategies. Organizations, including FEMA and utility companies like Pacific Gas &

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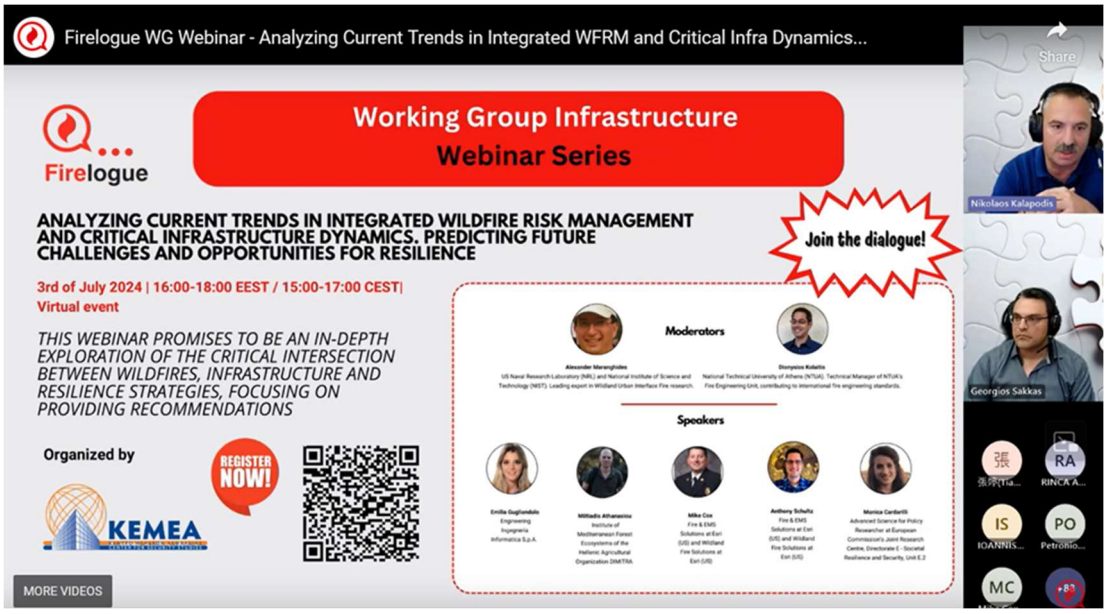
Electric company (PG&E), utilize geospatial technologies such as drones and machine learning for targeted risk identification and resource allocation. Additionally, analyzing demographic data helps identify vulnerable populations, while GIS and data visualization tools support informed decision-making and community resilience. ESRI presentation highlighted tools for risk mitigation, including geodata collection for improved preparedness.

Dr. Monica Cardarilli from the Joint Research Centre (JRC) discussed the evolving policy landscape for critical infrastructure resilience, focusing on the new Critical Entities Resilience (CER) Directive EU 2022/2257. This Directive mandates that Member States and critical entities enhance their resilience against various threats, including natural disasters and public health emergencies. The shift from "critical infrastructure" to "critical entity" reflects a broader, all-hazards approach that considers interdependencies across sectors and borders. The Directive emphasizes the need for a comprehensive risk assessment that accounts for dynamic risks influenced by multiple parameters, including geopolitical and climate changes. Key recommendations include adopting service-oriented approaches, engaging multiple stakeholders, and ensuring evidence-based decision-making to effectively plan and implement resilience strategies.

After a very interesting discussion with the audience and the presenters (panel session) moderated by Mr. Alexander Maranghides, US National Institute of Science and Technology (NIST) - National Fire Research Laboratory and Ass. Prof. Dr. Dionysis Kolaitis, School of Mechanical Engineering, National Technical University of Athens (NTUA), the panel provided valuable insights and recommendations for improving transboundary risk assessment and addressing the challenges posed by wildfire to infrastructure and vice versa.

For more information: https://firelogue.eu/webinar030724.php

To read the executive summary please click here: https://firelogue.eu/pdf/Webinar_WG_INFRA.pdf



Challenges for safety and reliability studies of the newly designed fusion-oriented facilities

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Many efforts have been made so far to demonstrate the technological and economic feasibility of nuclear fusion. However, today tokamaks and other fusion-oriented facilities are experimental installations working with very low availability. The newly designed facilities, like the demonstration power plant DEMO or the IFMIF-DONES neutron source, are subject to severe technological and engineering challenges as they are expected to operate with significantly higher availability and load factors. Therefore, the safety and reliability studies must be developed and implemented very early on during the design stage to achieve the goals. This is considered one of the main challenges of the nuclear fusion technology [1]. Of the numerous problems regarding the methodological aspects, three are outlined in this newsletter note.

1. Integration of the heterogeneous reliability data for fusion-specific components [2].

It is a common problem when the component failure rates for complex technological systems are estimated by the heterogeneous datasets extracted from several sources of different content, structure, and accuracy. The integration of the heterogeneous reliability data for fusion-specific components is a challenging issue, though several attempts to solve this problem have been proposed so far. The new method presented in [2] consists of the four main steps: (1) Identification of relevant data records relating to a given component type in different sources; (2) Determination of the Probability Distribution Functions (PDFs) of the failure rates for each data record – $f_{...}^{ij}(\lambda)$; (3) Monte Carlo sampling from the PDFs; and (4) Parameter's estimation for the resulting distribution – π_{ij} (Fig. 1).

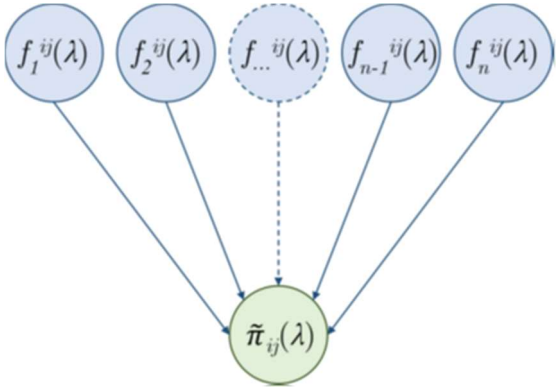

Fig. 1. Data integration by Monte Carlo method [2].

2. Unification of the design FMEA methodology for the safety and reliability aspects [3].

Failure Mode and Effect Analysis (FMEA) is a commonly used method for identification, prioritization, and mitigation of the potential failures of systems and processes. This is, however, the semi-quantitative approach, which means the analysis is sensitive to the classification criteria of the potential failure severity, occurrence, and detectability. The problem arises for the newly designed installations when several teams of experts are working independently on safety aspects and reliability optimization by developing FMEA for the same systems. To avoid contrary actions, doubling the work, or divergent recommendations for designers, there is a need to integrate the safety and reliability aspects into one analytical approach as proposed in [3], where the risk matrix has been divided into three regions of severity index (S): $S < 4$ – no effect for safety nor reliability, $4 \leq S < 8$ effect on reliability only, $S \geq 8$ – safety aspects.

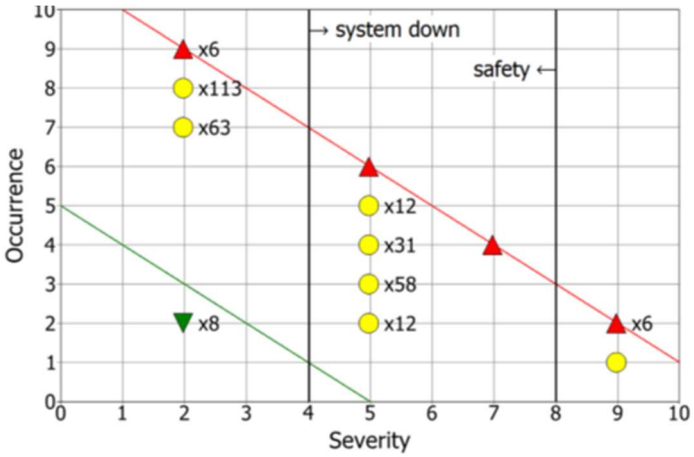

Fig. 2. Integration of the design FEMA for safety and reliability studies [3].

3. Modelling the life-cycle availability with ageing phenomena and imperfect maintenance [4].

Modelling the life-cycle availability of the newly designed facilities requires the combined consideration of two factors: the component ageing phenomena and the imperfect results of the preventive and corrective maintenance. The problem comes down to determining how fast the function of failure rate grows over time (ageing factor) and how much it can be reduced by the maintenance (restoration factor) – see Fig. 3. The new analytical method presented in [4] allows for modelling of the time dependent failure rates of the fusion-specific components based on the statistical spread of the data between different facilities where old and new devices are operated. Despite these efforts, the development of a unified approach to modelling time dependency of the component failure rates applicable to the fusion-oriented systems subject to imperfect maintenance is still in progress.

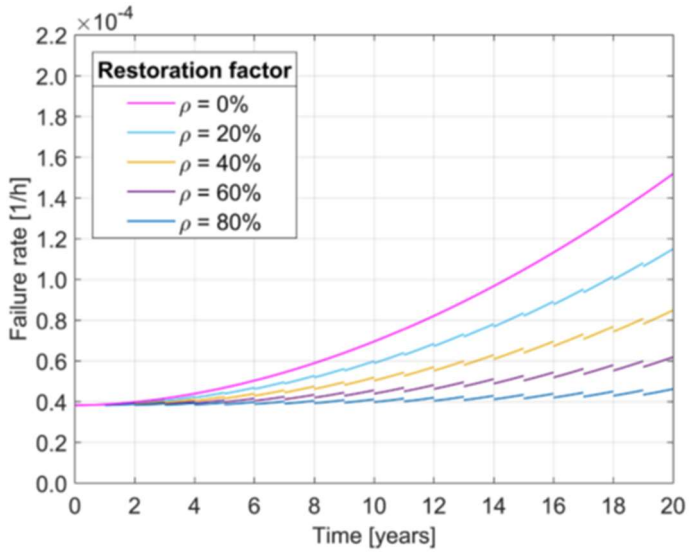

Fig. 3. Modelling the component failure rate with ageing and imperfect maintenance [4].

References:

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ESReDA's journey to Open Data-A personal reflection

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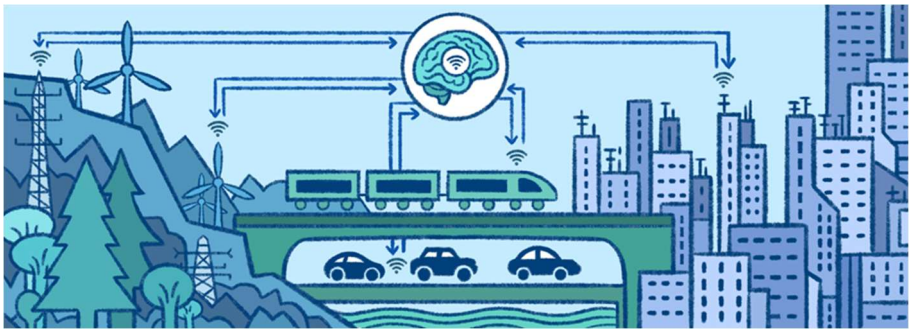
Developed countries are facing the nascent a digital revolution fueled by human-like artificial intelligence, bioinspired engineering, and deeply intelligent robots, where humans and digital assets will work together within a large smart ecosystem.

The built environment, particularly industrial and civil infrastructure, will certainly be part of this revolution since infrastructures (roads, railways, cities, energy facilities, etc.) are the foundation upon which this future smart ecosystem will be based. Deep integration of smart technologies into infrastructure has the potential to reduce European spending on infrastructure asset management while significantly increasing reliability and resilience.



However, achieving this advanced level of digitalization requires learning from and responding to high-quality data. The creation, updating, and refinement of predictive models for smart digital twins demands substantial amounts of high-value data.

Anyone working with digital twin technologies may already recognize the limitations posed by insufficient data to train and test these systems effectively. When available, data are often siloed within specific applications or components, making it difficult to use for training decision-making models across pervasive systems commonly found in industry and infrastructure.

In light of this, I see an opportunity for ESReDA to become a key player in providing open, high-value datasets related to asset management, reliability, and maintenance of physical and digital assets across various industries.

An Open Data Initiative at the core of ESReDA would align seamlessly with the Open Data and Open Science European policies, and particularly with the Horizon Europe provisions on Open Science. Of course, implementing such an initiative would come with challenges, like long-term data availability and curation, clear metadata specification and its connection to findability, data protection and use of European regulations, among others.

Nevertheless, these challenges should not obstacle an initiative with a transformative potential for research and development. More efficient and resilient research and technological advancement can be achieved through global scientific and technical collaboration, which is only possible through sharing of scientific knowledge, but also high-value data.

Call for Expressions of Interest: To all ESReDA members and EU experts in the field, if you are willing to participate actively in the **Open Data Initiative**, please, send your expression of interest to Dr. Manuel Chiachío (mchiachio@ugr.es) and Dr. Antonio J. Guillén (ajguillen@ucm.es).

Forthcoming ESReDA Seminars

The 66th ESReDA Seminar

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66th ESREDA Seminar

Transformative safety and resilience models in a smart digital and sustainable world
May 22nd – 23rd, 2025, University of Salento, Italy

Brief description

Several factors are contributing to increase dynamism and complexity of current approaches to prevent accidents and to guarantee business continuity: one critical factor to evaluate is the massive diffusion of digital technologies, which is forcing the adoption of new models to prevent accidents and to support more effective resilience models. Briefly, from one side, digitalization is characterized by a transformative potential mainly oriented to improve operational performance, reduce accidents and increase system reactiveness through several ways. One example could be related to the enabling effectively the potential of acquiring in real time and huge quantity of safety data – also related to early warning signals – which will be treated and analysed by AI models for extracting knowledge to prevent accidents. New risk management models and approaches are, thus, required. Moreover, from another side, digitalization is the source of new emerging risks, e.g. due to the massive use of intelligent robotics systems interacting directly with humans (like collaborative robots), to the use of decision support systems (e.g. based on algorithmic management) that provide automatic feedback to humans, e.g. workers as well as safety managers and/or analysts.

Similar conditions could be outlined in the resilience field, where digital technologies are contributing to increase also forecast capabilities and preparedness in complex systems, like critical infrastructures and complex organizations, thus transforming traditional approaches, tools and organizational models. Digital technologies could help to apply more proactive methods, e.g. to predict insight of what in the process can go wrong because of internal or external disruptive disturbance. In addition, the increasing attention towards sustainability issues is transforming safety and resilience approaches by adding new factors and impacts to be evaluated in an effective and holistic way.

Knowledge and experiences about these topics will be shared in a seminar organized by ESREDA and University of Salento from 22nd to 23rd May 2025 in Lecce (Italy). This seminar is aimed at addressing current and future challenges, tools and new approaches for accompanying the digital and the sustainable transformation in safety ad resilience models applied in complex systems.

The first call for paper will be available on ESReDA website by the beginning of January 2025.

Past ESReDA Seminars

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65th ESREDA Seminar

From risk imagination to safety intervention - Managing risks with knowledge,
14-15 November 2024, National Center for Scientific Research "Demokritos",
Athens, Greece

ESReDA's 'Risk, Knowledge, Management' (RKM) project group (PG) addresses the intricate relationships between risk, knowledge and management, aiming to find new ideas for preventing accidents and improving safety management with better use of knowledge. The RKM PG organises the 65th ESReDA seminar to foster an exchange of ideas and expert debate. The National Centre of Scientific Research Demokritos in Athens will provide the forum.

Theories, concepts, and experiences of enhancing the use of knowledge for better risk analysis, management and governance were discussed between the gathered experts. The seminar has

gathered some 60 participants: researchers, engineers, risk analysts and managers, and post-doctoral fellows, coming from different industrial and research sectors. During these two-day one-session seminar, about 21 oral presentations, including 5 keynotes, in 5 sessions were proposed.

The breakdown of the participants per EU country is shown in figure 1, below.

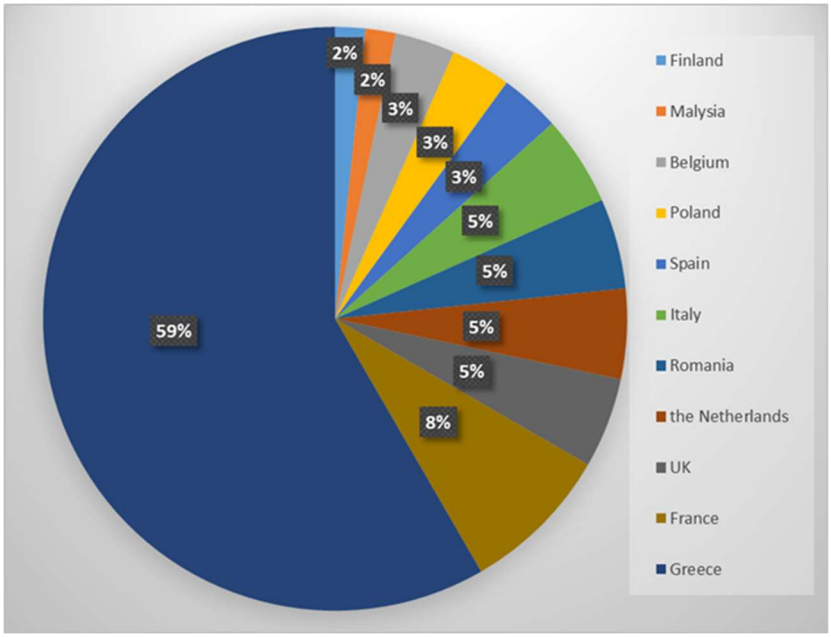

Figure 1: The breakdown of the participants per EU country

Though we are told we live and work in "information and knowledge" society, preventing accidents and enhancing resilience, through the use of relevant safety knowledge and expertise is not granted and requires continuous efforts to overcome the hurdles in an "age of uncertainty".

The seminar's program is available on:
https://drive.google.com/file/d/1TDbAxLmKLnNXq_T_kClvC4lB1bp5CKtP/view?usp=sharing

The official proceedings will be edited and be available, for free downloading within 6 months.

To follow the ESReDA mi-annual seminars, you are invited to visit its site on:
http://www.esreda.org/

ESReDA Project Group on Risks, Knowledge and Management

In 2020, ESReDA launched a project group to address the relationships between risks, knowledge and management. The scope defined is of interest to system designers, operators, managers, maintenance, lawyers, insurers, regulators, and many others working on safety and security including natural hazard management. The scope covers the safety, reliability and security related to multiple hazards and threats (natural, high-risk industry, critical infrastructure, communication and transport systems over different territories etc.) involving all stakeholders (public, operators, regulators and government).

Risk management integrates all activities and disciplines related to assessment, identification of early warning signs and emerging risks, foresight, investigation of events and lessons to be learned, management of barriers and lines of defence, reliability, and change of policies and culture. In this context, the keyword knowledge defines the main topic of the project: the endeavour to use knowledge to improve the management and governance of risks (from design to operation and dismantling/decommissioning).

To join ESReDA project group on RKM, you can write to the project leader *myrto@ipta.demokritos.gr* and express your interest. RKM-PG as all other ESReDA PGs is open to all EU experts, researchers and engineers working in the field. **It is not required to be ESReDA member to join any of ESReDA PGs.**

The 64th ESReDA Seminar

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64th ESReDA Seminar on

Digital Maintenance in the Digital Twin Era.

30-31 May 2024, Universidad de Deusto, Bilbao – Spain.

Digital Twins (DT) technology has become indispensable for understanding and deciphering the utility of current developments, unlocking the potential of digital transformation.

It operates like the keystone in an arch, seamlessly bringing together diverse elements of digital technologies and modeling techniques. This synergy creates a unified structural entity, crucial in the emergence of new and complex System of Systems (SoS) structures.

One of the most significant areas where this transformation is expected to make waves is **Digital Maintenance**. Analyzing how maintenance can benefit from this evolution is essential. The advent of new technologies has made the maintenance landscape more intricate, requiring efficient management of vast information and predictive alarms within dynamic schedules.

However, the complexity of the maintenance management process often hampers the technology's impact on organizations. Conventional maintenance practices persist, causing delays in embracing digitalization and hindering the expected return on investment for companies undergoing the digital transformation effort.

Furthermore, **the role of individuals in the context of maintenance digitalization** is critical. Embracing digital transformation offers an opportunity for human evolution, leveraging the expertise and experience of employees in the new digital environment. This provides a competitive edge in driving innovation and technological progress.

Join us at the 64th ESReDA seminar, where researchers, practitioners, and experts from various disciplines converge to share insights and advancements in the realm of digital maintenance and its relationship with digital twins, complex systems, and human resources. Topics include, but are not limited to:

1. Advancements of Digital Twins in Complex Systems Generation.
2. Current Barriers in Implementing Technologies for Real Maintenance Evolution.
3. The Role of Human Resources in the Context of Digital Maintenance and Digital Twins.

Bilbao, Spain, hosted the 64th ESReDA Seminar on **May 30th and 31st**, **2024**. Nestled along the Nervión River, Bilbao seamlessly blends rich history with cutting-edge architecture, epitomized by the iconic Guggenheim Museum designed by Frank Gehry. Participants will have the chance to immerse themselves in the lively Old Town, savor exquisite Basque cuisine, and explore a city that exudes charm at every turn. Join us for an event that marries knowledge exchange with the cool vibe of Bilbao.

The 64th ESReDA Seminar final proceedings is in processing and will be soon issued.




The 64th ESReDA Seminar - DOCTORAL WORKSHOP

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64th ESReDA Seminar on Digital Maintenance in the Digital Twin Era.
DOCTORAL WORKSHOP PLUS SESSIONS OF EXPERTS AS A FORMULA FOR SUCCESS AT THE 64TH ESREDA SEMINAR IN BILBAO

30-31 May 2024, Universidad de Deusto, Bilbao – Spain.

The 64th ESREDA Seminar plus Doctoral workshop, which took place on May 30th-31st, 2024 at the University of Deusto in Bilbao, Spain, focused on digital maintenance in the era of digital twins. The technical committee, led by Dr. Antonio Guillen, Dr. Aitor Goti, Drs Manuel and Juan Chiachio, Dr Antonio Sanchez and Prof. Adolfo Crespo considered necessary to have a common room for the exchange of experiences and expectations of young researchers and expert practitioners.

The seminar plus workshop was attended by over 60 people and explored the challenges and opportunities associated with integrating new technologies, such as digital twins, into traditional maintenance practices. It brought together researchers and practitioners from various fields to share their insights on how to overcome these challenges. The seminar covered topics such as digital twins, complex systems, and human resources.

The seminar aimed to bring together researchers, practitioners, and experts from various disciplines to share their insights and advancements in the realm of digital maintenance and its relationship with digital twins, complex systems, and human resources. The event intended to provide a vision of digital maintenance once the foundational technologies (AI, predictive analytics, digital twins, IoT, cloud/edge/fog computing, etc.) had reached a sufficient degree of maturity. This vision facilitated drawing conclusions on the approaches needed to overcome current barriers that limited the full development of digital maintenance, particularly in assets and systems with a low level of digitization. During the seminar, participants had the opportunity to share experiences in applying different technologies to improve maintenance, review the state of the art of these technologies, and evaluate their real impact on organizations and the evolution of their maintenance models.

As well, the doctoral workshop delved into the intricacies of digital twinning, encompassing both theoretical underpinnings and practical applications. It provided a rigorous exploration of the field, ranging from fundamental concepts and diverse applications to advanced computational techniques and probabilistic treatments.

The fascinating seminar plus workshop will result in a series of proceedings of the presentations that took place in Bilbao last June. The process of elaboration of these proceedings will activate in September and the proceedings will be published during autumn.

The 63rd ESReDA Seminar

Resilience assessment: Methodological challenges and applications to critical infrastructures 25-26 October 2023, JRC, Ispra – Italy.

Chairwoman
Kristine VLAGSMA
EC Joint Research Centre)

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Research in resilience of infrastructure systems has been constantly increasing during the last decade and is expected to grow further. Resilience applications in technical systems domain have evolved most significantly during the last two decades and the term resilience has already been transferred to the policy domain, as the Directive on the Resilience of Critical Entities (CER Directive) went into force in January 2023 and replaced the Critical Infrastructure Directive, published in 2008.

Two fundamental points in resilience domain to be addressed by the Seminar are:

Organiser

Vytis Kopustinskas
European Commission, Joint Research Centre

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- The methodological development of resilience assessment from a conceptual framework to modelling approaches.
- The metrics for resilience assessment and development of quantitative tools for decision making.

The 63rd ESReDA seminar explored these points and other related questions. We discussed theories, concepts, and experiences of resilience assessment methodologies and applications.

Authors were invited to present their proposals and discuss successes and/or failures and to identify future needs in resilience research. We wanted to encourage new ideas, scientific papers, conceptual papers, case studies and cross-sectoral research on this topic with examples and applications of infrastructures exposed to both technological and natural threats, hazards.

The seminar brought together some 50 researchers, practitioners, and decision-makers. While some 25 papers and invited keynotes were presented.

The proceedings of the 63rd Seminar is now available for free downloading on:
https://publications.jrc.ec.europa.eu/repository/handle/JRC139101

ESReDA members' external running-projects

Medelia Chair: Probabilistic fatigue analysis of steel structures

Julien Baroth, Associate Professor

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Grenoble-Alpes University (France)

The ageing of structures in France and around the world means that plant managers have to choose between several scenarios: extending their service life on an unchanged basis, repairs, reinforcements, or even complete replacement. The financial stakes are often very high, given manufacturing and construction costs, as well as operating losses during shutdowns. As a result, plant managers need as much information as possible to assess the residual service life and level of risk associated with each of the above scenarios.

In this context, the Medelia Chair, sponsored by SPRETEC [1] (Artelia Group [2]), created by the Foundation Grenoble INP [3], aims to improve the safety and durability of hydraulic structures. It will focus on the study of steel welded connections in non-standard engineering structures such as hydroelectric power plants and dams. The Chair's researchers will be working on new fatigue calculation methods to improve models for predicting the service life of structures. This work will enable more accurate estimates of damage and service life, helping managers to make informed decisions.

Julien Baroth, associate Pr. at Grenoble-Alpes Univ., co-holder of this chair, has recently presented it during the 63rd ESReDA seminar in the JRC Ispra (IT), he will contribute to the project group « Resilience Assessment of Critical Infrastructure ».

A thesis began in November, directed by Julien Baroth, 3SR [4], and Rafael Estevez , SIMAP [5], same university, with doctoral student Kamal Harb, entitled "Probabilistic fatigue analysis of mechanically-welded steel structures".

[1] https://www.spretec.fr/
[2] https://www.arteliagroup.com/
[3] https://fondation-grenoble-inp.fr/en/
[4] https://3sr.univ-grenoble-alpes.fr/en/3sr-lab
[5] https://simap.grenoble-inp.fr/en/about-simap

Horizon EU Project: BAG-INTEL

An intelligent system for improved efficiency and effectiveness of the customs control of passenger baggage from international flight arrivals

By Klaudia dos Santos, BAG-INTEL's Communication and Dissemination Lead, Martel Innovate

Martel Innovate

Klaudia dos Santos
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Today, we also shed light on BAG-INTEL, a 36-month Horizon Europe Research and Innovation Action in the domain of border security, which kicked off in September 2023. The project brings together a diverse team of 24 partners from 8 European countries, including industrial players, universities and research organizations, consultancy and advisory firms, ministries, and customs, tax, and civil authorities, who have come together to develop innovative tools, which will increase the effectiveness and efficiency of baggage customs controls at airports without the need of involving extra human resources.

Context and operational scenario

While the security scanning of outgoing luggage is well-developed, the customs scanning of incoming luggage is not full-fledged. The utilization of external data for luggage risk assessment is also not exploited to its full potential for customs controls. Furthermore, the current state-of-the-art in luggage reidentification has several drawbacks:

Tags must be manually placed in or on the suspect luggage and then removed before the traveller leaves the customs area following the manual inspection of their luggage to ensure they do not face another inspection the next time they travel with the same bag.

The smugglers may realize their luggage has been tagged and remove the tags before entering the customs area, thereby hindering the reidentification and capturing process.

While some airports apply radio-frequency identification (RFID) tagging for the customs reidentification of luggage, the RFID tags might damage the bag during their removal.

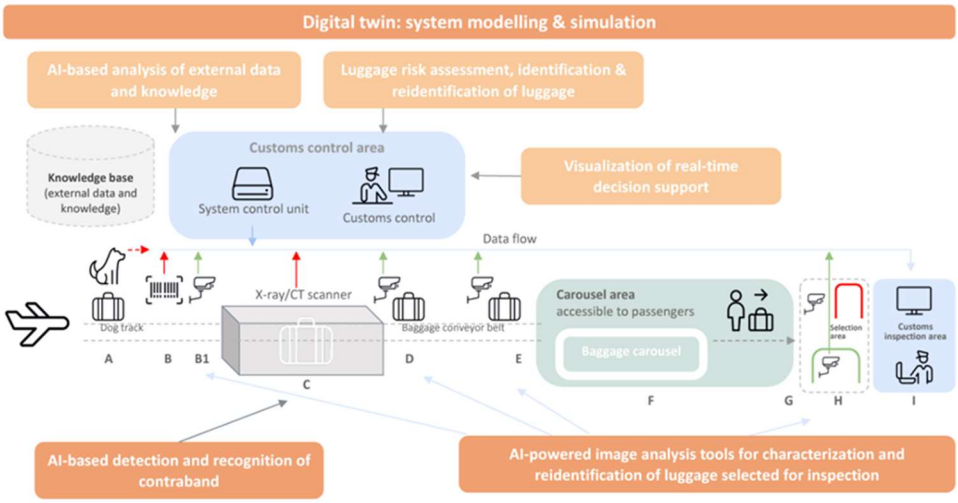
The current process has a relatively high operational and maintenance cost due to the manual labor involved, as well as an environmental impact caused by the production and immediate disposal of tags.

The BAG-INTEL solution

Addressing the limitations and drawbacks of the current processes, BAG-INTEL aims to enhance the effectiveness of the customs control of passenger baggage through several features and capabilities, including:

- an AI-powered functionality for enhanced contraband detection in X-ray scanning of incoming luggage,
- an AI-powered risk assessment based on external data analysis,
- an AI-camera-based end-to-end reidentification of luggage, and
- a digital twin for system visualization and performance optimization.

The **'BAG-INTEL system overview'** shown in Figure 1 illustrates the solution under development.



Upon flight arrival, as the incoming luggage is unloaded and placed on the conveyor belt, the customs risk of each piece of baggage is assessed using AI-supported tools under the supervision of the customs control officer(s). The applied risk indicators come from 4 sources:

1. The external data and knowledge, such as the Passenger Name Record and the databases of Law Enforcement Agencies, which record suspicious travel patterns and links to organized crime.
2. An X-ray/CT scanner with absorption sensing and object recognition in the scanning image, which will be trained to detect various kinds of contraband.
3. Customs control officer(s) who may notice suspicious content, which has not been flagged by the scanner.
4. The dog handler input (if the customs team applies a sniffer-dog track before the X-ray/CT scanner).

The risk indicator data from all sources is then integrated into an overall risk assessment, based on which a decision whether the luggage should be manually inspected is taken.

In summary, **BAG-INTEL aims to enhance customs control processes so that more contraband is detected and the cases of unnecessary manual inspections not leading to finding contraband decrease.** The objective is to reduce false positives and flag only the pieces of luggage which contain contraband. Because the manual inspections will focus on all, and only, suspect bags, more contraband will be captured without the need to involve extra human resources in the process. Furthermore, **the proposed AI-camera-based luggage reidentification is non-intrusive, eliminating the drawbacks of currently used methods.**

The Newsletter (September 2024) is available at the following link:
https://bag-intel.eu/2024/09/16/bag-intel-at-the-88th-thessaloniki-international-fair/
Project website: www.bag-intel.eu
email: info@bag-intel.eu
LinkedIn
X: @BAGINTEL
Project videos: www.bag-intel.eu/videos

BAG-INTEL
Type of action: HORIZON-RIA
Call: HORIZON-CL3-2022-BM-01
Topic: HORIZON-CL3-2022-BM-01-04
Grant Agreement No.: 101096649
https://www.bag-intel.eu/

News from ESReDA Project Groups

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ESReDA Project group on Resilience Assessment of Critical Infrastructure

The ESReDA project group on Resilience Assessment of Critical Infrastructure, active since June 2023, has organised two special sessions at the ESREL 2024 conference, held in Cracow, June 23-27, 2024. The special sessions are focused on resilience assessment in electricity sector (session 1) and critical infrastructures in general (session 2). The eight papers submitted are authored by the ESReDA members: JRC, University of Nottingham, Kaunas University of Technology & 'Horia Hulubei' National Institute of Physics and Nuclear Engineering (the latter two applied for ESReDA membership in 2023) and ESReDA partners: University College Dublin, German Aerospace Centre, ETH Zurich.

ESReDA Project group on Resilience Engineering and Modelling of Networked Infrastructure

Rasa Remenyte-Prescott & John Andrews

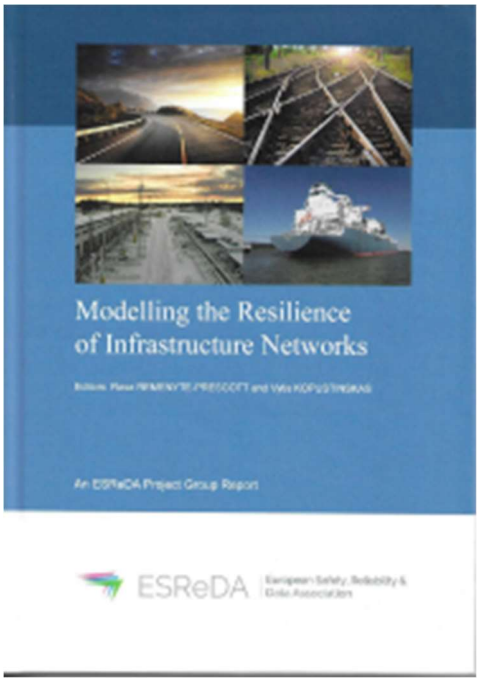
University of Nottingham, UK

Findings from the project group have been published in a book entitled "Modelling the Resilience of Infrastructure Networks", edited by Rasa Remenyte-Prescott and Vytis Kopustinskas.

This book is a selection of contributions written by members of the Project Group and concentrates on the themes of transportation and utilities. The papers intend to provide an insight into the state of the art of resilience modelling with a focus on Networked systems. The book is aimed at both an industrial and academic readership with interests in the resilience of engineering systems.

We would like to thank the authors for their contributions to this publication, and our colleagues at DNV for their practical support with printing and distribution.

For information on how to purchase a copy please contact ajguillen@us.es ESReDA General Secretary, Antonio J. Guillén (Ingeman, Spain).



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ESReDA RKM project group: Risk, Knowledge, and Management

The Risk Knowledge and Management Group is continuing its activities. During the last group meeting on the 22nd of February 2023 there was a shift-over of the Group Leader from Eric Marsden to Myrto Konstantinidou and an updating on the status of the discussion papers.

Currently, we have 14 discussion papers under preparation and another 6 under discussion. One is ready to be published in June 2023 and the rest will be published eventually until February 2024. The first one is entitled "Delegation of safety oversight" and it has been prepared by Eric Marsden. We are also planning to host a workshop and ESReDA Seminar in 2024, probably in Athens.

Delegation of safety oversight is a discussion paper on Risk, Knowledge and Management (RKM). It aims to share information on ongoing work undertaken in the context of the RKM project group.

The Delegation of Safety Oversight can directly be obtained from Eric Marsden (eric.marsden@foncsi.org).

ESReDA community recommended books:

Frank Verschueren
Senior Expert

Sacrificing Safety: Lessons for Chief Executives (May 16, 2022, by Andrew Hopkins)
Proposed by Frank Verschueren

Published: May 2022
Book Code: 10093306-0001
eBook Code: 10093307-0001
ISBN: 9781922509505 (Book)
ISBN: 9781922509673 (eBook)

Introduction

After having highlighted James Reason in the previous Newsletter, I choose another prominent figure in the field of safety: Andrew Hopkins. Andrew Hopkins' sociological perspective compliments the psychological approach of the former.

Andrew Hopkins background is sociology. He is a retired academic (Professor Emeritus of the Australian National University). He is well known as an author of safety books who has studied many[1] major industrial accidents.
In these case studies on major accidents, his main focus was on the cultural and organizational factors. Thanks to this multitude of detailed case studies he created a well-formed insight in how dysfunctional organizational practices or misguided safety culture in organizations can lead to catastrophic failures.

Book Review: Sacrificing Safety, Lessons for Chief Executives (2022)

The choice of his 15 books (in the period 1995-2022) to review was less obvious. But, as the author himself mentioned: "While the fundamental causes of the accidents are very similar, each inquiry uncovered fascinating new information which enabled me to extend my analysis. The books therefore complement each other, and each is built on the one before."

I consequently choose to review his last book: "Sacrificing Safety, Lessons for Chief Executives". In this book Hopkins studies the case of the explosion in the mine of Grosvenor, Australia. His purpose is to show how unsafe practices are induced by commercial pressures.

For Hopkins the right organizational structure is essential for managing major (catastrophic) risks and in his opinion, this should be a centralized type of organizational structure. His arguments are that a centralized structure

- is more independent and will make that safety prevails over profit and production
- ensures consistent implementation of safety across the whole organization
- leads to a culture of operational excellence and is therefore more suited to manage complex and high-risk operations

In my opinion one should apply a more nuanced perspective. Other safety experts are in favor of a decentralized structure or partly decentralized structure because of flexibility, local autonomy and employee motivation.

So, the specific context and needs of the organization should determine the choice of structure (centralized or decentralized). But what stays a fact is that when major industrial hazards (explosions, large fires or ecological spills) are present the safety function should not be focused solely on the "slips and trips" while neglecting the focus on major hazards.[2]

In this most recent book, he gives a description of the elements which assure that safety is integrated in the organization in a systemic and systematic way. These elements are grouped in what he calls "the model for CEOs." They consist of 7 pillars which are for every safety

responsible well worth knowing. Equally worth knowing are the supporting arguments which Hopkins presents.

[1] The list of major industrial accidents contain 3 cases in the Mining Business in his homeland Australia (Gretley Mine, Moura and Grosvenor Mines), 4 in the Oil and Gas Industry (Longford Gas explosion, BP Texas City Refinery, Deepwater Horizon and two pipeline fractures) and 1 ecological catastrophe in the Brazilian Mining Industry (Brumadinho).
[2] This neglect on major hazards focus is common for many of the studied major accidents. Most prominent case is Deep Water Horizon.

The first pillar is Leadership Commitment. The executive committee must demonstrate in a clear and visible manner its commitment to safety. This needs a safety strategy that elaborates clear safety strategic goals, leading to the main (collective, organization wide) and individual safety objectives. In this an optimal allocation of resources is guaranteed.

The second pillar is Safety Integration. Safety considerations should be part of every decision-making activity. Therefore, safety from top (strategic planning) to bottom (daily operations) should be well integrated at every organizational level.

The third pilar is Risk Management. Robust risk management practices (safety audits, risk assessments, incident investigations) are needed. Their purpose is to identify, assess and mitigate potential hazards.

The fourth pillar is Communication and reporting. The organizations willing to achieve safety performance are advised to provide open and accessible communication channels. Transparency and accountability should be promoted so employees feel motivated to report safety concerns without fear of retribution[3].

The fifth pillar is Training and Development. Organizations should give sufficient training and development to increase their safety awareness and safety skills.

The sixth pillar is Performance Metrics. Organizations must know their safety performance and review this (internal benchmark). Moreover, organizations must hold leaders and employees alike accountable to achieve these metrics. As such organizations can become more vigilant and go beyond mere compliance.

The seventh and last pillar that Hopkins promotes is Continuous Improvement. This means for him especially having a learning culture.

With these seven pillars every safety responsible - whether he chooses centralized, decentralized or partly centralized structure – has some robust and firm safety guiding principles.

Frank Verschueren:
MSc in chemical Engineering, 4 years Research in Catalytic reactions, Management functions, 18 years in Research, Production, Projects, Logistics, Operational, Quality, Technical support and in several sectors: non-ferrous and mining, Printing, Automotive
Belgian Federal Process Safety Inspector Major Hazards (Seveso industry) for 20 years: Inspections, audits, accident investigations (mainly with fatalities).
Specialised on mobbing and other psychological complaints
Editor of inspection instruments (checklist on dangerous chemical agents, inspection instruments on Human Factors, and on Safety Governance)
Conducting research on Accident investigation with the JRC agency.
Presentations on events (industrial communities, unions) and courses in universities (accident investigation, reactor safety)
ESReDA project member ("Foresight in Safety", "Risk Knowledge and Management") with focus on Organizational Factors and Human Factors.
Member of Energy Institute (London, UK) in HOFCOM (Human and Organizational Factors Committee).
Leader of the expert-group on "Safety and Security" in the Royal Flemish Engineers Association (Antwerp, Belgium)

Mohamed Eid
Senior Expert

From Risk to Resilience:
Towards Sustainable Development for All in a COVID-19 Transformed World

Global Platform for Disaster Risk Reduction- UN DRR

Proceedings of the Seventh Session, Bali, Indonesia, 23-28 May 2022

The Seventh Session of the Global Platform for Disaster Risk Reduction (GP2022) was a decisive moment for re-thinking our approach to managing risk. It was the first such gathering since the beginning of the COVID-19 pandemic and, despite the challenges, the Global Platform, which took place in a hybrid format, saw a record level of participation, with 5,000 participants from a total

[3] Here Hopkins touches here two aspects :
First the "Just Culture" theory where accountability and learning should be balanced, promoted by Sydney Dekker in his book "Just Culture" ((2007) 3rd edition in 2016)
Secondly "Psychological Safety" as promoted by HBR-Professor Amy Edmonson in her books ("The fearless organization" (2019) and "Right Kind of wrong" (2023))

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of 185 countries. It was also the most inclusive and accessible Global Platform to date, with over 200 persons with disabilities participating in person.

The outcomes of the Global Platform are captured in The Bali Agenda for Resilience. Its seven recommendations call to first, reconfiguring risk governance to ensure that management of risk is a shared responsibility across sectors. Second, funding for disaster risk reduction to be written into laws and included in integrated national financing frameworks. Third, it calls upon governments to honour the COP26 Glasgow commitments to drastically enhance financing for adaptation and resilience. Fourth, it calls for empowering those most at risk under the motto of "nothing about us without us". Fifth, it expresses support for the call by the United Nations Secretary-General that early-warning systems cover every person on Earth within five years. Sixth, that the world applies the lessons of the pandemic to build back better, greener, and equitable. Seventh, that all Member States, regional organizations, and stakeholders robustly engage in the Midterm Review of the implementation of the Sendai Framework.

(extracted from the introduction of Mme Mami Mizutori, Special Representative of the UN Secretary-General for Disaster Risk Reduction)

Proceedings are available for downloading at:

https://www.undrr.org/media/83505/download?startDownload=true

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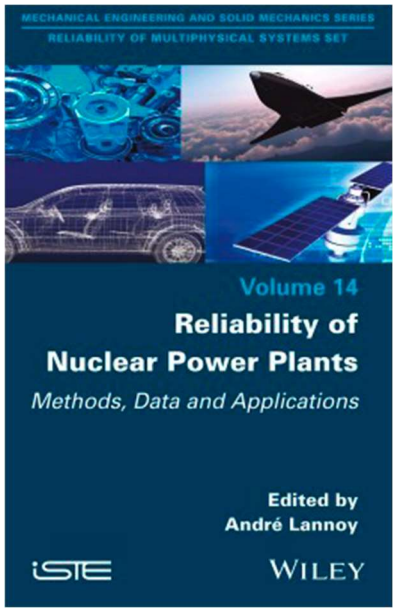
Reliability of Nuclear Power Plants Methods, Data and Applications

Edited by André Lanoy, Abdelkhalak El Hami
Prposed by Jean-François Raffoux



Since the 1970s, the field of industrial reliability has evolved significantly, in part due to the design and early operation of the first-generation nuclear power plants.

Indeed, the needs of this sector have led to the development of specific and innovative reliability methods, which have since been taken up and adapted by other industrial sectors, leading to the development of the management of uncertainties and Health and Usage Monitoring Systems.

In this industry, reliability assessment approaches have matured. There are now methods, data, and tools available that can be used with confidence for many industrial applications. The purpose of this book is to present and illustrate them with real study cases.

The book addresses the evolution of reliability methods, experience feedback and expertise (as data is essential for estimating reliability), the reliability of socio-technical systems and probabilistic safety assessments, the structural reliability and probabilistic models in mechanics, the reliability of equipment and the impact of maintenance on their behavior, human and organizational factors, and the impact of big data on reliability. Finally, some R&D perspectives that can be developed in the future are presented.

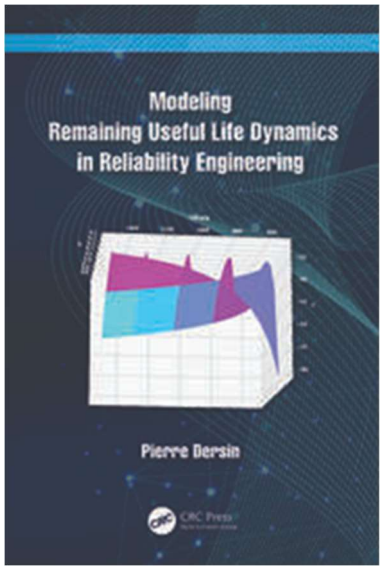
ESReDA Honoray President
Jean-François Raffoux

Written by several engineers, statisticians and human and organizational factors specialists in the nuclear sector, this book is intended for all those who are faced with a reliability assessment of their installations or equipment: decision-makers, engineers, designers, operation or maintenance engineers, project managers, human and organizational factors specialists, experts and regulatory authority inspectors, teachers, researchers, and doctoral students.

The book can be ordered here.

Pierre Dersin

Consultant en System Safety, Reliability, and Maintenance Modelisation & Analysis



Modeling Remaining Useful Life Dynamics in Reliability Engineering,

CRC Press, June 2023.

Pierre Dersin

This book applies traditional reliability engineering methods to prognostics and health management, and specifically Remaining Useful Life (RUL) dynamics.

In the context of the digital transformation, the last two decades have witnessed a significant evolution in the theory and practice of industrial maintenance : information and communication technologies now make it possible to replace traditional maintenance (i.e. scheduled preventive and corrective) with predictive maintenance, based on estimation and prediction of individual asset state of health.

To that end, an invaluable decision support tool is the estimation of asset remaining useful life (RUL). RUL is a function of time ; it is also stochastic since it is affected by observation errors, variability of environmental conditions and mission profiles, and imperfect knowledge of degradation mechanisms .

Taking that uncertainty into account is essential for sound risk management . Failing to do so will generally lead to inappropriate maintenance decisions.

Methods used to estimate RUL are numerous and diverse and, broadly speaking, fall into three categories: model-based, data-driven, and hybrid. The author starts by building on established theory and looks at traditional reliability engineering methods through their relation to Prognostics & Health Management (PHM) requirements and presents the concept of RUL loss rate.

Following on from this, the author presents an innovative general method for defining a nonlinear transformation enabling the mean residual life (MRL) to become a linear function of time, which leads to explicit analytical results, for instance for RUL confidence intervals and RUL probability distribution.

He applies this method to frequently encountered time-to-failure distributions, such as Weibull, gamma and lognormal, and first-hitting times of stochastic processes such as the Wiener or gamma process, used to model degradations .

Latest research results, including the author's (some of which were previously unpublished), are drawn upon and combined with very classical work. A complete chapter is devoted to the examination of the properties of the time transformation that allows for the linearization of the MRL. Statistical estimation techniques are then presented to estimate RUL from field data

Finally the use the results for maintenance support and in particular predictive maintenance, is discussed. A risk-based method for predictive maintenance optimization is presented.

The book ends with suggestions for future research, including links with machine learning.

Industrial applications are described and every chapter is followed by a series of exercises.

The book is of interest to engineers, researchers and students in reliability engineering, prognostics and health management, and maintenance management.

https://www.taylorfrancis.com/books/mono/10.1201/9781003250685/modeling-remaining-useful-life-dynamics-reliability-engineering-pierre-dersin

24th Lambda-Mu congress
14 to 17th October 2024, Bourges (France)
Risk-related professions: keys to reindustrialisation and ecological transition.

Every two years, the French scientific organisation IMDR (Institute for risk mastering and dependability) organizes the lambda-mu congress, which brings together 300 to 400 participants; They represent the different industrial sectors and the various risk professions inside organizations and their stake holders.

The 24th edition of the lambda mu congress organized by IMdR (Institut pour la maitrise des risques) at the INSA-Bourges from October 14 to 17, 2024 brought together 303 people on the theme “Risk professions: key to reindustrialization and ecological transition”. In the context of the issues related to climate change and the geopolitical situation, the congress invited representatives of the various risk professions to come and share their experiences, knowledge and skills to contribute to meet the challenge of reindustrialization and ecological transition.

Some 115 communications were presented in 30 sessions and made it possible to share knowledge, skills, feedback regarding the challenge faced by the various industrial, academic and public service stakeholders, to control the risks of sustainable reindustrialization involving their societal and environmental responsibility. Within 6 months these communications will be available in “open access” on the IMDR website (http://www.imdr.eu/). Several meetings in the form of round tables were open online to the public during the congress and are accessible in replay depository of the IMDR on YouTube. https://www.youtube.com/@institutmaitrisedesrisques/

Their themes concerned:

- Artificial intelligence and trust
- New extra-financial regulations and risk professions.
- Territorial consultation as a means of prevention and pooling of risks
- Innovation within risk professions.
- Reindustrialization: challenges and opportunities.
- The ecological transition: challenges and opportunities.

As is customary in lambda-mu congresses, a “Lamda-Mu d'or” prize rewarding the best communication evaluated by the scientific council was awarded this year year to 4 co-authors for their communication “Quantitative evaluation of risks for asset management with RestLife »

Francis Claude, president of the program committee of the congress, and Jacques Repussard president of IMDR, have outlined the results of the congress. The various debates and interventions of these 4 days clearly showed that the study of risks, within increasingly complex socio-economic systems, had to integrate the societal context and climate change. As a result, the new professions of risk must adapt and integrate more and more knowledge from very diverse disciplines.

To coordinate this approach, the president of IMDR gave to the association the objective of developing a reference document which brings together and presents the scientific and operational complementary knowledges supported by its members in order to make them accessible to these new professions. . This document will also highlight their weak points and encourage IMdR members to strengthen and disseminate

ESReDA Members, you are kindly invited to contribute to the ESReDA newsletter sharing news, announcement of events, your experiences, ideas, etc. You are supposed to elaborate proposals to create new Project Groups, host ESReDA Seminars or initiate collaborative activities.