ESReDA

European Safety, Reliability & Data Association

Newsletter

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ESReDA President's Inaugural Address

The inaugural address of the newly elected President of ESReDA
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I am deeply honored and truly grateful for the trust you have placed in me by electing me as the President of ESREDA. ESREDA has long been a vital point of reference for research, innovation, and collaboration in safety, reliability, and data analysis across Europe. Stepping into this role is both a privilege and a wonderful responsibility: I will do my best for our association.

I would like to express my sincere appreciation to the outgoing leadership- in particular to Mohamed Eid- for their dedication, vision, and guidance over the past years that have allowed our association to reach great results.

I look forward to working closely with the ESREDA Board of Directors, Project Groups, and all member organizations to address emerging challenges in the safety domain — e.g. from digital transformation and AI integration to sustainable safety management—and to further strengthen our collaborative network, which represents a core element of our association.

I would like also to introduce my research activities in the safety domain: I'm Full Professor of Industrial Mechanical Plants at the Department of Innovation Engineering at the University of Salento, a medium-sized University in southern Italy. My scientific activity focuses on sustainable production systems, digitalization of industrial processes, and innovative dynamic risk analysis. Key research areas and major contributions include dynamic models for Near-Miss and Precursor Event Management, Safety 4.0 and Emerging Digital Technologies, Risk Assessment in Digital Transformation, Investigation of causal models and accident dynamics to support "Zero Accidents" strategies in construction sites and high-risk industrial complexes.

In the next year, we will face new and complex challenges such as:

- **Integration of AI, Big Data, and Sensor Technology** (e.g. Safety 4.0): focusing, for example, on developing guidelines for reliability analysis based on artificial intelligence algorithms, machine learning, and data collected from IoT sensors or wearable devices as well as developing new predictive and prescriptive maintenance models fully integrated with safety issues.
- **Resilience of Critical Infrastructures and Socio-Technical Systems**: concentrating also on Multi-Risk Approach (such as NaTech), developing resilience assessment methodologies capable of addressing complex events, interdependencies across networks (e.g. energy, transport, digital), and systemic risks mainly due to rapid climate change.
- **The New Era of Nuclear Energy production and the green and safe transition:** supporting new technologies and systems as nuclear energy expands across several European countries, as well as the development of greener fuels—like hydrogen—which require complex risk assessment and control models.

These are just a few examples where the expertise of ESREDA members will be instrumental in advancing both traditional and emerging research topics in safety. My effort will be dedicated to supporting all members in sharing their knowledge both within and outside ESREDA.

Finally, I want to highlight that another core target will be attracting young researchers and SMEs. We have just started defining and promoting mentoring programs and research awards for young scholars in safety and reliability, and I will focus on developing new ways to engage these talents, who represent the future of our association.

Thank you once again for your support and confidence. I am excited to embark on this journey with all of you and to continue advancing our shared mission together.

CI Resilience & Emerging Risks

Enhancing the Resilience of District Heating Systems Under Contemporary Global Challenges

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District heating (DH) systems are crucial in many northern European countries and other parts of the world where air temperatures drop below comfortable levels, providing consistent, efficient heat to residential, commercial, and industrial users. Heat is delivered through a vast underground network of insulated pipes that connects components such as heat production facilities, pumping stations, heat exchangers, substations, valves, and control systems. Due to their high interdependence, a failure in a single asset can cascade, causing widespread disruptions and potentially interrupting heat supply to many consumers. Therefore, ensuring DH systems' ability to withstand, adapt and recover from disruptions is essential for maintaining reliable service during high-impact, low-probability disruptive events.

The notion of resilience itself is not new; it began to emerge during the oil crisis in the 1970s, alongside another important concept – energy security. In contrast to energy security, however, the quantitative methodology for measuring system resilience only began to be developed in the early 21st century, with one of the earliest works on quantitative resilience analysis aimed at enhancing community resilience to seismic disruptions [1]. Resilience analysis of other systems, including various energy systems, began to emerge later, with greater attention paid to electricity and gas networks rather than to district heating systems. Resilience evaluation of DH systems gained attention in 2015, with the number of scientific papers increasing significantly compared to previous years [2]. Although the number of quantitative and qualitative methods for assessing system resilience continues to grow, there is still no universally accepted definition of resilience or standardized framework that provides researchers with consistent guidelines for measuring and evaluating it [3].

Although resilience assessment provides information about the system state at the time of evaluation, it does not directly inform decision-makers or system managers about which actions or investments would most efficiently improve the system's preparedness for future disruptive events. To support decisions on system improvements, various optimization strategies can be employed. Among these, multi-objective Pareto-based optimization is particularly suitable, as it simultaneously considers multiple, often conflicting, objectives, such as maximizing the resilience index (or resilience metrics separately) while minimizing the investment costs of structural or operational modifications. Such approaches enable decision-makers to identify trade-offs and select improvement strategies that best balance resilience and implementation costs. Beyond multi-objective optimization, other paradigms have also been applied to enhance the resilience of complex systems under varying operational conditions and sources of uncertainty, including linear and nonlinear programming, stochastic optimization, robust optimization, multilevel, and decentralized approaches [4].

As district heating systems grow more complex and are expected to operate with increasing uncertainty from climate change, aging infrastructure, cybersecurity threats, and geopolitical disruptions, resilience will remain a key performance objective. Therefore, future district heating systems must be designed not only for efficiency and sustainability but also to anticipate, withstand, adapt to, and recover from disruptive events. Advancing methodologies that integrate resilience assessment with optimization-based decision support will be essential for guiding investments and operational strategies, ultimately contributing to more reliable, secure, and resilient district heating infrastructure.

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Climatic Extreme Conditions & Nuclear Energy Production

Electricité de France – EDF Facing June heatwave

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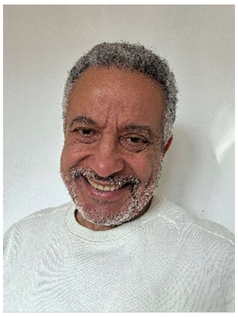

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During the extreme summer heatwaves of 2026, Europe experienced localized power infrastructure strains, resulting in precise generation drops and the enforcement of strict aquatic legal boundaries. [1, 2, 3]

Exact Power Output Losses Across Europe

- 5.5 GW overall reduction: At the height of the summer heatwaves, Électricité de France (EDF) was forced to temporarily pull around 5.5 GW of capacity offline. [3]
- 8.7% fleet drop: This sudden reduction effectively removed 8.7% of the total installed capacity of the entire French nuclear fleet from the regional grid. [3]
- 39 GW export cushion: Despite severe localized constraints forcing temporary shutdowns, France maintained an average available nuclear capacity of 39 GW during the high-demand periods. [1, 2]
- Temporal shift, not volume loss: Total monthly net exports remained stable at 7.6 TWh. However, the heatwave drastically shifted electricity flows, sharply curtailing power exports to neighboring countries precisely during the hottest peak-demand hours of the day. [2]
- Reversed cross-border trading: In an unusual shift for the European power grid, Spain—which historically imports French electricity—stepped in to supply power to France during peak afternoon heatwaves via its booming solar generation assets. [2]
- Hydropower drops: Concurrent drought and heatwaves thinned water levels in vital trans-European river pathways, dropping overall central European hydropower output by roughly 6.5%. [4, 5]

Environmental Temperature Thresholds for French Rivers

French environmental laws mandate specific water-heating caps to protect river ecosystems and prevent massive fish die-offs from thermal pollution. The critical thresholds include, [1, 3, 6, 7]:

- Downstream Heating Caps: Nuclear plants are restricted from heating downstream river waters past absolute maximum thresholds, which usually hover between 24°C and 30°C depending on the specific river and seasonal vulnerability.
- The Garonne River (Golfech): This plant faces the strictest threshold due to its sensitive salmon and migratory fish populations, capping downstream mixed water temperatures at 28°C.
- The Rhône River (Bugey & Saint-Alban): Typically regulated under a 26°C to 28°C maximum limit. When high ambient temperatures pushed the river past these limits, the French Economy Ministry had to grant temporary emergency environmental exemptions to Bugey to preserve grid stability.
- The Seine River (Nogent-sur-Seine): Experiences strict limits where the total temperature increase (Δ T) allowed between the water intake and the downstream discharge point cannot exceed a razor-thin window of 1°C to 2°C during summer low-flow periods. [8, 9]

1. The Condenser (Cooling) Circuit: The Thermal Bottleneck

To understand how an extreme hot climate impacts a nuclear power plant, we have to look at the efficiency and thermodynamics of the three independent water circuits: the Primary, Secondary, and Condenser (Cooling) circuits.

An extreme heatwave creates a chain reaction of thermal inefficiencies, heavily impacting the condenser circuit first, which then creates a bottleneck for the primary and secondary systems.

- Reduced Temperature Differential (Δ T): Power plants rely on a high temperature difference between the steam inside the condenser and the cold environmental water outside it. When river water enters at 26°C instead of 18°C, the Δ T shrinks.
- Higher Turbine Backpressure: Because the cooling water is warmer, it cannot condense the exhaust steam as quickly. This causes the pressure inside the condenser to rise (higher backpressure).
- The Carnot Efficiency Drop: According to the laws of thermodynamics (Carnot efficiency), as the temperature of your cold sink rises, the overall thermal efficiency of the power plant drops. For every 1°C increase in cooling water temperature, a plant loses roughly 0.1% to 0.5% of its electrical output purely due to physics.
- Flow Rate Limitations: Plants cannot simply pump more river water to compensate, because environmental laws restrict how much water they can extract, and pumping warmer water risks exceeding the legal downstream discharge limits.

2. The Secondary Circuit: Lower Mechanical Work

The secondary circuit is a closed loop where water is turned into steam by the reactor, spins the turbine, and is then cooled back into water by the condenser.

- Steam Condensation Stalls: Because the condenser circuit is running hotter, the steam exiting the low-pressure turbine does not liquefy instantly.
- Decreased Turbine Efficiency: The higher backpressure in the condenser acts like a "cushion" of air resisting the turbine blades. The steam cannot expand fully, meaning less mechanical energy is extracted from the steam to spin the generator.
- Feedwater Temperature Rise: The water returning from the condenser to the steam generator (feedwater) enters at a higher temperature. While this sounds efficient, it alters the precise thermodynamic balance and pressure boundaries inside the steam generators, requiring operators to carefully throttle thermal power to prevent stress on the system.

3. The Primary Circuit: Keeping the Core Safe

The primary circuit is a completely sealed, high-pressure loop that directly cools the nuclear reactor core and transfers heat to the secondary circuit. It is highly insulated from the outside climate, but it is still affected indirectly.

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Rotating the kaleidoscope: innovating human factors forensics to the next generation of aircraft and aviators

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With a continuous growth of aviation, aviation safety is showing signs of stabilizing into a non-plus ultra-safe system, approaching a 10-7 accident rate asymptote. Over the past two decades, safety research studies reveal specific flight deck dynamics as a key limiting factor of system safety performance. Due to a growing complexity of modern aircraft and operations, combined with a decrease in the requisite crew capacity, a gap is manifesting itself in an adaptive response of flight crews to such complexity. Performance standards centered on compliance, error-reduction and reproducibility and operational excellence have achieved a unprecedented safety performance level, but cannot challenge the asymptotic limit. Coping with dynamic responses in opaque and ambiguous situations must be understood, acknowledged and mitigated before catastrophic accidents occur in a changed operational environment of new technologies, business models and automation.

Limits of growth

Aviation safety performance has become volatile and requires prospective assessment of such changes and conditions. A systematic analysis of system characteristics and underlying design assumptions and limitations is required to identify irreversible bifurcation points. Constant (1973) and Vincenti (1990) describe this as a presumptive anomaly:

“A presumptive anomaly occurs when scientific insight or assumptions derived from science indicate either that under some future conditions the conventional system will fail (or function badly) or that a radically different paradigm will do a much better job or will do something entirely novel” (Constant 1973, p 555).

In recent years, a Year Over Year (YOY) improvement of the accident rate has continued in an unstable pattern, even showing a negative trend (IATA 2026). It is typical for 10-7 limit state operational performance to enter the domain of very low probabilities and major consequences with unforeseen and unpredictable system behavior. The evolutionary shift in automation can be described as a shift from a pilot-centric model to an automation-centric model. Such developments in autonomy and system integration cognitively isolates the flight crew from control loops, while the risk of future AI systems exacerbates the already-present opacity. The asymptotic limit indicates a possible re-appraisal of control paradigms. The growing complexity may indicate that the paradigm safety by reproducibility is at its limit, to be augmented by effective responses to opaque situations by a process of sensemaking. Present Joint Cognitive System (JCS) struggles with high performance through reproducibility within the deterministic domain. Contrasting the deterministic (prescriptive, compliant) paradigm with non-deterministic (sensemaking, learning) paradigm could increase crew awareness to its own cognitive capacity and enabling re-engagement after a setback, enabling the arrangement of (new) variables into a coherent mental model. Expanding modern airman models for the purpose of coping with both compliant and adaptive behaviors, a systematically nesting of compliant behavior within a resilient attitude is eminent. Kern’s airmanship model (2010) could be adapted to incorporate this new approach:

It is safer to assume opaque operations and, upon realizing that a situation is transparent, transition to a prescribed action, rather than assuming that an opaque situation is simpler than it is.

Pilots will feature a wider safety aperture, acknowledging non-deterministic realities in modern flight operations, combined with cognitive self-regulation and adaptability of mental models to cope with situation awareness in opaque situations. Such an Airmanship 2.0 concept aims to increase JCS adaptiveness while retaining established airmanship components. Airmanship 2.0 facilitates a co-existence of contributions of both existing compliance and new sensemaking behaviors, rebalancing between the safety paradigms of adaptability and reproducibility.

Paradigmatic deficiencies

In debates about the usefulness of safety investigation methodologies, several hybrid approaches have been developed. Leveson developed STAMP, focusing on socio-technical system reconstruction from operational practices, Hollnagel aimed at higher system level diagnostics by introducing FRAM as a diagnostic approach at the functional level, while Woods et.al. coined the concept of resilience engineering, a recovery paradigm coping with disruptions during operational practices.

In the human factor scientific research community, deficiencies were revealed by the investigations of several major air crashes, such as Air France 447, QF 32, West Air Sweden 294, Lion Air 610 and Ethiopian Airlines 302 on the B 737 MCAS air disasters. Deficiencies in forensic models and methods related to air crew behavior and competences in fourth generation commercial airplanes could not satisfactory describe and comprehend the dynamics of the events. Jean Michel Troadec, chairman of the French BEA at the time, reflected on the accident investigative limitations in human performance thinking:

‘This accident (AF 447) has also taught us that hypotheses used for safety analysis are not always relevant, that procedures are not always applied and that warnings are not always perceived. Only an improvement in the quality of (investigation) feedback will make it possible to detect any weaknesses in the safety model (Troadec 2012)’.

This observation raises key questions for future aviation forensics science. New generations of pilot models also require a new generation of human factors frameworks. Classic, academic human factor frameworks with their specific inductive and deductive logic are primarily classification systems and do not necessarily provide insight in underlying cognitive and operational processes regarding opacity, complexity and ambiguity. The unexpected and undesirable nature of emergent behavior requires a transition to more pro-active forensic capacity that seeks to unravel complexity. There is a special value of abductive logic in forensic engineering and the tacit knowledge embedded in technical investigations and engineering design. Both forms of logic have their place in aviation safety investigations and neither should be disregarded or discounted.

In order to enhance such a new framework, three specific human factors forensic lenses are proposed:

- Engaging competence based training in safety investigations provide a more structured pilot behavior with respect to problem solving, decision making, situation awareness and work load management by dedicated debriefing techniques and threat and error management.

- Assessing the ability of flight crews to effectively regulate their own cognitive and emotional state or their cognitive abilities in case of deterioration and recovery techniques.

- Behavioral mapping enables detection of behavioral trends -either beneficial or detrimental- and comparing different crews, scenarios and courses of action. Comparing complex failure patterns enables contrasting positive and negative outcomes of similar situations during simulated training conditions or context research.

The monitoring of human safety performance could engage a shift in safety management from individual operators to aircraft OEM’s and large training organizations. Investigating ‘uneventful’ flights under particular circumstances may reveal what behaviors actually increase safety, by a peer-to-peer learning in both positive and negative experiences. Such a Safety II shared learning will enable learning from prompt recovery might be more valuable than stories about negative outcomes. It might identify deficiencies in flight deck JCS design, certification and operations before they manifest themselves in marginal and critical situations, causing actual loss of safety.

Performance indicators

Measuring the actual safety performance of commercial aviation might be challenged as well. Already in 1977, Wittenberg analyzed the performance indicators for safety levels. For air services, the criterion was the fatality rate per passenger km, for air worthiness the level of safety is expressed by per aircraft hour of flight. A dimension analysis revealed showed that the statistical fatality rate per passenger-kilometer reduces with the introduction of long haul flight, increased survivability rate per accident, larger aircraft and increased block speed. Due to the non-linearity of complex systems, changes in public risk perception and risk appreciation these performance indicators must be readjusted. Rather than flown kilometers or flight hours, a contextualization of safety metrics under specific critical conditions is emerging, together with abductive investigation logic to understand emergent system behavior, limits and possible mitigations before the next accident. Such an approach van be described as a learning system.

It may allow an improved collaborative dynamic between forensic, academic and engineering domains. Such dynamic interrelations engages all three domains, systemic levels and life cycle phases in the iterative investigative process, identifying plausible, credible and reasonable safety enhancement measures.

Finally, derivative or disruptive, that's the question

In coping with presumptive anomalies, a wide plethora of solutions is available. First, the relevance and applicability of existing aviation forensic techniques can be assessed in coping with rare, yet characteristically brittle failure modes at their performance limits. Based on observations of their explanatory potential, reactive and derivative incident and accident diagnostics seem to reach their limits. The current academic research field of human factors seems to be scoped too narrowly and lags behind empirical findings form major safety investigations. Potentially recent developments, such as the CAST theory of Leveson seem to lack the ability to reflect on systems design, considering systems 'as they are', leaving 'intended' or 'as designed' out of scope. The FRAM model of Hollnagel focuses on functional resonance during operations without feedback from investigations. Challenging assumptions, inherent limitations, simplifications and trade-offs for preferred fit with customer demands should be incorporated into investigations to ensure the designed 'flight envelope' falls within the actual 'performance window', not vice versa.

A more disruptive investigation approach incorporates investigating events at the edge of their systemic context, operating conditions and performance limits. Seeking disruptive anomalies might indicate system changes that pose new risks or that perform better than conventional notions. Expanding forensics into scenario-based training and Evidence Based Training concepts might countermeasure safety taxonomies and design assumptions from the past. An Airmanship 2.0 JCS framework could serve as a referential starting point for such broader understanding of the interrelations and dynamics between aviators and aircraft within a highly automated environment. Applying such a forensic approach to a wider aviation community might grow a shared performance model across pilots, engineers, scientists, maintainers, inspectors, trainers, managers and not the least, investigators. Sharing insight, oversight and foresight ensures systemic forensics that learn faster than a system develops (ESReDA 2020).

Finally, can we identify a time when Airmanship 2.0 also reaches its limits? When do we need Airmanship 3.0? A prospective industry-level resilience might be based on a sequence of first gaining insight – by retrospective investigations-, then gaining oversight – by diagnosing system characteristics- and finally achieving foresight by designing these insights into the design of aviation systems before lessons are learned the hard way.

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Call for Expressions of Interest -I:

I-Risk Initiative: To Build a European network in the field of natural mass-driven hazards

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I-RISK is a national network in the field of natural, mass-driven hazards. It gathers companies, research laboratories and universities working in the field of landslides, rockfalls, mudslides, torrential floods, and avalanches. I-RISK is placed under the auspices of the National Pole Infr@2050. I-RISK organises strategical workshops on various topics to increase the resilience against mass-driven hazards:

- management and resilience against exceptional natural hazards
- dynamic behaviour of structures subjected to natural hazards
- snow cover in the climate change context
- the role of water in landslides
- impacts of permafrost melting on mountain infrastructure.

I-RISK also helps to adapt training offers responding to the needs expressed by the concerned Industrial sectors and end-users. It supports the development of specific and oriented training sessions for natural mass-driven risk practitioners and other stakeholders. The last two new professional educational offers and a summer school series were for Swiss I-Risk partners.

Besides, I-RISK conducts a series of webinars to shed light on, and share within the community, the tools and knowledge developed by the companies and the laboratories who are members in its national network.

Still, I-Risk is launching its new initiative to "Build a European network in the field of Natural Mass-Driven Hazards".

Why this initiative

The initiative aims at:

- Promoting and stimulating interactions between research and private stakeholders.
- Extending the existing I-Risk Network to the European sphere to foster multi-collaborative EU actions between different EU partners.
- Contributing into the development and the design of technical standards and recommendations.

We recognize the necessity to build a European partnership to answer EU Research & Innovation calls for projects, regularly emitted by the EC. We are convinced that we should improve our collective practices by exchanging on the different above-mentioned goals, and especially by changing the scale at which we organize these exchanges.

Next steps and proposed organisation

Setting up a European network will start with a first exchange with all potential partners through brain-storming meetings and discussions to build up a common shared ambition.

The next steps, including the creation of specific working groups, will be structured according to the outputs of the preceding phase of exchanges and consultations with other EU entities who will express their interest. Basically, the timeline could be as follows:

- Regular meetings (video and face-to-face if necessary) between all the partners engaged in the network - about 3 per year to share information on specific actions of interest, opportunities to build projects, etc. One of these meetings will be devoted to the strategy purposes for the coming year, including specific events to be conducted and related funding matters.
- Workshops to work on a specific topic.
- Organization of specific events to disseminate and share widely the problems encountered and the innovations obtained or participation of the collective in partner events.

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Call for Expressions of Interest-II: ESReDA's Open Data Initiative

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Developed countries are facing a nascent 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.

Those who are working with digital twin technologies already recognize the limitations due to data insufficiency 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, this is 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.

Call for Expressions of Interest:

To all ESReDA members and EU experts in the field, if you are willing to collaborate 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).

ESReDA Running Project Group

DMAD ESReDA Project Group: Building the Future of Digital Asset Management – Report from our recent meeting in Bilbao

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the DMAD (Digital Maintenance and Asset Digitalization) working groups' research seminar and technical meeting of the European Safety and Reliability Association (ESReDA) and the SKILLS4EII project (Skills Alliance for the Energy Intensive Industries) concluded at the University of Deusto. The event—an important milestone for the industrial safety and reliability sector—brought together leading researchers, academics, and business leaders in a hybrid format, with attendees both on site at the Bilbao campus and online. The discussion topic was "Reskilling Asset Management in the 5.0 era; strategic, tactical and operative implications" ("Retraining asset management in the 5.0 era; strategic, tactical and operational implications").

Organized and supported by ESReDA and SKILLS4EII, the meeting functioned as a showcase for the latest advances in optimizing industrial processes, digitizing maintenance activities, and addressing the near-term transformation that human talent would face under the demands of the new industrial revolution.

After the official opening by Iker Pastor, Vice Dean of International Affairs at the Faculty of Engineering of the University of Deusto, and Aitor Goti, the program began with an analysis of how urgently the supply and demand of job skills would need to evolve. Alberto Rodríguez

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(Sidenor) and María Blanco (Unesid) presented the progress of the Skills4EII European project, highlighting the digital and sustainable skills energy-intensive industries would need to maintain their global competitiveness.

The technical segment stood out for its presentations of solutions based on disruptive technologies. Jon Arambarri (ESTIA) and Aitor Oyarbide (University of Deusto) described the project's achievements, including DESGENAI—an initiative combining Discrete Event Simulation (DES) and genetic algorithms to optimize manufacturing environments. It was followed by SILENCE, introduced by Marco Vanucci (Sant'Anna), who explained how advanced algorithms could be implemented for preventive diagnosis of industrial machinery through correlated-noise analysis.

After a short break, the session turned to highly complex environments with the OPTIMA DONES project. Professor Juan Chiachío from the University of Granada presented an expert system based on semantic artificial intelligence, designed to support maintenance decision-making in high-radiation settings.

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Looking ahead, the event did more than review the state of the art—it also mapped out the roadmap for the coming years. Professor Antonio Jesús Sánchez Herguedas (University of Seville) provided an exclusive preview of the IFAC joint workshops (AMEST-IMS 2027), scheduled to be held in Seville in April 2027, focused on advanced maintenance engineering and smart manufacturing systems.

The day ended with an open roundtable discussion moderated by Antonio Jesús Guillén (Complutense University of Madrid and Secretary General of ESReDA). The speakers and attendees agreed on the need to strengthen links between universities and industry to guide the transition to Industry 5.0 effectively, where automation and the human factor would coexist in a well-balanced way.

For more information, please check the book of abstracts and presentations here: https://zenodo.org/records/20640449

Interested?
Contact the DMAD coordinators Antonio Sanchez Herguedas (antoniosh@us.es) and Aitor Goti (aitor.goti@deusto.es).

Forthcoming ESReDA Seminars

69th ESReDA Seminar
Risk mitigation of aging infrastructures and assets under NaTech events
December 3-4, 2026 Savoie Mont-Blanc University, Chambéry, France

https://esreda.org/seminars/69th-esreda-seminar-risk-mitigation-of-aging-infrastructures-and-assets-under-natech-events/

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Transport and energy infrastructures are increasingly threatened by natural hazards such as mass movement processes, floods, and wildfires. These NaTech risks are exacerbated by both climate change and the ageing of infrastructures. Indeed, the growing physical vulnerability of exposed assets, combined with the increasing intensity of hazards, contributes significantly to rising risk levels. In this context, the development of innovative approaches for risk mitigation has become crucial.

The ageing of strategic infrastructures leads managers to choose between several scenarios, including service life extension, repair, reinforcement, or even complete replacement. These decisions involve operating safety level upgrading and financial implications, given the function of the structures, the cost of manufacturing (often involving facility-specific prototypes), construction expenses, and operational losses during both scheduled (maintenance) and unscheduled outages. Managers therefore need as much information as possible to assess the reliability level associated with each of the scenarios, as well as the residual life.

The aging of critical infrastructure pushes decision making to trade off considering different variables and criteria. That may include description of accident sequences (cascading effects), risk and reliability assessment, advanced maintenance strategy, health monitoring

& surveillance, regulatory constraints, partial or full replacement and certainly financial and other resources availability. The effectiveness of such multi-criteria decision-making processes depends on access to diverse and reliable datasets, as well as robust models capable of processing them.

Given the current context (and the near future one), climate change and related natural hazards (floods, strong wind, torrential rain, wildfires, landslides and earthquakes) are amongst the most critical threats as far as ageing infrastructures are concerned. This includes both transport systems (roads, rivers, rail, metro, highway), and energy assets (electricity, gas, water). The challenge is compounded not only by the increasing frequency and intensity of these events but also by the lack of robust predictive models and reliable data. However, protecting ageing infrastructures against natural hazards driven by climate change remains a major stake.

It is important to understand the operational mode of the NaTech hazards and their dynamics, to prevent or mitigate the destructive consequences. Emerging technologies, such as weak signal detection, remote sensing, continuous monitoring networks, and artificial intelligence-based data processing, offer promising tools to improve risk management and resilience.

The 69th ESReDA Seminar will be a forum for exploring these and other related issues. We aim to discuss theories, concepts, and experiences of methods to limit the impact of NaTech risks on infrastructures and at territorial level (cascading effects, decision making under uncertainty). Authors are invited to share their research and experience and discuss challenges in developing more efficient detection or protective systems, through modelling. ESReDA are encouraging new ideas, case studies and cross-sectoral and inter-disciplinary research on this theme. This seminar will bring together researchers, practitioners, specialists and decision-makers to discuss strategies and practical experiences.

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You may equally visit our site: https://www.esreda.org/

Past ESReDA Seminars

68th ESReDA Seminar
Multidisciplinary Approaches to Resilience Assessment in Critical Infrastructures and Digital Systems

Building a Shared Language for Resilient Critical Infrastructures – From energy transition and digital systems to safety, reliability, standards and international cooperation
May 14th - 15th, 2026, Riga Nordic University, Riga, Latvia

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On 12–15 May 2026, Riga and Jūrmala hosted the 68th ESReDA Seminar and thematic discussions on energy, critical infrastructures, digital systems, safety, reliability and the practical impact of science. Organised by Riga Nordic University in cooperation with the European Safety, Reliability & Data Association (ESReDA), the event created a common platform for researchers, industry representatives, public authorities, students and international partners.

The central question of the week was both practical and scientific: how can interdependent physical, digital and social systems preserve essential functions under climate, technological and geopolitical stress? This question is especially relevant for the ESReDA community because modern critical infrastructures are no longer isolated assets. Electricity, heat, transport, communications, data platforms, water services, public administration and emergency response interact continuously. A disturbance in one system can cascade into others; physical threats can overlap with cyber threats; and climate-related extremes increasingly test the assumptions on which infrastructure design and crisis management have traditionally relied.

The 68th ESReDA Seminar, “Multidisciplinary Approaches to Resilience Assessment in Critical Infrastructures and Digital Systems”, therefore approached resilience not as a slogan, but as a system-level property that can be analysed, modelled, governed and improved. The seminar provided space for the exchange of scientific knowledge, practical experience and methodological advances related to complex socio-technical systems.

A three-day resilience cycle

The structure can be read as a three-stage resilience cycle: capacity building, scientific analysis, and transfer to cooperation and impact.

The Community and Capacity Building Day on 13 May addressed the human and organisational foundations of resilience. Presentations and discussions covered artificial intelligence in the workplace, psychological resilience in unfamiliar systems, cross-cultural communication, the mitigation of energy poverty, industry-university co-creation in European projects, and the H2alue hydrogen initiative. In parallel, student and school sessions explored robotics education, educational data analytics, AI applications, smart cities, electricity market price monitoring, environmental challenges and digital systems recoverability. The message was clear: research capacity is built not only by laboratories and funding, but also by the ability to communicate, cooperate and involve the next generation of researchers.

The Science Day on 14 May at the Baltic Beach Hotel in Jūrmala was the main scientific event of the week. The keynote session connected energy transition, digitalisation and resilience from several perspectives. Climate change and energy transition were discussed as drivers of development and resilience; computer vision and artificial intelligence were examined through both opportunities and algorithmic challenges; the role of renewables in sustainability and resilience was highlighted; and research on the resilience of electricity systems was presented as an important input for policy support.

The Cooperation and Impact Day on 15 May in Mežaparks shifted the discussion toward standards, institutional cooperation and practical implementation. Sessions on ICT standards and standardisation for emerging technologies underlined that innovation becomes scalable and trustworthy only when it is supported by interoperability, transparent rules and shared professional language. The ESReDA General Assembly and Safety Session further strengthened the link between scientific exchange and the development of a long-term European community of practice.

Critical infrastructures as socio-technical systems

One of the most important insights of the week was the need to analyse technical systems as socio-technical systems. Even a technically sound solution may fail in practice if social trust is weak, procedures are perceived as unfair, responsibilities are unclear, or costs and benefits are distributed unevenly.

This was particularly visible in discussions on energy transition. Renewable energy, hydrogen, storage, flexible demand, district heating optimisation and digital control tools are essential for future energy systems. Yet their success depends not only on engineering performance, but also on affordability, procedural justice, public acceptance and institutional coordination. The contribution on procedural justice, trust and renewable-energy-related conflicts in Latvia made this link especially explicit. Energy poverty, in turn, reminded the audience that resilience must also be assessed at household level. An energy system cannot be considered fully resilient if a significant part of society cannot access essential energy services at an affordable price.

From an ESReDA perspective, this confirms that resilience assessment must integrate engineering principles, risk and systems sciences, human and organisational factors, data quality and public policy. The resilience of an infrastructure is shaped by technical redundancy and reliability, but also by decision-making procedures, information flows, crisis communication and the ability to learn from disturbances.

From modelling to decision support

The technical sessions demonstrated how resilience can be translated into analytical instruments. Contributions addressed resilience modelling for supply continuity and disaster management decision support, a hybrid simulation-optimisation framework for railway disruption management, a PyPSA-based tool for tabletop exercises on energy infrastructure resilience, probabilistic characterisation of the fatigue lifetime of ageing infrastructures, and the resilience assessment of integrated multi-energy systems.

These approaches show why resilience cannot remain a general political ambition. It must be described by indicators, scenarios, models and comparable methods. Simulations and digital tools allow researchers and practitioners to test not only the behaviour of technical components, but also the sequence of decisions, the flow of information and the coordination between institutions. In energy infrastructure, this is particularly important because the integration of renewables, storage, hydrogen, flexible consumption and digital control changes both the operating envelope and the risk profile of the system.

The programme also addressed district heating optimisation using thermal-hydraulic simulation, hybrid threats to critical infrastructure and multi-risk approaches to NaTech events in process industries. Together these contributions pointed to a common methodological message: investment, maintenance and emergency preparedness should be based not only on historical data, but also on credible future scenarios and systematic uncertainty analysis.

Digitalisation, AI and governance

Digitalisation was present throughout the week, from computer vision and autonomous AI agents to cloud-native architectures, access control, civil-defence monitoring, educational analytics and smart-city applications. These topics are highly relevant to ESReDA because digital systems increasingly support the observation, prediction and control of critical infrastructures.

At the same time, the discussions avoided the assumption that digitalisation automatically increases resilience. A system may become more efficient in normal operation while becoming more vulnerable in abnormal conditions if model uncertainty, data provenance, cyber security, usability and human oversight are not sufficiently addressed. AI-based decision support can help to detect anomalies and compare scenarios, but its outputs must be interpretable, auditable and embedded in clear organisational responsibilities.

This is why standards and governance were a central part of the week. Effective digital resilience requires shared terminology, interoperable architectures, reliable data, cyber-secure implementation and well-defined roles for human supervision. The quality of algorithms must therefore be assessed together with organisational processes, regulatory expectations and the competence of users.

Energy transition and the ESReDA perspective

Energy systems offered a concrete lens through which the broader ESReDA agenda could be seen. The programme linked climate change, renewables, electricity system resilience, high-frequency solar resource characterisation, hydrogen initiatives, district heating, integrated multi-energy systems and energy poverty. These topics reflect the classic energy trilemma of security, affordability and environmental sustainability, while also adding a fourth dimension that is central to ESReDA: reliability and resilience under uncertainty.

As energy systems become more decentralised, digitalised and interconnected, resilience requires more than reserve capacity. It requires flexibility, data quality, forecasting, asset management, cyber security, emergency exercises, stakeholder trust and coordination between operators, regulators, researchers and society. The ESReDA community has an important role in ensuring that the energy transition is not only faster and cleaner, but also safer, more reliable and socially robust.

Building a European community of practice

Seminar also had an important institutional dimension. The event gathered participants from more than ten countries and connected engineering, energy, information technologies, economics, psychology, education and public administration. This diversity reflected the very nature of resilience: no single discipline can fully understand or manage the behaviour of complex socio-technical systems.

The long-term impact of the event was strengthened by Riga Nordic University joining ESReDA. These developments open new opportunities for Latvian researchers and practitioners to contribute to European-level discussions on safety, reliability, data, energy systems and critical infrastructure resilience.

The involvement of students and school pupils was equally important. Young researchers presented work on robotics, AI, digital systems, electricity market forecasting, environmental issues and organisational development. By bringing early-career researchers into the same programme as experienced scientists and practitioners, the event supported continuity in scientific communication and helped build the next generation of resilience professionals.

Key takeaways

Resilience is a property of systems, not of isolated technologies. It emerges from infrastructure condition, digital tools, human behaviour, organisational learning and institutional coordination.

Digitalisation strengthens resilience only when it is supported by governance, cyber security, standards, data quality and meaningful human oversight.

Models, simulations, digital twins and probabilistic methods are most valuable when they support decision-making, scenario comparison, emergency exercises and investment planning.

Energy transition must balance security, affordability, sustainability and reliability. Renewable energy, hydrogen, storage and digital control create new opportunities, but they also change risk profiles and social expectations.

International networks are themselves resilience infrastructure. ESReDA provides a forum in which researchers, industry, regulators, public authorities and students can develop a shared language for complex risks.

<u>Conclusion</u>

The 68th ESReDA Seminar showed that resilience assessment is both a scientific challenge and a collaboration practice. The value of such an interdisciplinary platform lies in its ability to connect energy, digital technologies, safety, reliability, governance and society into one conversation. This shared conversation is a precondition for infrastructures that are not only technologically advanced, but also safe, reliable, adaptive and trusted.

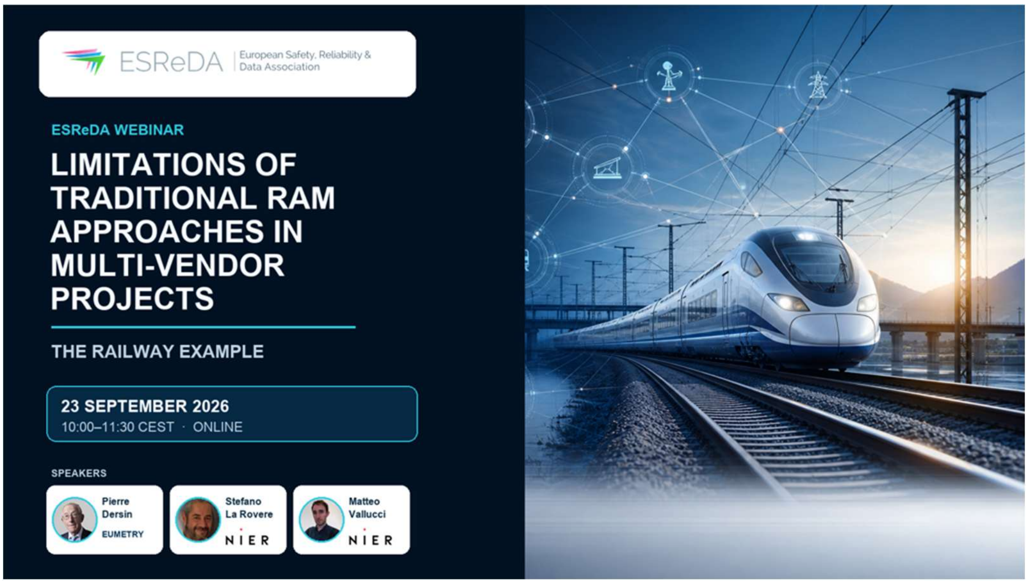
In preview: ESReDA Next Webinar Event

"The Limitations of the Traditional RAM Approaches in Multi-Vendor Projects – the Railway Case"

Pierre Dersin (pierre.dersin@gmail.com), Stefano La Rovere (S.LaRovere@nier.it), Matteo Vallucci (M.Vallucci@nier.it)

23 September 2026, 10:00-11:30 CEST, Online

Details will soon be available on https://esreda.org/news-learning/ and other socio-prof medias.



Collapsing Structures and public Mismanagement

by Wolfgang Seibel – Professor of Political Science and Public Administration at the University of Konstanz (Germany)

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Read and recommended by Jean-Fraçois Raffoux, ESReDA Honorary President

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Wolfgang Seibel, Professor of Political Science and Public Administration at the University of Konstanz (Germany), examines the consequences of poor public management on citizen safety. He analyzes in detail several concrete cases where the collapse of structures built or overseen by public authorities resulted in significant loss of life:

- The West Gate Bridge in Melbourne (1970)
- The I-35W Bridge over the Mississippi River in Minneapolis (2007)
- The Canterbury Television Building in Christchurch (2011)
- The Bad Reichenhall Ice Rink (2006)

While engineering and technical safety are often emphasized, Seibel stresses that managerial, institutional, and bureaucratic negligence plays a central role in these failures.

The context

The context and the background are amazingly explained through the book preface, with his own wordings:

This book was written in the year of the great pandemic, 2020, a phenomenon connected to this book's subject in more than one way. The pandemic raised the awareness of how important capable and reliable public agencies are when it comes to the implementation of governmental action. The pandemic crisis also made us aware that good government is not only a matter of good decision making but also, even to a decisive degree, a matter of sound and reliable implementation by public administration.

Whether or not public authorities were working properly and effectively impacted immediately on public health conditions and, ultimately, death tolls. The general importance of public administration for human safety is, basically, the very subject of this book. Moreover, one banal consequence of the pandemic was that it facilitated the book's production. Confined to my home office for months, the range of distractions and excuses shrank considerably (Palgrave staff may object).

This book is about the threats to life and limb as a result of public mismanagement. Conversely, it emphasizes the importance of good governance and a sound sense of responsibility outside the well-known risk zones of critical infrastructure or acute crisis management. Much of what goes wrong in public administration at the expense of safety and human security is enrooted in standard pathologies of the bureaucratic organization such as lack of flexibility due to hierarchized governance and horizontally fragmented division of labor, the proverbial red tape and rigid standard operating procedure. By the same token, however, these pathologies are known and, in principle, manageable so that their undesirable effects are usually kept under control, especially when human safety is at stake.

This book focuses on cases and circumstances where that control failed. It therefore addresses two questions: What explains the unlikely failure of professional public agencies to protect human safety? What can be generalized on the basis of exemplary case for the sake of learning and prevention?

The research on which the book is based is part of the project "Black Swans in Public Administration: Rare Organizational Failure with Severe Consequences" funded by the German Research Foundation (DFG) in the framework of the DFG Reinhart Koselleck program. I would like to express my gratitude to two more institutions whose hospitality and highly stimulating intellectual environment greatly mobilized my physical and mental energy in preparing and writing this book.

One is the Stellenbosch Institute for Advanced Study (STIAS) where I had the privilege of being a Fellow from February through April 2019. The other one is the Utrecht University School of Governance (USBO) where I spent a very productive sabbatical as a guest scholar ages ago, i.e., in the pre-pandemic Fall and Winter of 2019/2020.

I am particularly indebted to Mark Bovens and Paul ´t Hart for making this possible and to the wonderful staff—Inge Bakker-Simon, Esther Verheijen and Liliane van der Vaart in particular—who supported me and my work.

I also would like to thank Stavros Zouridis and the Oderzoeksraad voor Veiligheid (Dutch Safety Board) as well the Tilburg Institute of Governance and my dear friends Patrick Kenis and Joerg Raab for the opportunity to discuss the analytical concept of this book in various meetings and discussions.

Moreover, I am profoundly grateful to Annette Flowe without whose enduring support and patience the manuscript would not exist and to Paulina Ulbrich who relentlessly assisted me in creating figures, tables and lists of all kinds and carefully coordinated all related activities. Finally, I would like to thank my editors, Nicholas Barclay and Stewart Beale, of Palgrave Macmillan for his consul tancy and support and Ruby Panigrahi and Nirmal Kumar GnanaPrakasam for their diligence and patience in editing the manuscript.

I alone am responsible for all remaining flaws and errors.

Comments by some international experts in system safety & forensics:

"***This is a must-read for those who want to better understand such "black swan" events and the search for resilience.***"

Andrew B. Whitford, Professor at the School of Public and International Affairs, University of Georgia, US

"***…profound insight in the intersection of public administration mismanagement and the absence of responsible leadership. Through a series of devastating cases, he provides a forensic analysis of how and why disasters occur, …***"

Janine O'Flynn, Professor of Public Management, The Australia and New Zealand School of Government, Australia

"Wolfgang Seibel convincingly demonstrates that learning from collapsing structures should not be left to the engineers only."

—Stavros Zouridis, member of the Dutch Safety Board and Professor of Public Administration, Tilburg University, The Netherlands

All ESReDA Members, 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 activiti