SAFETY ENGINEERING & RISK ANALYSIS DIVISION

Division Newsletter
Volume 16, First Quarter

In This Issue

Highlights

Robotics Workshop)
An outline of the topics addressed in the Robotics Working Group workshop (held in 2022

Journal News
Updates on the most recent contents and award-winning articles in the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems

Call for Papers
Submit your new research and findings to Part A and Part B journal sections

Editorial Page
Thoughts on risk and energy policy as we move away from fossil fuels.

Chair's Message

Dear SERAD Members,

SERAD has been busy with several forward planning activities. Michael M. Khonsari, Professor of Mechanical Engineering at the Louisiana State University has kindly accepted to be the plenary speaker at IMECE 2023 to be held in-person from October 29 to November 2, 2023 at New Orleans Ernest N. Morial Convention Center, New Orleans, LA, USA. Abstracts have been received for the "Safety Engineering, Risk and Reliability Analysis" track scheduled for Monday and Tuesday. Full-length papers are due by May 1, 2023. We look forward to seeing you in New Orleans! The administrative lead and track chair for the IMECE event will be Bill Munsell. He has been proposed to be the SERAD representative for the IMECE Congress Steering Committee.

Meanwhile, Mihai Diaconeasa and Andrey Morozov have drafted a 3-plane chart connecting fundamental knowledge, enabling technologies, and systems for robotic systems. This chart aids in understanding the fundamentals of robotics safety well enough to find solutions that remove the barriers to the overall vision.

I have taken the initiative of proposing a new technical conference in July 2024 on large-scale hydrogen storage risk assessment. We are seeking support from ASME SERAD, ASME PVP, and ASME and Pacific Northwest National Laboratory senior management. The business plan template for the event is under review and a conference manager will be duly assigned. Would you like to be involved at any degree in the hydrogen revolution? Join our SERAD LinkedIn group and receive latest updates.

On the administrative front, the ASME Technical and Engineering Communities (TEC) has been making sure SERAD is on top of its planning and business continuity activities. We have been working on SERAD's FY24 annual and strategic plans.

But of most important note is that SERAD is very honored by and grateful to FM Global for their continued sponsorship to support our annual student contest.

Sincerely,

Arun Veeramany, Chair for FY23, ASME SERAD

Links to SERAD Activities

Links to SERAD Activities

LinkedIn: ASME Safety Engineering and Risk Analysis Division

The ASME SERAD Home page

ASME Safety Engineering & Risk Analysis Division Home Page

The Joint Rail Conference 2023 Track 5 Sponsored by SERAD

Joint Rail Conference 2023 Track 5

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems. Part B: Mechanical Engineering

Mechanical Engineering

Robotics news

Topics addressed in the robotics road mapping workshop (2022)

Motivation (challenges & opportunities)

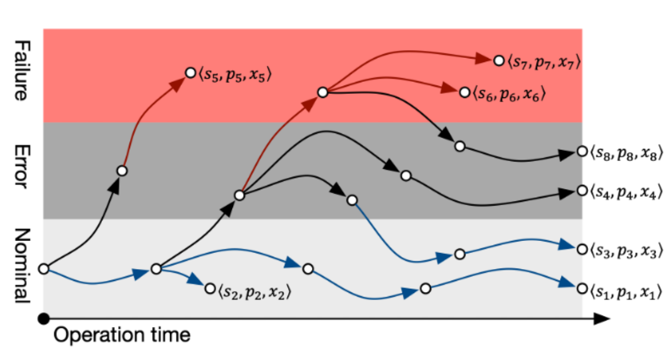
What is Safety? How Safe is Safe Enough? Future Robotics Systems. Challenges to the Safety of Robotics Systems. Brainstorming Promising Solutions.

“Absence of unreasonable risk due to hazards caused by malfunctioning behavior of Electrical/Electronic systems.” [ISO]

Safety: Absence of catastrophic consequences on the user or environment. Hazard: A condition with the potential of causing an undesired consequence. Reliability: The ability of a system to perform a required function, under stated conditions for a stated period of time. Availability: The ability of a system to perform a required function, under stated conditions at a stated time. Fault Tolerance: The ability to avoid failures in the presence of faults (based on the fault-error-failure chain). Fault: Defect in the system. Error: Incorrect internal system state. Failure: Incorrect delivered service.

Resilience:

- The ability to recover from failures.
- The persistence of dependability when facing changes.



Safety assessment is a study of how the systems behave during fault conditions due to various hazards. Safety assessment is a step in the design process and an essential part in the licensing process. The objective is to verify that the acceptance criteria are met (e.g., that consequences are acceptable). Safety assessment is usually carried out in two different ways, which complement each other: deterministically and probabilistically.

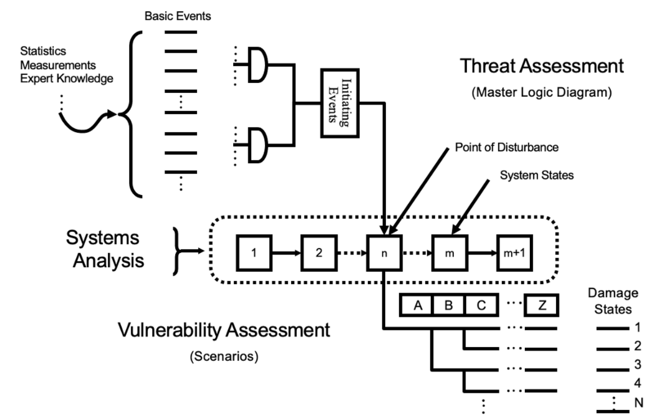
To assess safety:

- Deterministic Safety Assessment
  - A specific set of rules and acceptance criteria is applied.
  - It is suitable for events of higher frequency.
- Probabilistic Safety Assessment
  - It is a top-down examination approach of the risk versus performance of a function, system, and finally component to provide:
  - Insights into the role that each individual system plays in providing protection against the consequences.
  - The effect of the individual systems acting in concert.

Why Quantify Risk?

- Provides a science-based foundation for meaningful safety assessment and management
- To enhance decision making
- Makes transparent the risk contributors and their importance for prioritizing corrective actions
- Explicitly exposes the uncertainties, the primary contributor to rare event risk

The Triplet Definition of Risk. What can go wrong? Answered by a structured set of scenarios s_i. How likely is it to go wrong? Requires the calculation of the "likelihoods" L_i of each of the scenarios s_i. What is the consequence? Answered by describing the "damage states" or "end states" x_i resulting from the risk scenarios.



ISO 31000 Risk Management Processn

Articulate the context. Is the risk assessment for human-machine interaction, machine-machine interaction, group of machines interaction, autonomous machine operation, or a combination thereof?

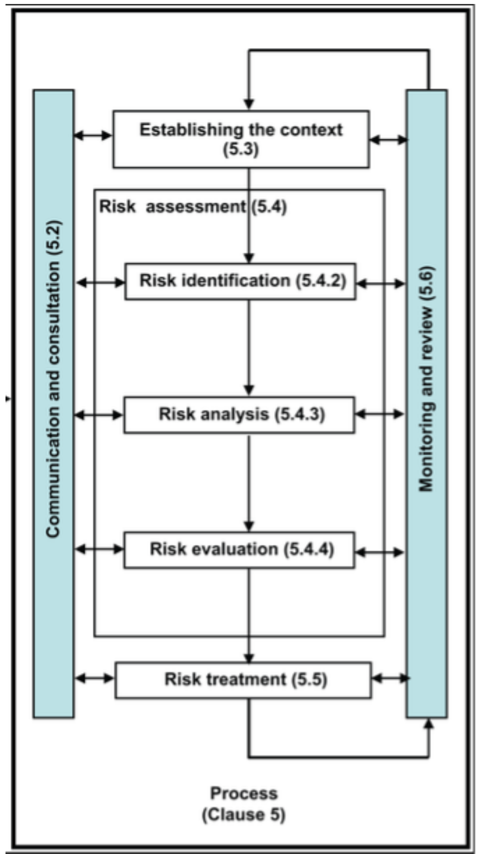
What are the hazards and threats associated with this interaction or operation? Are they internal or external? Is the system vulnerable to these? Do they harm the mission, operators, users, or other systems? What is the cause? What is the effect? Is it detectable? What is the mission impact? Draft a list of likely accident scenarios. How fault tolerant is the system? Refer to ISO 31010 risk assessment techniques.

How likely is each accident scenario? What is the consequence? Can the likelihoods and consequence severity be quantified? What is the risk to workers, public, property, environment? Choose a risk metric that suits the mission. Estimate accident scenario risks and aggregate them at component, system, as well as mission level. What level of risk is acceptable? Is the estimated risk too low or high? What is the risk appetite? What is the risk tolerance?

Can the risk be avoided, mitigated, or transferred? Would redundancy help? Is a barrier required? Is a firmware change required? What decisions should the humans/machines make to contain this risk? Can the decisions be autonomous? Should there be human in the loop? How do the decisions turn into actions?

Frequent events need continuous monitoring. Extremely rare events require expert judgments. Risk assessment may have to repeated in a dynamic context. This feedback loop needs to be closed. Review and change processes, training and procedures as needed.

Establish communication protocols for all interactions identified in the context establishment phase. Ensure there is right amount of communication and that it is timed well.



State of current enabling technologies

Features of Future Robotics Systems to be Modeled in Safety Assessment Cyber-Physical Systems (CPS), Industrial CPS, Cyber-Physical Production Systems,

Cyber Manufacturing.

Industry 4.0, Smart Factories, IoT, Cloud, Edge, Fog.

Artificial Intelligence (AI), Deep Learning (DL), AI regulation.

Digital Twin, System of systems.

Flexible Production, Smart/Advanced Manufacturing, Software-Defined Manufacturing (SDM).

Industry 5.0, Sustainable and resilient production.

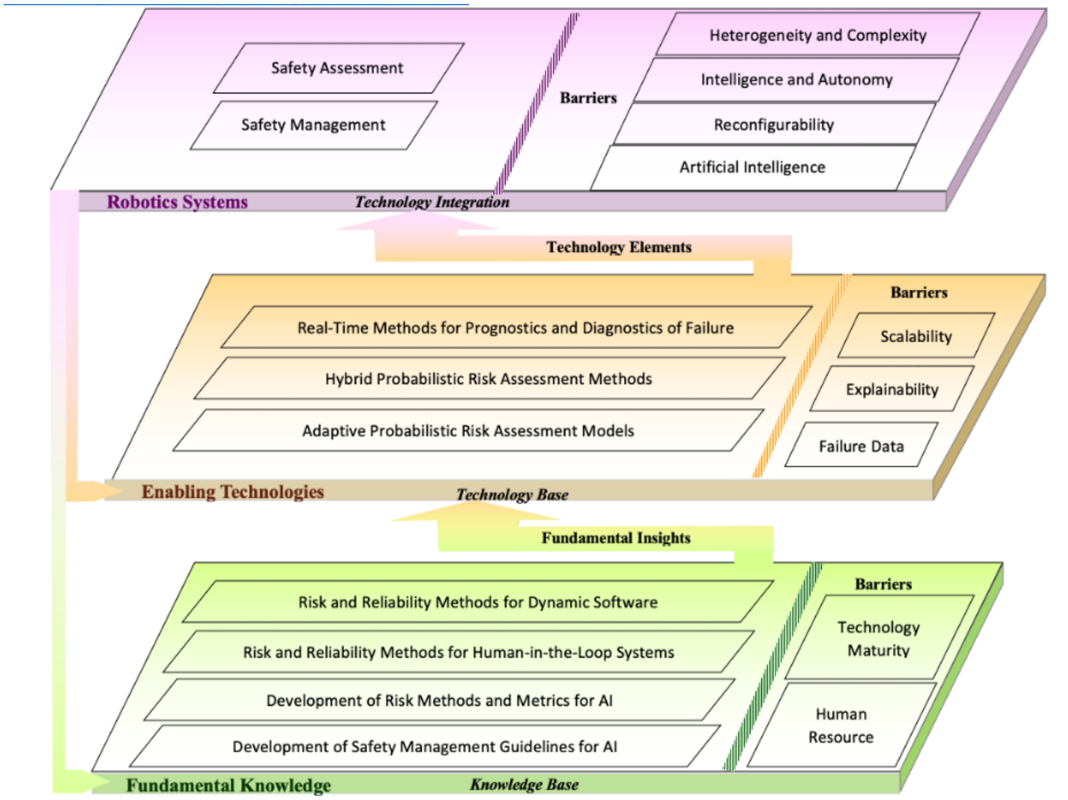
Human centric, Human-in-the-Loop.

- (i) Heterogeneity and complexity:
  - (a) Physical parts, hardware, software;
  - (b) Structural and behavioral complexity
- (ii) Intelligence and autonomy:
  - (a) Complex algorithms;
  - (b) Distributed agents.
- (iii) Reconfigure-ability and re-purpose-ability:
  - (a) Universal robotics, software-defined production.
- (iv) Artificial intelligence:
  - (a) Deep learning, new architectures;
  - (b) Data centric development.

Technical Challenges to Assessing the Safety of Future Robotics Systems

- (i) How to identify critical failure scenarios?

(ii) How to analyze complex dynamic systems?
(iii) How to assess risk facing continuous changes?
(iv) How to assess reliability of AI components?



ASME Roles/Gaps (both current offerings & what is missing)

ASME Codes and Standards for AI-Based Systems

ASME Educational Workshops and Conferences

Open Source Code Development

Implementable Actions

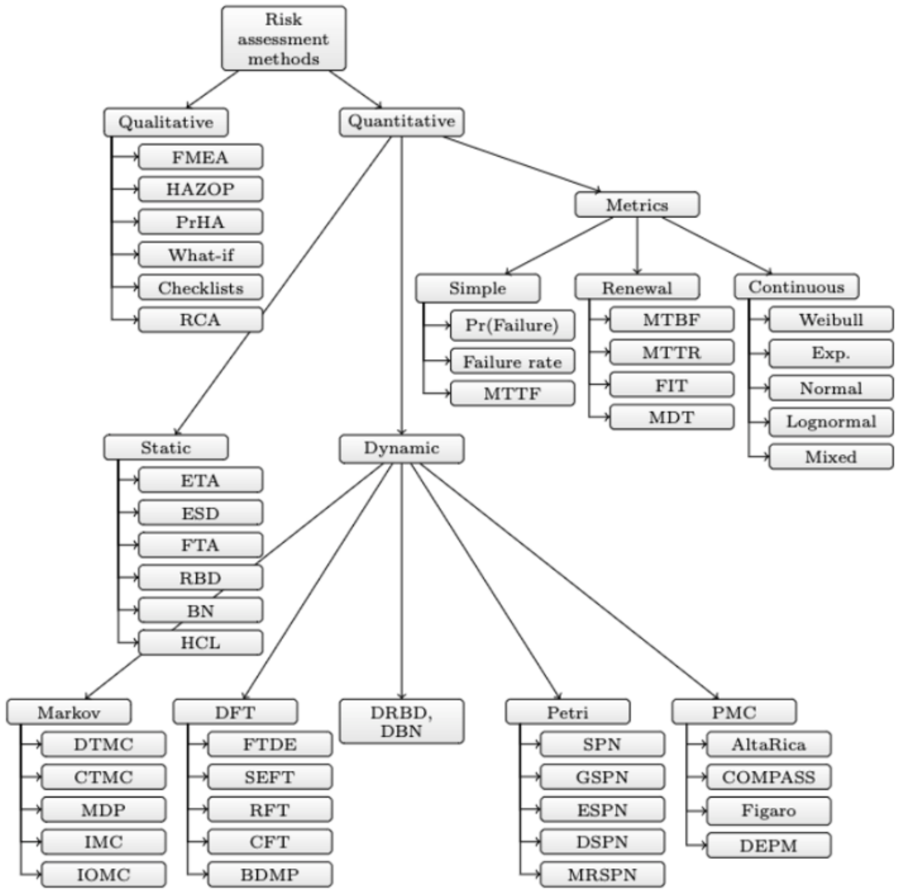
Call for proposals for Codes and Standards

Call for proposals for educational workshops

Appendix

Deep dives on enabling technologies from working groups (one per group)

1. Identify additional key recommendation/action for each enabling tech
2. Format can be group specific, based on what they deem is most critical to focus on/communicate Risk assessment today is done using the methods shown in the figure that follows. TODO: Write about main groups of risk evaluation methods and tools.
   Conclusion this methods are currently used but they work for "simple" systems.
   Sharing of Ideas with the other groups: https://docs.google.com/document/d/19hwT4EXAPH00TS4iA9_wZYrFdZ-ZldZXwNVUyYQMdUc/edit#heading=h.xs4np1skqb3t



Classes of risk assessment methods

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems
More Information: https://ascelibrary.org/journal/ajrub7 Contact Prof. Bilal M. Ayyub, Editor in Chief, ba@umd.edu

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering, Part B: Mechanical Engineering

Alba Sofi, PhD

University "Mediterranea" of Reggio Calabria, Italy, e-mail: alba.sofi@unirc.it

Established in 2014 by Professor Bilal M. Ayyub from the University of Maryland College Park, the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering and Part B: Mechanical Engineering serves as a medium for dissemination of research findings, best practices and concerns, and for discussion and debate on risk and uncertainty-related issues in the areas of civil and mechanical engineering and other related fields. The journal addresses risk and uncertainty issues in planning, design, analysis, construction/ manufacturing, operation, utilization, and life-cycle management of existing and new engineering systems.

The current Editor-in-Chief is the Founding Associate Editor, Professor Michael Beer, from Leibniz Universität Hannover. Professor Michael Beer, from Leibniz Universität Hannover.

Both Part A and Part B are listed in the Emerging Citation Sources by Clarivate Analytics, formerly Thomson Reuters, and are eligible for indexing in 2018. From 2016 onward, all articles will be included in Web of Science. They are also included in Scopus.

Part A has successfully secured an impact factor for 2021 of 3.084 based on the latest Journal Citation Reports by Clarivate Analytics.

Contents

Part A	Latest Issues & (Issue Date)	Part B	Latest Issues & (Issue Date)
		Part B	Volume 9-Issue 3 (September 2023, in progress)
Part A	Volume 9-Issue 2 (June 2023, in progress)	Part B	Volume 9-Issue 2 (June 2023)
Part A	Volume 9-Issue 1 (March 2023)	Part B	Volume 9-Issue 1 (March 2023)
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Part A	Volume 8-Issue 4 (December 2022)	Part B	Volume 8-Issue 4 (December 2022)
Part A	Volume 8-Issue 3 (September 2022)	Part B	Volume 8-Issue 3 (September 2022)
Part A	Volume 8-Issue 2 (June 2022)	Part B	Volume 8-Issue 2 (June 2022)
Part A	Volume 8-Issue 1 (March 2022)	Part B	Volume 8-Issue 1 (March 2022)

Latest State of the Art Reviews: Part A

"Resilience-Based Design of Infrastructure: Review of Models, Methodologies, and Computational Tools Resilience-Based Design of Infrastructure: Review of Models, Methodologies, and Computational Tools" by Mahdi Shadabfar, Mojtaba Mahsuli, Yi Zhang, Yadong Xue, Bilal M. Ayyub, Hongwei Huang and Ricardo A. Medina

"Time-Dependent Reliability of Aging Structures: Overview of Assessment Methods" by Cao Wang, Michael Beer, and Bilal M. Ayyub

"Structural System Reliability: Overview of Theories and Applications to Optimization" by Junho Song, Won-Hee Kang, Young-Joo Lee, and Junho Chun

"Emerging Technologies for Resilient Infrastructure: Conspectus and Roadmap" by Mahmoud Reda Taha, Bilal M. Ayyub, Kenichi Soga, and Sherif Daghash

"Probabilistic Inference for Structural Health Monitoring: New Modes of Learning from Data" by Lawrence A. Bull, Paul Gardner, Timothy J. Rogers, and Elizabeth J. Cross

Latest Review Articles: Part B

"A Recent Review of Risk-Based Inspection Development to Support Service Excellence in the Oil and Gas Industry: An Artificial Intelligence Perspective", by Taufik Aditiyawarman, Agus Paul Setiawan Kaban, Johny Wahyuadi Soedarsono

"Prognostics and Health Management of Wind Energy Infrastructure Systems", by Celalettin Yüce, Ozhan Gecgel, Oğuz Doğan, Shweta Dabetwar, Yasar Yanik, Onur Can Kalay, Esin Karpat, Fatih Karpat, Stephen Ekwaro-Osire

"Uncertainty Quantification for Additive Manufacturing Process Improvement: Recent Advances", by Sankaran Mahadevan, Paromita Nath, Zhen Hu

"Optimizing Predictive Maintenance With Machine Learning for Reliability Improvement", by Yali Ren

"Path Integral Methods for the Probabilistic Analysis of Nonlinear Systems Under a White-Noise Process", by Mario Di Paola and Gioacchino Alotta

"Sensemaking in Critical Situations and in Relation to Resilience - A Review" by Stine S. Kilskar, Brit-Eli Danielsen, and Stig O. Johnsen

Latest Special Collections: Part A

"Special Collection on Benchmarking Data-Driven Site Characterization", Kok-Kwang Phoon, Takayuki Shuku, Jianye Ching, Ikumasa Yoshida

"Special Collection on Structural Time-Dependent Reliability Assessment: Advanced Approaches for Engineered Structures", Cao Wang, Hao Zhang, Michael Beer

"Special Collection on Bayesian Learning Methods for Geotechnical Data", Ka-Veng Yuen, Jianye Ching, and Kok Kwang Phoon

"Special Collection on Resilience Quantification and Modeling for Decision Making", Gian Paolo Cimellaro, and Nii O. Attoh-Okine

Latest Special Issues And Special Sections: Part B

"Special Section on Decommissioning and Life Extension of Complex Industrial Assets", Raphael Moura, Michael Beer, Gilberto Francisco Martha de Souza, and Edoardo Patelli

"Special Section on Risk, Resilience, and Reliability for Autonomous Vehicle Technologies: Trend, Techniques, and Challenges", Mohammad Pourgol-Mohammad, Arun Veeramany, and Bilal Ayyub

"Special Section on Probabilistic Approaches for Robust Structural Health Monitoring of Wind Energy Infrastructure", Imad Abdallah and Eleni Chatzi

"Special Issue on Uncertainty Quantification and Management in Additive Manufacturing", Zhen Hu, Saideep Nannapaneni, and Sankaran Mahadevan

"Special Section on Risk and Uncertainties in Offshore Wind and Wave Energy Systems", Vikram Pakrashi, Jimmy Murphy, and Budhaditya Hazra

"Special Section: Nonprobabilistic and Hybrid Approaches for Uncertainty Quantification and Reliability Analysis", by Matthias G. R. Faes, David Moens, Michael Beer, Hao Zhang, and Kok-Kwang Phoon

"Special Section on Response Analysis and Optimization of Dynamic Energy Harvesting Systems in Presence of Uncertainties", Agathoklis Giaralis, Ioannis A. Kougioumtzoglou, and Pol D. Spanos

Recognitions & Awards

Recognitions for Papers

Part A	
Editor's Choice Paper	"A Stochastic Formulation to Evaluate the Sustainability of Structural Systems" by Paul Gharzouzi and Paolo Gardoni
Most Read Paper	"Structural System Reliability: Overview of Theories and Applications to Optimization" by Junho Song, Won-Hee Kang; Young-Joo Lee, and Junho Chun
Most Cited Paper	"Scale of Fluctuation for Spatially Varying Soils: Estimation Methods and Values" by Brigid Cami, Sina Javankhoshdel, Kok-Kwang Phoon, and Jianye Ching
Editor's Choice Collection	For each issue of the journal, the Chief Editor may select a paper to be featured on the journal homepage in the ASCE Library. The paper is available for free to registered users for 1 to 4 months, depending on how frequently the journal is published. A list of Editor's Choice selections is available here.
Part B	
Most Read Paper	"Digital Twins: State-of-the-Art and Future Directions for Modeling and Simulation in Engineering Dynamics Applications" by D. J. Wagg, K. Worden, R. J. Barthorpe, P. Gardner
Most Cited Paper	"Digital Twins: State-of-the-Art and Future Directions for Modeling and Simulation in Engineering Dynamics Applications"" by D. J. Wagg, K. Worden, R. J. Barthorpe, P. Gardner
Featured Article	"Resilience Decision-Making for Complex Systems", by Julian Salomon, Matteo Broggi, Sebastian Kruse, Stefan Weber, Michael Beer

Outstanding Reviewers

Part A 2021 Outstanding Reviewers	Part B 2021 Reviewers of the Year
André T. Beck	Chen Jiang, *Huazhong University of Science and Technology, China*
Nicholas Chileshe	Imad Abdallah, *Eidgenössische Technische Hochschule Zürich, Switzerland*
You Dong	
Ketson Roberto Maximiano dos Santos	
Ao Du	
Cheng-Wei Fei	
Wenping Gong	
Cao Wang	
Jie Zhang	
Wengang Zhang	

Bilal M. Ayyub Research Award for Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering Bilal M. Ayyub Research Prize for Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering

Established in 2019, the Editor's Award is given annually to one paper in Part A and one paper in Part B appearing in the preceding volume year. Papers are evaluated based on the following criteria:

- fundamental contributions
- potential impact
- practical relevance to industry
- intellectual depth
- presentation quality.

ASCE and ASME post the winning paper's information on the journal website as well as on social media. The winning papers are made freely available from the ASCE Library (Part A) and from the ASME Digital Collection (Part B) for one year to anyone interested once registered and logged in to download. Moreover, ASME offers the authors a one-year free subscription to Part B.

Starting from 2022, the Editor's Award for Part A and Part B was named "Bilal M. Ayyub Research Award" and "Bilal M. Ayyub Research Prize", respectively, in recognition of the outstanding professional leadership of the founding

Editor-in-Chief, Professor Bilal M. Ayyub, Dist. M. ASCE and Hon. M.ASME.

Early Career Editorial Board

Starting in 2020, the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems in its two parts has implemented the Early Career Editorial Board (ECEB) program to bring onboard young members to its editorial board under the mentorship of the journal leadership.

The ideal ECEB member is within 1–3 years of having earned a doctorate degree. The term of an ECEB member is 2 years with the possibility of renewal for a second term. After a selection procedure, eight new ECEB members have been appointed for the next two years.

After a selection procedure, eight new ECEB members have been appointed for the next two years.

Part A: active Calls for Special Collections

Special Collection on "Resilience of Power Infrastructure System". Paper submission deadline: September 30, 2023.

Special Collection on "New Technologies in Risk Assessment of Maritime Transport". Paper submission deadline: July 31, 2023.

Special Collection on "Non-Deterministic Model Updating and Structural Health Monitoring for Existing Structures". Paper submission deadline: August 31, 2023.

Part B: active Calls for Special Issues

Special Issue on "Modeling and Analysis of Inspection Uncertainties in Structural Health Monitoring" (SI059B). Paper submission deadline: July 31, 2023.

Special Issue on "Probabilistic Digital Twins in Additive Manufacturing". Paper submission deadline: September 30, 2023.

Social media (Twitter and LinkedIn)

The ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems in its two parts is now also active on Social Media. Follow our pages on Twitter and LinkedIn:

Twitter: ASCE-ASME Journal of Risk and Uncertainty

LinkedIn: ASCE-ASME Journal of Risk and Uncertainty

https://chinahow.guide/wechat-registration-sign-up/

to stay up-to-date on latest issues, highlighted journal content, active calls for special issues and special collections, recognitions and awards.

Calls for Papers

Submission

Part A: Submit to Part A here

Part B: Submit to Part B here

State-of-the-Art Reviews (Part A) and Review Articles (Part B) on topics of current interest in the field of risk and uncertainty are especially welcome.

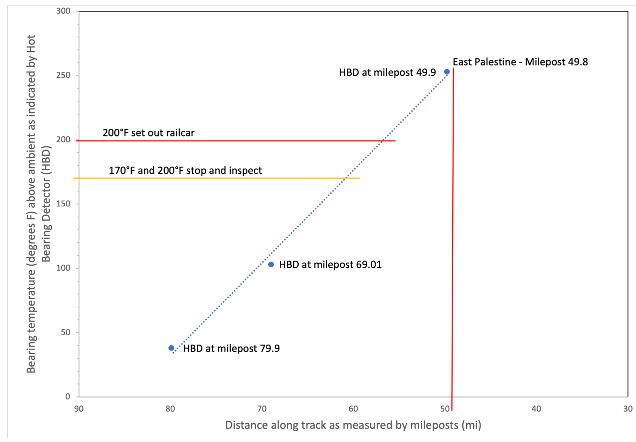
Please contact the Editor or Managing Editors by email if you are interested in guest editing a Special Collection (Part A) or a Special Issue (Part B).

A Case for Organizational Risk Analysis in Transportation

They gave him his orders
At Monroe, Virginia
Sayin' Pete you're way behind time
This is not '38, but its old '97

VERNON DALHART, 1926 *"The Wreck of the ol' 97"*

(a) The engine and other wreckage of the mail train designated 97



(b) Temperature trend of the HBDs near Palestine, OH

Figure 1. Two train wrecks separated by 120 years but proximal by cause.

The February 3, 2023 Norfolk Southern train wreck in Palestine, Ohio has its roots going back to the old Southern Railroad, a railroad that is merged into the Norfolk Southern Railroad. A 1903 Southern Railroad mail train wreck on the rail line between Monroe and Spencer was the subject of the folk ballad titled "The Wreck of the Ol' 97". In different versions of the ballad, the young engineer, Joseph A. Broady, is referred to with the nicknames "Steve" or "Pete". The 33 year old engineer took over the 97 mail train route in the Monroe, Virginia crew change with the train about an hour behind schedule.

In the lyrics of the ballad, the engineer is ordered "To get her into Spencer on time". This line may have basis in fact although there are no actual records beyond the average speed the train needed to make to arrive in Spencer on time. In any case the young engineer was unfamiliar with the route and had worked for Southern for only about 30 days. The railroad investors were keen to keep the mail trains on time because they were fined for late mail arrival and had strong incentive to maintain the lucrative mail delivery contract held with the US Government. Nine were killed in wreck when the train left the tracks and careened off the Dan River trestle (Figure 1a. It is estimated the train was travelling about 40 mph or 50 mph on the 15 mph curve at the bridge.

Fast forward to 2023 as the engineer approaching East Palestine Ohio with cars carrying toxic chemicals. The engineer has a wealth of information available in the cab including wayside detector measurements or more generally, Hot Bearing Detectors (HBDs). A sophisticated data analysis is unnecessary to see from HBDs at 80 and 70 miles the HBD temperature would exceed 170°F in roughly 5 mi and 200°F in roughly 11 mi. A more sophisticated analysis, say 2nd order fit including prior data points would show even more urgency.

What is common between the two wrecks 120 yr apart? It seems that, although he investigation of the Palestine accident is ongoing, organizational contributors are likely at the root of both. What sort of pre-shift briefing is conducted "Make up an hour" (1903) "Maintain your legal speed" (2023)? Were there warnings of potential hazards ("Sharp curves at the Dan River"–1903) ("Your manifest includes dangerous toxic chemicals, exercise great caution, make conservative decisions"–2023)? It would seem that in both cases, the decision-making is left up to a single individual who may have lacked the information or organizational guidance that would put risk management at the top priority. Unfortunately, the more we try to help with technological advances, the more organizational breakdowns rise to thwart them.[1]

Let's talk!
Ernie Kee, SERAD Editor

[1] Schröder-Hinrichs, Jens-Uwe, Erik Hollnagel, and Michael Baldauf. "From Titanic to Costa Concordia–a century of lessons not learned." WMU journal of maritime affairs 11 (2012): 151-167. Harvard.

SERAD Committee

Table 1. 2022–2023 SERAD Committee Membership

Executive Committee		Appointments	
Position	Person	Position	Person
Chair	Arun Veeramany	**Chair: Awards and Fellow Nomination Committe**	Mohammad Pourgol-Mohammad
1st Vice-Chair	Stephen Ekwaro-Osire	**Newsletter Editor**	Ernie Kee
2nd Vice-Chair-Treasurer	Mihai Diaconeasa	**Webinars / Outreach Chair**	Open
3rd Vice Chair-Membership	Andrey Morozov	**Student Program Coordinator**	Deivi Garcia
4th Vice-Chair-Secretary	Dr. Alba Sofi	**Track Co-Chairs**	Mihai Diaconeasa Ernie Kee John Wiechel Alice Sun
Past Chair	Xiaobin Le, Ph.D., PE	**Technical Content Coordinator**	Giulio Malinverno
IMECE 2023 Track Chair	Bill Munsell		