



Literatur-Rechercheergebnisse (2015–2025)

1. **Title:** *Risk management in medical product development process using traditional FMEA and fuzzy linguistic approach: a case study*

Authors: Milind S. Kirkire, Santosh B. Rane, Jagdish R. Jadhav

Year: 2015

Publication: *Journal of Industrial Engineering International* (Springer, Volume 11)

Description: Demonstrates a comparison of traditional FMEA with a fuzzy FMEA in a medical device development context. The fuzzy FMEA approach avoids duplicated Risk Priority Numbers and translates expert linguistic judgments into quantitative risk values, leading to clearer differentiation of critical, moderate, and low risks ¹. The study shows that incorporating fuzzy logic into FMEA (aligned with ISO 14971 for medical devices) improves risk prioritization and informs a targeted risk mitigation model in practice ².

DOI: 10.1007/s40092-015-0113-y

2. **Title:** *Comprehensive risk management using fuzzy FMEA and MCDA techniques in highway construction projects*

Authors: Mohsen Ahmadi, Kourosh Behzadian, Abdollah Ardestir, Zoran Kapelan

Year: 2017

Publication: *Journal of Civil Engineering and Management* (Taylor & Francis, Vol. 23(2))

Description: Proposes an integrated framework for construction project risk management by combining fuzzy FMEA with multi-criteria decision analysis. Identified risks are assessed and prioritized using fuzzy FMEA, while a fuzzy AHP is used to quantify criteria like cost, time, and quality ³. An expert system then recommends appropriate risk response actions based on a "scope expected deviation" index derived from the fuzzy analysis ⁴. Applied to a highway project case study, this approach illustrates how fuzzy logic and MCDA together enhance risk evaluation and guide effective mitigation decisions in line with ISO 31000's risk treatment step ⁵.

DOI: 10.3846/13923730.2015.1068847

3. **Title:** *Project risk management using fuzzy failure mode and effect analysis and fuzzy logic*

Authors: Emad Roghanian, Nazanin Moradinasab, Elham N. Afruzi, Rahman Soofifard

Year: 2015

Publication: *International Journal of Services and Operations Management* (Vol. 20, No. 2)

Description: Introduces a fuzzy FMEA-based method for comprehensive project risk management. The approach extends the standard FMEA by incorporating five factors (severity, occurrence, non-detection, project phase weight, and overall risk weight) to calculate a fuzzy risk magnitude ⁶. This model covers multiple ISO 31000 risk process steps – from risk identification and assessment to response planning – under uncertainty ⁷. A construction industry case study demonstrates how the fuzzy logic-enhanced FMEA can prioritize project risks and assist in selecting appropriate risk responses, showcasing a knowledge-based decision support for project managers.

DOI: 10.1504/IJSOM.2015.067477

4. **Title:** *An Ontology to Support Semantic Management of FMEA Knowledge*

Authors: Zobia Rehman, Claudiu V. Kifor

Year: 2016

Publication: *International Journal of Computers, Communications & Control* (Vol. 11, No. 4)

Description: Focuses on knowledge engineering in risk management by making FMEA results machine-interpretable and reusable. The authors observe that organizations invest heavily in FMEA studies, but the findings (in natural-language form) are rarely reused ⁸. To address this, they develop an OWL ontology for Process FMEA in the automotive domain, enabling semantic structuring of failure modes, causes, effects, and mitigations ⁹. The ontology allows FMEA knowledge to be queried and inferred (using tools like Protégé and SPARQL), facilitating knowledge reuse and consistency in risk assessments. This work is relevant as it integrates semantic knowledge representation with FMEA, paving the way for knowledge-based decision support in risk management.

DOI/URL: [IJCC Vol. 11\(4\) 2016, pp. 507–521 \(Open Access\)](#)

5. **Title:** *Development of a knowledge-based intelligent decision support system for operational risk management of global supply chains*

Authors: Yang-Byung Park, Sung-Joon Yoon, Jun-Su Yoo

Year: 2018

Publication: *European Journal of Industrial Engineering* (Vol. 12, No. 1)

Description: Presents an intelligent DSS (Decision Support System) for managing operational risks in supply chains, exemplifying the integration of AI and knowledge-based methods with risk management. The system (DSSRMG) predicts supply chain performance using an enhanced neural network optimized by particle swarm algorithms, identifies core risk sources via principal component analysis, and evaluates risk-mitigation alternatives through a digraph-matrix framework ¹⁰. Notably, an adaptive neuro-fuzzy inference system (ANFIS) is employed to construct the knowledge base for ranking and selecting mitigation strategies ¹¹. An industrial case study shows that this knowledge-driven DSS improves risk prediction accuracy and helps decision-makers proactively control supply-chain risks ¹² ¹³. This source underscores how knowledge representation (rules learned by ANFIS) and fuzzy logic can be leveraged in a practical, ISO 31000-aligned risk management tool.

DOI: 10.1504/EJIE.2018.089878

6. **Title:** *A novel decision support system for proactive risk management in healthcare based on fuzzy inference, neural network and support vector machine*

Authors: Amine En-Naaoui, Mohammed Kaicer, Aicha Aguezzoul

Year: 2024

Publication: *International Journal of Medical Informatics* (Vol. 186)

Description: Describes a modern DSS for healthcare risk management that integrates fuzzy logic with machine learning techniques, aligning with ISO 31000's emphasis on risk evaluation and treatment. The proposed system improves the traditional FMEA approach by using fuzzy inference to calculate a fuzzy RPN for each failure mode ¹⁴. An artificial neural network then classifies risks into tolerance categories with high accuracy (>98% correct classification) ¹⁵, and a new "control factor" is introduced to gauge the ease of mitigating each intolerable risk ¹⁶. Finally, a support vector machine prioritizes these risks for treatment based on the fuzzy RPN combined with the control factor ¹⁷. In a hospital sterilization unit case study, this hybrid fuzzy-AI system outperforms classical FMEA by handling uncertainty better and providing a more reliable decision support for risk mitigation ¹⁸.

DOI: 10.1016/j.ijmedinf.2024.105442

7. **Title:** *A Fuzzy Decision Support System for Risk Prioritization in Fine Kinney-based Occupational Risk Analysis*

Authors: Yu Chen, Xinyue Yu, Zhengyan Yang

Year: 2025

Publication: *Journal of Soft Computing and Decision Analytics* (Vol. 3, No. 1)

Description: Introduces a novel fuzzy logic approach to occupational health & safety risk assessment, extending the classic Fine-Kinney method. The authors develop a framework that uses **spherical fuzzy sets** to capture expert uncertainty (including hesitation and non-membership) and applies the MABAC multi-attribute method with an Ordered Weighted Averaging operator for risk ranking ¹⁹ ²⁰. This fuzzy DSS accounts for interactions among risk factors and provides a more nuanced prioritization of workplace hazards than crisp scoring methods. A practical case is provided to illustrate how the spherical-fuzzy MABAC approach yields improved hazard prioritization, demonstrating the value of fuzzy logic in handling uncertainty in risk evaluations (beyond FMEA).

DOI: 10.31181/jscda31202545

8. Title: *A Knowledge Graph-Based Failure Information Fusion Method for Enhancing Reliability in Sustainable Systems*

Authors: Yangqianhui Zhang, Huayong Yang, Dong Han

Year: 2024

Publication: *Sustainability* (MDPI, Vol. 16, No. 23)

Description: Explores the integration of knowledge representation (knowledge graphs) with risk/reliability analysis. The paper addresses the limits of traditional FMEA in complex systems by semantically interlinking historical failure data and expert FMEA knowledge into a unified **knowledge graph** ²¹. This ontology/graph-based approach enables automated reasoning and fusion of information from multiple sources, which helps quantify expert subjective inputs and handle uncertainty in failure risk assessment ²². In essence, the method provides a “semantic risk model” that improves maintenance planning and reliability analysis by reusing failure-mode knowledge and uncovering interdependencies. This is a cutting-edge example of combining FMEA, fuzzy/uncertain reasoning (e.g. Dempster-Shafer and belief-rule bases cited in the work), and knowledge representation to support decision-making in risk management.

DOI: 10.3390/su162310651

¹ ² Risk management in medical product development process using traditional FMEA and fuzzy linguistic approach: a case study | *Journal of Industrial Engineering International*

<https://link.springer.com/article/10.1007/s40092-015-0113-y>

³ ⁴ ⁵ [journals.vilniustech.lt](https://journals.vilniustech.lt/index.php/JCEM/article/download/964/734)

<https://journals.vilniustech.lt/index.php/JCEM/article/download/964/734>

⁶ ⁷ Article: Project risk management using fuzzy failure mode and effect analysis and fuzzy logic
Journal: *International Journal of Services and Operations Management (IJSOM)* 2015 Vol.20 No.2 pp.207 - 227 Abstract: Risk management is one of the most important phases of the project management which attracts increasing attentions of many researchers. The proposed method in this research considers different kinds of risk through the project life cycle. We combine fuzzy failure mode and effect (FMEA) and some weighting methods for determination of project risk magnitude. Our method uses five factors; severity, occurrence, not detection, project phase's weight and risk weight for evaluation of risks and also selecting an appropriate risk response. In fact, our model covers four parts of risk management process: risk management planning, risk identification, quantitative risk analysis and risk response planning. Finally, we use this model for a given construction company to show how it can be employed in reality. Inderscience Publishers - linking academia, business and industry through research <https://www.inderscience.com/info/inarticle.php?artid=67477>

⁸ ⁹ An Ontology to Support Semantic Management of FMEA Knowledge | *INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL*

<https://univagora.ro/jour/index.php/ijccc/article/view/1674>

[10](#) [11](#) [12](#) [13](#) Article: Development of a knowledge-based intelligent decision support system for operational risk management of global supply chains Journal: European Journal of Industrial Engineering (EJIE) 2018 Vol.12 No.1 pp.93 - 115 Abstract: This paper proposes a knowledge-based intelligent decision support system for operational risk management of global supply chains (DSSRMG), a full-phase system not yet treated in the literature. DSSRMG predicts the supply chain performance using the enhanced artificial neural network combined with particle swarm optimisation, infers the core risk source using a method based on principle component analysis, and evaluates risk mitigation alternatives using the digraph-matrix approach combined with principle component analysis. A methodology using an adaptive-network-based fuzzy inference system is suggested to construct the knowledge base for mitigation alternatives. An industrial example is used to illustrate the performance of DSSRMG. Computational experiments show that the techniques used for DSSRMG are excellent. Especially, the algorithm for selecting the useful operation indicators improves the performance prediction accuracy by 7.1% on average. DSSRMG provides supply chain managers with a practical tool to accurately predict and effectively control the operational risk. [Received: 9 March 2017; Revised: 22 July 2017; Accepted: 2 October 2017] Inderscience Publishers - linking academia, business and industry through research

<https://www.inderscience.com/info/inarticle.php?artid=89878>

[14](#) [15](#) [16](#) [17](#) [18](#) A novel decision support system for proactive risk management in healthcare based on fuzzy inference, neural network and support vector machine - PubMed

<https://pubmed.ncbi.nlm.nih.gov/38564960/>

[19](#) [20](#) A Fuzzy Decision Support System for Risk Prioritization in Fine Kinney-based Occupational Risk Analysis | Journal of Soft Computing and Decision Analytics

<https://jscda-journal.org/index.php/jscda/article/view/45>

[21](#) [22](#) A Knowledge Graph-Based Failure Information Fusion Method for Enhancing Reliability in Sustainable Systems

<https://www.mdpi.com/2071-1050/16/23/10651>