# Proceedings

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ODSIE 2025

**International Conference on Optimization and Data Science in Industrial Engineering**

**November 20-22, 2025**

**Istanbul, Turkey**

odsie2025.refconf.com

# Proceedings of

# International Conference on Optimization and Data Science in Industrial Engineering

**November 20-22, 2025**

**Istanbul, Turkey**

**Editors:**

**Prof. A. Mirzazadeh, Dr. Zohreh Molamohamadi,**
**Dr. Erfan Babaee Tirkolaee**

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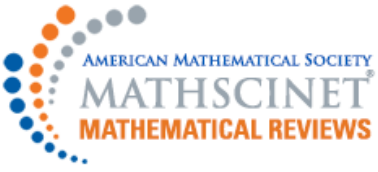
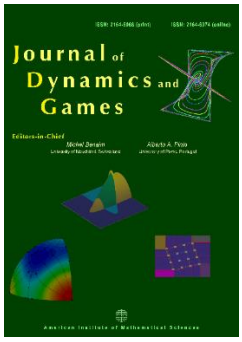
# Publisher and Indexing








# Journals

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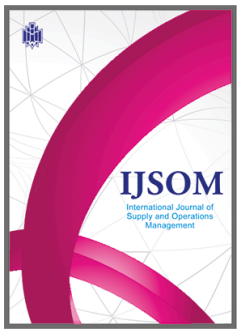


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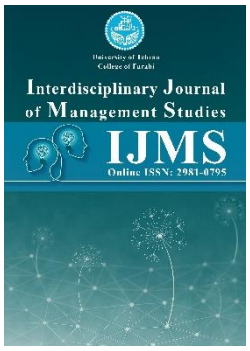


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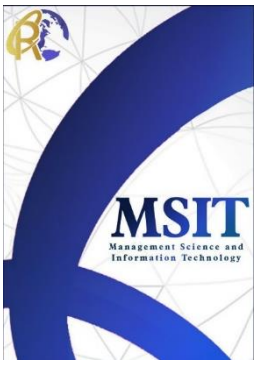


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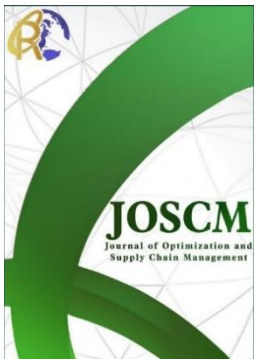


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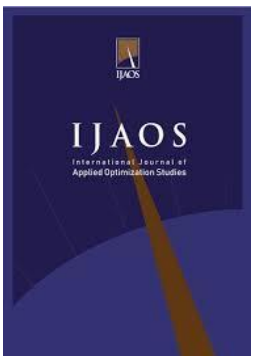


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# About ODSIE 2025

The Third International Conference on Optimization and Data Science in Industrial Engineering (ODSIE 2025) brings together faculty members, researchers, educators, industry professionals, and students from across the globe. The conference aims to provide a platform for sharing the latest theoretical and practical advancements in engineering management and information technology, bridging the gap between research and industry applications. ODSIE 2025 offers a unique opportunity for experts to address current national and international challenges in data science and optimization while fostering collaboration between academia and industry. In addition to paper presentations, keynote speeches, and invited lectures, the conference features practical workshops and other programs, detailed on the conference website (https://odsie2025.refconf.com/). A special highlight of the conference is the PhD Thesis Competition, designed to encourage emerging scholars to conduct innovative research in optimization and data science, promoting vitality and scholarly engagement in the field. ODSIE 2025 warmly welcomes researchers, lecturers, students, and industry professionals interested in optimization and data science.

The official language of the conference is English, and submissions may be in English or Turkish. Selected English papers will be published in Springer's CCIS book series or forwarded to journals listed on the conference website, which are indexed in prominent databases such as Scopus.

With the rapid growth in Industrial Engineering, optimization, and data science, the RefConf organization launched the Third International Conference on Optimization and Data Science in Industrial Engineering (ODSIE 2025) in collaboration with Istinye University, Istanbul. The conference attracted participants from multiple countries through presentations across twenty panels, keynote lectures by distinguished professors, and applied workshops.

**Conference Topics**

ODSIE 2025 welcomes submissions from all areas of optimization and data science. Both full papers and abstracts are accepted for presentation and publication in the conference proceedings. Contributions may be theoretical, practical, or case-study-based, focusing on the application of exact and approximate optimization methods, as well as data science and engineering tools, to support improved decision-making. Topics include, but are not limited to, the following areas:

- Artificial intelligence and expert systems
- Smart manufacturing
- Sustainable, digital and smart cities
- Heuristic and metaheuristic algorithms with applications
- Big data analytics and Data mining in the industry
- Robotic process automation
- Fintech and algorithmic finance
- Sustainable and circular supply chain management
- Optimization and Data Science in service organizations

- Facilities design and planning
- Transportation and routing
- Inventory planning, Production, and scheduling
- Quality control and reliability engineering
- Project management
- Quantitative finance and risk modeling
- Integrated manufacturing and Enterprise resource planning
- Maintenance planning
- Process/Systems design and improvement

# Istinye University Preface

Istinye University was established in 2015 by the 21st Century Anatolian Foundation as the continuation of a 29-year knowledge and experience of the MLP Care Group which has brought three different hospital brands, namely, “Liv Hospital”, “Medical Park” and “VM Medical Park” under one roof.

With its academic staff successfully committed to education and research to make a difference, Istinye University aims to take a place among Turkey and the world’s most prestigious universities by contributing to producing new knowledge through its education and research performance while helping its students become well-equipped in their fields by sharing existing knowledge with them.

Applying a student-oriented understanding of education to all of its processes, Istinye University intends to expand the borders of science thanks to the academic staff’s research, put the findings obtained through scientific developments into practice for social welfare, and offer quality and accessible health services to the society in line with its vision of being a science and research center. By conducting education, research and social service activities at universal standards, the university provides its students with a wide range of knowledge, as well as a learning and progressive environment that also covers the fields of technology and art.

The university elevates its students as individuals who are equipped with leadership skills, believe in the power of science, closely follow developments in the world, are capable of critical thinking and hold humanitarian and ethical values and the habit of self-improvement and using creativity. It directs its graduates to working environments where they can use these skills, especially to Liv Hospital, Medical Park and VM Medical Park gathered under the umbrella of MLP Care Group.

By elevating the competent, creative and forward-looking individuals of the future, Istinye University aims at contributing to the progress of humankind and playing a significant role in the social, cultural, economic, scientific and technological development of our society.

# Conference Report

**Prof. A. Mirzazadeh,**

**Kharazmi University, Tehran, Iran**

**Institution of International Scientific Services, Chair**

The Institution of International Scientific Services (RefConf), in collaboration with Istinye University, holds the Third International Conference on Optimization and Data Science in Industrial Engineering (ODSIE 2025). The event aimed to reflect the rapid advancements in industrial engineering and data science and to strengthen collaboration between academia and industry.

ODSIE 2025 provided a rich platform for experts to address contemporary challenges in data science and industrial engineering. The conference featured 20 paper presentation panels, numerous scientific and applied presentations delivered by distinguished keynote speakers and senior scholars, and a series of workshops, all of which contributed to the active engagement of participants.

A key strength of the conference was the extensive academic support from 18 universities and scientific associations, including:

- The University of Texas at Dallas, Texas;
- Prague University of Economics and Business, Czech Republic;
- University of Sfax, Tunisia;
- Ankara Science University, Turkey;
- Süleyman Demirel University, Turkey;
- Iranian Institute of Industrial Engineering;
- Iraqi Society for Engineering Management;
- LR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunisia;
- Tunisian Operational Research Society (TORS), Tunisia;
- Halic University, Turkey;
- West Ukrainian National University, Ukraine;
- Chitkara University, India;
- Vidyasagar University, India;
- National Institute of Food Technology Entrepreneurship and Management, India;
- International Institute of Innovation Science- Education- Development in Warsaw, Poland;
- Australian University, Kuwait;
- Manisa Celal Bayar University, Turkey;

- Noida International University.

Selected papers from the conference will appear in seven reputable scientific journals:

1) Journal of Dynamics and Games (JDG);
2) International Journal of Supply and Operations Management (IJSOM);
3) Interdisciplinary Journal of Management Studies (IJMS);
4) Journal of Management Science and Information Technology (MSIT);
5) Journal of Optimization and Supply Chain Management (JOSCM);
6) International Journal of Applied Optimization Studies (IJAOS);
7) Researcher.

Another significant feature of ODSIE 2025 was the participation of seven keynote and workshop speakers representing Turkey, the United States, India, Italy, and the United Arab Emirates, whose contributions enhanced the academic quality of the event. The conference was further supported by 86 members of the International Technical Program Committee from 31 different countries. Figure 1 illustrates the geographical diversity of ODSIE 2025 committee members from 33 various countries.

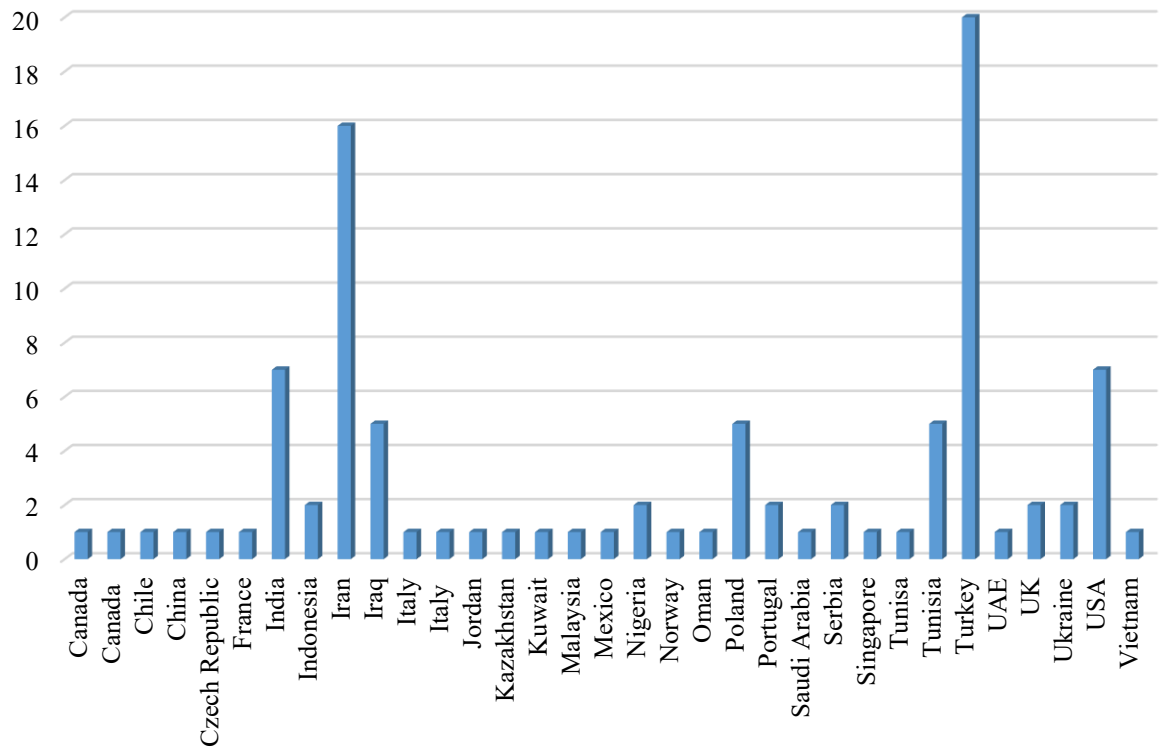


**Figure 1. Geographical Diversity of ODSIE 2025 Colleagues**

Figure 2 shows the distribution of countries represented among the accepted papers.

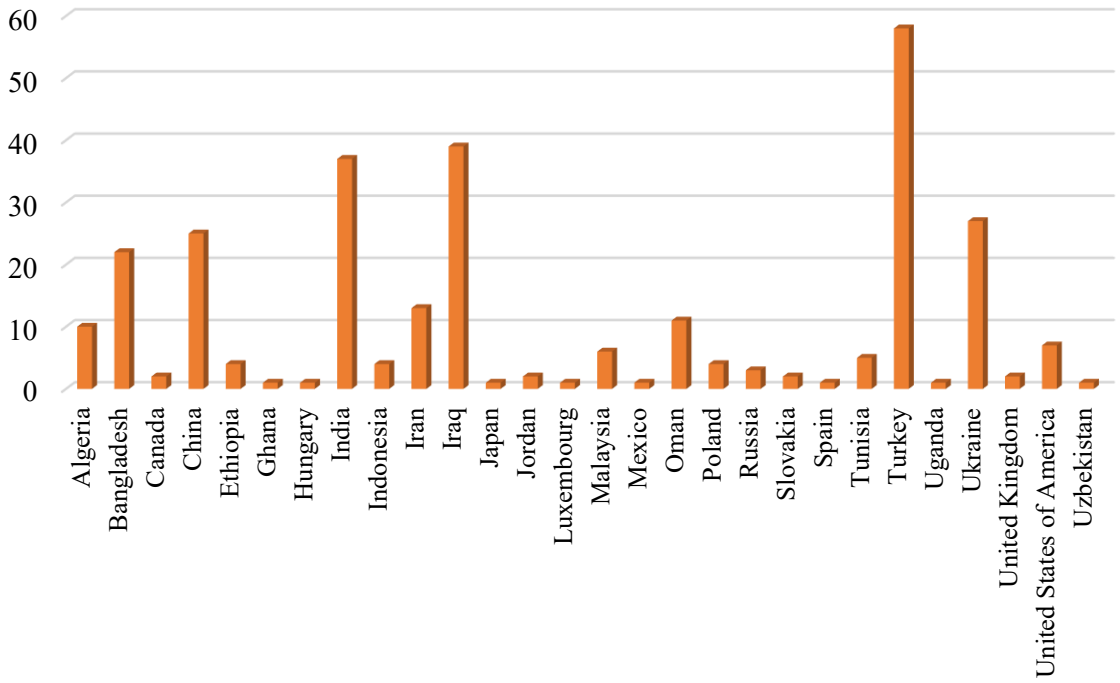


**Figure 2. Countries' Participation in ODSIE 2025**

In addition, a selection of English-language papers will be published in Springer's CCIS book series, which is indexed in:

- Scopus
- SCImago
- EI-Compendex
- DBLP
- Google Scholar
- Mathematical Reviews

CCIS volumes are also submitted for the possible inclusion in Web of Science, subject to evaluation by Clarivate Analytics.

We hope that ODSIE 2025 has contributed meaningfully to advancing Engineering Management, Information Technology, and the broader multidisciplinary fields related to optimization and data science in industrial engineering. Finally, we extend our sincere appreciation to all individuals and institutions whose dedication made this conference possible: colleagues from Istinye University and partner universities, board members, students, panel chairs, the steering and scientific committees, reviewers, keynote speakers, workshop facilitators, organizers, presenters, and attendees. Their commitment and collaborative spirit were central to the success of this event.

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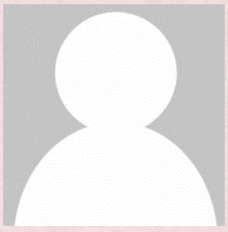

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Tokat Gaziosmanpaşa University, Türkiye

**Dr. Vijay Kumar Gahlawat**
NIFTEM-K, India

**Dr. Ali Asghar Rahmani Hosseinabadi**
University of Regina, Canada

**Dr. Amir Hassanzadeh**
Urmia University, Iran

**Dr. Amin Hosseinian Far**
University of Hertfordshire, UK

**Dr. Beata Mrugalska**
Poznan University of Technology, Poland

# Technical Program Committee Members

**Dr. Vladimir Simic**
University of Belgrade, Serbia

**Dr. Hêriş Golpîra**
Sanandaj Branch, Islamic Azad University, Iran

**Dr. Sarfaraz Hashemkhani Zolfani**
Universidad Catolica del Norte, Chile

**Dr. Mohit Malik**
School of Business Management, Noida International University, India

**Mr. Vuppulapati Chandra Sekhar Naidu**
Computer Science (AI/ML)- Coforge

**Dr. Srinivasan Balan**
North Carolina State University, USA

**Dr. Tanko Bako**
Taraba State University, Nigeria

**Dr. Saeid Rezaei**
Arak University, Iran

**Prof. Omur Ugur**
Middle East Technical University (METU), Turkey

**Dr. Justin Eduardo Simarmata**
Universitas Timor, Indonesia

**Dr. Ismail Ozcan**
University of Parma, Italy

**Prof. Adewoye Olabode**
Yaba College of Technology, Nigeria

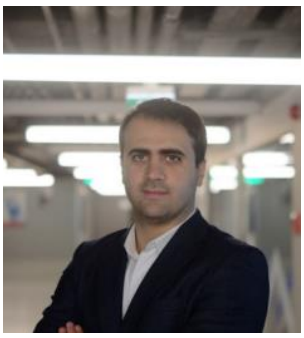
# Technical Program Committee Members

**Prof. Kerem Ugurlu**
Nazarbayev University,
Kazakhstan

**Mr. Harshavardhan Yedla**
Principal Architect Practitioner
Data, AI & Digital Products,
Wipro LLC, USA

# General co-Chairs

**Dr. Saliha Karadayi-Usta**
Istinye University, Turkey



**Dr. N. Serhan Aydın**
Istinye University, Turkey

# Executive Team Members

**Elmira Salavati**
Kharazmi University, Iran

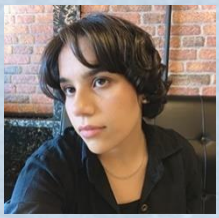
**Fereshteh Sarabadani**
Kharazmi University, Iran

**Zahra Shahedipour**
Kharazmi University, Iran

**Mehrshad Jamshidipour**
Kharazmi University, Iran

**Yasna Yeganeh**
Kharazmi University, Iran

**Zahra Norouzi Shad**
Kharazmi University, Iran



**Mobina Mostajabi**
Kharazmi University, Iran

**Arshia sahraeei**
Kharazmi University, Iran

**Yasin Bonyadi**
Kharazmi University, Iran

# Keynote Speech

## Digital Twins & XR for Translational Healthcare: From Simulation to Clinical Impact

**Prof. Dr. Şenol Pişkin**

Istinye University, Türkiye

### Short Biography

**Dr. Şenol Pişkin** is Professor and PI of the ISU XR Lab at Istinye University, Istanbul. His research spans translational healthcare technologies, extended reality (XR), digital twins, computational modelling, and AI-driven clinical image analysis. He leads multidisciplinary projects in collaboration with hospitals and clinical specialists to translate simulation and XR tools into clinical workflows and decision support.

### Abstract

Healthcare is entering an era where rich data streams, physics-based simulation, and immersive interaction converge to create patient-specific digital twins. In this keynote I will outline a practical roadmap for combining digital-twin models, XR-enabled visualization, and machine learning to accelerate diagnosis, surgical planning, and rehabilitation. I will present case studies from cardiovascular and neurorehabilitation domains that demonstrate how optimization and data-science methods (parameter estimation, model personalization, and predictive analytics) reduce uncertainty, improve intervention planning, and enable remote, clinician-in-the-loop workflows. Finally, I will discuss translational challenges — data governance, clinical validation, and integration with hospital systems — and propose opportunities where optimization and industrial engineering approaches can speed adoption and ensure robust, ethical deployment.

# Keynote Speech

## The Future of Work with AI: Building Human–AI Collaboration Skills

**Dr. AbdulQuddus Mohammed**

Assistant Professor in Business, Higher Colleges of Technology, UAE

### Short Biography

**Dr. AbdulQuddus Mohammed** is a globally recognized educator, author, and thought leader with over 20 years of experience transforming education and leadership development across the GCC and beyond. Currently serving as Assistant Professor at the Higher Colleges of Technology (HCT), UAE, he is dedicated to empowering Generation Z with the mental codes to thrive in the AI-driven future. A dynamic keynote speaker and certified expert in HR and leadership, Dr. Mohammed has delivered impactful sessions at Expo 2020, SHRM, UAE University, FAHR, and other global forums. His signature themes—AI for Leadership, Future of Work, Digital Fluency, Entrepreneurial Mindset, and Sustainable Leadership—bridge academia with industry realities. He is the author of the upcoming book "Thrive AI: Codes for Generation Z to Survive in the AI Age", a practical guide on leading in a disruptive world. His work integrates AI, HR analytics, and competency-based education to prepare students and professionals for meaningful impact in the Fourth Industrial Revolution. Dr. Mohammed holds a DBA from ESC Clermont Business School (France), Ph.D. in HR Management, and is a Fellow of CIPD, CMI, HEA, and SHRM-CP certified. His career is marked by numerous accolades including the ACBSP Teaching Excellence Award (2024), Sheikh Mansour Best HR Research Award (2020), and Queen Effat Excellence in Teaching Award (2014). Driven by the belief that "AI can process data, but it is the human spirit that shapes the future," Dr. Mohammed continues to inspire young minds to lead with creativity, ethics, and resilience.

### Abstract

By 2030, the future of work will be defined not by static job titles but by adaptable skills that enable people to collaborate effectively with AI based agentic intelligent systems. The World Economic Forum (2025) projects that 60% of core skills required for the job market will change by 2030, with this global labor market experiencing both disruption and opportunity: 92 million jobs displaced and 170 million created, a net gain of 78 million roles, which no one knows. Yet the scale of change is daunting: 59% of workers will require retraining within just five years. Industry is already responding—78% of firms report AI adoption in at least one business function (McKinsey, 2025), and PwC (2025) finds that skill requirements in AI-exposed jobs are evolving 66% faster than in non-exposed roles.

Emerging skill demands cluster in three domains. Technical skills such as AI, big data, cybersecurity, and digital literacy are accelerating in demand. Human skills—critical thinking, adaptability, resilience, and creativity—remain enduring and essential. At the same time, ethical competencies—governance, fairness, inclusion, and human agency—are gaining prominence as AI reshapes decision-making and work processes.

For higher education, the implications are profound. Research suggests that up to 60% of curricula risk misalignment with labor market needs, while static degree models cannot keep pace with rapid change. Faculty themselves require retraining to integrate AI into pedagogy and assessment. To remain relevant, universities must shift from degree-centric models to skills-first, adaptive learning ecosystems. This includes modular, stackable micro-credentials; AI-integrated, work-based projects; and continuous learning platforms supported by AI tutors and simulators. Equally urgent are embedding AI ethics and AI governance training (UNESCO, 2025), fostering academia–industry partnerships for skills forecasting and internships, and investing in faculty development and institutional AI governance.

This keynote will provide a blueprint for universities to transition into dynamic ecosystems of lifelong learning, equipping graduates not only with technical fluency but also with the capacity to collaborate with AI responsibly, creatively, and inclusively.

# Keynote Speech

## Towards Waste Management 5.0

**Dr. Erfan Babaee Tirkolaee**

Istinye University, Turkey

### Short Biography

**Dr. Erfan Babaee Tirkolaee** obtained a BSc. (2012) and MSc. (2014) in Industrial Engineering from Isfahan University of Technology, Iran. Then, he received a Ph.D. degree (2019) in Industrial Engineering from Mazandaran University of Science and Technology, Iran. Dr. Erfan Babaee Tirkolaee is currently an Associate Professor in the Department of Industrial Engineering at Istinye University in Istanbul, Turkey. Meanwhile, he worked as a Quality Assurance expert in various automotive industries in Iran and completed different relevant training courses, including ISO 9001:2015 and IATF 16949:2016. He has published more than 170 papers in high-quality journals, including IEEE Transactions on Fuzzy Systems, Expert Systems with Applications, Waste Management, Journal of Cleaner Production, Computers & Industrial Engineering, and Annals of Operations Research. He has been serving as a chair, organizing committee member, as well as a keynote speaker in several prestigious international conferences. Moreover, he is a reviewer in many reputed WoS/Scopus journals and has been recognized as a Top Peer Reviewer in 2 of the Essential Science Indicators research areas by Clarivate WoS. Dr. Erfan Babaee Tirkolaee is currently an Editor in different prestigious WoS/Scopus journals, such as IEEE Transactions of Fuzzy Systems (IEEE), Artificial Intelligence Review (Springer), Facta Universitatis, Series: Mechanical Engineering (University of Niš), and PLOS One (PLOS). He has also been serving on the guest editorial board in several journals, like as Annals of Operations Research (Springer) and Engineering Applications of Artificial Intelligence (Elsevier). Dr. Erfan Babaee Tirkolaee has been featured among the "World's Top 2% Researchers/Scientists in 2021 – 2024" list identified by Elsevier BV, Stanford University.

### Abstract

Efficient Waste Management (WM) is vital for environmental protection, public health, and resource conservation, especially as global waste generation is projected to reach 2.59 billion tons by 2030 and 3.4 billion tons by 2050. A well-designed Waste Management System (WMS) ensures the systematic collection, transportation, processing, and treatment of waste while minimizing ecological and human impacts. Rapid industrial and social growth has intensified resource consumption and amplified waste generation, prompting the need for comprehensive optimization approaches that reduce waste, maximize recycling and reuse, and ensure safe disposal. Recent advancements in digitalization and Artificial Intelligence have transformed industries under the Industry 4.0 (I4.0) paradigm; however, its limitations regarding social fairness, environmental protection, and resilience have accelerated the emergence of Industry 5.0 (I5.0). Integrating human-centricity, sustainability, and resilience, I5.0 offers promising opportunities for next-generation WMSs. Moreover, its strong synergy with Circular Economy (CE) principles (i.e., refuse, reduce, reuse, repurpose, and recycle) enables smarter, greener, and more adaptable solutions. Leveraging AI, IoT, and robotics, WM5.0 fosters efficient resource utilization, encourages end-of-life-focused product design, and enhances sustainable waste practices across the entire lifecycle.

# Workshop

**Dr. Meenakshi Kaushik**

Academician (18 Years), Author of 3 Edited Books, India

## Transforming Education in the AI Era: Opportunities, Challenges, and Pedagogical Evolution

Theme Overview

The integration of Artificial Intelligence in education represents a pivotal moment in pedagogical history, challenging traditional teaching methodologies while offering unprecedented opportunities for personalized learning. This panel discussion explores the multifaceted implications of AI adoption in educational institutions, examining both its transformative potential and critical considerations for stakeholders across the academic spectrum.

As a Moderator I shall be coming up with 3 to 4 rounds of questions based on below topics.

Key Discussion Areas

1. Pedagogical Transformation and AI
2. Ethical Considerations and Academic Integrity
3. Institutional Readiness and Implementation
4. Student Development in the AI Age
5. Future Directions and Innovation

Target Outcomes

- Develop framework for responsible AI integration in educational settings
- Identify best practices for balancing traditional and AI-enhanced learning
- Create guidelines for maintaining academic integrity
- Establish roadmap for institutional AI adoption
- Define metrics for measuring success of AI integration

Panel Format

- Moderated discussion of key themes
- Interactive Q&A session with audience
- Collaborative development of actionable recommendations
- Closing synthesis of key insights and future directions

Suggested Participants

- Educational Technology Experts
- Curriculum Development Specialists

- AI Ethics Researchers
- Educational Psychologists
- School Administrators
- Teaching Faculty
- Educational Policy Makers
- Student Representatives

This theme framework provides a structured foundation for a meaningful discussion while remaining flexible enough to accommodate various institutional contexts and perspectives.
Panel experts: 3 to 5 professors and Deans from reputed central universities / industry people

# Workshop

**Mr. Udaya Veeramreddygari**

Lead Software Engineer, USA & IEEE member USA

## Short Biography

Experienced software engineering leader with over two decades of proven expertise in architecting, developing, and managing enterprise-scale applications across domains like automotive, finance, and telecommunications. Specialized in Java, Spring Boot, Microservices, and AWS. Udaya has led cross-functional teams across global locations, delivering high-performance, cloud-native solutions aligned with business strategy. His current role as Lead Software Engineer at Cox Automotive highlights his strengths in system modernization, ML/AI integration, and GenAI enablement, fostering automation and innovation across the SDLC. Beyond engineering, Udaya is deeply engaged in the technology community through conference speaking, peer reviews, and judging for global tech awards. He is an active member of IEEE and serves on technical program committees for multiple international conferences. With certifications in AWS, Scrum, ITIL, and architecture, along with scholarly contributions on LLMs, AI productivity, and sustainability, Udaya brings a unique combination of technical depth, leadership acumen, and thought leadership to every engagement.

## Smart Dev Assistant: AI Agent Mode in VS Code

**Abstract**

This workshop highlights the incredible capabilities of AI Agent Mode in Visual Studio Code. Here, a smart coding assistant works independently to support developers as they write, debug, and refactor code in real-time. By using natural language prompts, the agent can understand tasks, offer suggestions for improvements, and even take actions directly within the code editor. This creates a smooth, context-aware development experience that's perfect for enhancing productivity, minimizing context-switching, and optimizing workflows.

# Workshop

**Mr. Harshavardhan Yedla**

Principal Architect Practitioner Data, AI & Digital Products, Wipro LLC, USA

**Mr. Venkat Sharma Gaddala**

Software Engineer, Google, USA

**Short Biography**

**Mr. Harshavardhan** Yedla is a seasoned IT professional with 18 years of experience in implementing and architecting digital technologies, having made significant contributions at renowned organizations like Wipro, Persistent & Genpact. His expertise encompasses a broad spectrum of areas including Data Engineering, AI/ML, Cloud Solutions & Business Transformation. Mr. Yedla has successfully led cross-functional teams, managed complex data transformation projects & driven innovative solutions across various domains such as finance, healthcare, and manufacturing & Supply Chain. He has published scholarly articles on advanced forecasting techniques and environmental sustainability and actively contributes as a reviewer for numerous international conferences and journals. His role as a Principal Architect Practitioner has seen him leading transformative projects at prominent companies like Disney+, Zelle, Walmart, GE where he has shaped technology roadmaps and enhanced business processes. Yedla is a Senior Member of IEEE and a Fellow of the IETE & SAS Society, Mr. Yedla continues to drive strategic initiatives and provide thought leadership in the realms of data analytics and digital transformations & AI.

**Mr. Venkat Sharma Gaddala** is a seasoned IT professional with over 19 years of experience in architecting and implementing enterprise solutions across leading organizations such as Google, Anaya Technologies, and Infosys. His expertise spans Enterprise Generative AI, LLM applications, supply chain transformation, Google Cloud integration, and SAP solutions. Known for his ability to lead complex implementations and design data-driven, efficient architectures, Mr. Gaddala has consistently delivered impactful results. He has authored seven research papers on the application of Generative AI in supply chain management. He actively contributes to the academic community as a paper reviewer and editorial board member for an international journal. In his current role as Engineering Lead at Google, he spearheads innovation and drives supply chain transformation through advanced Enterprise Generative AI and LLM technologies. Recognized for his contributions, he holds distinguished affiliations, including Senior Member of IEEE, Fellow of IETE, Eminent Fellow of the SAS Society, and Distinguished Fellow of SCRS. Mr. Gaddala continues to provide thought leadership and guide strategic initiatives in enterprise AI and digital transformation.

# AI Across Industries: Driving Innovation, Efficiency, and Sustainable Growth -Transforming Manufacturing, Agriculture, Real Estate, Governance, Cybersecurity, and Entertainment

## Abstract

Artificial Intelligence (AI) is revolutionizing industries by enhancing efficiency, innovation, and decision-making. In manufacturing, AI powers predictive maintenance and autonomous operations, boosting productivity and reducing downtime. Digital agriculture enables smarter crop management and resource use, promoting sustainable practices. Real estate leverages AI for accurate property valuation and smart building systems, improving energy efficiency and tenant experiences. Governments and public sectors use AI for predictive modeling and policy simulation, supporting better governance. In cybersecurity, AI strengthens encryption, threat detection, and authentication systems. Meanwhile, in media and entertainment, it drives content creation, personalized streaming, and immersive virtual experiences. Across sectors, AI delivers measurable ROI, advances sustainability, and empowers more informed decisions.

# Workshop

## Abhi Desai

Research Scholar — AI, ML, Data Science & Analytics
Former Lead Data Analyst at Saks Fifth Avenue, NY, USA

**Short Biography**

**Mr. Abhi Desai** is a Data Science and AI professional with over 10 years of experience delivering analytics, machine learning, and data-driven solutions. He holds a dual M.S. in Data Science and Analytics and a B.E. in Computer Science and Engineering. He has contributed to AI initiatives at leading organizations including Saks Fifth Avenue, Target, and IPG Media Brands in New York, USA, delivering AI-driven solutions that improved operational efficiency and decision-making in retail and logistics.

He has authored and published multiple peer-reviewed papers in AI, machine learning, explainable AI, and retail analytics. Abhi actively contributes to the global research community as a session chair, workshop organizer, hackathon judge, review panelist, and invited speaker, and serves as an ethics and technical paper reviewer for international conferences and journals across multiple industries and international contexts. He is a Senior Member of IEEE and holds fellowships in leading professional societies. He bridges academia and industry to deliver transformative AI and analytics solutions with global impact.

## AI and ML Driven Customer Analytics to Operational Optimization in Retail Industry

### Abstract

This workshop demonstrates how analytics and data science can transform retail operations by connecting customer insights to operational decision-making. Participants will explore how AI and ML techniques are applied to customer segmentation, lifetime value (LTV), lifetime revenue (LTR), and customer acquisition cost (CAC), and how these insights inform labor planning, shipping optimization, and inventory management. Real-world retail examples illustrate the end-to-end workflow, highlighting measurable improvements in efficiency, accuracy, and strategic decision-making. Attendees will gain practical guidance on leveraging AI and ML to bridge customer analytics and operational optimization, enabling them to drive tangible business impact in retail and beyond.

# Workshop

## İsmail Özcan

Department of Engineering for Industrial Systems and Technologies, University of Parma, Parma/Italy

**Short Biography**

**Dr. İsmail Özcan** is a Postdoctoral Research Fellow at the Department of Engineering for Industrial Systems and Technologies, University of Parma, Italy. Prior to this appointment, he held a postdoctoral position at the Operations Research Center, Universidad Miguel Hernández, Spain. He obtained his Ph.D. in Mathematics from Süleyman Demirel University, Turkey, and later received official Ph.D. equivalence recognition in Spain, confirming the international academic standing of his degree. His research explores the intersection of cooperative game theory, fuzzy and grey systems, artificial intelligence (AI), and operational research (OR), with a focus on developing quantitative models for decision-making under uncertainty and hierarchical collaboration in industrial and economic systems. Dr. Özcan has authored and co-authored several distinguished contributions in international journals and academic volumes, advancing both theoretical foundations and applied dimensions of game theory, optimization, and intelligent systems. His scholarly agenda bridges mathematical abstraction with real-world analytics, contributing to the integration of AI and OR methodologies in modern research. He actively serves as a reviewer for leading SCI-Expanded journals in optimization, operations research, and fuzzy systems, and is a member of EURO, INFORMS, SEIO, and the American Mathematical Society.

## The k-Proportional t-Value in Big Boss Games: Bridging Game Theory, Artificial Intelligence, and Operational Research

**Abstract**

This workshop explores the *k-proportional t-value*, a fresh perspective on how collaboration and influence can be modeled in complex organizations. Building on ideas from game theory, Artificial Intelligence (AI), and Operational Research (OR), this approach helps us understand how leaders and teams share value and make balanced decisions in hierarchical settings. Rather than focusing purely on mathematical details, the session will emphasize how the k parameter introduces flexibility in distributing payoffs and maintaining fairness among players — especially in *big boss games*, where one dominant actor significantly shapes the group's success. To make the discussion more engaging, participants will form small coalitions to simulate "big boss" decision-making scenarios and observe how different *k* values affect cooperation outcomes. An interactive visualization will illustrate how changes in proportionality impact fairness and stability, while a real-world case inspired by Amazon's AI teams developing personalized recommendation systems will show how data-driven cooperation can be analyzed through this framework. By blending theory with practical examples and interactive exercises, the workshop demonstrates how the k-proportional t-value can inform smarter, fairer, and more adaptive decision-making in industrial operations, logistics, and AI-based organizations. Participants will leave with both conceptual insights and an intuitive sense of how hierarchical collaboration can be optimized.

# Panels

Dr. Meenakshi Kaushik

**Panel:**

**Technology Integration & Digital Transformation: Smart Operations and Process optimization**

Dr. Ammar Odeh

**Panel:**

**The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems**

Dr. Rohit Bansal

Dr. Fazla Rabby

Dr Ridhima Sharma

Dr. Arti Gupta

**Panel:**

**Industry 6.0, Emerging Technologies and Sustainable Development**

Dr. Erfan Babaee Tirkolaee

**Panel:**

**AI-Driven Autonomy: Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance**

Dr. Zohreh Molamohamadi

**Panel:**

**Generative AI in Healthcare: Transforming Patient Care and Medical Innovation**

Dr. Simerjeet Singh Bawa

**Panel:**

**E-Government, E-Commerce, and E-Learning**

Dr. Zohreh Molamohamadi

**Panel:**

**AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios**

Dr. Aybike Özyüksel Çiftçioğlu

Dr. Soheyl Khalilpourazari

**Panel:**

**Artificial Intelligence Solutions for Engineering Problems**

Prof. Subhash Verma

Dr. Pooja Goel

Mr. Naveen Nanda

**Panel:**

**Optimization and Strategic Decision-Making in Industrial Management**

Dr. Vijay Kumar Gahlawat

Dr. Kumar Rahul

Mohit Malik

**Panel:**

**Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities**

Dr. Prince Kumar

**Panel:**

**Data-Driven Strategies for Sustainable and Smart Business Operations**

Dr. Saeid Rezaei

**Panel:**

**New Approaches to Achieving Sustainable Development Goals (SDGs)**

Dr. Priyadarshani Singh

Dr. Rashmi Manhas

Dr. Mona Sharma

**Panel:**

**Smart Cities for a Sustainable Future: Optimization and Data Science Approaches**


Dr. Mohit Malik


Dr. Dhiraj Kumar Yadav


Dr. Parveen Siwach

**Panel:**

**Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability**


Dr. Marwa Hasni

**Panel:**

**Forecasting Techniques for Operations Research**


Dr. Luan-Thanh Nguyen

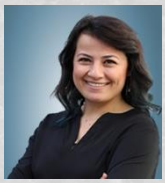

Dr. Tri-Quan Dang


Dr. Huynh Bao Thach


Dr. Son-Hoang Dang

**Panel:**

**Emerging Trends in Science, Business and Technology Innovation**


Dr. Serap Ergün

**Panel:**

**Mathematics, Computation and Complex Systems**


Dr. Mazdak Khodadadi Karimvand

**Panel:**

**Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems**


Dr. Sita Ram Sharma


Dr Dinesh Kumar Sharma

**Panel:**

**Data-Driven Governance, Organizational Performance & Digital Communication**


Dr. Seyed Mohammad Javad Mirzapour Al-E-Hashem

**Panel:**

**AI-Driven Optimization and Intelligence in Modern Logistics**

# Conference Program

➢ ***The conference programs are scheduled based on Istanbul Time Zone (UTC+3).***

**Room 1**:https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5

**Room 2:** https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T

**Room 3:** https://teams.microsoft.com/meet/36378593045888?p=Qma1WeOsxrMWsNeLPg

**First day: Thursday 20.11.2025**

| Location/time | 9-10:30 | 10:45-12:15 | 12:15-13:30 | 13:30-15:00 | 15:15-16:45 |
|---|---|---|---|---|---|
| **Room 1** | **Opening Ceremony**<br><br>Keynote speech<br>***Dr. AbdulQuddus Mohammed*** | 10:45-11:30<br>Workshop<br>***Mr. Udaya Veeramreddygari***<br><br>11:30-12:15<br>Workshop<br>***Mr. Harshavardhan Yedla*** | Break time | Paper Session<br>**Dr. Meenakshi Kaushik** | Panel Discussion<br>***Dr. Meenakshi Kaushik*** |
| **Room 2** | Closed | Paper Session<br>**Dr. Saeid Rezaei** | Break time | Paper Session<br>**Dr. Ammar Odeh** | Paper Session<br>**Dr. Rohit Bansal** |

**Second day: Friday 21.11.2025**

| Location/time | 9-10:30 | 10:45-12:15 | 12:15-13:30 | 13:30-15 | 15:15-16:45 |
|---|---|---|---|---|---|
| **Room 1** | Paper Session<br>**Dr. Luan-Thanh Nguyen** | 10:45-11:30<br>Workshop<br>***Mr. Abhi Desai***<br>11:30-12:15<br>Workshop<br>***Dr. İsmail Özcan*** | Break time | Keynote speech<br>***Dr. Şenol Pişkin*** | Paper Session<br>**Prof. Vijay Kumar Gahlawat** |
| **Room 2** | Paper Session<br>**Mr. Vijay Kumar Sridharan** | Paper Session<br>**Mr. Santosh Kumar** | Break time | Paper Session<br>**Dr. Priyadarshani Singh** | Paper Session<br>**Dr. Prince Kumar** |
| **Room 3** | Paper Session<br>**Dr. Mazdak Khodadadi Karimvand** | Paper Session<br>**Dr. Sita Ram Sharma** | Break time | Paper Session<br>**Dr. Ali Asghar Rahmani Hosseinabadi** | Paper Session<br>**Dr. Seyed Mohammad Javad Mirzapour Al-E-Hashem** |

**Third day: Saturday 22.11.2025**

| Location/time | 9-10:30 | 10:45-12:15 | 12:15-13:30 | 13:30-15 | 15:15-16:45 |
|---|---|---|---|---|---|
| **Room 1** | Paper Session<br>**Dr. Mohit Malik** | Paper Session<br>**Dr. Marwa Hasni** | Break time | Paper Session<br>**Dr. Simerjeet Singh Bawa** | **Closing Session**<br>Keynote speech<br>***Dr. Erfan Babaee Tirkolaee*** |
| **Room 2** | Paper Session<br>**Dr. Serap Ergün** | Paper Session<br>**Dr. Aybike Özyüksel Çiftçioğlu** | Break time | Paper Session<br>**Prof. Subhash Verma** | Closed |

- **Opening Ceremony**

**Thursday, 20.11.2025, At 9:00 (Istanbul Local Time)**

| # | Title | Time | Duration (min) |
|---|---|---|---|
| 1 | Opening Presentation | 9:00-9:05 | 5 |
| 2 | Welcome Speech, Dr. Erfan Babaee Tirkolaee (Conference Chair) | 9:05-9:15 | 10 |
| 3 | Conference Report, Prof. A. Mirzazadeh (Conference Chair) | 9:15-9:30 | 15 |
| 4 | ODSIE 2025 Clip | 9:30-9:35 | 5 |
| 5 | Keynote Speech, Dr. AbdulQuddus Mohammed (Higher Colleges of Technology, UAE) | 9:35-10:20 | 45 |
| 6 | Istinye University Clip | 10:20-10:25 | 5 |
| 7 | Introduction to the Conference Programs and Schedules | 10:25-10:30 | 5 |

- **Closing Session**

**Saturday, 22.11.2025, At 15:15 (Istanbul Local Time)**

| # | Title | Time | Duration (min) |
|---|---|---|---|
| 1 | Closing Presentation | 15:15-15:20 | 5 |
| 2 | Keynote Speech, Dr. Erfan Babaee Tirkolaee (Istinye University, Turkey) | 15:20-16:20 | 60 |
| 3 | ODSIE 2025 Clip | 16:20-16:25 | 5 |
| 4 | Appreciation and Group Photo | 16:25-16:45 | 20 |

| Date: **Thursday, 20.11.2025**<br>Time:**9:30-10:15** | **Keynote Speech** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Yasin Bonyadi & Yasna Yeganeh |
|---|---|---|

Title:

***"The Future of Work with AI: Building Human–AI Collaboration Skills"***

Keynote Speaker:
**Dr. AbdulQuddus Mohammed,** Assistant Professor in Business, Higher Colleges of Technology, UAE

**Abstract:**
By 2030, the future of work will be defined not by static job titles but by adaptable skills that enable people to collaborate effectively with AI based agentic intelligent systems. The World Economic Forum (2025) projects that 60% of core skills required for the job market will change by 2030, with this global labor market experiencing both disruption and opportunity: 92 million jobs displaced and 170 million created, a net gain of 78 million roles, which no one knows. Yet the scale of change is daunting: 59% of workers will require retraining within just five years. Industry is already responding—78% of firms report AI adoption in at least one business function (McKinsey, 2025), and PwC (2025) finds that skill requirements in AI-exposed jobs are evolving 66% faster than in non-exposed roles.

Emerging skill demands cluster in three domains. Technical skills such as AI, big data, cybersecurity, and digital literacy are accelerating in demand. Human skills—critical thinking, adaptability, resilience, and creativity—remain enduring and essential. At the same time, ethical competencies—governance, fairness, inclusion, and human agency—are gaining prominence as AI reshapes decision-making and work processes.

For higher education, the implications are profound. Research suggests that up to 60% of curricula risk misalignment with labor market needs, while static degree models cannot keep pace with rapid change. Faculty themselves require retraining to integrate AI into pedagogy and assessment. To remain relevant, universities must shift from degree-centric models to skills-first, adaptive learning ecosystems. This includes modular, stackable micro-credentials; AI-integrated, work-based projects; and continuous learning platforms supported by AI tutors and simulators. Equally urgent are embedding AI ethics and AI governance training (UNESCO, 2025), fostering academia–industry partnerships for skills forecasting and internships, and investing in faculty development and institutional AI governance.

This keynote will provide a blueprint for universities to transition into dynamic ecosystems of lifelong learning, equipping graduates not only with technical fluency but also with the capacity to collaborate with AI responsibly, creatively, and inclusively.

| Date: **Thursday, 20.11.2025**<br>Time:**10:45-11:30** | **Workshop** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Yasin Bonyadi & Yasna Yeganeh |
|---|---|---|
| Title:<br>***"Smart Dev Assistant: AI Agent Mode in VS Code"*** | | |
| Keynote Speaker:<br>**Mr. Udaya Veeramreddygari**<br>Lead Software Engineer, USA & IEEE member USA | | |
| **Abstract:**<br>works independently to support developers as they write, debug, and refactor code in real-time. By using natural language prompts, the agent can understand tasks, offer suggestions for improvements, and even take actions directly within the code editor. This creates a smooth, context-aware development experience that's perfect for enhancing productivity, minimizing context-switching, and optimizing workflow | | |

| Date: **Thursday, 20.11.2025**<br>Time:**11:30-12:15** | **Workshop** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Yasin Bonyadi & Yasna Yeganeh |
|---|---|---|

Title:

***"AI Across Industries: Driving Innovation, Efficiency, and Sustainable Growth -Transforming Manufacturing, Agriculture, Real Estate, Governance, Cybersecurity, and Entertainment"***

Speakers:
**Mr. Harshavardhan Yedla**
Principal Architect Practitioner Data, AI & Digital Products, Wipro LLC, USA
**Mr. Venkat Sharma Gaddala**
Software Engineer, Google, USA

**Abstract:**
manufacturing, AI powers predictive maintenance and autonomous operations, boosting productivity and reducing downtime. Digital agriculture enables smarter crop management and resource use, promoting sustainable practices. Real estate leverages AI for accurate property valuation and smart building systems, improving energy efficiency and tenant experiences. Governments and public sectors use AI for predictive modeling and policy simulation, supporting better governance. In cybersecurity, AI strengthens encryption, threat detection, and authentication systems. Meanwhile, in media and entertainment, it drives content creation, personalized streaming, and immersive virtual experiences. Across sectors, AI delivers measurable ROI, advances sustainability, and empowers more informed decisions.

| Date: **Thursday, 20.11.2025**<br>Time:**10:45-12:15** | Session Code: **OP12** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |
|---|---|---|
| Title:<br>***"New Approaches to Achieving Sustainable Development Goals (SDGs)"*** | | |
| Panel Chair:<br>**Dr. Saeid Rezaei,** Arak University, Iran | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1095-ODSIE2025 | Saeid Rezaei | Smart Circular Economy: A Resilient Optimization Approach within the Framework of Sustainable Development Goals |
| 1108-ODSIE2025 | Maryna Gorobei; Oleksandr Bondar | Digitalisation for smart and climate-neutral cities: the case of Ukraine |
| 1019-ODSIE2025 | Md Salah Uddin; Kazi Jahid Hasan; Arif Ahmed; Abdullah Jafree; Md Alik Akandh | Addressing Technical Challenges and Workflow Optimization in 3D Prototype Manufacturing with Creality Ender 3 V2 Neo |
| 1145-ODSIE2025 | Duygu Nur Arslan; Senar Nur Yoğurtcu; Syed Shah Sultan Mohiuddin Qadri; Kıvılcım Naz Böke | Aircraft Assignment under Demand Uncertainty: A Stochastic MILP Optimization Model for Private Jet Operators |
| 1186-ODSIE2025 | Mehmet Kiziltaş | An Analysis of Metropolization Via Clustering in Arabic Peninsula for Transportation Efficiency |

| Date: **Thursday, 20.11.2025**<br>Time:**13:30-15:00** | Session Code: **OP01** | **Room 1:**<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Yasin Bonyadi & Yasna Yeganeh |
|---|---|---|
| Title:<br>***"Technology Integration & Digital Transformation: Smart Operations and Process optimization"*** | | |
| Panel Chair:<br>**Dr. Meenakshi Kaushik,** Academician (18 Years), Author of 3 Edited Books, India | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1043-ODSIE2025 | Meenakshi kaushik; Paras Mahajan; Md Sakif Uddin Khan; Nishu Bansal | Interpretable Deep learning for Early Diagnosis in Low-Resource Healthcare Settings |
| 1045-ODSIE2025 | Mehmet Kiziltaş | An Analysis of Metropolization and High Capacity National Network Via Clustering in Argentina |
| 1065-ODSIE2025 | Haider Abdulkareem Alobaidi; Zahraa Ghazi Sadiq; Rafid Ali Laftah Hamad; Hameed Salim Alkabi; Waleed Nassar; Dmytro Kocherev | Defamation in the Age of Social Media: Legal Responses to Digital Reputation Crises |
| 1101-ODSIE2025 | ZhiAng Yu; Rexford Nii Ayitey Sosu | Quantitative Modelling of AI-Driven Consumer Behaviour in Digital Economies |
| 1020-ODSIE2025 | Md Salah Uddin; Abu Shahed Shah Md Nazmul Arefin; Kazi Jahid Hasan; Abu kausar; Nushrat Jahan Bristi; Mohidul Islam; Mohidul Islam | Cloud-Based Multi-Langual License Plate Recognition Using YOLO and OCR |
| 1195-ODSIE2025 | Khouloud Elloumi; Walid Chebbi | Digitization of an assembly station integrated into a learning 4.0 production line |

| Date: **Thursday, 20.11.2025**<br>Time:**13:30-15:00** | Session Code: **OP02** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |
|---|---|---|
| Title:<br>***"The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems"*** | | |
| Panel Chair:<br>**Dr. Ammar Odeh,** Princess Sumaya University for Technology, Jordan | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1002-ODSIE2025 | Ammar Odeh; Selvakumar Manickam; Nabeel Alassaf; Mohammed Anbar | Security and Privacy Challenges in Wireless Sensor Network Communications for the Internet of Things |
| 1034-ODSIE2025 | Subhash Verma; Kirti Kirti; Shubneet .; Anushka Raj; Charu Sood; Navjot Singh Talwandi | Quantum-Enhanced Federated Learning: Pushing the Boundaries of Privacy and Speed in Distributed AI |
| 1120-ODSIE2025 | Kumar Rahul; Shraddha Verma; Charu Sood; Anushka Raj Yadav; Shubneet; and Subhash Kumar Verma | A Privacy-Preserving and Explainable Machine Learning Model for Student Performance Prediction in Virtual Environments |
| 1125-ODSIE2025 | Jiaqi Han | Analysing the Strategic Impact of Artificial Intelligence-Generated Content (AIGC) Using Machine Learning Models: Value Realisation in Corporate Management |
| 1063-ODSIE2025 | Abdulqadous Abdullah; Suzan Mohammed Jawad Alkazraji; Ayah Ahmed Jasim; Aseel Ibraheem Muhsin; Faris Abdul Kareem Khazal; Radomyr Mykolenko | Sovereignty in the Digital Age: Social, Legal, and Governance Challenges of Global Networks |

| Date: **Thursday, 20.11.2025**<br>Time:**15:15-16:45** | **Panel Discussion** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Yasin Bonyadi & Yasna Yeganeh |
|---|---|---|

Title:

***"Transforming Education in the AI Era: Opportunities, Challenges, and Pedagogical Evolution"***

Speaker:
**Dr. Meenakshi Kaushik**
Academician (18 Years), Author of 3 Edited Books, India

**Theme Overview**

The integration of Artificial Intelligence in education represents a pivotal moment in pedagogical history, challenging traditional teaching methodologies while offering unprecedented opportunities for personalized learning. This panel discussion explores the multifaceted implications of AI adoption in educational institutions, examining both its transformative potential and critical considerations for stakeholders across the academic spectrum.

As a Moderator I shall be coming up with 3 to 4 rounds of questions based on below topics.

**Key Discussion Areas:** Pedagogical Transformation and AI; Ethical Considerations and Academic Integrity; Institutional Readiness and Implementation; Student Development in the AI Age; Future Directions and Innovation

**Target Outcomes:** Develop framework for responsible AI integration in educational settings; Identify best practices for balancing traditional and AI-enhanced learning; Create guidelines for maintaining academic integrity; Establish roadmap for institutional AI adoption; Define metrics for measuring success of AI integration

**Panel Format:** Moderated discussion of key themes; Interactive Q&A session with audience; Collaborative development of actionable recommendations; Closing synthesis of key insights and future directions

**Suggested Participants:** Educational Technology Experts; Curriculum Development Specialists; AI Ethics Researchers; Educational Psychologists; School Administrators; Teaching Faculty; Educational Policy Makers; Student Representatives

This theme framework provides a structured foundation for a meaningful discussion while remaining flexible enough to accommodate various institutional contexts and perspectives.

Panel experts: 3 to 5 professors and Deans from reputed central universities / industry people

| Date: **Thursday, 20.11.2025**<br>Time:**15:15-16:45** | Session Code: **OP03** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |
|---|---|---|
| Title:<br>***"Industry 6.0, Emerging Technologies and Sustainable Development"*** | | |
| Panel Chairs:<br>**Dr. Rohit Bansal**, Adjunct Faculty, Rockford College, Sydney, Australia<br>**Dr. Fazla Rabby**, Director, Stanford Institute of Management & Technology, Australia<br>**Dr. Ridhima Sharma**, Associate Professor, Vivekananda Institute of Professional Studies- TC, New Delhi, India<br>**Dr. Arti Gupta**, Assistant Professor, J.C. Bose University of Science and Technology, YMCA, Faridabad, India | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1028-ODSIE2025 | Maria Seraphina Astriani; Alysha Puti Maulidina; Kimberly Mazel; Wahyu Sardjono; Lee Huey Yi | GeneArcana: Solution for Investigating Measles Susceptibility Candidate Genes on a Global Scale by Integrating Genomic Databases |
| 1099-ODSIE2025 | Maryna Gorobei; Oleksandr Bondar | Optimisation framework for environmental risk assessment of blockchain technologies |
| 1131-ODSIE2025 | Mehmet Kiziltaş | An Analysis of Metropolization Via Clustering in Venezuela and Its Periphery for Transportation Efficiency |
| 1119-ODSIE2025 | Manisha Nagpal; Rani Priyambada Singh; Shubneet; Anushka Raj Yadav; Parveen Siwach; Navjot Singh Talwandi | AI-Driven Threat Intelligence for Predictive Cyber Defense in Smart Cities |
| 1140-ODSIE2025 | Deniz Şeref; Beyza Aksoku; Kıvılcım Naz Böke; Syed Shah Sultan Mohiuddin Qadri | A MILP-Based Framework for Sustainable and Service-Aware Dairy Vehicle Routing under Cold Chain Constraints |

| Date: **Friday, 21.11.2025**<br>Time:**9:00-10:30** | Session Code: **OP16** | **Room 1:**<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Arshia Sahraeei & Yasna Yeganeh |
|---|---|---|

Title:

***"Emerging Trends in Science, Business and Technology Innovation"***

Panel Chairs:

**Dr. Luan-Thanh Nguyen,** Ho Chi Minh City University of Foreign Languages-Information Technology (HUFLIT)

**Dr. Tri-Quan Dang, Senior researcher,** Ho Chi Minh City University of Foreign Languages-Information Technology (HUFLIT)

**Dr. Huynh Bao Thach, Senior researcher,** Ho Chi Minh City University of Foreign Languages-Information Technology (HUFLIT)

**Dr. Son-Hoang Dang, Senior researcher,** Ho Chi Minh City University of Foreign Languages-Information Technology (HUFLIT)

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1132-ODSIE2025 | Yuxia Sun | Leveraging Artificial Intelligence for Enhancing Data Security in Contemporary Communication Networks Through Advanced Encryption Methods |
| 1017-ODSIE2025 | İrem Aytan; Eyüp Ensar Isık | Modeling and Optimization of Campaign-Based Staffing Needs in Call Center Operations |
| 1046-ODSIE2025 | Rajesh Ranjan; Rashmi Singh; Saumya Tripathi | Role of Information Technology in Advancing Sustainability in India: A Case Study Analysis |
| 1098-ODSIE2025 | Nurşah Yilmaz Erdeş; İsmail Karaoğlan | A Heuristic Method for The Generalized One-to-One Pickup and Delivery Vehicle Routing Problem |
| 1182-ODSIE2025 | Bahriye Cesaret | Dynamic Omni-Channel Fulfillment with Switching Customers |

| Date: **Friday, 21.11.2025**<br>Time:**9:00-10:30** | Session Code: **OP04** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mobina Mostajabi & Yasin Bonyadi |
|---|---|---|
| Title:<br>***"AI-Driven Autonomy:Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance"*** | | |
| Panel Chair:<br>**Mr. Vijay Kumar Sridharan,** Vice President- Goldman Sachs- AI/ML Engineering, USA | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1047-ODSIE2025 | Khem Chand; Prince Kumar; Laxmi Dhaniya; Sushila; Suman Yadav; M P Singh | Scientific Landscape of Telemedicine and Digital Healthcare: A Bibliometric Approach to Research Dynamics (2012-2025) |
| 1056-ODSIE2025 | Yahya Majeed Alsaad; Faiza Abdulla Ali; Baydaa Essam Abdulrahman Jasim; Aqeel Mahmood Jawad; Ali Alsaray; and Viktoriia Trofymchuk | AI-Driven Managerial Strategy and Institutional Readiness: Social Science Insights into Data-Centric Transformation |
| 1018-ODSIE2025 | Md Salah Uddin; Kazi Jahid Hasan; Abhijit Roy Abhi | A Comparative Study of AI-Generated 3D Models and Conventional Software-Based 3D Modeling Techniques: Accuracy, Efficiency, and Creative Potential |
| 1078-ODSIE2025 | Abdulqadous Abdullah; Hayder Mohammed Hassan; Ibrahim Khalil Ibrahim; Nameer Hashim Qasim; Hasan Ali Abbas; Ievgenii Gorbatyuk | Cognitive Automation and Consumer Experience: Socio-Legal Dimensions in Textile Retail Innovation |
| 1093-ODSIE2025 | Muzaffer Yassen; Marwan Salah Noaman; Taghreed Alaa Mohammed Ali Hassan; Nameer Hashim Qasim; Hamza Aljebouri; Ihor Averichev | Digital Influence and Strategic Communication in the Global Information Order: The Role of Social Media Marketing Ecosystems |

| Date: **Friday, 21.11.2025**<br>Time:**9:00-10:30** | Session Code: **OP18** | **Room 3:**<br>https://teams.microsoft.com/meet/36378593045888?p=Qma1WeOsxrMWsNeLPg<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |
|---|---|---|
| Title:<br>***"Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems"*** | | |
| Panel Chair:<br>**Dr. Mazdak Khodadadi Karimvand,** University of Science and Culture, Iran | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1143-ODSIE2025 | Mustafa Berke; Ahmet Kabarcık; Syed Shah Sultan Mohiuddin Qadri | Enhancing Delivery Reliability Through Simulation-Based Production Time Estimation |
| 1176-ODSIE2025 | Demet Özgür Ünlüakın; Şimal Ekin Çağlar | Integrating HAZOP and Dynamic Bayesian Networks for Maintenance Optimization of Complex Systems |
| 1187-ODSIE2025 | Hossein Mokhtari; Kourosh Eshghi | Applications of Machine Learning Models in Multi-Criteria Decision-Making with Pairwise Comparisons |
| 1189-ODSIE2025 | Demet Özgür Ünlüakın | Probabilistic and Decision-Theoretic Approaches for Maintenance Optimization |
| 1016-ODSIE2025 | Meriam Ayari; Sonia Nasri; Hend Bouziri; Wassila Aggoune-Mtalaa | An Insertion Reasoning Approach based on Local Search |

| Date: **Friday, 21.11.2025**<br>Time:**10:45-11:30** | **Workshop** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Arshia Sahraeei & Yasna Yeganeh |
|---|---|---|
| Title:<br>***"AI and ML Driven Customer Analytics to Operational Optimization in Retail Industry"*** | | |
| Speaker:<br>**Mr. Abhi Desai**<br>Research Scholar — AI, ML, Data Science & Analytics<br>Former Lead Data Analyst at Saks Fifth Avenue, NY, USA | | |
| **Abstract:**<br>This workshop demonstrates how analytics and data science can transform retail operations by connecting customer insights to operational decision-making. Participants will explore how AI and ML techniques are applied to customer segmentation, lifetime value (LTV), lifetime revenue (LTR), and customer acquisition cost (CAC), and how these insights inform labor planning, shipping optimization, and inventory management. Real-world retail examples illustrate the end-to-end workflow, highlighting measurable improvements in efficiency, accuracy, and strategic decision-making. Attendees will gain practical guidance on leveraging AI and ML to bridge customer analytics and operational optimization, enabling them to drive tangible business impact in retail and beyond. | | |

| Date: **Friday, 21.11.2025**<br>Time:**11:30-12:15** | **Workshop** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Arshia Sahraeei & Yasna Yeganeh |
|---|---|---|

Title:

***"The k-Proportional t-Value in Big Boss Games: Bridging Game Theory, Artificial Intelligence, and Operational Research"***

Speaker:
**Dr. İsmail Özcan**
Department of Engineering for Industrial Systems and Technologies, University of Parma, Italy

**Abstract:**
This workshop explores the k-proportional t-value, a fresh perspective on how collaboration and influence can be modeled in complex organizations. Building on ideas from game theory, Artificial Intelligence (AI), and Operational Research (OR), this approach helps us understand how leaders and teams share value and make balanced decisions in hierarchical settings.
Rather than focusing purely on mathematical details, the session will emphasize how the k parameter introduces flexibility in distributing payoffs and maintaining fairness among players — especially in big boss games, where one dominant actor significantly shapes the group's success.
To make the discussion more engaging, participants will form small coalitions to simulate "big boss" decision-making scenarios and observe how different k values affect cooperation outcomes. An interactive visualization will illustrate how changes in proportionality impact fairness and stability, while a real-world case inspired by Amazon's AI teams developing personalized recommendation systems will show how data-driven cooperation can be analyzed through this framework.
By blending theory with practical examples and interactive exercises, the workshop demonstrates how the k-proportional t-value can inform smarter, fairer, and more adaptive decision-making in industrial operations, logistics, and AI-based organizations. Participants will leave with both conceptual insights and an intuitive sense of how hierarchical collaboration can be optimized.

| | | |
|---|---|---|
| Date: **Friday, 21.11.2025**<br>Time: **10:45-12:15** | Session Code: **OP05** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mobina Mostajabi & Yasin Bonyadi |
| Title:<br>***"Generative AI in Healthcare: Transforming Patient Care and Medical Innovation"*** | | |
| Panel Chair:<br>**Mr. Santosh Kumar,** HCLTech, Technical Lead (AI/ML), USA | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1009-ODSIE2025 | Parnian Rashidy; Maryam Ghorbani; Mohammad Jalal Nematbakhsh; Nader Rahnama | AI-Based Detection of Postural Anomalies for Sport Medicine and Physiotherapy: Comparative Deep Learning and Clinical Thresholding Approaches |
| 1107-ODSIE2025 | Zichun Chao and Jiahao Liu | Machine learning-based diabetes prediction model construction and analysis: a case study of the Kaggle diabetes dataset |
| 1021-ODSIE2025 | Abu Kausar; Abu Shahed Shah Md Nazmul Arefin; Mohidul Islam; Md. Salah Uddin; Kazi Jahid Ha-san; S M Monowar Kayser; Md.Shafikul Islam | Deep Transfer Learning for Rice Blast Disease Classification: A Multi-Model Comparative Study |
| 1115-ODSIE2025 | Jan Francisti; Kristián Fodor; Zoltán Balogh | Smartwatch-Based Heart Rate Tracking |
| 1124-ODSIE2025 | Jiaqi Han | ML-Driven Optimisation of Management Efficiency and Strategic Business Models in the Big Health Sector in the Digital Economy |

| Date: **Friday, 21.11.2025**<br>Time: **10:45-12:15** | Session Code: **OP19** | **Room 3:**<br>https://teams.microsoft.com/meet/36378593045888?p=Qma1WeOsxrMWsNeLPg<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |
|---|---|---|
| Title:<br>***"Data-Driven Governance, Organizational Performance & Digital Communication"*** | | |
| Panel Chair:<br>**Dr. Sita Ram Sharma,** Chitkara University, India | | |

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1049-ODSIE2025 | Mohammed Zuhair; Khalis Kadhim; Sarah Aamer Riyadh Abdulrahman; Adhraa Odah Hussan; Abdalfattah Sharad; Kyrylo Voronezhsk | Artificial Intelligence in Criminal Justice: Examining Legal, Ethical, and Social Impacts |
| 1052-ODSIE2025 | Saif Saad Ahmed; Ibrahim Khilel Khinger; Deena Waleed Hameed; Majid Fadhil Ziboon; Akram Fadhel Mahdi; Danylo Bohatyrov | Econometric and Computational Modeling of Corporate Governance and Firm Performance in Emerging Markets |
| 1058-ODSIE2025 | Baker Mohammed KhalilNabaa Latif; Muhamad Falih Hassan Al-Kanani; Khadijah Zuweid Khalif Mukhay; Nataliia Bodnar; Baker Mohammed Khalil; Liubov Zgalat-Lozynska | Computational Assessment of Gender-Inclusive Leadership as a Strategic Asset: Implications for Corporate Governance and Financial Performance |
| 1070-ODSIE2025 | Adnan Khaleel Kadhim; Mohammed Taqi Fadhil; Jasim Hameed Naseef; Ghazwan Salim Naamo; Thamer Kadum Yousif Al; Vasyl Matskovskyi | A Data-Driven Framework for Evaluating Non-Profit Sector Performance: Integrating Multidimensional Metrics and Stakeholder Engagement |
| 1073-ODSIE2025 | Sarah Salah Hadi; Jafaar Aqeel Al-Jomaily; Shahd Nasser Saadi Hassan; Nazar Habeeb Abbas; Intesar Abbas; Oksana Zghurska | Algorithmic Authority and Contractual Sovereignty: Legal and Social Implications of AI Negotiation Systems Across Jurisdictions |

| Date: **Friday, 21.11.2025**<br>Time:**13:30-15:00** | **Keynote Speech** | **Room 1**:<br>https://teams.microsoft.com/meet/3554736770092?p=VZ0RrDKIK7EaMQjQn5<br>Hosts: Arshia Sahraeei & Yasna Yeganeh |
|---|---|---|
| Title:<br>***"Digital Twins & XR for Translational Healthcare: From Simulation to Clinical Impact"*** | | |
| Keynote Speaker:<br>**Dr. Şenol Pişkin**<br>Istinye University, Türkiye | | |

**Abstract:**
Healthcare is entering an era where rich data streams, physics-based simulation, and immersive interaction converge to create patient-specific digital twins. In this keynote I will outline a practical roadmap for combining digital-twin models, XR-enabled visualization, and machine learning to accelerate diagnosis, surgical planning, and rehabilitation. I will present case studies from cardiovascular and neurorehabilitation domains that demonstrate how optimization and data-science methods (parameter estimation, model personalization, and predictive analytics) reduce uncertainty, improve intervention planning, and enable remote, clinician-in-the-loop workflows. Finally, I will discuss translational challenges — data governance, clinical validation, and integration with hospital systems — and propose opportunities where optimization and industrial engineering approaches can speed adoption and ensure robust, ethical deployment.

| Date: **Friday, 21.11.2025**<br>Time: **13:30-15:00** | Session Code: **OP13** | **Room 2:**<br>https://teams.microsoft.com/meet/37338956605998?p=dhPKIkcR8AR6TWSX2T<br>Hosts: Mobina Mostajabi & Yasin Bonyadi |
|---|---|---|

Title:

***"Smart Cities for a Sustainable Future: Optimization and Data Science Approaches"***

Panel Chair:

**Dr. Priyadarshani Singh,** School of Business Management, Noida International University, India
**Dr. Rashmi Manhas,** School of Business Management, Noida International University, India
**Dr. Mona Sharma,** School of Business Management, Noida International University, India

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1038-ODSIE2025 | Şule Şevval Karakaya; Vilda Purutçuoğlu; Ahmet Bursalı; Ekin Can Erkuş | Revealing Cyclic Dynamics in Electricity Consumption: A Hybrid Feature-Based Clustering Framework |
| 1044-ODSIE2025 | Mona Sharma; Priyadarshani Singh; Rashmi Manhas | Crisis-Resilient Learning and Smart Cities: An Empirical Approach to Smart Education Models for Sustainable Urban Futures |
| 1097-ODSIE2025 | Hakan Erdeş; Saadettin Erhan Kesen | A Metaheuristic Algorithm for Bi-Objective Speed and Load-Dependent Multi-Depot Electric Vehicle Routing Problem with Half-Open Rotations |
| 1138-ODSIE2025 | Engin Durmaz; Fatma Corut Ergin | Scalable Technician Dispatch with SLA Deadlines: Unified Path Extraction and Anchor-Based Partitioning |
| 1148-ODSIE2025 | Nilgün Beyza Yavuz; Aslı Ahsen Vurgun; Syed Shah Sultan Mohiuddin Qadri | Optimization of Portable Electric Vehicle Charging Station Deployment Using a Mixed-Integer Programming Approach |
| 1196-ODSIE2025 | Bahadır Alp Öner; Mutluhan Akçam; Mehmet Mert Baş; İrem Hamurcu; Muhammed Emin Altın; Sinem Özkan | Integrated Raw Material Segmentation and Periodic Review Inventory Control: A Case Study in an Electronic Manufacturing Company |

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|---|---|---|
| Date: **Friday, 21.11.2025**<br>Time: **13:30-15:00** | Session Code: **OP07** | **Room 3**:<br>https://teams.microsoft.com/meet/36378593045888?p=Qma1WeOsxrMWsNeLPg<br>Hosts: Mehrshad Jamshidipour & Zahra Norouzi Shad |

Title:

***"AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios"***

Panel Chairs:

**Dr. Ali Asghar Rahmani Hosseinabadi**, Department of Computer Science, University of Regina, Canada
**Dr. Navid Naghsh**, Department of Pharmacy, Shahid Sadoughi University of Medical Sciences, Iran
**Dr. Maryam Mohebbi**, Department of Psychology, Islamic Azad University Qazvin Branch, Iran
**Dr. Seyedsaeid Mirkamali**, Department of Computer Engineering and IT, Payame Noor University, Tehran, Iran

| Paper Code | Authors | Paper Title |
|---|---|---|
| 1006-ODSIE2025 | Maryam Mardani; Sara Mardani; Ali Asghar Rahmani Hosseinabadi | Prediction of Oral Squamous Cell Carcinoma Based on Deep Learning of Breath Samples |
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**Dr. Dhiraj Kumar Yadav,** Department of Agricultural Engineering, North Eastern Regional Institute of Science and Technology, Nirjuli, India
**Dr. Parveen Siwach,** Symbiosis Centre for Management Studies, Noida Campus, Symbiosis International (Deemed University), Pune, India

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| Keynote Speaker:<br>**Dr. Erfan Babaee Tirkolaee,** Istinye University, Turkey | | |

**Abstract:**
Efficient Waste Management (WM) is vital for environmental protection, public health, and resource conservation, especially as global waste generation is projected to reach 2.59 billion tons by 2030 and 3.4 billion tons by 2050. A well-designed Waste Management System (WMS) ensures the systematic collection, transportation, processing, and treatment of waste while minimizing ecological and human impacts. Rapid industrial and social growth has intensified resource consumption and amplified waste generation, prompting the need for comprehensive optimization approaches that reduce waste, maximize recycling and reuse, and ensure safe disposal. Recent advancements in digitalization and Artificial Intelligence have transformed industries under the Industry 4.0 (I4.0) paradigm; however, its limitations regarding social fairness, environmental protection, and resilience have accelerated the emergence of Industry 5.0 (I5.0). Integrating human-centricity, sustainability, and resilience, I5.0 offers promising opportunities for next-generation WMSs. Moreover, its strong synergy with Circular Economy (CE) principles (i.e., refuse, reduce, reuse, repurpose, and recycle) enables smarter, greener, and more adaptable solutions. Leveraging AI, IoT, and robotics, WM5.0 fosters efficient resource utilization, encourages end-of-life-focused product design, and enhances sustainable waste practices across the entire lifecycle.

# Abstracts Proceedings

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*OP01: Technology Integration & Digital Transformation: Smart Operations and Process optimization*

# Interpretable Deep learning for Early Diagnosis in Low-Resource Healthcare Settings

**Meenakshi Kaushik[1], Paras Mahajan[2], Md Sakif Uddin Khan[3], and Nishu Bansal[4]**

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## Abstract

Early diagnosis in low-resource healthcare environments is often hampered by limited access to qualified professionals and advanced diagnostic tools. In order to improve diagnostic accuracy and transparency, this study suggests an interpretable deep learning framework that combines explainability strategies like saliency maps, SHAP, and LIME with sophisticated neural network architectures. To make AI out- puts understandable to clinicians with different levels of expertise, the methodology uses a multi-stage pipeline that processes sparse, diverse medical datasets and produces concise, actionable explanations for each model decision. A thorough comparative analysis shows that interpretable models and a hybrid human–AI approach perform noticeably better than traditional deep learning and clinician-only diagnoses, resulting in in- creases in specificity, sensitivity, and accuracy. Incorporating explanatory outputs promotes practitioner trust, supports ongoing clinical capacity- building, and speeds up knowledge transfer among less experienced staff. These results highlight the potential of interpretable deep learning systems to provide safer and more equitable patient care, fill important gaps in early disease detection, and facilitate sustainable healthcare delivery in environments with limited resources. The suggested strategy lays the groundwork for the ethical and extensive use of AI-powered diagnostics that are suited for marginalized communities.

**Keywords:** Interpretable Deep Learning, Early Diagnosis, Low-Resource Healthcare, Explainable AI, Trust, Medical Imaging, Health Disparities.

*OP01: Technology Integration & Digital Transformation: Smart Operations and Process optimization*

# An Analysis of Metropolization and High Capacity National Network via Clustering in Argentina

**Mehmet Çağrı Kızıltaş**[1]

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**Abstract**

High-speed system and networks are the most significant dynamics of innovative transportation. It is a transportation approach that has a position between cities with high speed, high capacity, and high comfort. Also, it is an effective power of sustainable transportation policies that is related with intercity metropolization trends too. Metropolization is related to high speed, high capacity and high comfort advanced technology mobility. This mobility type enhances planned and livable city development. Metropolization is also connected with publicity, nationality and balanced national development. Regional plans and high metropolization are coordinated issues. In this paper, a cluster-based analysis was conducted for Argentina, by using population, gross domestic product, livability and similar parameters through statistical methods (K-means, PAM and CLARA) via R Studio program. Line proposals and metropolization trends were presented by taking into account the competitive operating distances of high-speed and distance for discrete urbanization. Results and suggestions were given in this context.

**Keywords:** Clustering Analysis, Urban, High Speed, Tourism, Economy.

*OP01: Technology Integration & Digital Transformation: Smart Operations and Process optimization*

# Defamation in the Age of Social Media: Legal Responses to Digital Reputation Crises

**Haider Abdulkareem Alobaidi[1], Zahraa Ghazi Sadiq[2], Rafid Ali Laftah Hamad[3], Hameed Salim Alkabi[4], Waleed Nassar[5,*], Dmytro Kocherev [6]**

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## Abstract

This study provides an integrated legal–statistical–technological analysis of social-media defamation. We combine (1) doctrinal comparative review (Indonesia ITE vs. selected U.S./EU standards), (2) an empirical appellate corpus of 45 decisions (2018–2024) and 120 expert interviews, and (3) computational experiments on 5,000 labeled social-media posts to benchmark defamation detection models. We apply $\chi^2$ tests to measure cross-jurisdictional enforcement variation, estimate a regression model of prosecution likelihood (jurisdiction type, political sensitivity, reputational-harm score), and evaluate ML pipelines (TF–IDF + BERT embeddings; SVM, Random Forest, Transformer fine-tuning) using stratified 5-fold CV. Key results: significant cross-jurisdictional disparities ($\chi^2$, $p < 0.001$), deep-learning pipelines reach F1 ≈ 0.90 (Precision 0.92, Recall 0.88) on held-out data, and a regression shows criminal regimes increase prosecution odds by $\beta \approx 0.34$ ($p<0.01$). We propose targeted policy reforms: narrow criminal provisions, adopt restorative-justice pathways for low-severity cases, and require human-in-the-loop AI with notice/appeal for platform takedowns. These findings demonstrate both the promise and limits of automated moderation when balanced with procedural safeguards.

**Keywords:** Social Media Defamation; AI Moderation; Comparative Law; Restorative Justice; Platform Due Process; Defamation Detection.

***OP01: Technology Integration & Digital Transformation: Smart Operations and Process optimization***

# Quantitative Modelling of AI-Driven Consumer Behaviour in Digital Economies

**ZhiAng Yu[1,*], Rexford Nii Ayitey Sosu[2]**

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## Abstract

This study presents an advanced quantitative framework for modelling AI-generated consumer behaviour within the rapidly evolving digital economy. As artificial intelligence (AI) increasingly shapes personalized recommendations, pricing strategies, and online engagement, understanding consumer responses to algorithm-driven platforms has become crucial for both businesses and policymakers. The proposed model integrates behavioural economics with machine learning to capture the dynamic patterns of consumer decision-making under algorithmic influence. Specifically, the framework employs an Agent-Based Modelling (ABM) approach combined with Reinforcement Learning (RL) techniques to simulate how consumers adapt their preferences and purchasing choices in response to real-time stimuli such as targeted advertisements, dynamic pricing, and social network effects. This hybrid model not only provides micro-level insights into individual behavioural adaptations but also connects them to macro-level market dynamics. The results demonstrate the framework's potential in predicting emerging consumption trends, guiding data-driven marketing strategies, and informing regulatory policies in AI-powered digital ecosystems.

**Keywords:** AI-Driven Consumer Behaviour, Digital Economy, Agent-Based Modelling, Reinforcement Learning, Behavioural Simulation.

***OP01: Technology Integration & Digital Transformation: Smart Operations and Process optimization***

# Digitization of an assembly station integrated into a learning 4.0 production line

**Khouloud Elloumi; Walid Chebbi**
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## Abstract

The digital transformation of manufacturing systems highlights the need for digitizing manual assembly stations, which remain critical in small-to-medium enterprises (SMEs) as well as in educational contexts. This paper presents the design and implementation of a smart manual assembly workstation equipped with a Pick-to-Light system, controlled by an ESP32 microcontroller and connected to an Android application and a central database. The workstation is integrated into a pedagogical assembly line (Learning Factory 4.0) that reproduces realistic industrial scenarios. The proposed architecture enables operator guidance, detailed traceability of operations, and real-time performance monitoring through a Power BI dashboard. Experimental validation demonstrates that the system improves task accuracy, reduces picking errors, and enhances local supervision. Beyond technical benefits, the platform offers a hands-on environment for students to interact with Industry 4.0 technologies and digital logistics practices. The contribution of this work lies in providing a cost-effective, modular, and scalable approach to integrating digitalization into manual assembly processes, addressing both training and industrial needs.

**Keywords:** Manual assembly workstation, Pick-to-Light system, Learning factory, Traceability, Performance monitoring, Industry 4.0.

*OP02: The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems*

# A Survey of Security and Privacy Challenges in Wireless Sensor Network Communications for the Internet of Things

**Nabeel Alassaf[1] , Selvakumar Manickam[1] , Ammar Odeh[2*], Mohammed Anbar[1]**

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**Abstract**

Wireless Sensor Networks (WSNs) form the backbone of the Internet of Things (IoT), enabling a wide spectrum of applications such as smart metering, environmental monitoring, industrial automation, and healthcare services. Despite their critical role, WSNs remain highly vulnerable due to their resource-constrained nature, reliance on open wireless channels, and frequent operation in unattended environments. These characteristics expose them to a wide range of security and privacy risks that threaten the reliability and trustworthiness of IoT ecosystems. This paper presents a comprehensive survey of communication-level vulnerabilities and corresponding defense mechanisms in WSN-enabled IoT. We systematically review key protocols, including IEEE 802.15.4, ZigBee, 6LoWPAN, and Bluetooth Low Energy, identifying their inherent weaknesses and mapping them to common attack vectors such as eavesdropping, replay, wormhole, and Sybil attacks. We classify countermeasures into lightweight cryptography, key management, secure routing, intrusion detection, and privacy-preserving aggregation. Comparative analysis and case study evidence are provided to evaluate performance trade-offs between security strength, resource consumption, and privacy guarantees. Our findings highlight that lightweight mechanisms can provide meaningful protection within constrained environments but leave open challenges regarding post-quantum resilience, AI-driven intrusion detection, and regulatory compliance. The survey concludes with a roadmap for advancing secure, privacy-preserving WSN communications to enable sustainable IoT adoption.

**Keywords:** Internet of Things (IoT), Wireless Sensor Networks (WSNs), Security, Privacy, Lightweight Cryptography, Intrusion Detection.

*OP02: The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems*

# Quantum-Enhanced Federated Learning: Pushing the Boundaries of Privacy and Speed in Distributed AI

**Kirti[1], Charu Sood[2], Shubneet[3], Anushka Raj Yadav[4], Subhash Kumar Verma[5*], and Navjot Singh Talwandi[6]**

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## Abstract

Quantum-enhanced federated learning (QFL) represents a cutting-edge paradigm that integrates quantum computing and quantum communication technologies with federated learning to address emerging challenges in distributed artificial intelligence. This chapter presents a comprehensive framework combining variational quantum circuits, quantum- safe cryptographic protocols, and privacy-preserving aggregation mechanisms to improve model accuracy, enhance communication efficiency, and accelerate convergence speed. Extensive experiments on both classical and quantum datasets demonstrate QFL's superiority over classical federated and centralized quantum models, achieving up to 50% reduction in communication overhead and faster training convergence. Security analyses confirm robust privacy guarantees against classical and quantum adversaries through quantum key distribution and post-quantum secret sharing. The methodology addresses practical challenges such as hard- ware heterogeneity, non-IID data, and network scaling using adaptive model personalization, hierarchical aggregation, and compressed parameter transmission. Nonetheless, limitations related to noisy intermediate- scale quantum (NISQ) devices, hardware scalability, and protocol complexity persist. This discussion highlights the current state and future directions of QFL, emphasizing the necessity of interdisciplinary advances in quantum engineering, machine learning, and cryptography for realizing secure, scalable, and efficient distributed AI in the quantum era.

**Keywords:** Quantum Computing · Federated Learning · Privacy-Preserving Machine Learning · Quantum Cryptograph · Distributed Artificial Intelligence.

*OP02: The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems*

# Analysing the Strategic Impact of Artificial Intelligence-Generated Content (AIGC) Using Machine Learning Models: Value Realisation in Corporate Management

**Jiaqi Han**[1]

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**Abstract:**

The strategic implications of Artificial Intelligence-Generated Content (AIGC) in corporate management remain underexplored, particularly from a data-driven, predictive perspective. While AIGC technologies are increasingly adopted to enhance productivity, engagement, and decision-making, there is limited empirical evidence quantifying their impact on corporate value realisation. Addressing this research gap, the present study develops a simulation-based framework to model AIGC adoption and its effects on key organisational performance indicators using supervised machine learning. Synthetic corporate data were generated to reflect varying levels of AIGC integration, and multiple machine learning models, including Random Forest, XGBoost, Support Vector Regression, and Logistic Regression, were applied for both prediction and classification. The Random Forest Regressor achieved the best performance with an RMSE of 5.06 and an MAE of 4.11, while Logistic Regression achieved 72% accuracy and 0.79 recall in classifying firms by high or low value realisation. These results demonstrate that even in the absence of real-world data, simulation-driven ML analysis can provide meaningful strategic insights. The study contributes a novel, replicable approach for organisations and researchers to assess AIGC's strategic value using synthetic data and predictive analytics. It is recommended that corporate decision-makers leverage interpretable ML models to guide digital transformation initiatives. However, findings are limited by the use of simulated data and should be validated against real corporate environments in future research.

**Keywords:** Artificial Intelligence-Generated Content (AIGC), Machine Learning, Value Realisation, Corporate Strategy.

*OP02: The Role of Machine Learning in Predictive Cybersecurity for Industrial Systems*

# Sovereignty in the Digital Age: Social, Legal, and Governance Challenges of Global Networks

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## Abstract

In the era of digitalization, the existing doctrine of state sovereignty faces unprecedented tests as cross-border data flows, platform-mediated governance, and transnational cybersecurity threats continue to reshape territorial boundaries of jurisdiction. Traditionally, state sovereignty has been defined by territorial authority and exclusive legal control, yet digital infrastructures increasingly challenge this classical foundation. The article explores whether traditional understandings of sovereignty, tied to territorial possession and unilateral imposition, can be reintegrated into digital informational contexts. The performance of botspot in ten countries from 2019–2024 is evaluated through a five-dimensional framework: jurisdictional reach, governance model profiling, regulatory interaction with digital platforms, cyber-enforcement resilience, and international legal convergence. The evidence suggests that sovereignty remains practically possible, but increasingly dependent on coordination, institutional flexibility, and harmonization rather than absolute control or strict data-localization mandates.In contrast, states that are hybrid-legalist—those with judicial clarity, multilateral cooperation, and specialized digital oversight—show enforcement as strong as, or stronger than, clearly centralized regimes. Sound cyber governance relies not only on technical capability but also on cross-sector cooperation and international coordination. Specific successes in platform regulation are associated with regulatory accuracy and fiscal unification rather than coercive force. Participation in international legal frameworks strengthens, rather than weakens, domestic sovereignty by enabling mutual enforcement and greater normative power. The article concludes that flexible, network-aware regulatory designs provide the most effective pathway for protecting public authority in a world of distributed, fluid, and rapidly changing digital infrastructures.

**Keywords:** Digital sovereignty; Transnational jurisdiction; Cybersecurity governance; Platform regulation; Legal harmonization; State–platform relations.

*OP03: Industry 6.0, Emerging Technologies and Sustainable Development*

# GeneArcana: Solution for Investigating Measles Susceptibility Candidate Genes on a Global Scale by Integrating Genomic Databases

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**Abstract.**

Measles is a highly infectious disease caused by Morbillivirus genus and the Paramyxoviridae family. This disease continues to pose a major public health concern despite decades of vaccination efforts because it can cause death. The virus carries a non-segmented, negative-sense RNA genome and spreads solely among humans, primarily through respiratory droplets, with secondary attack rates in susceptible close contacts often exceeding 90%. The disease remains widespread throughout the world, with the highest impact in Africa and Southeast Asia, and causes around 100,000 deaths annually. Although vaccination has prevented millions of deaths, measles-related fatalities persist, highlighting the need for improved elimination strategies. This study applies a bioinformatics approach by using Principal Component Analysis or PCA to create a solution called GeneArcana to investigate genetic variations and analyze measles from a geographic and genomic viewpoint. The result shows Single Nucleotide Polymorphisms or SNPs have similar patterns of susceptibility to measles across diverse ethnicities. Authors hope the solution can provide useful information to design more effective vaccine implementations.

**Keywords:** Measles, Gene, Genomic, Bioinformatic, Population, PCA.

*OP03: Industry 6.0, Emerging Technologies and Sustainable Development*

# Optimisation framework for environmental risk assessment of blockchain technologies

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## Abstract

Blockchain technologies have emerged as major enablers of digitalisation, yet their rapid expansion has raised serious environmental concerns. Bitcoin mining consumed approximately 121 TWh of electricity in 2023 and is projected to exceed 130 TWh in 2025, generating average annual emissions of about 40 Mt $CO_2$e and producing substantial electronic waste through accelerated hardware turnover. Despite multiple studies quantifying the environmental footprint of blockchain, existing assessments – mainly based on life-cycle analysis or economic estimation – remain descriptive and fragmented, lacking a coherent structure for environmental risk classification and optimisation.This study introduces, for the first time, an optimisation-based Environmental Risk Assessment (ERA) framework specifically designed for blockchain technologies. The framework defines five core ecological dimensions – energy use, greenhouse-gas emissions, material intensity, cooling requirements, and electronic waste – and employs a consequence–probability matrix to classify risk levels across technological and geographical scenarios. Scenario modelling compares four technological pathways: Proof-of-Work on fossil-heavy grids, Proof-of-Work on renewables-rich grids, Proof-of-Stake (PoS), and permissioned distributed-ledger technologies (DLTs). International case studies, including the United States, Kazakhstan, Iceland, and Hyperledger Fabric pilots, illustrate how regional energy mixes and operational conditions influence risk outcomes. The results demonstrate that Proof-of-Work under fossil-intensive conditions represents a critical environmental risk, whereas Proof-of-Stake and permissioned architectures substantially mitigate energy and emission impacts. The proposed ERA methodology provides a structured approach for assessing and optimising ecological risks of blockchain technologies and for supporting evidence-based decision-making. It can also serve as a foundation for the development of new blockchain systems, infrastructures, and services sustainable by design.

**Keywords:** Blockchain, Sustainability, Environmental Risk Assessment, Optimisation Framework, Proof-of-Work, Proof-of-Stake.

*OP03: Industry 6.0, Emerging Technologies and Sustainable Development*

# An Analysis of Metropolization via Clustering in Venezuela and Its Periphery for Transportation Efficiency

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## Abstract

Venezuela has a central location in South America that connects Iber America to Mexico and USA. It has a big population and large area with its neighbors and periphery. Venezuela is a very rich country in terms of naturel sources like oil, gold and natural gas. The geo strategical point of the country has a very high importance according to accessibility, transportation, metropolitan trends and military bases. The country provides a naturel gateway from north to south at the continental point. Urbanization and transportation are focus issues for regional integration. Metropolization is related to high speed, high capacity and high comfort advanced technology mobility. This mobility type enhance planned and livable city development. Metropolization is also connected with publicity, nationality and balanced national development. Regional plans and high metropolization are co-ordinated issues. Advanced technology is supporter of sustainability, inter modality, high level of service and urbanization. In this paper, a cluster-based analysis was conducted for Venezuela and its peripherals, which has not yet entered high-speed trains, using population and development parameters through cluster statistical methods. Metropolization trends and high capacity network were examined and presented by taking into account distances among emerging cluster cities, and results and suggestions were given in this context.

**Keywords:** Clustering Analysis, Urban, Metropolization, Tourism, Economy.

*OP03: Industry 6.0, Emerging Technologies and Sustainable Development*

# A MILP-Based Framework for Sustainable and Service-Aware Dairy Vehicle Routing under Cold Chain Constraints

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## Abstract

This study presents a mixed-integer linear programming (MILP) model for the Sustainable and Service-Aware Dairy Vehicle Routing Problem (SS-DVRP). From a single depot, three refrigerated vehicles serve ten customers under customer time windows, vehicle load and refrigeration capacities, and a network-wide $CO_2$ emissions cap. The objective minimizes a composite cost of transportation cost, service-delay penalties, undelivered or spoilage penalties, and emissions, making the trade-offs among service, cost, and emissions visible in cold-chain operations. In addition, we conduct a 3×3×3 full-factorial experiment (27 scenarios) on three parameters: vehicle refrigeration capacity ($R_k$), service-delay penalty ($g_i$), and maximum route length ($Dmax_k$). Using heatmaps and main-effect plots together with eta-squared (η^2) analysis, we quantify how these inputs affect the total objective value, transport cost, and minimum waste. The results show that $g_i$ has a clearly large effect on both the objective and minimum waste, $R_k$ has a small but non-negligible effect (including on transport cost), and $Dmax_k$ remains relatively negligible within the tested range. With this integrated approach, SS-DVRP provides a practical decision-support framework that can improve on-time delivery and product integrity while keeping environmental impact under control.

**Keywords:** Vehicle Routing; Cold-Chain Logistics; Time Windows; MILP; Emissions Cap; Service Penalties; Sustainable Distribution; Effect-Size (η^2) Analysis; Full-Factorial Design

*OP04: AI-Driven Autonomy: Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance*

# Scientific Landscape of Telemedicine and Digital Healthcare: A Bibliometric Approach to Research Dynamics (2012-2025)

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## Abstract

This study examines the scientific progression and research trends in telemedicine and digital healthcare from 2012 to 2025 using a bibliometric approach. A total of 122 English-language documents were retrieved from the Scopus database, using the keywords “telemedicine” and “digital healthcare.” The analysis was conducted through Biblioshiny (R package), following a five-phase bibliometric framework involving data collection, analysis, visualization, interpretation, and discussion. Key bibliometric techniques such as co-authorship, co-citation, and keyword co-occurrence analyses were applied to map the research landscape. The findings show a steady increase in scholarly output, with noticeable publication peaks in 2021 and 2024. Approximate 48% research was conducted after 2020. Most research belongs to the domains of medicine, health professions, and nursing. The United States led in contributions, followed by India and the United Kingdom. Frequently used keywords included “telehealth,” “digital health,” “remote monitoring,” and “artificial intelligence.” Thematic mapping and collaboration networks revealed global partnerships and emerging research clusters. While limited to English-language, Scopus-indexed articles, the study offers a comprehensive overview of the field’s development. It captures the post-pandemic surge in interest and technological integration, offering valuable insights for researchers, policymakers, and practitioners seeking to understand evolving trends in digital healthcare.

**Keywords:** Telemedicine, Digital Healthcare, Remote Monitoring, Artificial Intelligence, COVID-19 Pandemic.

*OP04: AI-Driven Autonomy: Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance*

# AI-Driven Managerial Strategy and Institutional Readiness: Social Science Insights into Data-Centric Transformation

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## Abstract

With the exponential growth of data and computational power, organizations are increasingly adopting data-driven decision-making (DDDM) to enhance strategic agility, operational efficiency, and managerial precision. This study empirically investigates how the adoption of DDDM improves decision quality, performance metrics, and organizational outcomes across five key industry sectors, finance, healthcare, manufacturing, retail, and telecommunications, using a mixed-methods explanatory design. Based on structured surveys, multi-year panel data, and predictive model validation, it examines the combined effects AI utilization, data completeness, and managerial adaptability on decision performance. Findings reveal that decision quality, cost-effectiveness, and operational speed improve most significantly when high data quality is paired with employee readiness for AI. Sectoral comparisons show that industry-specific characteristics, particularly investment intensity and immediacy of benefits, moderate the rate and scale of benefit realization. The proposed Decision Optimization Score (DOS) integrates four key dimensions: AI exposure, data readiness, workforce adaptability, and decision-cycle speed. Empirical evidence indicates that balanced investment across these levers yields superior firm performance compared to focusing on a single factor. The study concludes that successful DDDM implementation depends not only on technological advancement but also on human and institutional readiness, offering pragmatic insights for leaders pursuing scalable and sustainable analytics transformation.

**Keywords:** Data-Driven Decision-Making, AI Integration, Decision Optimization, Organizational Adaptability, Analytics Governance, Operational Efficiency.

*OP04: AI-Driven Autonomy: Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance*

# Cognitive Automation and Consumer Experience: Socio-Legal Dimensions in Textile Retail Innovation

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## Abstract

The advent of blockchain technology has brought about a sea change in the legal domain, with smart contracts posing a fundamental challenge to traditional contract law. This article analyzes the volatile interface between blockchain smart contracts and legacy legal systems through a comparative, multidisciplinary perspective. Evaluating ten jurisdictions and different blockchain platforms, the study proposes a systematic, computational framework using five indices: The Legal Compatibility Index (LCI), Smart Contract Efficiency Score (SCES), Regulatory Readiness Coefficient (RRC), Fuzzy Composite Literacy Index (FCLI), and Hybrid Arbitration Efficacy Index (HAEI). These indices measure preparedness and success in terms of legal, technical, and institutional capabilities. The results indicate that jurisdictions like Singapore and the USA are leading in legal adoption through preemptive laws, while systems with established statutory rigidity face challenges in enforcing smart contracts. Performance experiments demonstrate high variation in transaction throughput and auditability across blockchain systems. Crucially, hybrid arbitration models, which integrate institutional enforceability with smart contract logic, prove superior for dispute resolution compared to fully decentralized forms. The findings highlight the necessity of coordinated legal reform, stakeholder education, and process innovation to establish blockchain as a legally viable infrastructure. This study presents a rigorous, replicable model to evaluate blockchain adoption in contract law, providing strategic guidance for policymakers, legal scholars, and technologists.

**Keywords:** Smart Contracts; Blockchain Law; Legal Harmonization; Dispute Resolution; Contract Enforcement; Digital Infrastructure.

*OP04: AI-Driven Autonomy: Revolutionizing Customer Self-Service with Intelligent, Real-Time Assistance and Predictive Guidance*

# Digital Influence and Strategic Communication in the Global Information Order: Insights from Social Media Marketing Ecosystems

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## Abstract

The rise of social media has transformed traditional marketing paradigms, offering unprecedented opportunities for audience targeting, content dissemination, and consumer engagement. This study investigates how marketing strategies have evolved in the digital era by analyzing the effectiveness of content formats, influencer tiers, and platform-specific dynamics. Using a multi-method approach, the research combines structured surveys, platform analytics, and experimental campaign tracking across Facebook, Instagram, Twitter/X, LinkedIn, TikTok, and YouTube. Key metrics include engagement rate, click-through rate, conversion rate, return on ad spend, audience growth, sentiment analysis, and user session behavior to assess the depth and quality of user interaction. The findings highlight the effectiveness of short-form video and the cost efficiency of micro-influencer campaigns, where platform fit and customization emerged as strong predictors of conversion. The results further indicate that success in digital marketing arises not from isolated tactics but from the strategic integration of content format, duration, and influencer selection. Employing multilevel modeling and negative binomial regression on a large-scale dataset, the study underscores the complexity of user behaviors in today's digital environment and provides empirically grounded recommendations for optimizing campaign effectiveness.

**Keywords:** Social Media Marketing, Influencer Strategy, Digital Content Performance, Audience Engagement, Conversion Optimization, ROI Analysis.

*OP05: Generative AI in Healthcare: Transforming Patient Care and Medical Innovation*

# AI-Based Detection of Postural Anomalies for Sport Medicine and Physiotherapy: Comparative Deep Learning and Clinical Thresholding Approaches

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## Abstract

Postural anomalies are a significant concern in sports medicine and physiotherapy, as they can contribute to musculoskeletal disorders and reduced athletic performance. In this paper introduces an Artificial Intelligence (AI)-based framework for automated detection of postural deviations using computer vision and Machine Learning (ML) techniques. The proposed approach integrates feature extraction from depth images with classification algorithms to evaluate spinal alignment and joint positioning. Comparative experiments were conducted using both conventional classifiers and Deep Learning (DL) models on a dataset of annotated postural images. The results demonstrate that the proposed model achieves superior accuracy and robustness compared to baseline methods, highlighting its potential for practical application in clinical and sports environments. Importantly, the system provides an objective, non-invasive, and rapid assessment tool that supports physiotherapists and sports practitioners in early anomaly detection and personalized intervention planning. This research contributes to the growing field of AI-driven healthcare by bridging the gap between clinical expertise and computational methods. Future work will focus on expanding the dataset with more diverse postural conditions and integrating the system into real-time monitoring applications.

**Keywords:** Postural Anomalies, Deep Learning, Convolutional Neural Networks, Sports Medicine, RGB Image Analysis, AI-Driven Diagnostics.

*OP05: Generative AI in Healthcare: Transforming Patient Care and Medical Innovation*

# Machine Learning-based Diabetes Prediction Model Construction and Analysis: A Case Study of the Kaggle Diabetes Dataset

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## Abstract

This study presents a machine learning-based framework for diabetes prediction using the Kaggle Pima Indian Diabetes dataset. The research integrates Random Forest, Synthetic Minority Oversampling Technique (SMOTE), and SHAP (SHapley Additive exPlanations) to improve predictive accuracy, interpretability, and class balance. After comprehensive data cleaning and feature engineering, including the creation of medically informed interaction variables, six supervised algorithms were compared. Random Forest demonstrated the best performance (AUC = 0.91), effectively capturing nonlinear relationships and providing clinically interpretable insights. SHAP analysis identified glucose, BMI, and family history as dominant predictors, aligning with known pathophysiological mechanisms. The proposed model's interpretability and robustness make it suitable for clinical decision support and real-time mobile health applications. This study contributes to bridging the gap between algorithmic performance and clinical usability while highlighting the importance of balanced, transparent, and scalable approaches for early diabetes risk prediction and personalized healthcare management.

**Keywords:** Diabetes prediction, Machine learning, Random Forest, SMOTE, Feature engineering

*OP05: Generative AI in Healthcare: Transforming Patient Care and Medical Innovation*

# Smartwatch-Based Heart Rate Tracking

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## Abstract

The integration of wearable devices into computing environments represents a significant advancement in digital healthcare and fitness monitoring. This paper presents the design and implementation of a lightweight system for real-time acquisition and processing of heart rate data from Samsung Galaxy smartwatches running WearOS. The solution consists of two applications: a Kotlin-based application on the smartwatch for sensor data collection and a Python-based application on the computer for data reception, visualization, and storage using the Firestore cloud platform. Experiments confirmed that the system operates reliably in real-world conditions, achieving end-to-end latency below 200 ms, mean absolute percentage error (MAPE) below 5% across resting, walking, and jogging activities, packet loss under 2%, and battery consumption of approximately 3–4% per hour. These results demonstrate that the system provides both accurate and efficient monitoring while maintaining low complexity and resource requirements. The contributions of this work include seamless PC integration without requiring a smartphone intermediary, real-time cloud synchronization, and user-friendly visualization and export functionalities. While the current implementation is limited to heart rate monitoring and one smartwatch model, it highlights the potential of wearable–cloud integration for scalable health monitoring solutions. Future directions involve extending support to additional sensors and devices, improving energy efficiency, enhancing security mechanisms, and conducting multi-user and clinical evaluations. This study demonstrates that combining WearOS devices with cloud services can enable practical, lightweight, and scalable health monitoring systems applicable in personal fitness, elderly care, and clinical healthcare contexts.

**Keywords:** Wearable devices, Smartwatches, Heart rate, Biometric data, Digital healthcare

*OP05: Generative AI in Healthcare: Transforming Patient Care and Medical Innovation*

# ML-Driven Optimisation of Management Efficiency and Strategic Business Models in the Big Health Sector in the Digital Economy

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**Abstract**

The growing complexity of healthcare management in the digital economy has heightened the need for intelligent, data-driven approaches to enhance operational efficiency and strategic decision-making. This study presents a machine learning (ML)-driven framework for optimising management efficiency and forecasting cost savings in the Big Health sector using simulation-based data. The research adopts a quantitative experimental methodology, implementing four advanced ML models, Random Forest, Support Vector Machine (SVM), XGBoost Regressor, and Linear Regression, developed and executed in Python (Google Colab). Simulated data representing healthcare operations were generated to address real-world constraints around data accessibility and privacy. The Random Forest classifier achieved a high accuracy of 99.67% and an F1 Score of 0.994 in identifying efficient management practices. For predictive analysis, XGBoost outperformed Linear Regression with an RMSE of 1173.41 and an MAE of 933.44 in forecasting future cost savings. The results confirm that ensemble ML models trained on realistic, simulation-based datasets can significantly support strategic decision-making in healthcare environments. This study recommends the use of ML-simulation pipelines as decision-support tools, offering practical implications for digital health management. However, the reliance on synthetic data presents limitations, calling for future validation with real-world datasets.

**Keywords:** Machine Learning, Health Management, Simulation, Strategic Optimisation, Predictive Analytics.

*OP06: E-Government, E-Commerce, and E-Learning*

# Introducing Adaptive Student Evaluation and Feedback Systems for English Language Learning

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**Abstract**

In recent years, traditional English learning assessment methods have struggled to provide timely, personalized feedback that supports learner motivation and engagement. This limitation has generated growing interest in adaptive feedback systems that integrate data-driven evaluation with individual learning trajectories. However, the existing literature lacks large-scale empirical studies that validate such adaptive systems in authentic classroom settings, especially in higher education contexts.To address this gap, this study develops and evaluates an Adaptive Student Evaluation and Feedback System (ASEFS) designed to enhance learners' English proficiency through continuous, automated feedback. Using data from 250 university students divided into control and experimental groups, we conducted correlation, regression, and Wilcoxon signed-rank analyses. The findings reveal that student engagement, learning strategies, and motivation significantly predict proficiency ($R^2 = 0.905$, $p < 0.001$), with post-intervention gains of over 10 points in the experimental group. The study contributes a novel, empirically validated framework demonstrating how adaptive evaluation can outperform conventional methods by fostering self-regulated learning and sustained performance improvement.

**Keywords:** Adaptive Learning Systems, English Language Proficiency, Student Engagement.

*OP06: E-Government, E-Commerce, and E-Learning*

# Incorporating Adaptive Feedback and Dynamic User Profiles into Personalized Learning Resource Recommendations with Large Models

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**Abstract**

This work presents a novel system that connects dynamic user profiles and adaptive feedback with language models, thereby rectifying the limitations of the usual recommendation systems currently deployed. The design will incorporate Retrieval-Augmented Generation (RAG) that customizes the retrieval step so that the content available in the domain is of an academic nature and that the answers are always straightforward and will suit new as well as seasoned researchers. In contrast to normal two-module splicing, our design pulls user modelling and retrieval layers nearer together, learning to automatically update profile information in real time. Along with that, we also established feedback loops, which enhance user embeddings based on the quality of the interaction experience and the degree of comprehension of the topics by the user. The framework applies constraints based on the particular academic fields, the extent and strength of the knowledge that people possess, which is not generic to typical generic recommendation algorithms. We tested the model on numerous experiments with known data sets and compared it to three alternative models. According to the researchers, the model increased the accuracy of recommendations, the quality of personalization, and user satisfaction. Furthermore, ablation studies have made it evident that failure to follow the proper design of the adaptive feedback loop or to properly lay out the fusion modules results in significantly worse performance. It proposes a versatile and intelligent answer to the suggestion of academic materials, a combination of technological and practical advantages of personal study.

**Keywords:** Adaptive Feedback, Personalized Recommendation, Retrieval-Augmented Generation, Academic Resource Recommendation, User Profiling.

*OP06: E-Government, E-Commerce, and E-Learning*

# Enhancing College English Translation Teaching with AI-Assisted Error Detection and Correction Tools

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**Abstract**

As the significance of English translation training in multilingual higher education grows, the introduction of well-developed AI technologies can offer a reasonably good opportunity of improving the outcomes on the side of learners. The paper presents a novel AI-advised model, which permits enhancing the learning of English translation within the frames of college education, which refers to the specially created Bidirectional Error Prediction and Correction Network (BEPC-Net). BEPC-Net is simply a trained education-based model which employs two attention paths and the contextual embedding layers to identify and correct errors in translations completed at all levels of grammar, lexical and semantic levels. An experimental setting has been applied to the system in a college translation course where students were supposed to work with the tool and get instructions of the instructors. Evaluation measures, i.e. precision, recall, accuracy of corrections revealed that BEPC-Net exhibited superior performance compared to the traditional grammar-checking software in the case of idiomatic phrases and domain-specific vocabulary. There was a significant improvement in the performance, regarding translation fluency and structural diversity, which can be explained by the survey feedback data that demonstrates the improved confidence and engagement. The system that is also suggested in this paper does not only automate the detailed feedback but also maintains formative assessment, which reveals the error pattern of the learner in due time. The strength and applicability of BEPC-Net in actual classroom contexts is further justified by an independent assessment with the help of baseline tools and key performance measures.

**Keywords:** English Translation, AI in Education, BEPC-Net, Error Correction, Language Pedagogy.

*OP06: E-Government, E-Commerce, and E-Learning*

# Exploring the Impact of ChatGPT on EFL Learners' Lab Report Writing: A Comparative Study

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## Abstract

The present paper analyzes the impact of ChatGPT on instructing EFL students in writing lab reports by English as a Foreign Language (EFL) students taking engineering courses. Since artificial intelligence technology stands to be a thorn in the side of EFL learners particularly when technical courses are being contracted, the paper aimed at evaluating how the use of artificial intelligence technology can assist in enhancing orderly, structured and well references writing. It employed the quasi-experimental design, and two groups were chosen; one of them was taught according to the standard pattern, and the other group took working on ChatGPT to write the text. Coh-Metrix was used to analyze the written outputs and its results give intricate measures of cohesion in text, syntactic diversity, lexical complexity, and readability of the said tool. Routine assignments and feedbacks were applied where the intervention were carried out within six weeks. Along with the quantitative analysis, structured interviews and reflective journals were used to assess their reflections and perceptions, which was a method of assessing engagement, feeling of confidence and independence. The conclusions are intended to inform the pedagogists and curriculum creators in EFL about the prospects and limitations of pedagogy related to the use of writing assistants on the basis of AI. This paper suggests to find a compromise according to which ChatGPT should be used as a scaffold towards facilitating critical thinking, learning a language, and skills in regard to different genres in terms of writing science.

**Keywords:** ChatGPT, EFL writing, lab reports, Coh-Metrix, academic English.

*OP06: E-Government, E-Commerce, and E-Learning*

# AI-Powered Personalized Blended Learning Based on Learning Styles and the Community of Inquiry Framework

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## Abstract

The paper suggests a novel process-Adaptive Learning Style Inference with reinforcement-enriched ontology mapping (ALSIREOM), that is to drive the AI assistive-powered personalization of Immersion blended learning environments. The provided model dynamically varies the teaching material and the manner of interactions with the learners upon in-real-time inference of the need of cognitive, social and teaching presence of the learners along with the modes of preferred learning styles. The ALSIREOM system leverages fuzzy logic to model learners' styles—drawing on frameworks such as VARK and Felder-Silverman—and integrates this with an ontology-based content classification framework that is continuously trained using reinforcement learning. The key contributions of the study include the following (1) it is practical to come up with an AI-powered personalization engine and learn the dynamics of learners preferences, (2) to maintain a healthy balance between the virtual and real worlds, Concepts of CoI need to be integrated and (3) the case study of undergraduate studies involving learners of STEM subjects demonstrates that the proposed personalization engine is feasible in aspects of enjoyment and performance.

**Keywords:** Personalized Learning, AI in Education, Community of Inquiry, Learning Styles, Reinforcement Learning.

*OP07: AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios*

# Prediction of Oral Squamous Cell Carcinoma Based on Deep Learning of Breath Samples

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## Abstract

Oral Squamous Cell Carcinoma (OSCC) is one of the most common and aggressive malignancies in the oral cavity, often diagnosed at advanced stages, resulting in poor prognosis and high mortality rates. Recently, Deep Learning (DL), a subset of Artificial Intelligence (AI), has shown remarkable capabilities in analyzing complex medical data, particularly in medical imaging. This paper investigates the potential of DL models for predicting OSCC using histopathological images, radiological data, and clinical information. Convolutional Neural Networks (CNNs) have been widely employed to extract critical features from tissue images and have demonstrated promising performance in tumor classification, staging, and prognosis prediction. Despite these advancements, challenges such as the requirement for large, annotated datasets, overfitting risk, and lack of model interpretability remain significant. Integrating DL with domain expertise, leveraging transfer learning techniques, and developing hybrid models may pave the way for more accurate and early detection of OSCC, ultimately improving patient outcomes. This study introduces a DL based framework for the prediction of OSCC using histopathological images, radiological scans, and clinical information. The proposed CNN–BiLSTM architecture with an integrated attention mechanism captures both spatial and sequential dependencies across multimodal datasets. Unlike previous studies that rely solely on single-modality data, our method introduces a novel integration strategy that improves predictive accuracy and interpretability. Experimental results demonstrate that the framework achieves 95.7% accuracy, 94.3% sensitivity, and 96.5% specificity, significantly outperforming conventional baselines. These findings highlight the originality of our approach and its potential contribution to advancing real-world diagnostic support systems.

**Keywords:** Oral Squamous Cell Carcinoma, Deep Learning, Convolutional Neural Networks, Medical Image Analysis, Early Cancer Detection, Disease Prediction

*OP07: AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios*

# Data-Driven Assessment of Healthcare Institutions: A Combined Bayesian BWM, MAIRCA, and Boosted Decision Tree Regression

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## Abstract

Healthcare systems are increasingly complex. Evaluating hospital performance is now a strategic necessity to ensure accountability, efficiency, and better patient outcomes. Traditional expert-based methods, while valuable, often suffer from subjectivity, high time costs, and a lack of scalability. This study presents a novel hybrid framework. It integrates Bayesian Best-Worst Method (BBWM), Multi Attributive Ideal-Real Comparative Analysis (MAIRCA), and Boosted Decision Tree Regression (BDTR) to create a transparent, data-driven, and predictive hospital evaluation model. Initially, eight key performance indicators were selected and weighted using BBWM to reflect expert preferences under uncertainty. MAIRCA was then employed to calculate performance scores by comparing hospitals' actual performance to an ideal reference point. These scores were used to train the BDTR model, allowing for accurate performance prediction based solely on input indicators. The proposed method was applied to data from 250 Iranian hospitals. Results showed that the BDTR model achieved high predictive accuracy, with an $R^2$ of 0.697 and a Mean Absolute Error (MAE) of just 0.090. Feature importance analysis highlighted that financial efficiency, operational costs, and bed utilization were the strongest predictors of hospital performance. Compared to traditional Decision Tree (DT) models, the boosting technique improved prediction accuracy by over 10.8%, and it also outperformed Random Forest (RF) and Extreme Gradient Boosting (XGBoost) by 3.5% and 1.6%, respectively. The proposed model supports scalable performance monitoring and benchmarking, and the case study demonstrates its practical viability for health policymakers and hospital administrators seeking to implement evidence-based evaluation systems.

**Keywords.** Hospital Performance Evaluation, Bayesian Best-Worst Method, Boosted Decision Tree Regression, MAIRCA, Multi-Criteria Decision-Making, Performance Prediction.

***OP07: AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios***

# The Use of X-ray Image Processing in the Diagnosis of External Defects of Tires

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## Abstract

Industrial defect detection has become an indispensable task in advanced manufacturing systems, as it directly influences product reliability, customer trust, and overall production efficiency. Although machine vision techniques have evolved considerably, achieving accurate detection of subtle and heterogeneous defects in X-ray images remains a significant challenge due to noise interference, complex background patterns, and variability in defect characteristics. In this study, we propose a hybrid Deep Learning (DL) framework that integrates Convolutional Neural Networks (CNNs) with tailored feature enhancement techniques to overcome these limitations. Unlike conventional CNN-based approaches, the proposed method emphasizes the refinement of discriminative features prior to classification, thereby improving detection robustness across diverse defect types and orientations. The experimental evaluation was conducted on a dataset of 3,500 X-ray images encompassing five major defect categories with varying scales and orientations, closely resembling real-world industrial conditions. The results demonstrate that the proposed framework achieves state-of-the-art performance, with an accuracy of 96.2%, precision of 95.5%, recall of 94.8%, and F1-score of 95.1%. Comparative analyses against existing methods further confirm the superiority of our approach in terms of both accuracy and generalization capability. Overall, this study contributes a reliable and scalable solution for automated quality inspection in industrial environments. The findings underline the practical applicability of the framework, offering manufacturers a cost-effective and efficient alternative to manual inspection while ensuring consistent quality assurance in large-scale production.

**Keywords:** Industrial Defect Detection, X-ray Imaging, Deep Learning, Convolutional Neural Networks, Hybrid Approach, Quality Inspection.

*OP07: AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios*

# Review, Applications, Challenges and Research Directions in Increasing the Deployment of DNN in Current and New Cloud Computing Systems

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**Abstract**

Deep Neural Networks (DNN) are currently used as machine learning technology in a wide variety of important real-world applications. DNNs consist of a large number of parameters that require millions of floating-point operations (FLOPs) to run in both learning and prediction modes. A more effective method is to implement DNNs in a cloud computing system equipped with centralized servers and data storage subsystems with high-speed and high-performance computing capabilities. This paper provides an up-to-date survey of the current DNNs deployed for cloud computing. Different complexities of DNN related to different architectures are presented and discussed along with the necessity of using cloud computing. We also provide an overview of various cloud computing platforms for deploying DNNs and discuss them in detail. In addition, DNN applications already deployed in cloud computing systems are reviewed to demonstrate the benefits of using cloud computing for DNNs. This paper highlights the challenges of deploying DNNs in cloud computing systems and provides guidance for enhancing current and new deployments.

**Keywords:** Big Data, Cloud Computing, Deep Neural Networks, High Performance Computing

*OP07: AI for Healthcare Optimization: Metaheuristics, Machine Learning, Mental Health, Ambulance Routing problem in Emergency Scenarios*

# An Efficient Model for Smart Agriculture Based on Smart Irrigation with Thermal Imaging

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## Abstract

The crisis of water shortage in our country makes us use an advanced system with facilities that we can use this system for different places, agricultural land and other lands. The smart irrigation system is one of the latest technologies available, which makes you choose the best method for irrigation by reducing water consumption and preventing water consumption. In addition, this smart irrigation system helps you to determine the best time to water and manage and control irrigation from thousands of kilometers away with smart devices such as phones. Using a smart irrigation system helps you to do smart irrigation according to the type of plant needs and different land conditions. In this paper focuses on the development and application of a thermal imaging-based framework for managing agricultural irrigation systems. The main objective is to identify and monitor crop water requirements across farmland through thermal image analysis, thereby improving irrigation efficiency and reducing unnecessary water use. To achieve this, the study adopts an iterative model, selected for its higher efficiency and adaptability. The system integrates image recognition techniques and programmable software tools in combination with thermal cameras specifically designed for irrigation monitoring. Importantly, the system operates autonomously without the need for direct human intervention. By incorporating this approach into existing irrigation practices, both water and energy consumption can be significantly optimized. Ultimately, the proposed system is anticipated to enhance agricultural productivity and overall irrigation efficiency, contributing to sustainable resource management.

**Keywords:** Internet of Things, Smart Irrigation, Smart Agriculture, Precision Farming, Thermal Imaging, Wireless Sensor Networks.

*OP08: Artificial Intelligence Solutions for Engineering Problems*

# Machine Learning-Based Multi-Class Classification of Physiological Signals from WESAD Dataset for Stress and Affective State Detection

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## Abstract

Stress has a detrimental impact on multiple physiological systems of the human body, including psychological, cardiovascular, immune, and musculoskeletal sys-tems. Early detection of stress and related emotional states is crucial for safeguar-ding both mental and physical health, as well as for enhancing productivity in daily activities. Recent advances in wearable technologies have enabled the continuous monitoring of emotional states through physiological signals, thereby facilitating timely detection. In this study, we propose a multi-class machine learning framework utilizing chest and wrist sensor data from the publicly available WESAD dataset. The dataset comprises a diverse range of physiological signals, including accelerometer (ACC), electrocardiogram (ECG), electromyogram (EMG), galvanic skin response (EDA), blood volume pulse (BVP), temperature, and respiration. From each signal channel, statistical features such as mean, standard deviation, and minimum values were extracted. Several machine learning models were trained to classify three emotional states: rest (baseline), stress, and positive emotion (amusement). Performance met-rics were computed for each model, and the results were comparatively analyzed. Experimental findings reveal that the Gradient Boosting algorithm achieved the highest accuracy of 97.93%. Compared with existing studies in the literature, this outcome demonstrates a remarkably high performance for a multi-class classification setting that integrates multiple physiological signal sources.

**Keywords:** WESAD, Machine Learning, Stress and Affective State Detection.

*OP08: Artificial Intelligence Solutions for Engineering Problems*

# AI-Driven Intelligent Operation and Maintenance and Fault Prediction for Data Center Networks

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**Abstract**

In modern data center networks (DCNs) high reliability, low downtime and effective management of the operations carried out is of significance. The conventional methods of maintenance and fault detection however tend to be reactive in most occasions and bring about the subject of unplanned down time and high operating costs. This paper introduces an intelligent operation and maintenance framework by using AI to overcome those challenges with fault prediction and active system monitoring based on Extreme Gradient Boosting (XGBoost). XGBoost is an efficient ensemble learning model in the gradient-boosted decision trees family, new to be resilient, scalable, and produce high predictive performance in structured data settings. The model in the proposed system is being trained on large amounts of data produced by network devices including logs, performance data, the number of errors, and the environmental conditions. Once trained, the XGBoost model effectively classifies system states and accurately predicts potential faults, enabling proactive intervention before failures occur and allowing for the automatic generation of alert messages. The application is designed to adapt over time by periodically retraining with new data, ensuring continued performance under evolving operational conditions.

**Keywords:** AI-driven maintenance, fault prediction, data center networks, XGBoost, predictive analytics.

*OP08: Artificial Intelligence Solutions for Engineering Problems*

# Data-Driven Assessment of Bond Strength in Reinforced Concrete Under Corrosion Effects

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## Abstract

The reliable estimation of bond strength degradation caused by corrosion is a major concern in reinforced concrete research, as it directly affects service life and structural safety. This study develops a machine learning framework to predict bond behavior using 254 experimental literature-based pull-out test data. Six regression algorithms—Random Forest, Extra Trees, XGBoost, AdaBoost, Decision Tree, and Ridge regression—are trained and validated through 5-fold cross-validation to ensure accuracy and robustness. Comparative results indicate that ensemble-based methods provide the highest predictive capability, with Extra Trees achieving a coefficient of determination of 0.923 and a root mean squared error of 2.43 MPa on the test set, followed by Random Forest with a coefficient of determination of = 0.917. Feature importance analysis identifies corrosion level and compressive strength as the dominant parameters, contributing 39.9% and 29.6% to the overall prediction, respectively. Concrete cover and bond length exert moderate influence, while steel diameter and type have marginal effects. The findings demonstrate that machine learning provides a reliable data-driven means of quantifying the relative importance of physical parameters and predicting corrosion-induced bond deterioration. This framework enhances structural performance assessment and supports service life prediction, maintenance planning, and rehabilitation design in reinforced concrete structures.

**Keywords:** Bond strength, Corrosion, Ensemble learning, Feature importance, Machine learning, Reinforced concrete.

*OP08: Artificial Intelligence Solutions for Engineering Problems*

# A Hybrid GA–RF Approach to Cloud-Based Scheduling in Smart Factories: A Techno-Managerial Perspective

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**Abstract**

The growing variability and intricacy of cloud-based manufacturing smart factory production require a technically capable and contextually adaptable scheduling solution. This work introduces a hybrid, data-driven scheduling framework integrating a Genetic Algorithm (GA) with a Random Forest (RF) regression model to optimize and rank multiple performance objectives simultaneously. From literature-based selection, the five most critical criteria—Makespan Improvement, Cost Saving, Resource Utilization, Idle Time Saving, and Cloud Resource Utilization—were chosen. Using these criteria, 100 artificial scheduling scenarios were synthesized based on empirical value ranges reported in recent literature, aiming to represent a realistic spread of operational conditions. Each scenario was automatically scored, while performance priorities can be context-dependent. Using the RF model trained on these scores, high predictive accuracy ($R^2 \approx 0.81$) was obtained with 5-fold cross-validation. Feature importance analysis revealed that Resource Efficiency and Cloud Utilization had the greatest impact, and that Idle Time Reduction had the least impact. Sensitivity analysis also confirmed the stability of these rankings and delivered understandable insights into performance trade-offs. Clustering analysis also separated the scenarios into three groups, each with distinct strategic scheduling profiles—e.g., cost-oriented or efficiency-oriented. From the techno-management perspective, these findings enable more prompt, adaptive, and data-based decision-making in fast-paced manufacturing settings. The proposed GA-RF model offers a scalable and adaptive framework for intelligent scheduling. The model is testable and verifiable on practical datasets by future research, further augmenting the set of Key Performance Indicators (KPI), and pushing applications to multi-factory and supply chain-level optimization.

**Keywords:** Cloud-Based Smart Manufacturing, Adaptive Scheduling Optimization, Genetic Algorithm (GA), Random Forest Regression, Techno-Managerial Decision Support.

*OP08: Artificial Intelligence Solutions for Engineering Problems*

# Deprem Enkaz Atıklarının Sınıflandırılması, Yönetimi Ve Geri Dönüşüm Potansiyeli

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**Abstract**

deneyimlerden hareketle, olası bir İzmir depreminde oluşacak milyonlarca tonluk enkazın yönetimi için bütüncül, çevre dostu ve uygulanabilir bir sistem geliştirilmesi gereklidir. Bu çalışma, İnşaat Mühendisleri Odası İzmir Şubesi öncülüğünde hazırlanan "Enkaz Atık Yönetimi Raporu" temelinde; (i) ulusal ve yerel mevzuatın değerlendirilmesini, (ii) geçici enkaz depolama alanlarının planlanma kriterlerini, (iii) saha uygulamaları ve 6 Şubat sonrası edinilen dersleri, (iv) geri dönüşüm ve yeniden kullanım potansiyelini ele almaktadır. Araştırma kapsamında yapılan analizler, İzmir'de mevcut geçici depolama kapasitesinin olası bir büyük deprem senaryosunu karşılamaya yetmeyeceğini göstermektedir. Ayrıca, enkaz atıkları içindeki tehlikeli bileşenler (özellikle asbest ve ağır metaller) halk sağlığı açısından kritik risk oluşturmaktadır. Çalışmada, geri dönüştürülebilir malzemelerin (beton, metal, ahşap, cam vb.) ekonomiye yeniden kazandırılması ile hem çevresel etkilerin azaltılabileceği hem de yeniden inşa sürecine sürdürülebilir kaynak sağlanabileceği ortaya konulmaktadır. OECD (2020) raporunda, afet sonrası atık yönetiminde çevresel etkilerin azaltılması kadar, yerel istihdamın ve geri dönüşüm ekonomisinin güçlendirilmesi de temel politika olarak tanımlanmaktadır. Uluslararası iyi uygulamalar (Japonya, Şili, Yeni Zelanda) ışığında geliştirilen öneriler; İzmir'de afet öncesi hazırlık, kurumlar arası koordinasyon ve çevresel güvenliği önceleyen bir "Enkaz Atık Yönetim Sistemi"nin gerekliliğini vurgulamaktadır. İzmir için önerilen çoklu alan stratejisi de çevresel risklerin azaltılması ve kaynak verimliliğinin sağlanması açısından bu yaklaşımla örtüşmektedir.

**Keywords:** Deprem, Enkaz Atığı, Yönetim,Geçici Depolama Alanı, Sürdürülebilirlik

*OP09: Optimization and Strategic Decision-Making in Industrial Management*

# Inventory Optimization Control Method for Power Materials Supply Chain Driven by Digital Twin Technology

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**Abstract**

This paper proposes a dynamic inventory optimization method for power materials supply chains leveraging Digital Twin (DT) technology and Model Predictive Control (MPC). Modern power systems involve complex supply networks for critical materials such as transformers, cables, and switchgear components, which face challenges from fluctuating demand, supplier lead times, logistical uncertainties, and operational costs. The DT collects real-time data on material consumption, equipment status, supplier performance, as well as transportation issues, providing a synchronized virtual representation of the supply chain. MPC utilizes this data to dynamically optimize inventory decisions, determining order quantities and timing to balance demand fulfillment and cost efficiency. A multi-objective optimization model is embedded to manage trade-offs among inventory holding costs, stockout risks, and delivery delays. By integrating predictive analytics with situational awareness, the proposed framework enhances supply chain resilience, minimizes material waste, improves response times, and ensures efficient operations across the power materials network. The approach establishes a foundation for intelligent, data-driven decision-making in future smart grid supply chain management.

**Keywords:** Digital Twin Technology, Inventory Optimization, Power Materials Supply Chain, Model Predictive Control (MPC), Smart Supply Chain Management.

*OP09: Optimization and Strategic Decision-Making in Industrial Management*

# A Fuzzy Multi-Criteria WASPAS-H Approach to Agricultural Water Resource Management

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## Abstract

One of the core Operational Research-based methodologies is Multi-Criteria Decision Making (MCDM), which provides systematic tools for evaluating and ranking alternatives under multiple conflicting criteria. In this study, we develop a hierarchical Fuzzy Weighted Aggregated Sum Product Assessment – Hierarchical (Fuzzy-WASPAS-H) model to optimize irrigation water allocation for sustainable olive cultivation in water-scarce regions. The model structures criteria into a hierarchy, generating partial rankings at each sub-criterion node and a global ranking at the top-level goal, enhancing decision transparency and reliability. Criteria weights are determined using the Fuzzy Analytic Hierarchy Process (Fuzzy-AHP), allowing the model to incorporate expert judgment while handling uncertainty and subjectivity in the relative importance of criteria. Key criteria, including water reliability, crop productivity, economic feasibility, environmental impact, and socio-political acceptability, are assessed using linguistic expert judgments represented as fuzzy numbers, addressing qualitative uncertainties. The approach supports strategic prioritization and efficient allocation of limited irrigation water, enabling policymakers and farmers to optimize irrigation practices and improve overall resource management. The results indicate that **Localized Drip Irrigation is the most suitable alternative, followed by Saline Water Management and Deficit Irrigation, whereas Smart/Precision and Subsurface Drip Irrigation are less preferred**, reflecting practical constraints in the study region. A case study in the Tunis region demonstrates the framework's effectiveness in data-driven, evidence-based decision-making, highlighting the potential of hierarchical fuzzy MCDM as an intelligent, robust tool for sustainable water resource management in agriculture.

**Keywords:** Fuzzy MCDM, WASPAS-H, Irrigation, Water Resource Management, Olive Cultivation.

*OP09: Optimization and Strategic Decision-Making in Industrial Management*

# Evaluating Sustainable Design Factors for Co Working Spaces with the Best Worst Method

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## Abstract

This study aims to identify and prioritize the key factors influencing the design of sustainable co-working spaces (CWSs) using the Best–Worst Method (BWM). In response to the growing demand for flexible, healthy, and environmentally re-sponsible work environments, nine sustainability-related criteria were determined through an extensive literature review and expert consultation. A panel of five experts with backgrounds in sustainable architecture, urban planning, environ-mental engineering, and workplace design evaluated the relative importance of these factors. The analysis results revealed that Indoor Air Quality and Low Vol-atile Organic Compound Materials, Daylight and Lighting Quality, and Thermal Comfort and User Control are the most influential criteria, highlighting the im-portance of health, comfort, and accessibility in shaping sustainable co-working environments. In contrast, Water Efficiency and Reuse, Material Circularity and Waste Management, and Biophilic and Restorative Design were found to have lower significance. These findings suggest that user-centered and comfort-oriented design elements play a more dominant role than purely technical or aes-thetic considerations in achieving sustainability. The study contributes to literature by providing a structured decision-making framework that supports architects, planners, and policymakers in designing resilient, inclusive, and environmentally conscious CWSs aligned with sustainable development goals.

**Keywords:** Co-Working Space, Design Factors, Best Worst Method.

*OP09: Optimization and Strategic Decision-Making in Industrial Management*

# Systematic Ranking of MARPOL Risks using FMEA with Picture Fuzzy Numbers

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**Abstract**

This study aims to systematically prioritize risks related to preventing marine pol-lution caused by ships. Within this scope, potential risks defined under the MARPOL Convention were structured using the Failure Mode and Effects Analysis (FMEA) approach; Probability (Occurrence), Severity, and Detectabil-ity were considered as evaluation criteria. The importance levels of the criteria were calculated using the Picture Fuzzy Step-wise Weight Assessment Ratio Analysis (PiF-SWARA) method, and the risks were ranked using the Picture Fuzzy Technique of Order Preference Similarity to the Ideal Solution (PiF-TOPSIS) method. Based on the evaluations obtained from five experts, the sever-ity criterion was found to have the highest weight with 0.3431, followed by de-tectability (0.3300) and probability (0.3269). The analysis identified the following as the highest priority risks: marine oil spills, flammability and explosion, docu-mentation deficiencies, ventilation failure, and human factor-related risks. The findings enable environmental risks under International Convention for the Pre-vention of Pollution from Ships (MARPOL) to be prioritized more reliably under uncertainty and provide an integrated decision support framework for risk-based auditing, maintenance planning, and policy development processes.

**Keywords:** MARPOL, SWARA, TOPSIS, FMEA.

*OP09: Optimization and Strategic Decision-Making in Industrial Management*

# A Mathematical Optimization Approach for Food Waste Reduction in the Hospitality Industry

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## Abstract

In the hospitality industry, food waste has become a significant problem, contributing to both environmental degradation and economic inefficiencies. Due to the perishability of ingredients, overproduction, and fluctuating customer demand, hotel restaurants are particularly vulnerable to high levels of waste. Turkey, as one of the world's major tourist destinations with a rich gastronomic tradition, faces considerable challenges in this area, as many hotels and restaurants generate substantial amounts of ingredient and food waste.This study focuses on a four-star hotel restaurant with the aim of enhancing its sustainability. First, the problem categorizes food waste into three main components: ingredient waste, unmet food demand, and plate waste. Then, a mathematical optimization model is developed to determine the optimal preparation quantities for each dish across multiple daily meal periods, incorporating demand forecasts, kitchen capacity, and customer satisfaction constraints. The model aims to balance cost efficiency, sustainability, and service quality using real operational data. The findings of the model show a major reduction in ingredient waste while maintaining the sustainability of the hotel restaurant at a high level.

**Keywords:** Food Waste, Sustainability, Hospitality Industry.

*OP10: Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities*

# Big Data Analytics for Cross-Cultural Communication Patterns in Online English Learning

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**Abstract**

In the age of digital globalization, online English learning platforms have turned out to be must in eradicating linguistic and cultural gaps of virtual learners. To systemically uncover and interpret cross cultural communication pattern in such environment, this study introduces a big data analytics framework. The proposed methodology is designed into four main phases such as data collection and preprocessing, feature engineering and analysis, pattern detection and modelling, and interpretation and visualization. A wide number of platforms including forums, mobile apps, and digital classrooms are then automatically collected data, filtered and processed into language translation, audio/video transcription and anonymization. Additionally, the framework addresses cultural variations and ensures data privacy and ethical compliance. In order to accommodate the differences in cultural variations in communication style, emotional expression, and collaborative behavior, features are extracted based on sociolinguistic and sentiment. The extracted features enable detailed modeling of learner engagement patterns and emotional dynamics across different cultural cohorts. To model communication trends and discover unique time-based interaction patterns taking place culturally, the advanced machine learning and deep learning techniques are leveraged including the K-Means clustering, Support Vector Machines (SVM) and Long Short-term Memory (LSTM) network. Then, they are visualized with heatmaps and network graphs for both the design of an adaptive course and the personalized learning. It enables the culture responsive digital education development as well as the improving of learner engagement and intercultural understanding in online global learning environments.

**Keywords:** Cross-Cultural Communication, Big Data Analytics, Online English Learning, Sociolinguistics, Machine Learning Models.

*OP10: Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities*

# Optimizing E-Business Marketing with Big Data and AI: A Study on Precision Strategies

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## Abstract

To deal with the issues behind the long duration of time it takes to make the current e-business precision marketing strategies, resulting in the low rates of accuracy in marketing operations, this paper explores the idea of improving the efficacy of the afore-mentioned strategies by incorporating big data and AI. The paper first develops a unified framework of e-business precision marketing strategies, the notion of precision marketing in e-business and examines the different properties, including correlation, interaction and data dimensionality which affect e-business precision marketing strategies The proposed model achieved a significant reduction in marketing time (as low as 213.12 units) and demonstrated superior accuracy, with marketing error reduced to as low as 91.32, compared to over 213 in baseline models. Furthermore, the model achieved a marketing result score of 12212.34, indicating its practical advantage in optimizing marketing effectiveness. The conducted simulation experiments indicate that the proposed model is practical, since it has a low time consumption and high marketing accuracy.

**Keywords:** E-Commerce, Precision Marketing, Big Data, AI Fusion, Strategy.

*OP10: Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities*

# AI-Driven Customer Analytics for End-to-End Operational Optimization in Retail and Logistics

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## Abstract

Modern opportunity at present is building an all inclusive end-to-end AI engine that links customer analytics (CAC, LTV, and RFM modeling) with operational optimization for retail and logistics. This study provides a special machine- learning method that is undergoing very thorough ablation analysis and converts raw transactional, behavioral, and operational data into integrated real-time intelligence, which controls just-in-time inventory holding, labor assignment, and logistics routing for real-time personalized decision-making. Empirical trials on the different datasets exhibited improved volumes and revenues in sales, retention rate increases, better inventory efficiency, and agility compared to standard heuristics. The top take-aways suggest real-time execution, ethical AI, and dependency on data that would speak to the success in deployment at scale. The possible future will look into reinforcement learning in adaptive control, generative modeling in scenario-planning, and explainable AI for transparency and trust. Such an inclusive solution would become the strategic energy blueprint for the infrastructural development of countervailing forces that would be able to resist the coming onslaught from retail and logistics enterprises that would indeed flourish even in a totally digital and extremely dynamic world.

**Keywords:** AI-driven customer analytics, Retail and logistics optimization, Lifetime value (LTV) modeling, Real-time operational decision-making, Explainable AI and generative models

*OP10: Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities*

# AI-Driven Fraud Detection in Real-Time Financial Transactions: A Deep Learning Approach

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## Abstract

By evaluating three machine learning techniques—XGBoost, BiLSTM, and a lightweight Transformer—on a real-world transaction dataset, this paper addresses the growing problem of credit card fraud. We used personalized preprocessing for every model type and chronological data splits to prevent temporal leakage in order to guarantee realistic results. Sequence models were trained using sliding windows of transaction histories, whereas XGBoost was trained using SMOTE to handle extreme class imbalance. Our analysis reveals that BiLSTM outperforms both XGBoost (F1 = 0.7941) and the Transformer (F1 = 0.7857) by achieving the best detection performance with an F1-score of 0.8000 and an AUC-ROC of 0.9844. Nonetheless, with 412 transactions per second and 2.1 ms latency, XGBoost continues to offer distinct op- operational advantages. We suggest a hybrid deployment framework based on these results, in which BiLSTM carries out secondary verification on suspicious cases while XGBoost does initial high-speed screening. This method gives financial institutions a workable solution that strikes a balance between operational efficiency and detection accuracy, processing 98% of transactions in 5 ms and achieving 94.2% recall.

**Keywords:** Bidirectional LSTM, lightweight Transformer, XGBoost, SMOTE, explainable AI, streaming deployment, low-latency detection.

*OP10: Industrial Transformation Through Big Data Analytics: Trends, Challenges, and Opportunities*

# Analyzing Metropolization and Peripheral Trends in India via Clustering Methods

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**Abstract**

High-speed mobility has emerged as an important element of modern transportation that presents high-speed, high capacity and high-comfort mobility between regions. Beside its functional possibilities, high speed has a strategic position on increasing local and national tourism potential and advancing sustainable transport approaches. It also holds important position to help socio-economic improvement on developing economies. This paper reveals a cluster-based analysis that focus on India. By use of significant parameters like population and city livability, clustering methods are used to designate potential urban metropolization for high-speed systems. Based on the competitive distances of mobility, proposals were done to connect of regions. The findings and offers to enlighten infrastructure plan and policy, roadmap has given about intercity metropolization.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy.

*OP11: Data-Driven Strategies for Sustainable and Smart Business Operations*

# Analyzing the Role of Corporate Culture in Leadership-Driven Employee Engagement: A Big Data Perspective

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## Abstract

The big data analytical approach is used in this paper to analyze how leadership in corporate culture contributes to engaging the employees. Organizations are increasingly becoming aware of the magnitude of cultural alignment in driving greater performance and retention of their talent throughout their stay in the organisation, therefore, it is important to have an idea of the slight interaction between the behaviour of leadership and the feeling of the employees. The research leverages sentiment analysis via natural language processing (NLP) to process and analyze a large volume of employee-generated textual data collected from company feedback forms, review platforms such as Glassdoor, and publicly available social media accounts including LinkedIn and Twitter. Support Vector Machine (SVM) is a supervised machine learning algorithm that is applied to categorise the levels of engagement with respect to the textual features/ attributes that have been extrapolated. The model has been cognitive-conditioned to recognize the cues of engagement since it has learned the lingual patterns, due to cultural traits such as openness, collaboration, innovation and trust. Organizations with a transformational leadership that had been a central part of an inclusive and transparent culture have been found to have significantly higher ratings with regard to employee engagement. The classification accuracy was sufficiently high to confirm that the model effectively distinguishes between high and low employee engagement instances. The current study provides an empirical validation of the fact that the combination of the big-data practices and cultural insights enables the organization to diagnose and enhance the engagement strategy.

**Keywords:** Corporate Culture, Employee Engagement, Leadership, Big Data, SVM Classification.

*OP11: Data-Driven Strategies for Sustainable and Smart Business Operations*

# Comparing IP Operation Strategies in China and Japan: Data-Driven Insights from Pop Mart and Anime Models

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**Abstract**

In the context of China and Japan, the emerging field of Intellectual Property (IP) operation is now a strategic mode of cultural and commercial value production (representative of which is the Pop Mart system of designer toy as well as the anime production system of Japan, with its corresponding influence in the global cultural and commercial sphere). The paper develops a comparative analysis of the IP operation strategies on a basis of a new Hybrid Knowledge Graph-Enhanced Sentiment-Topic Mining Framework integrating multi-source data analytics and domain context-specific mapping. The architecture combines knowledge graph building to represent entity relationship (e.g., creators, brands, licensing networks, and fan groups) and supplements it by sentiment-topic mining of user-generated content over texts at Weibo, Bilibili, and Twitter. Measuring emotional engagement, brand loyalty, and the means by which the monetization will take place, the analysis presents strategic differences, which are critical. The findings summarize that even though both of the ecosystems are dependent on touch point of emotions and collectibles, China has its model supported on the speed, social trading and real-life communication, whilst Japan has a model supported on long term capital of story and the series of contents.

**Keywords:** IP Operation, Knowledge Graph, Sentiment-Topic Mining, Pop Mart, Anime Industry.

*OP11: Data-Driven Strategies for Sustainable and Smart Business Operations*

# Electrical circuit parameter identification based on state-space model

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## Abstract

A new approach to solving the problem of parameter identification of an electrical system of known structure with passive elements is proposed and investigated. This problem is often reduced to a conditional optimization problem and is solved by heuristic algorithms that have known shortcomings. We have proposed a solution based on the state variable method. It is implied that state variables of electrical system model may be obtained as phasor unit measurements. It is shown how a system of equations is formed for an electrical circuit with respect to state variables. Two different methods of approximating the derivatives of state variables are considered. Parameter identification is reduced to solving a system of linear equations. The dependence of the accuracy of the proposed method on the measurement error is analyzed.

**Keywords:** parameter identification, state-space model, numerical differentiation

*OP11: Data-Driven Strategies for Sustainable and Smart Business Operations*

# Optimizing Logistic Decisions Through Machine Learning

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**Abstract**

In this thesis, a data driven dynamic decision optimization framework is developed and evaluated for depot customer assignment problems using synthetic logistics data. Various algorithmic methods including traditional and advanced ones are compared to maximize expected returns and acceptance rates. The proposed approach utilizes customer location, distance and offer features to predict acceptance probabilities and optimize offer iteratively. Batch and iterative learning strategies are implemented and thresholding techniques are applied to ensure maximum acceptance probabilities. Experimental results show that machine learning based dynamic offer methods outperform standard offer in terms of operational efficiency. In addition, the findings demonstrate that integrating predictive models into offer generation can lead to better and more robust solutions in large-scale logistics networks.

**Keywords:** Machine Learning, Logistics Optimization, Dynamic Decision Making

*OP12: New Approaches to Achieving Sustainable Development Goals (SDGs)*

# Smart Circular Economy: A Resilient Optimization Approach within the Framework of Sustainable Development Goals

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## Abstract

The transition from a linear to a Circular Economy (CE) is widely recognized as a critical pathway to reducing environmental pressures and conserving resources. Yet, without explicitly addressing system resilience against disruptions and shocks, such a transition cannot ensure genuine sustainability. At the same time, the United Nations' Sustainable Development Goals (SDGs) provide a global framework for assessing and prioritizing sustainable strategies. Despite their importance, existing research has rarely developed quantitative tools that integrate circular economy principles, resilience metrics, and selected SDG targets into a unified decision-making framework. This paper develops a multi-objective mathematical model that combines the core pillars of the circular economy—reduction, reuse, and recycling—with resilience indicators such as supply chain flexibility and recovery capacity, as well as targeted SDGs, including responsible consumption and production (SDG 12), industry, innovation and infrastructure (SDG 9), and climate action (SDG 13). To address computational complexity, a tailored heuristic solution method is designed and implemented on a real-world inspired case study. Numerical experiments based on simulated scenarios demonstrate that the proposed framework not only reduces costs and enhances resource efficiency but also strengthens system resilience to disruptions while simultaneously improving performance against the targeted SDG indicators. Sensitivity analysis further reveals that varying the weights assigned to sustainability objectives and the severity of external disturbances leads to diverse optimal strategies. The findings contribute to the academic literature by advancing an integrated approach to circular economy and resilience, while offering decision-makers a practical tool for designing policies that are both sustainable and robust. The results can be strengthened with real-world data from industries such as [e.g., waste management, energy systems], providing further insights into its applicability in practical scenarios.

**Keywords:** Smart Circular Economy, Resilience-Oriented Optimization, Sustainability-Driven Decision Models, Adaptive Multi-Objective Heuristics, Integrated SDG Performance Metrics, Next-Generation Resource Systems.

*OP12: New Approaches to Achieving Sustainable Development Goals (SDGs)*

# Digitalisation for smart and climate-neutral cities: the case of Ukraine

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## Abstract

Digitalisation is now widely recognised as a key driver for the transition to smart and climate-neutral cities. By reshaping governance, public services and energy systems, digital technologies optimise resources, improve transparency and foster citizen participation. However, their ecological and social implications remain contested: energy-intensive models, governance constraints and inequalities risk undermining the climate-neutral objectives that digitalisation is meant to support. This study focuses on Ukraine as a critical case of accelerated digital transformation under extraordinary stress. The country's trajectory demonstrates rapid progress: from early experiments in e-government, through the institutionalisation of the Ministry of Digital Transformation, to the adaptive use of digital platforms during wartime. The Ukrainian case shows that despite severe disruption, digital and ecological initiatives can advance in parallel, offering lessons for other countries where such progress is possible under less extreme conditions. This research provides the first integrated assessment of Ukraine's digital transformation through the dual lens of ecological transition and urban sustainability, showing how digitalisation interacts with climate objectives under crisis conditions. Ukraine is presented not only as a case of resilient digital governance and wartime innovation, but also as an emerging reference point for climate-neutral pathways. The findings indicate that while digitalisation is not inherently sustainable, technologies such as digital twins and smart grids hold strong potential for post-war reconstruction, renewable integration and climate-responsive planning. These insights offer a foundation for future research and for shaping twin transition roadmaps that align digitalisation with climate neutrality and long-term resilience at both national and metropolitan levels.

**Keywords:** Digitalisation, Smart Cities, Climate-neutral Transition, Twin Transition, Blockchain, Urban Sustainability.

*OP12: New Approaches to Achieving Sustainable Development Goals (SDGs)*

# Aircraft Assignment under Demand Uncertainty: A Stochastic MILP Optimization Model for Private Jet Operators

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## Abstract

This paper addresses the aircraft assignment problem for small-scale private jet operators under uncertain demand. A stochastic mathematical programming mod-el is proposed to maximize expected profit while considering real-world opera-tional and financial constraints. The model assumes three aircraft serving five destinations, with ticket demand represented by three scenarios (high, medium, and low sales) and associated probabilities. Constraints include aircraft range, seat capacity, maximum assignable flights, and a monthly operational budget. The objective function maximizes scenario-based revenues minus operating costs through binary assignment decisions. Results highlight the model's potential as a decision-support tool, enabling operators to balance efficiency and profitability under uncertainty, and offering a practical link between large-scale airline plan-ning methods and the unique needs of private jet services.

**Keywords:** Aircraft Assignment; Stochastic Optimization; Demand Uncertainty; MILP; Stochastic Demand; Taguchi L9 Design of Experiment; Flight Scheduling; Profit Maximization.

*OP12: New Approaches to Achieving Sustainable Development Goals (SDGs)*

# An Analysis of Metropolization and High Capacity National Network Via Clustering in Argentina

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**Abstract**

High-speed system and networks are the most significant dynamics of innovative transportation. It is a transportation approach that has a position between cities with high speed, high capacity, and high comfort. Also it is an effective power of sustainable transportation policies that is related with intercity metropolisation trends too. In this paper, a cluster-based analysis was conducted for Argentina, by using population, gross domestic product, livability and similar parameters through statistical methods (K-means, PAM and CLARA) via R Studio program. Line proposals and metropolisation trends were presented by taking into account the competitive operating distances of high-speed and distance for discrete urbanization. Results and suggestions were given in this context.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy

*OP13: Smart Cities for a Sustainable Future: Optimization and Data Science Approaches*

# Crisis-Resilient Learning and Smart Cities: An Empirical Approach to Smart Education Models for Sustainable Urban Futures

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## Abstract

As smart cities are becoming hubs of technological innovations, less focus has been there on how the urban citizens are dealing with learning capabilities when they face crisis. Given that cities are increasingly confronted with disruptions caused by climate events, health crises, and systemic failures, the ability of residents to adapt and learn during these periods is important for the long-term sustainability of urban environments. This study evaluated how digital education frameworks contribute to improve Crisis-Resilient Learning Readiness (CRLR) among urban residents by investigating the relationships between the accessibility of digital infrastructure, the effectiveness of educational platforms, individual levels of digital confidence, institutional trust, and actions taken for emergency preparedness. The research utilized a survey instrument including 487 participants belonging to three smart cities. By applying SEM technique, we analyzed the relationships among digital infrastructure access, platform effectiveness perceptions, digital confidence levels, governmental trust and their collective impact on CRLR and preparedness actions. The results of this study indicate that digital confidence and perceptions of platform effectiveness are the substantial predictors of CRLR, which in order affects preparedness actions. Access to infrastructure and CRLR were mediated by government trust, while the relationship between confidence and CRLR has been affected by socioeconomic indicators. We present the empirically validated CRLR framework, which widens the scope of smart city research to include citizen-centered sustainable learning strategies, and also to provide evidence-based recommendations for the development of resilient educational systems in urban settings.

**Keywords:** Smart Cities, Crisis-Resilient Learning, Sustainable Futures.

*OP13: Smart Cities for a Sustainable Future: Optimization and Data Science Approaches*

# A Metaheuristic Algorithm for Bi-Objective Speed and Load-Dependent Multi-Depot Electric Vehicle Routing Problem with Half-Open Rotations

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**Abstract**

Sustainable logistics systems encompass critical components of environmental sustainability, such as reducing carbon emissions, and social sustainability, improving community well-being and ensuring fair working conditions. Consequently, there has been a growing shift towards alternative transportation modes like Electric Vehicles (EVs), which have increasingly attracted the attention of the operations research community. In this paper, we investigate the Speed and Load Dependent Multi-Depot Electric Vehicle Routing Problem with Half-Open Rotations (SLD-MDEVRP-HOR), considering two conflicting objective functions: the minimization of $CO_2$ emissions and the minimization of total tardiness. In this problem, customer demands are fulfilled by a homogeneous and limited fleet of EVs with specific battery and load capacities. EVs are allowed to serve multiple routes (rotations) and may end their journeys at a different depot from the one they depart from (half-open rotations). While recharging is possible both at depots and at Recharging Stations, load replenishment is only performed at depots. An energy consumption model is employed, which incorporates the effects of five discrete speed modes and the vehicle's carried load. Given that the problem is a variation of the well-known NP-hard Vehicle Routing Problem, we develop a metaheuristic algorithm named the Multi-Directional Local Search algorithm, which is based on the concept of Pareto dominance. Computational experiments are conducted on modified small- and large-sized instances derived from recent literature. To evaluate the performance of the proposed algorithm, we report the number of Pareto solutions, Quality Metric values, Hypervolume values and run time of each solution with different seeds.

**Keywords:** Electric Vehicle Routing Problem, Half-Open Rotations, Multi-Directional Local Search, Multi-Objective Optimization

*OP13: Smart Cities for a Sustainable Future: Optimization and Data Science Approaches*

# Scalable Technician Dispatch with SLA Deadlines: Unified Path Extraction and Anchor-Based Partitioning

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## Abstract

Efficiently dispatching technicians to client locations under service level agreements (SLAs) is a critical challenge for modern call centers and field service operations. The objective is to maximize the number of client locations visited within a daily travel constraint, while ensuring all locations with expiring SLAs are prioritized. In this study, we extend the classical technician routing problem to scenarios involving multiple technicians and complex, real-world network topologies. To address the increased complexity, we propose a scalable approach that partitions the set of locations based on the farthest SLA anchor method: locations with expiring SLAs that are maximally distant are selected as anchors, and all other locations are assigned to the nearest anchor, forming compact and practical technician groups. For each group, we leverage classical shortest path algorithms—Dijkstra and Floyd-Warshall—to precompute all-pairs shortest paths, enabling rapid feasibility checks for candidate technician routes. Our unified route extraction framework efficiently searches for feasible paths under SLA and path length constraints within each group. Experiments on both small and large real/synthetic network instances, including multi-technician scenarios, demonstrate the effectiveness and scalability of our approach. The results highlight the benefits of problem decomposition and anchor-based partitioning for real-world technician dispatch under SLA constraints. Comparative results with Google OR-Tools further highlight that our method achieves similar or better solution quality with significantly improved computational efficiency, especially in large-scale and multi-technician settings.

**Keywords:** Service Level Agreement, Multi-Technician Routing, Farthest Anchor Partitioning, Graph Partitioning, Path Optimization, Dijkstra Algorithm, Floyd-Warshall Algorithm, Field Service Routing, Route Feasibility.

*OP13: Smart Cities for a Sustainable Future: Optimization and Data Science Approaches*

# Optimization of Portable Electric Vehicle Charging Station Deployment Using a Mixed-Integer Programming Approach

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## Abstract

This study presents a comprehensive optimization framework for determining the efficiency factors of electric vehicle (EV) charging station deployment. Develops a mixed-integer programming (MIP) model to determine the optimal deployment strategy for portable EV charging stations under limited resources. The proposed framework integrates operational, economic, and spatial dimensions into a unified optimization structure that aims to maximize total profit. Parameters such as budget, coverage radius, station capacity, and penalty cost for unmet demand were also considered to reflect real-life planning conditions. Using GAMS, twelve different scenarios were tested across different matrix sizes and parameter combinations and solved using CPLEX. A scenario-based sensitivity analysis was conducted, and the results revealed that penalty costs for unserved demand significantly influence profitability, overshadowing the effects of installation and operating expenses. Scenarios with balanced budgets and moderate coverage radius achieved the highest efficiency. Demonstrating resource allocation strategies focusing on accessibility yields better outcomes than just budget expansion. The findings suggest that adaptive and demand-responsive station planning is essential for ensuring both economic viability and service quality. The proposed model of this paper offers the decision makers a flexible decision-support tool for designing sustainable and profitable EV charging networks.

**Keywords:** Electrical Vehicle (EV), Portable Charging Station, Facility Location Problem, Mixed-Integer Programming (MIP), Sensitivity Analysis, Profit Maximization, GAMS Optimization.

*OP13: Smart Cities for a Sustainable Future: Optimization and Data Science Approaches*

# Integrated Raw Material Segmentation and Periodic Review Inventory Control: A Case Study in an Electronic Manufacturing Company

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## Abstract

This study presents a data-driven analysis of raw material segmentation and integrated inventory–order management in an electronic manufacturing company. The project aims to improve cost efficiency and operational performance by classifying raw materials based on real consumption data, lead times, costs, and freight parameters through a multi-criteria analysis approach. Materials were evaluated using multiple criteria to capture their criticality and supply variability. Following the segmentation study, a periodic review (R,s,S) inventory control policy was designed as the most suitable model for the company's operational structure, where inventory levels are reviewed at regular intervals. In this policy, R defines the review period, s represents the reorder point that triggers replenishment, and S denotes the maximum inventory level. The algorithms developed in this study enable both the multi-criteria classification of raw materials and the calculation of R, s, and S levels based on demand variability, lead time, and cost parameters. All algorithms were implemented in Excel VBA, resulting in a user-friendly decision-support interface that allows users to update parameter weights, visualize segmentation outcomes, and generate inventory control parameters dynamically. The developed system supports sustainable operational improvement by enhancing coordination between procurement and production, reducing excess inventory, and minimizing stockout risks.

**Keywords:** Raw Material Segmentation; Multi-Criteria Analysis; Periodic Review Policy (R,s,S); Inventory-Order Management; Decision Support System.

*OP14: Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability*

# A Mixed-Integer Framework for Sustainable, Service-Aware Vehicle Routing in Heterogeneous Fleets

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## Abstract

This paper develops a practical vehicle routing model that embeds environmental and service-quality considerations into a single cost-minimization framework. The formulation captures realistic operations by modeling a heterogeneous fleet with type-specific capacities, fuel consumption, and emission intensities, and by including soft time windows with linear tardiness penalties and an aggregate emission cap with an exceedance penalty. The model is implemented in GAMS and solved as a mixed-integer program with CPLEX. To assess parameter sensitivity, a Taguchi L9 ($3^3$) orthogonal design varies three multipliers—emission penalty (Pe), tardiness penalty (Pt), and fuel-cost multiplier (Cf)—across nine runs. For each run we record total cost, total emissions, emission and lateness penalties, fleet size, and solver time. ANOVA on the Taguchi results reveal a clear pattern: emission penalties (Pe) dominate cost-related variability and penalty outcomes, whereas tardiness penalties (Pt) primarily drive operational responses such as fleet size and aggregate emissions; fuel-cost scaling (Cf) remains secondary. These findings imply that budgetary control is most effectively achieved by calibrating emission penalties, while tightening tardiness penalties improves punctuality at the expense of higher vehicle-kilometers and emissions. We conclude with managerial recommendations and avenues for extending the model to stochastic and dynamic settings.

**Keywords:** Vehicle Routing Problem (VRP), Sustainable Logistics, Heterogeneous Fleet, Emission Penalty, Time Windows, Taguchi L9, Sensitivity Analysis.

*OP14: Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability*

# Analysing an EOQ model with imperfect quality using absorbing state markov chain

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## Abstract

The classical economic order quantity (EOQ) model makes assumptions like “perfect quality of supply batches” which do not conform to real world situations. To address this shortcoming studies in the recent past have considered problems with “all or none” policy where the entire supply batch is screened and either rejected or accepted. But such studies have assumed that the probability of a batch being rejected is fixed and defective delivery occurrences are independent of each other. We have relaxed both these assumptions and used absorbing state markov chain theory to model the uncertainty period between two acceptable delivery batches. In addition we have also considered that there is an upper bound on the number of failed attempts to deliver an acceptable batch. Under these settings we have found the optimal order quantity and optimal planned shortage. We have also used numerical examples to demonstrate our results.

**Keywords:** Supply Chain; Supply disruptions; Inventory; Markov Chain; Imperfect Quality; Economic Order Quantity

*OP14: Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability*

# A Data-Driven Framework for Assessing the Impact of Economic Sanctions on Supply Chain Operations: Evidence from Iran's Private Medical Equipment Sector

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## Abstract

Economic sanctions are increasingly employed as instruments of international policy, yet their consequences often extend far beyond political objectives. In the case of Iran, repeated waves of sanctions have generated widespread economic and social repercussions, with the healthcare sector being one of the most severely affected. While previous studies have concentrated on pharmaceuticals and public hospitals, limited attention has been paid to the private medical equipment sector, despite its essential role in sustaining healthcare delivery. This study investigates the impact of sanctions on the efficiency and effectiveness of supply chain operations in this sector. A quantitative, cross-sectional survey was conducted among 120 managers and specialists from 50 private medical equipment companies. Data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) implemented in SmartPLS 3.0, evaluating both measurement and structural models to ensure reliability and validity. Findings reveal that sanctions significantly disrupt procurement, logistics, and financial transactions, increasing costs, delaying supplies, and restricting access to international banking systems. The model explains 57.6% of the variance in supply chain performance, with robust validity and reliability indicators. The study contributes theoretically by integrating Transaction Cost Economics, Resource Dependence Theory, and Institutional Theory, and practically by offering strategies for resilience, including diversification, localised production, and digital supply chain monitoring.

**Keywords:** Sanctions, Supply Chain Resilience, Iran Private Healthcare, PLS-SEM.

*OP14: Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability*

# Managing strategic Omanisation for localization of skills in the logistics sector in Oman and dealing with challenges and headwinds

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## Abstract

The main thrust of this seminal research is to strategically analyse strategic Omanisation in the logistics sector to meet employer human capital requirements and expectations in Oman and to localise skills. The main reasons giving rise to this research are to illuminate world best practices on recruitment, staff retention and consolidation of localisation in the logistics sector to meet employer human capital requirements and expectations in Oman logistics firms which logistics industries, government departments and academia can then use to advantage and benefit the country. This research is based on literature review and field research done at Sohar and Barka, Muscat, Oman for fair coverage of the economic hubs of Oman, and analysis and identification of substantive gaps in knowledge thus making a contribution to the stock of knowledge available. This is theory building in the human resources theory of the General Systems Theory (GST) which proffers that organizations depend on their environments for several essential resources: customers who purchase the product or service, suppliers who provide materials, employees who provide labor or management, shareholders who invest, and governments that regulates. In this research researchers would focus on strategic logistics employees who provide labour and management, with focus on Omanisation. A survey research method will be used as well as interviews for a deeper understanding of the issues.

**Keywords:** Recruitment, Selection, Training and Development, Induction, Incentives, Staff Development

*OP14: Strategic Supply Chain Analytics: Optimizing Circularity, Resilience, and Sustainability*

# An Analysis of High Urbanization Via Clustering in Pakistan for Regional Integration by High Speed Network

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**Abstract**

High-speed trains are one of the most important elements of transportation currently. It is a mobility mode that stands out in transfer across urbans via high speed, high capacity, and high technology. This mode has a vital position for development attractiveness. It is an efficient version of sustainable transport approaches that helps inter urban mobility too. It is also a significant dynamic of advancing countries. In this article, a cluster-based analyze was conducted for Pakistan, that has not yet entered high-speed mobility. This analyze has done by usage of population and livability indexes of cities via cluster statistic process. Line proposals were presented by taking into account competitive distances for high mobility in terms of urban clusters, and results and suggestions were given in this parallel.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy

*OP15: Forecasting Techniques for Operations Research*

# Labor Market Demand and Supply Forecasting model under the Background of Big Data

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## Abstract

This study presents a novel Hybrid Attention-based Temporal Graph Convolutional Network (HAT-GCN) for forecasting labour market demand and supply under the context of big data analytics. The model addresses critical challenges such as workforce mismatch, rapid technological changes, and fluctuating industrial demands that limit the accuracy of traditional forecasting methods. By integrating temporal learning and graph-based spatial modeling, HAT-GCN captures complex interdependencies among industries, regions, and skill categories over time. The framework utilizes multi-source data, including job advertisements, social media discussions, scholarly publications, and economic indicators, enabling a holistic understanding of labour dynamics. Unstructured textual data are processed through Natural Language Processing (NLP) to extract emerging skills and sectoral trends, ensuring the system's adaptability to evolving market signals. Empirical results using national labour datasets reveal that HAT-GCN achieves superior predictive accuracy with $R^2 \approx 0.90$, precision of 0.92, and recall of 0.90, outperforming traditional LSTM and standard GCN models. Forecasts closely aligned with actual labour demand values ranging from 98 to 148 across a 12-month evaluation period. The proposed model offers policymakers, educational planners, and employers a powerful data-driven tool for workforce planning, skills development, and strategic policy design in an era of continuous digital transformation.

**Keywords:** Labor market forecasting, big data analytics, temporal graph convolution, skill demand prediction, workforce planning.

*OP15: Forecasting Techniques for Operations Research*

# Design and Optimization of a Panoramic Real-time Monitoring System for Integrated Intelligent Power Supply and Distribution in Data Center Rooms

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## Abstract

With the continuous increase of load in the computer room, it is difficult for traditional monitoring methods to accurately predict power changes and identify anomalies. Therefore, an intelligent monitoring system integrating LSTM and SVM algorithms is researched and designed to improve load prediction accuracy and anomaly detection ability. The experimental results show that the mean square error (MSE) of the LSTM-SVM model is reduced to 0.031, and the accuracy is 94.6%. After SVM model is combined with wavelet denoising and RBF kernel function, the anomaly detection accuracy is improved to 91.6%, and the recall rate is 89.2%. The intelligent monitoring system combined with LSTM and SVM shows high accuracy and stability in the task of load prediction and anomaly detection, which can provide strong technical support for the future intelligent operation and maintenance of the computer room. The study further incorporates a terminal–edge–cloud architecture to ensure real-time monitoring and decision-making. Comparative analysis with traditional models validates the superiority of the proposed approach. The originality of this work lies in unifying forecasting and anomaly detection, while addressing high-dimensional power data. Practical implications include improved resilience, energy efficiency, and reduced downtime for modern data centers.

**Keywords:** Data Center Room Monitoring System, Intelligent Power Supply and Distribution, **Real-**Time Monitoring, LSTM, SVM.

*OP15: Forecasting Techniques for Operations Research*

# Digital Ecosystems for Intangible Cultural Heritage: Virtual Simulation and Social Media Strategies in Vocational Education Dissemination

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## Abstract

This paper presents a new digital ecosystem of the international distribution and conservation of the Intangible Cultural Heritage (ICH) as a vocational education. It offers the two-way model consisting of the immersive training of Virtual Reality (VR) simulation and controlled interaction with social media. VR facilitates the learners to practice traditional crafts and rituals both in real and virtual interactive environments. This helps in learning of the skills and cultural information is retained. Meanwhile, the cultural exchange, cooperation, and interaction on the global level is available in the social media platforms. The research will use the mixed-methodology approach and involve the case studies of the vocational institutes that have already implemented the VR modules and social media approaches. Both teachers and students overcome quantitative measures of engagement with quantitative and qualitative feedback. The findings indicate that an increased number of individuals are encouraged, learn more about the culture, and have an expanded global connection. This framework is democratic and non-elitist in access to localized cultural information. It encourages a lifelong learning process and intercultural communications. These results confirm the hypothesis that VR simulation and application of social media as an educational tool and means of creating awareness of ICH all over the world is a better educational outcome.

**Keywords:** Intangible Cultural Heritage, Virtual Reality Simulation, Vocational Education, Social Media Matrices, Digital Ecosystems.

*OP15: Forecasting Techniques for Operations Research*

# AI-Driven Quantum Approaches to Water Purification and Pollution Control for SDG 6

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## Abstract

Clean and safe water is a fundamental human right, yet achieving Sustainable Development Goal 6 (SDG 6) ensuring water and sanitation for all remains a persistent global challenge due to pollution, climate stress, limited resources, and aging infrastructure. This study presents a novel, end-to-end AI-quantum hybrid framework that advances water purification, pollution control, and infrastructure monitoring beyond the scope of existing methods. Unlike previous works, which typically focus on isolated tasks or singular model types, we propose the first unified benchmarking pipeline that systematically compares classical, deep learning, and quantum-enhanced models across ten real-world smart water management tasks, including pollutant forecasting, leak detection, microbial risk classification, and anomaly detection. Leveraging large-scale environmental datasets, our models predict contamination trends, optimize treatment protocols, and enable real-time health monitoring of water systems. Quantum models such as Quantum Graph Neural Networks (QGNN), variational quantum circuits, and hybrid CNNs capture high-dimensional, nonlinear relationships that classical models often fail to learn. To enhance transparency and policy integration, we incorporate visualization-driven interpretability tools and ethics-aware deployment strategies. Case studies in arsenic mitigation, heavy metal detection, and microbial purification demonstrate the framework's real-world applicability and scalability. Overall, this work offers a first-of-its-kind, modular, and ethically aligned AI-quantum architecture designed for resilient and adaptive smart water systems, accelerating measurable progress toward SDG 6, particularly in underserved and resource-constrained regions.

**Keywords:** Quantum Computing, Artificial Intelligence (AI), Water Purification, Pollution Control, Sustainable Development Goal 6 (SDG 6), Real-Time Decision-Making.

*OP15: Forecasting Techniques for Operations Research*

# An Analysis of Metropolization and High Capacity Transportation of Brazil Via Clustering Methods

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**Abstract**

High-speed systems and networks are the most important elements of transportation infrastructure and city. It is an infrastructural concept that is related to high standard and high technology services. Urbanization, digitalization and sustainability are mobility phenonema of 21st century. Metropolization and high technology mobil systems are integrated issues to each other strongly. This systematic has a critic role for tourism attractiveness. In this paper, a cluster-based analysis was conducted for Brazil, which is on a strong point about big metropolitans by using population, gross domestic product, livability through cluster statistical methods. Metropolization trends were presented by taking into account the agglomerations between cities. Lastly results and suggestions were given in this context.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy

*OP15: Forecasting Techniques for Operations Research*

# Assessing Metropolization and Peripheral Trends in Indonesia through Cluster Analysis

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**Abstract**

High-speed systems has emerged as a significant dynamic of modern transport that offers high-speed, high-capacity, and high-comfort mobility through urbans. Beyond its functional benefits, high speed plays a strategic role in enhancing regional tourism attractiveness and advancing sustainable transportation policies. It also holds significant potential for supporting socio-economic development in emerging economies. This study presents a cluster-based analysis focused on Indonesia—a country that has not yet implemented a high-speed rail system. Using important indexes such as population and city livability, clustering methods were applied to specify potential urban metropolization arrange for high speed development. Based on the competitive distances of integrations, proposals were done for connection of these clusters. The findings offer practical minds and offers to enlighten future infrastructure plan and policy decision related with sustainable intercity metropolization.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy

*OP16: Emerging Trends in Science, Business and Technology Innovation*

# Leveraging Artificial Intelligence for Enhancing Data Security in Contemporary Communication Networks Through Advanced Encryption Methods

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## Abstract

With the advent of hyper-connected systems and dynamic cyber threats, secure and efficient data transmission within the contemporary communication networks has become paramount of priority. The solutions that are offered by this paper are a hybrid intelligent scheme that comprises Deep Q-Network (DQN), a deep reinforcement learning method, and NTRU, a lattice-based public key encryption algorithm, to strengthen data security in dynamic network scenarios, including those of Mobile Ad Hoc Networks (MANETs) and the Internet of Things (IoT). The main idea is that the suggested model uses an adaptive learning ability of the DQN to decide in real-time regarding routing and encryption schemes depending on network conditions, such as node density, mobility, the stability of links, and traffic characteristics. At the same time, NTRU provides post-quantum security, efficient encryption and decryption operations, which is applicable to the resource-restrained devices. In order to confirm the designed framework, NS2 extensive simulations were carried out by employing different performance metrics that include throughput, energy consumption, packet delivery ratio and end to end delay. Experiments indicate that the proposed DQN-NTRU hybrid model is more efficient and secure than the conventional encryption algorithm, such as RSA and ECC, in terms of security strength and computation alacrity.

**Keywords:** Deep Q-Network, NTRU Encryption, Secure Communication, Reinforcement Learning, Mobile Ad Hoc Networks.

*OP16: Emerging Trends in Science, Business and Technology Innovation*

# Modeling and Optimization of Campaign-Based Staffing Needs in Call Center Operations

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## Abstract

The efficiency of call center operations is strongly dependent on the accuracy and effectiveness of human resource planning. In campaign-based operations, dynamically forecasting and optimizing future staffing needs is a complex problem. This study presents an integrated modeling approach to forecasting and optimizing staffing requirements for campaign-based call center operations. The developed modeling approach begins with the user inputting fundamental data for a new campaign, such as campaign type, date range, and the number of leads. The model is based on selecting a benchmark campaign from past campaigns and transferring its historical call distribution metrics (weekly, daily, and hourly) to the new campaign through a weighting mechanism. Using the hourly inbound and outbound call forecasts obtained through this method, the required number of staff is optimized using the well-known Erlang C formulation. Key performance indicators such as shrinkage rate, maximum occupancy, service level target, and average speed of answer are used as parameters in the optimization process. In the study, an interactive interface is also developed that allows users to modify these parameters on a scenario basis flexibly, create different optimization scenarios, and analytically examine the results. Consequently, the proposed model significantly contributes to increasing operational efficiency. Initial comparisions with as is system demonstrated that this data-driven approach can reduce costs associated with overstaffing by up to 15% compared to static planning methods. The results show that customer interactions are handled effectively, thereby helping to maximize the campaign's overall success rate. The proposed modeling approach provides call center operations managers with a powerful tool to shape future campaign plans effectively.

**Keywords:** Call Center, Workforce Planning, Workforce Optimization, Erlang C, Capacity Planning, Forecasting Modeling

*OP16: Emerging Trends in Science, Business and Technology Innovation*

# A Heuristic Method for The Generalized One-to-One Pickup and Delivery Vehicle Routing Problem

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**Abstract**

Generating appropriate routes for vehicles that meets customer demands is the goal of the Vehicle Routing Problem (VRP), which is a crucial kind of problem in the transportation sector. VRP is studied under different versions, one of which is the Pickup and Delivery Vehicle Routing Problem (PDVRP) where demands of customers for both pickup and delivery are considered. There are three categories of this problem, based on demand type and route structure: one-to-many-to-one problems, many-to-many problems, and one-to-one problems. In one-to-many-to-one problems, products at the depot must be delivered to the customers and products from the customers must be transported back to the depot. In many-to-many problems, a node can be origin or destination for several products, but in one-to-one problems, there is a single origin and destination for each product. This paper introduces a general version of one-to-one problems where a customer can be both a pickup and delivery node, and multiple vehicles are allowed to depart the depot with products and return with undelivered products. Since PDVRP is a variant of VRP which is an NP-hard problem, a heuristic method is developed based on Local Search algorithm to find optimal or near-optimal solutions to the problem in a short time. Solutions found with heuristic method are compared to the results of a mathematical model from the recent literature. Computational experiments indicate that in 15 out of 45 test instances, our heuristic method found optimal solutions in less than one second and competitive solutions in rest of the instances.

**Keywords:** Heuristic, Local Search, Logistic and Supply Chain Management, One-to-one Pickup and Delivery, Transportation, Vehicle Routing Problem.

*OP16: Emerging Trends in Science, Business and Technology Innovation*

# Dynamic Omni-Channel Fulfillment with Switching Customers

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## Abstract

Technological advancements have reshaped how customers interact with retailers, increasing their tendency to switch between sales channels. While omni-channel retailing aims to offer a seamless shopping experience, managing customer switching behavior and its impact on profitability remains a challenge. Omni-channel strategies enhance convenience by allowing customers to purchase and return products through any channel. Customers may place orders online or in-store and choose between home delivery and store pickup, influencing fulfillment costs and profit margins. Common practices include Buy-Online-Ship-to-Home (BOSH), Buy-Online-Pick-up-in-Store (BOPS), Buy-in-Store-Ship-to-Home (BSSH), and Buy-in-Store-Pick-up-in-Store (BSPS). We examine these four omni-channel strategies and address how retailers can effectively manage fulfillment operations to control associated costs and profits. Customer switching behavior is modeled based on the initial channel selection. Some online shoppers visit physical stores to examine products before purchasing, while some in-store shoppers switch to online channels, often seeking better prices. The fulfillment process and associated profits vary depending on where the order is placed and fulfilled. Customers pay for products at the time of order placement. Fulfillment choices directly affect profitability, as home delivery incurs handling and shipping costs, while in-store pickup may not. This study addresses two key questions: (1) What is the optimal fulfillment strategy for a retailer offering BOSH, BOPS, BSSH, and BSPS under customer switching behavior? (2) How do different omni-channel strategies impact sales and profits? We propose a dynamic programming framework to optimize fulfillment decisions, accounting for demand and shipping cost uncertainties. Our findings highlight optimal strategies and offer insights through numerical experiments.

**Keywords:** Omni-channel retailing, ship-to-home, in-store pick up, customer switching behavior.

*OP17: Mathematics, Computation and Complex Systems*

# Exponential Approximation for Lp (D), p>0

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**Abstract**

The major target of this paper is to study the approximation properties by using the definition L_p (D). In many applications we need various types of operators to solve many problems in real life such as electronic problems & engineering problem or problems in image processing. Therefore, many researchers have studied this topic from different perspectives. Hence, it is meaningful to present and introduce an exponential operator and study its L_p (D) approximation properties. Finally, We got some results in approximation such as upper estimate, voronovskaya type and exact estimate formula and this work can be extend to other related topics.

**Keywords:** Exact estimate, upper estimate, approximation properties, complex exponential kind operator, and Voronovskaya formula.

*OP17: Mathematics, Computation and Complex Systems*

# Detection of Outliers via Extended Form of Conformal Robust Neural Network with Stochastic differential equations

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**Abstract**

Conformal robust neural network is one of the recent approaches used to detect outliers. On the other hand, this approach has certain limitation when the data is discrete. In this work, we have tried to overcome this limitation by inserting stochastic differential equation so that the underlying regression can convert the discrete data to continuous form. Furthermore, we embed the conformal prediction in the calculation in order to improve the detection of outliers in the data. Additionally, we suggest the stochastic differential equation (SDE), more specifically, Brownian motion, within the robust feed-forward neural network with conformal prediction. Therefore, we evaluate the performance of proposal strategy with and without conformal prediction with SDE under different numbers of parameters, i.e., predictors in the construction of the conformal robust neural network, and different numbers of observations. The simulation results indicate the promising gain in accuracy under given scenarios. Under regression SDE produce better results to detect outlier under all parameters and sample sizes. Whereas classification model, split conformal prediction is better results than SDE to finding outlier all selected cases.

**Keywords:** Conformal prediction, Robust neural networks, Outlier detection, Stochastic differential equations.

*OP17: Mathematics, Computation and Complex Systems*

# E-Values Multiple Testing for Conformal Prediction on Biological Networks

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## Abstract

Conformal prediction (CP) is a statistical framework for uncertainty quantification that generates valid prediction regions for any underlying point predictor, relying solely on the assumption of data exchangeability. Conformal predictors yield set-valued or functional predictions that remain valid under the assumption of randomness, specifically when data are independently and identically distributed. Biological networks are highly intricate systems that capture the interactions and relationships among biological entities such as genes, proteins, and cells. They serve as a powerful framework for elucidating the complex mechanisms underlying biological functions and systems. Nevertheless, conducting inference in high-dimensional biological networks poses significant computational challenges. Multiple testing arises in contexts where several hypotheses are evaluated simultaneously. When decisions regarding individual hypotheses rely on unadjusted marginal p-values, the probability of incorrectly rejecting true null hypotheses increases substantially. To mitigate these challenges, we propose the integration of conformal prediction methods into biological network analysis. Furthermore, we evaluate the performance of a proposed e-values-based multiple testing procedure across varying sample sizes and parameter settings in both scale-free and random biological networks.

**Keywords:** graphical models, conformal prediction, multiple testing procedure.

*OP17: Mathematics, Computation and Complex Systems*

# Digital Twin-Driven Energy Management for Hybrid Renewable Microgrids

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**Abstract**

This paper presents a Digital Twin (DT)-enhanced energy management system for real-time operation of hybrid renewable microgrids. The proposed system builds a cloud-platform DT model to connect the physical components of the microgrid which includes solar photovoltaic (PV) systems and battery energy storage systems (BESS) diesel generators (DG) and dynamic electrical loads. The DT analyses microgrid real-time data in a continuous fashion to produce control methods that optimize both the system performance and enhance its efficiency and reduce costs. The energy management procedure commences through data acquisition when the DT tracks vital indicators that involve BESS state of charge (SoC) together with PV output and electricity rates and power consumption demand. Real-time measurements produce simulations which model the operating state of the microgrid to optimize the way energy flows through it. Inside the DT optimization algorithms determine how renewable energy sources and storage control and grid activities should be managed to deliver the lowest energy expenses combined with steady power availability. The DT implements a dynamic feedback control loop to relay its commands to the physical microgrid infrastructure by using OPC Unified Architecture (UA) protocols. The system executes three key actions to respond to rapidly changing conditions which include BESS operations for charging and discharging and the control of distributed generators and the adjustment of connected loads. This system showed its effectiveness through testing which proves its ability to both stabilize power grids and effectively merge renewable systems and maintain sustainable microgrids.

**Keywords:** Digital Twin, Energy Management, Hybrid Renewable Microgrid, Optimization Algorithms, Battery Energy Storage System (BESS).

*OP17: Mathematics, Computation and Complex Systems*

# A study for assessing the potential breakdown of a boiler tank transporting dangerous goods during an emergency impact.

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**Abstract**

The study examines the scenario of a railway tank car boiler subjected to impact loading under emergency conditions, specifically during derailment and subsequent fall onto the railway track. Such an accident may result in boiler rupture, release of hazardous cargo, and ignition. The methodological framework addresses three key objectives: establishing a procedure for analyzing the stress–strain state (SDS) of a cy-lindrical shell in the elastic regime; developing an approach to evaluate the deformation energy of the boiler shell upon attainment of the yield stress in the localized impact zone; defining criteria for the initiation of the limiting state associated with shell failure. The mechanical response of the shell is described through the moment theory of shells, incorporating nonlinear stress–strain dependencies. The governing system of equations is derived from energy-based principles formulated within the framework of Lagrange's variational principle. The limiting state is defined by the condition of material separation along the perimeter of the impactor. The solution process involves applying numerical methods to a nonlinear system at the initial stage and to a transcendental equation at the subsequent stage. The proposed approach offers a foundation for developing protective strategies, particularly with respect to the attachment of auxiliary structural elements to the boiler

**Keywords:** Shell; deformation; yield point; deformation energy; outer force work; Lagrange principle; shunting collision, method of characteristics

*OP18: Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems*

# Enhancing Delivery Reliability Through Simulation-Based Production Time Estimation

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## Abstract

Accurate estimation of production times is essential for reliable delivery planning in manufacturing systems. This study develops a simulation model of a fastener manufacturing company to address inaccuracies in production time estimation that often cause delivery delays. The model, created using Arena simulation software, represents the entire production flow from raw material input to the dispatching of finished products. In the first scenario, the company's actual system was simulated. Three scenarios were analyzed to examine the impact of stock availability: (i) both raw materials and finished products available according to historical probabilities, (ii) raw materials always available, and (iii) no finished product stock, requiring production to start from raw materials. In the base case, average production times were 37.27 hours for bolts, 54.95 hours for nuts, and 81.36 hours for washers, with a total monthly output of 714 tons. Scenario comparisons highlighted the strong influence of stock conditions on efficiency, particularly the delays caused by subcontracted washer production in the absence of finished product stock. Validation against real production data confirmed the model's reliability, with minimal deviations observed. Overall, the study demonstrates that simulation can provide realistic and consistent production time estimates, offering the company a decision support tool for improving planning and delivering accurate customer commitments.

**Keywords:** Production time estimation, Simulation, Manufacturing planning, Stock availability, Fastener manufacturing.

*OP18: Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems*

# Integrating HAZOP and Dynamic Bayesian Networks for Maintenance Optimization of Complex Systems

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## Abstract

Many industrial environments include complex, multi-component systems where only partial observations are available. Unexpected failures within such systems can lead to substantial financial losses, making the development of effective maintenance strategies a critical concern. However, the intricate interactions and dependencies among system components can significantly complicate the formulation of optimal maintenance policies. To overcome these challenges, accurately modeling the structural and functional relationships within complex systems becomes essential. In this context, Hazard and Operability Analysis (HAZOP) plays an important role as a systematic, structured, and qualitative technique that identifies potential deviations, hazards, and operational risks within industrial processes. By uncovering possible failure scenarios and their causes, HAZOP provides a solid foundation for proactive risk mitigation and maintenance planning. Meanwhile, Bayesian Networks (BNs) offer a powerful approach for representing and analyzing complex interdependencies through conditional probability modeling. Extending this capability, Dynamic Bayesian Networks (DBNs) further incorporate temporal changes in system behavior, such as degradation and aging, enabling more realistic and dynamic reliability and maintenance assessments. Together, these methods enhance decision-making by enabling comprehensive risk evaluation and optimized maintenance strategies for complex industrial systems. In this study, we address the maintenance challenges of a complex system composed of numerous interacting and partially observable components. By leveraging the HAZOP methodology, the overall structure is systematically decomposed into several subsystems through expert guidance and targeted questioning aimed at identifying critical operational deviations and risks. The components and cause-and-effect relationships within the selected system are identified using HAZOP analysis to better understand the interactions and dependencies. These relationships are then combined with the degradation behaviors of the components and represented through DBNs, also considering maintenance actions, enabling a probabilistic and time-dependent analysis of system performance. The costs of maintenance actions and downtime are determined, and the maintenance process is subsequently simulated using the developed integrated HAZOP-DBN framework with the objective of minimizing the total maintenance cost. The results show that the proposed methodology adequately reflects real-world behavior and enables cost-effective maintenance decisions under various conditions.

**Keywords:** Multi-component Maintenance, HAZOP, DBN

*OP18: Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems*

# Applications of Machine Learning Models in Multi-Criteria Decision-Making with Pairwise Comparisons

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## Abstract

In the current era—defined by data and artificial intelligence (AI)—the integration of AI-based tools into diverse applications and decision-making con-texts has grown markedly. In particular, opportunities exist to automate the construction of pairwise comparison matrices using empirical data and ma-chine learning algorithms. In this paper, a data-driven decision-making framework is proposed, comprising three sequential phases. In the first phase, the decision maker (DM) employs two machine learning techniques—Principal Component Analysis (PCA) and Random Forest—to identify and select the most relevant decision criteria. In the second phase, once non-essential criteria have been removed from the dataset, another machine learning model—the Bradley-Terry model—is utilized to uncover decision-maker preferences and generate pairwise comparisons among the selected criteria. In the third phase, the extracted comparisons are then fed into a Multi-Criteria Decision-Making (MCDM) method to complete the decision-making process. The proposed approach was applied to a case study involving mobile phone selection, using a real-world dataset containing specifications and features of various smartphone models. The results demonstrated high-quality decision outcomes, highlighting the effectiveness of the frame-work. Overall, the study confirms that AI and machine learning techniques can significantly enhance both the efficiency and accuracy of preference learning and criteria selection in pairwise comparison-based MCDM methods.

**Keywords:** Decision-Making, Multi-Criteria Decision-Making, Artificial Intelligence, Machine Learning, Pairwise Comparisons

***OP18: Computational Intelligence and Decision Optimization for Reliability and Maintenance Systems***

# Probabilistic and Decision-Theoretic Approaches for Maintenance Optimization

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**Abstract**

Modern industrial systems comprise several interdependent components operating under uncertainty and partial observability. The dynamic and stochastic nature of degradation processes, coupled with limited system observability, poses significant challenges to developing cost-effective and reliable maintenance strategies. To address these issues, various probabilistic graphical models (PGMs) and decision-theoretic modeling frameworks have been developed in the literature, each offering unique perspectives on representing uncertainty, system dynamics, and optimal decision-making. PGMs model probabilistic dependencies among system variables, allowing for reasoning about uncertainty and failure propagation. Meanwhile, decision-theoretic models extend these probabilistic structures by integrating actions, rewards, and objectives to support optimal decision-making under uncertainty. This study aims to comparatively evaluate the capabilities of Bayesian networks (BNs), dynamic Bayesian networks (DBNs), Markov decision processes (MDPs), partially observable Markov decision processes (POMDPs), and factored POMDPs in the context of maintenance modeling and optimization. The comparative analysis highlights how these methods differ in representational power, computational complexity and suitability for various maintenance scenarios. While BNs and DBNs are efficient for probabilistic diagnosis and prediction, approaches utilizing MDP and POMDP models offer optimization capability built upon the same probabilistic foundations. The study provides guidance on selecting and applying appropriate probabilistic and decision-theoretic models for modeling and optimizing maintenance in complex, multi-component systems.

**Keywords:** Maintenance Optimization, Probabilistic Graphical Models, Decision-Theoretic Models

*OP19: Data-Driven Governance, Organizational Performance & Digital Communication*

# Artificial Intelligence in Criminal Justice: Examining Legal, Ethical, and Social Impacts

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## Abstract

The integration of artificial intelligence (AI) technologies into the criminal justice system is progressing rapidly, often outpacing our comprehensive understanding of its legal, ethical, and social ramifications. While AI offers significant potential for enhancing procedural efficiency, its deployment necessitates a critical assessment of its impact on fundamental principles of justice. This study aims to explore the dual impact of AI tools—specifically in risk assessments and sentencing practices—by examining their capacity to streamline legal procedures alongside the challenges they introduce concerning fairness, transparency, and accountability. Employing a mixed-methods approach, we analyze quantitative data from 570 instances of AI usage in case processing and qualitative data gathered through interviews with 40 legal professionals. Our analysis focuses on three key variables—Sentencing Time Deviation, Risk Assessment Bias Coefficient, and Regulatory Compliance Index—to empirically test the hypothesis that AI enhances efficiency while simultaneously raising significant ethical and legal concerns. The findings confirm a statistically significant reduction in processing times but also reveal persistent, quantifiable biases in risk assessment outcomes, particularly across demographic groups. Furthermore, a comparative review of regulatory frameworks across jurisdictions highlights the urgent need for standardized, transparent governance structures to ensure that AI-driven systems promote equitable and accountable justice.

**Keywords:** Artificial Intelligence (AI), Criminal Justice, Legal Technology, Sentencing, Risk Assessment, Procedural Efficiency, Algorithmic Fairness.

*OP19: Data-Driven Governance, Organizational Performance & Digital Communication*

# Econometric and Computational Modeling of Corporate Governance and Firm Performance in Emerging Markets

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## Abstract

Corporate governance plays a critical role in shaping firm performance, especially in emerging markets where regulatory systems are still evolving. This study develops an econometric modeling approach to examine how governance structures—such as board independence, ownership concentration, investor protection, and disclosure quality—affect financial outcomes. Using a mixed-methods design, the analysis combines quantitative financial data with qualitative insights from governance frameworks. Regression equations and structural models were employed to link governance indicators with key performance metrics, including Return on Equity (ROE), Return on Assets (ROA), Tobin's Q, and measures of agency costs. Results show that firms with more independent boards and stronger shareholder protections achieve higher ROE and ROA, while disclosure quality and investor protection significantly improve market valuation. Governance reforms, such as the creation of independent board committees, were also found to reduce agency costs compared to traditional structures. By integrating socio-legal context with data-driven econometric analysis, the study provides practical insights for policymakers, regulators, and corporate leaders seeking to strengthen governance systems, enhance transparency, and promote sustainable growth in emerging economies.

**Keywords:** Corporate Governance, Firm Performance, Emerging Markets, Board Independence, Econometric Modeling, Governance Reforms.

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# Computational Assessment of Gender-Inclusive Leadership as a Strategic Asset: Implications for Corporate Governance and Financial Performance

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## Abstract

This study investigates the impact of gender diversity in corporate leadership on business performance, using a panel of 570 publicly listed firms from six industries over five years. It employs fixed-effects regression, instrumental-variable estimation, and dynamic system models to assess whether greater female representation among executives correlates with enhanced financial, operational, and market outcomes. The analysis includes key performance metrics such as return on equity, earnings per share, revenue growth, total shareholder return, and economic value added, with control variables including firm size, leverage, board independence, and market volatility. The findings reveal a robust positive relationship between increased female executive participation and improved firm performance, particularly in knowledge-intensive sectors such as technology and healthcare. These results suggest that gender-inclusive leadership structures not only promote social equity but also contribute meaningfully to corporate financial health and market competitiveness, offering a strategic advantage for firms focused on long-term value creation and governance resilience.

**Keywords:** Gender Diversity; Corporate Leadership; Firm Performance; Financial Metrics; Governance Resilience; Panel Data Analysis.

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# A Data-Driven Framework for Evaluating Non-Profit Sector Performance: Integrating Multidimensional Metrics and Stakeholder Engagement

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**Abstract**

Performance measurement in non-profit organizations (NPOs) presents unique challenges due to the sector's multidimensional goals, diverse stakeholders' expectations, and reliance on both financial and non-financial resources. Traditional evaluation approaches often fail to capture critical aspects such as volunteer contributions, donor loyalty, and program alignment. This study develops and validates a data-driven, multidimensional framework for evaluating non -profit performance. The model incorporates modified and weighted metrics: Administrative Cost Ratio (ACR), Program Efficiency (PE), Donor Retention (DR), Volunteer Engagement (VE), and Stakeholder Satisfaction (SS), to provide a more realistic assessment of operational effectiveness. Data were collected from 50 NPOs across healthcare, education, environmental advocacy, social work, art and culture, humanitarian aid, and research sectors. The updated measures were fairer in measuring use of resources and sustainability of connections. The metrics were normalized, weighted, and analyzed to ensure comparability and fairness across organizations. The results suggest that NPO performance should be assessed from a multidimensional and evidence-based perspective, integrating financial efficiency, mission alignment, and stakeholder-focused outcomes. The framework provides a flexible, evidence-based solution for evaluating non-profit performance, with practical implications for funders, board members, and policymakers. It also paves the way for higher-tier data-driven performance evaluation solutions in the non-profit sector.

**Keywords:** Non-Profit Organizations, Performance Evaluation, Data-Driven Framework, Multidimensional Metrics, Stakeholder Engagement, Entropy Weighting.

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# Algorithmic Authority and Contractual Sovereignty: Legal and Social Implications of AI Negotiation Systems Across Jurisdictions

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## Abstract

The use of Artificial Intelligence (AI) in contract negotiation is stretching the limits of legal automation and raising important ethical and legal questions. The study evaluates five popular AI-driven contract platforms: LexAI, ClauseBot, LegalMind, JurisDraft, and SmartClause5, in five contract types (leasing, employment, procurement, IP licensing, NDAs). As part of a multi-dimensional approach, the research evaluates the performance of platforms in clause amendment, draft throughput, enforceability calibration, multi-party negotiation support and transparency. A series of refined equations and indices were developed to measure the operational and semantic reliability of each of the vehicles under negotiation stress. The results further demonstrate that systems with the more advanced natural language processing and adaptive semantic modeling technology, including LegalMind and LexAI, performed better than the rest in producing legally coherent and enforceable agreements in the shortest possible time frames. However, there were substantial differences in jurisdictional transferability, traceability, and bias sensitivity, highlighting ongoing shortcomings in existing AI frameworks. It's yet another reminder of the need for human oversight and ethical control of automated legal decisions. The findings from this study suggest that although AI can produce significant efficiencies in contracting contexts, such technology should continue to be limited to hybrid model approaches involving machine-generated output and legal review. The results support the adoption of standard auditing procedures and indicate the relevance of aligning algorithmic power with de jure expectations. Future work is also needed to investigate enforcement outcome in the field, inter-cultural negotiation dynamics, and the development of AI legal agency.

**Keywords:** AI Contract Negotiation; Legal Automation; Enforceability; Transparency; Algorithmic Law; Ethical Governance.

*OP20: AI-Driven Optimization and Intelligence in Modern Logistics*

# Automated Dimensional Measurement for Logistics Using Computer Vision and Deep Learning

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## Abstract

Accurate and reliable acquisition of product dimension and weight data is critically important for solving planning and optimization problems in logistics management. Traditional manual measurements performed by operators result in significant time costs and lead to errors in measurement accuracy. This situation causes inefficiencies in efforts aimed at improving storage, packaging, and shipping operations. Therefore, this study investigates the use of image processing algorithms and artificial intelligence-based models for the dimensional measurement of products in industrial environments. In this context, object boundaries were first detected using classical edge detection algorithms such as Canny, Sobel, and Prewitt, and geometric features were extracted. Subsequently, Convolutional Neural Network (CNN) based architectures were implemented to improve the accuracy of edge detection, segmentation, and dimensional estimation processes. Numerical results demonstrate that deep learning-based methods outperform traditional image processing techniques. These models provide higher robustness against illumination variations, background noise, and perspective distortions. Additionally, the proposed approach reveals that the combined use of computer vision and deep learning significantly enhances measurement accuracy, speed, and consistency. By reducing the time cost of measurement processes, the proposed system enables real-time digital recording of product dimensions, minimizes the need for manual verification, and supports data-driven warehouse management.

**Keywords:** Image Processing, Deep Learning, Computer Vision, Warehouse Management, Dimension Measurement

*OP20: AI-Driven Optimization and Intelligence in Modern Logistics*

# Comparative Analysis of Transformer-Based Language Models for Candidate-Job Matching in Logistics Industry

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**Abstract**

Human resources management involves complex processes regarding resume screening, candidate evaluation, elimination and hiring decisions. For a logistics service provider company, the effectiveness of recruitment processes is critical to improving both operational efficiency and competitive advantage. For this reason, companies benefit from analytical solution approaches to solve CV evaluation-related problems such as candidate-position matching, skill analysis, experience scoring and competency assessment. In recent years, transformer-based language models have demonstrated high performance in natural language processing tasks. However, comparing different usage paradigms of transformer models (pre-trained, fine-tuned, and generative) in solving the candidate–job matching problem in terms of performance, cost, and explainability is of critical importance. At this point, transformer-based approaches can be classified into three categories: pre-trained models, fine-tuned models, and generative large language models. Numerous approaches can be employed to address candidate–job matching problems, including text-mining-based techniques, classification algorithms, and transformer-based models. In this study, candidate scoring decisions based on CV samples received by a logistics company are analyzed using a pre-trained Sentence-BERT model, a fine-tuned BERT model, and generative large language models accessed via Azure AI Foundry. These approaches are compared in detail in terms of accuracy, inference speed, training cost, operational cost, explainability, and overall performance.

**Keywords:** Transformer Based Models, CV Evaluation, Large Language Models, Logistics Sector, Candidate-Job Matching

*OP20: AI-Driven Optimization and Intelligence in Modern Logistics*

# A Decomposition Approach for the Travelling Salesman Problem with Time Windows and Non-Linear Energy Consumption

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**Abstract**

The energy-efficient routing of electric vehicles has been studied for the last two decades [1]. We propose an extension of the Travelling Salesman Problem with Time Windows (TSP-TW) with an electric vehicle and energy consumption, namely the Electric TSP-TW (ETSP-TW). The energy consumption is modelled using a nonlinear function [2], considering the speed as a decision variable. Hence, we propose a mixed integer nonlinear formulation for the ETSP-TW, whose goal is to minimise the energy and routing costs. Unlike most existing approaches that rely on linearisation, we preserve the non-linearity by representing the framework as a two-stage decision problem. The first-stage problem corresponds to the classic TSP that provides a feasible routing solution, aimed at minimising the routing costs. The second-stage problem is related to the definition of the speed along the arcs, and the verification of the time windows constraints. We solve the problem using an exact decomposition-based approach [3], introducing two different types of cuts. Our computational experiments on synthetic and benchmark instances show the effectiveness of the proposed approach.

**Keywords:** Travelling Salesman Problem, Electric Vehicle, Non-Linear Energy Consumption, MINLP.

*OP20: AI-Driven Optimization and Intelligence in Modern Logistics*

# An Analysis of Metropolization and High Capacity Transportation of Brazil Via Clustering Methods

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## Abstract

High-speed systems and networks are the most important elements of transportation infrastructure and city. It is an infrastructural concept that is related to high standard and high technology services. Urbanization, digitalization and sustainability are mobility phenonema of 21st century. Metropolization and high technology mobil systems are integrated issues to each other strongly. This systematic has a critic role for tourism attractiveness. In this paper, a cluster-based analysis was conducted for Brazil, which is on a strong point about big metropolitans by using population, gross domestic product, livability through cluster statistical methods. Metropolization trends were presented by taking into account the agglomerations between cities. Lastly results and suggestions were given in this context.

**Keywords:** Clustering analysis, urban, high speed, tourism, economy

*OP20: AI-Driven Optimization and Intelligence in Modern Logistics*

# AI-Driven drug discovery: Accelerating the identification of Novel Therapeutics Using Artificial Intelligence

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## Abstract

Drug discovery of new therapeutics, although critical to human health, is an inherently long and resource-intensive process that tends to rely on high-throughput screening and computational methods, such as Quantitative Structure-Activity Relationship (QSAR) modeling. Nevertheless, both QSAR and high-throughput screening fall short in their ability to move quickly and offer uniqueness. This paper presents an approach that is powered by reinforcement learning (RL) and a multi-layer perceptron neural network called deep Q-network (DQN) for accelerated identification and, ultimately, optimization of new drug candidates. By utilizing AI-based algorithms, our approach is capable of operating in vast chemical spaces, producing new molecular structures, and optimizing various attributes, such as potency, selectivity, and drug-likeness, all at the same time. The RL agent is trained with a dynamic reward function, balancing competing objectives such as maximizing binding affinity while minimizing toxicity. Our results show that the approach outlined in this paper outperforms conventional methods, yielding an accuracy of 91.2% in molecular property predictions and a 40% increase in the novelty of molecules compared to both traditional QSAR and high-throughput screening methods and conventional chemists. Furthermore, the output of this model can produce new drug-like molecules in less than five minutes per iteration, laying a novel approach to accelerating drug discovery, the optimization of molecular attributes, and neglected diseases.

**Keywords:** AI-Driven Drug Discovery, Reinforcement Learning (RL), Deep Q-Network (DQN), Molecular Optimization, Generative Models.

*OP21: Computational Law, Governance, and Political Economy in the Digital Age*

# The Evolution of Digital Privacy Laws: Social, Legal, and Ethical Implications in the Age of Big Data

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## Abstract

The rapid proliferation of digital technologies and the explosion of big data have fundamentally altered the landscape of individual privacy, creating a regulatory gap where the pace of legal adaptation lags significantly behind technological innovation. This study addresses the urgent need for a more adaptive and effective regulatory framework by exploring the determinants of digital privacy enforcement outcomes across diverse global jurisdictions. Using a robust mixed-methods approach, we analyzed 200 enforcement cases from 15 jurisdictions, 120 regulatory documents, and 45 in-depth expert interviews. We employ a Logistic Regression Model to identify the factors most significantly associated with the imposition of high penalties, thereby providing a predictive framework for regulatory effectiveness. Our findings reveal that the severity of the breach, the size of the company, and the frequency of repeat violations are the most critical drivers of penalty levels. Furthermore, comparative analysis highlights that jurisdictions with adaptive frameworks and a strong commitment to enforcement, such as those adhering to GDPR principles, achieve the highest compliance rates. This research offers a structured guide for policymakers and legal practitioners, providing empirical evidence and best practices to inform the development of scientifically rigorous, equitable, and forward-looking digital privacy regulations that can effectively govern emerging technologies like Artificial Intelligence and cross-border data flows.

**Keywords:** digital privacy, compliance, GDPR, data protection, enforcement patterns, penalty severity, predictive modeling, cross-jurisdictional analysis.

*OP21: Computational Law, Governance, and Political Economy in the Digital Age*

# Mass Surveillance and Human Rights: Legal Challenges in the Digital Era

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## Abstract

Mass surveillance is expanding rapidly, with some regions expected to generate 800 terabytes of data annually, escalating concerns over human rights. This study investigates the complex relationship between state surveillance practices and privacy protections, aiming to identify key factors that influence the security-privacy equilibrium. Utilizing a multi-method approach that combines legal doctrinal analysis, comparative legal studies, and empirical data evaluation from over 50 surveillance programs and 200 legal documents, this research assesses the impact of legal oversight, public awareness, and technological measures on privacy outcomes. Our findings reveal a strong correlation between robust, independent oversight mechanisms and a reduction in privacy violations; countries with strong oversight report 30% fewer violations and amend privacy laws twice as fast. Conversely, laissez-faire regulatory approaches are associated with a higher surveillance-to-privacy ratio. Statistical modeling further confirms that each unit increase in oversight strength corresponds to a significant reduction in reported privacy violations. The study concludes that a combination of strong legal frameworks, enhanced public awareness, and international cooperation is essential to safeguard human rights in the digital age, advocating for a future where privacy protections are not merely fundamental but actively prioritized.

**Keywords:** Mass Surveillance, Human Rights, Privacy Law, Legal Oversight, Data Protection, Regulatory Frameworks.

*OP21: Computational Law, Governance, and Political Economy in the Digital Age*

# Cognitive Bias and Consumer Behavior: Political Economy Perspectives on Decision-Making in the Digital Age

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## Abstract

This study investigates the influence of five core cognitive biases—loss aversion, anchoring, social proof, framing effect, and impulse buying—on consumer decision-making in the digital marketplace. Employing a structured quantitative methodology, the research analyzed survey data from 300 participants using a multi-attribute behavioral economics model that integrates psychometric validation, logistic regression, and structural path analysis. The findings reveal that social proof and impulse buying are the most potent drivers, significantly increasing purchase probability while reducing decision time. Loss aversion and anchoring also demonstrated significant, though less pronounced, effects. The framing effect's influence was found to be more context-dependent. A key contribution of this research is the empirical validation of a model that quantifies the direct and mediated effects of these biases, with decision-making speed identified as a crucial mediator. The results offer actionable insights for marketers, consumer protection agencies, and policymakers by providing a ranked hierarchy of psychological triggers and underscoring the ethical need for transparency in digital commerce. The study highlights the necessity of integrating behavioral metrics into predictive models of consumer choice and sets a foundation for future research into algorithm-bias interactions and cross-cultural validation.

**Keywords:** behavioral economics; cognitive bias; consumer decision-making; social proof; impulse buying; loss aversion.

*OP21: Computational Law, Governance, and Political Economy in the Digital Age*

# Cybercrime Legislation as a Catalyst for Digital Economic Growth: A Social Science Approach

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## Abstract

Digital transformation has reshaped economic systems worldwide, yet cybercrime continues to undermine financial stability, critical infrastructure, and individual privacy. Existing legislative frameworks remain fragmented and insufficient to manage transnational threats, creating security gaps that hinder sustainable digital economic growth. The study develops a comprehensive framework linking cybercrime legislation with social and economic dimensions to enhance cybersecurity governance and foster digital development. Through comparative legal analysis and empirical case studies from diverse jurisdictions, the paper demonstrates how integrated legislative and economic strategies can strengthen international cooperation, improve law enforcement capabilities, and stimulate technological innovation. The research contrasts successful models from South Korea and the United States with outdated criminal codes in Nigeria and other African contexts, where limited enforcement capacities constrain progress. Findings reveal that effective digital economic growth depends on adaptive, enforceable, and technology-driven legal systems. The study concludes with policy recommendations emphasizing global collaboration, flexible governance, and the strategic use of emerging technologies such as artificial intelligence and blockchain to ensure secure, inclusive, and resilient digital economies.

**Keywords:** Cybercrime Legislation, Digital Economy, Cybersecurity Governance, International Cooperation, Technological Innovation, Policy Development.

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# Data-Driven Modeling of Cross-Cultural Management: Predictive Analytics for Enhancing Global Team Performance

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## Abstract

This study employs a quasi-experimental, longitudinal design to evaluate the causal impact of structured cross-cultural management training on global team performance in multinational enterprises. A total of 320 participants were divided equally into an experimental group receiving six months of targeted training and a control group with no intervention. Data collection integrated structured Likert surveys, automated performance logs, managerial feedback, and interview transcripts, all normalized for comparability across constructs. Core dimensions of leadership adaptability, communication efficiency, conflict resolution, and innovation were operationalized using Principal Component Analysis, achieving high internal consistency (Cronbach's $\alpha > 0.82$). Statistical inference combined paired t-tests, McNemar's test, and regression modeling to quantify treatment effects, with effect sizes calculated for robustness. A predictive multivariate regression framework was applied to model the influence of these constructs on team performance, supplemented by interaction analysis and model fit assessment through Adjusted $R^2$ and AIC criteria. Results demonstrate significant performance improvements among trained teams, including enhanced collaboration, decision-making, conflict resolution, and creativity. The findings provide empirical evidence that cross-cultural training yields measurable, statistically validated outcomes, highlighting the importance of data-driven approaches in human resource and management research. This study contributes methodological innovations through the integration of predictive modeling, multivariate statistics, and cross-cultural theory, offering scalable insights for global leadership development and organizational policy.

**Keywords:** Cross-Cultural Management, Leadership Adaptability, Data-Driven Analysis, Global Team Performance, Predictive Modeling, Decision-Support.

*OP21: Computational Law, Governance, and Political Economy in the Digital Age*

# Cybersecurity and Social Order: Strategies for Combating Internet Crimes in the Global Context

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**Abstract**

The rapid expansion of the Internet has fostered remarkable connectivity and innovation but has also created fertile ground for escalating cybercrimes, including data breaches, phishing, ransomware, and distributed denial of service (DDoS) attacks. These crimes pose severe threats to individuals, businesses, and governments worldwide. This study examines effective strategies for combating global Internet crimes through an integrated approach that combines traditional cybersecurity methods with artificial intelligence (AI) and machine learning (ML) technologies. A comprehensive review of existing cybersecurity frameworks and an experimental assessment of proposed strategies were conducted using simulated and real-world attack scenarios. The results demonstrate that integrating AI and ML significantly enhances the detection, prediction, and mitigation of cyber threats, improving system resilience and threat response time. The study highlights the necessity of adopting proactive, technology-driven approaches to digital protection, emphasizing system hardening, threat intelligence, and user education as essential pillars of global cybersecurity. Ultimately, this research contributes to strengthening cybersecurity frameworks and provides a foundation for developing adaptive strategies to safeguard the digital ecosystem.

**Keywords:** Cybersecurity, Cybercrime, Phishing, Ransomware, Artificial Intelligence, Machine Learning.

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# Balancing Security and Civil Liberties: A Mixed-Methods Analysis of Constitutional Frameworks and Proportionality in Governance

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## Abstract

The tension between national security and civil liberties remains a defining constitutional challenge of the twenty-first century, intensified by terrorism, cyber threats, and global crises. This study employs a mixed-methods approach, combining comparative legal analysis, empirical data collection, and statistical modeling, to examine how constitutional systems reconcile security imperatives with democratic rights. Comparative analysis of frameworks from the United States, the European Union, Pakistan, and Poland identifies variations in judicial oversight, legislative design, and executive accountability. Empirical data were gathered through surveys of 1,200 participants and 60 semi-structured interviews with legal experts and policymakers to capture public and institutional perspectives on liberty–security trade-offs. A theoretical model of proportionality is developed to quantify the balance between security measures, judicial review, threat severity, and their impact on civil rights. Regression analysis validates this model and demonstrates the strong judicial scrutiny and proportional legislative mechanisms significantly enhance constitutional balance. The findings underscore that adaptive constitutional systems, grounded in transparency, proportionality, and accountability, are more resilient in safeguarding both security and fundamental freedoms in evolving global contexts.

**Keywords:** Constitutional Law, National Security, Civil Liberties, Judicial Oversight, Proportionality, Comparative Governance.

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# Cryptocurrency Regulation and Society: Evolving Legal Frameworks in a Globalized Economy

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## Abstract

Cryptocurrency regulation remains a complex and evolving challenge as jurisdictions adopt divergent legal frameworks to balance financial innovation and risk mitigation, leading to inconsistencies in enforcement effectiveness and compliance mechanisms. This study examines the impact of these varying regulatory approaches, from strict prohibitions to legal integration, on illicit cryptocurrency transactions and financial stability. We employ a rigorous multi-method research approach, integrating comparative legal analysis of 47 national regulatory frameworks with a novel computational model. This model utilizes data from blockchain transaction tracking (1.2 million transactions), case studies, industry surveys, and expert interviews to empirically assess regulatory impact on compliance effectiveness. Findings show that China's strict ban led to the highest reduction in illicit transactions (65.4%), while Switzerland's flexible regulatory framework achieved a significant 56.8% decrease. The United States and European Union displayed similar effectiveness ($\sim 58\%$), though regulatory fragmentation remains a challenge. We conclude that a balanced regulatory approach, combining robust AML/KYC enforcement with adaptable legal structures, proves most effective in mitigating financial crime while fostering cryptocurrency market development.

**Keywords:** Cryptocurrency regulation, AML/KYC enforcement, blockchain compliance, financial crime, decentralized finance, legal frameworks

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# Open Innovation and Intellectual Property Laws: Social and Legal Perspectives

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## Abstract

The increasing complexity of Intellectual Property (IP) laws has created significant challenges in balancing exclusive rights protection with fostering open innovation ecosystems, particularly in fields like AI and biotechnology. Traditional proprietary IP frameworks often slow down knowledge-sharing and innovation diffusion. This study critically examines the legal, economic, and technological impacts of stringent IP enforcement and explores the effectiveness of alternative adaptive IP frameworks. A systematic review of over 500 legal documents, 3,500 IP lawsuits, and 200,000 patent deposits was conducted, alongside case law analysis and studies on patent pools and open licensing strategies. The findings indicate that excessive IP protection often leads to more legal disputes than innovation. However, non-exclusive licensing models, combined with global patent standardization and blockchain-based IP governance, significantly enhance cross-industry collaboration and R&D efficiency. This study presents a novel adaptive IP governance framework, demonstrating its potential to accelerate technology transfer and reduce legal conflicts. The research provides evidence that such models can increase industry collaboration by 30% and decrease legal disputes by 25%. Policy recommendations are offered to integrate hybrid IP strategies, AI-specific provisions, and decentralized patent tracking systems, ensuring alignment with emerging digital innovation ecosystem.

**Keywords:** Intellectual Property, Open Innovation, Hybrid IP Models, Licensing Frameworks, Blockchain-Based IP, Legal Harmonization

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# Modeling the Effectiveness of Workplace Gender Equality Laws: A Legal, Comparative, and Empirical Analysis

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## Abstract

Gender equality in the workplace remains a global challenge and an agenda for institutional and legal adoption. Weak enforcement, cultural resistance, and a lack of corporate compliance have prevented equitable employment practices from becoming a reality. This study combines doctrinal legal analysis, comparative legal methodology, and econometric modeling to evaluate the effectiveness of workplace gender equality frameworks across jurisdictions. The legal component evaluates international instruments, alongside national labor laws covering anti-discrimination, equal pay, parental leave, and workplace harassment. A comparative lens highlights divergence between countries with strong enforcement mechanisms (e.g., Sweden, Germany) and those with weaker oversight (e.g., Kazakhstan, India). On the empirical side, data were collected from 100 interviews with employees, HR professionals, and legal experts, 500 workplace discrimination cases (2015–2024), and 300 corporate reports on diversity and inclusion policies. Statistical models, including logistic regression and Chi-square tests, were employed to test the hypothesis that stricter legal mechanisms and capable enforcement agencies lead to measurable improvements in gender equality outcomes. The results indicate that rules mandating pay transparency, leadership quotas and enforceable provisions to prevent discrimination effectively shrink gender pay gaps. Cultural biases and weak judicial systems, however, undermine the effectiveness of such policies. Companies that implemented holistic gender equality measures saw faster revenue growth, higher employee satisfaction and lower turnover. Addressing gender inequality must integrate strict enforcement capabilities, intersectional approaches, and corporate accountability-based incentives. Such measures will help achieve equitable workplaces around the world over the long term.

**Keywords:** Gender Equality, Workplace Policies, Employment Law, Comparative Legal Analysis, Empirical Modeling, Doctrinal Legal Research.

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# Globalization and Labor Law Compliance: A Comparative Legal–Quantitative Modeling Framework for Developing Economies

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**Abstract**

In emerging economies, where labor law enforcement is often compliance-averse due to the weak regulatory environment and economic pressures, globalization plays a dual role. While economic integration stimulates industrial development, it also raises risks of regulatory arbitrage and diluted protections for workers. This paper examines the impact of globalization on labor rights by integrating comparative legal analysis with quantitative modeling techniques to assess compliance and enforcement trends across 15 jurisdictions. The study employs a three-part research design: (1) comparative legal analysis of statutory frameworks and labor protections; (2) review of 50 landmark court rulings and international labor treaties; and (3) policy analysis combined with econometric modeling. Using the Comparative Compliance Index (CCI), the Labor Rights Impact Score (LRIS), the Economic Trade-Off Function (ETF), and a regression model, we quantify the relationship between globalization, institutional capacity, and labor law compliance. The findings reveal that countries with strong institutions achieve higher compliance and better outcomes (low CCI, high LRIS), while weak governance correlates with greater violations and reliance on low-cost labor strategies. Sectoral differences are evident, with manufacturing and agriculture facing the largest compliance gaps, compared to higher adherence in service-based industries. Furthermore, countries with labor provisions in trade agreements demonstrate greater compliance with international standards. The article demonstrates that in countries where labor right protections have weakened, the demand for stronger safeguards exists but is undermined by weak institutions. Addressing this gap requires progress on multiple fronts, including institutional reforms, sector-specific policy interventions, and enhanced global governance of labor standards.

**Keywords:** Globalization, Labor Laws Compliance, Comparative Compliance Index, Foreign Direct Investment, Regression Analysis, Developing Countries.

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# Autonomous Weapons Systems under International Humanitarian Law: A Legal–Ethical and Data-Driven Analysis of Modern Warfare

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**Abstract**

This study examines whether existing International Humanitarian Law (IHL) adequately regulates Autonomous Weapons Systems (AWS) and whether new international frameworks are required. AWS are increasingly deployed in modern warfare, yet current IHL frameworks were not designed to govern autonomous decision-making, creating challenges for accountability, compliance, and oversight. Using a mixed methodological approach—combining doctrinal legal analysis, comparative case studies of AWS-related violations from 2010 to 2024, and expert interviews (N=30) with legal scholars, military personnel, and AI ethicists—the study evaluates regulatory gaps, enforcement challenges, and ethical implications in autonomous warfare. Empirical data on AWS deployment trends, legal accountability, and reported violations were analyzed to assess the effectiveness of oversight mechanisms. The results reveal persistent inconsistencies across regulations, limited clarity on accountability, and insufficient ethical safeguards, while observed AWS-related incidents indicate weak enforcement and minimal legal consequences. These findings underscore the urgent need for a binding international treaty, enhanced human oversight, and clear allocation of liability among operators, commanders, and developers. The paper concludes with policy recommendations for improving data transparency, clarifying developer responsibility, and amending existing treaties to ensure AWS remain compliant with humanitarian principles. It further highlights the need for continuous monitoring of autonomous weapons and the potential for empirical assessment of decision-making models to strengthen accountability in autonomous combat.

**Keywords:** Autonomous Weapons Systems (AWS); International Humanitarian Law; Legal Accountability; AI Ethics; Compliance; Human Oversight

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# Quantifying the Role of Customary Law in Environmental Conflict Resolution: A Mixed Legal-Statistical Framework

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## Abstract

Customary law has long served as a mechanism for solving environmental conflicts, especially in communities where indigenous governance plays a central role in land and resource management. However, its recognition and integration with statutory legal frameworks vary across jurisdictions, shaping both its applicability and effectiveness. This study employs a mixed-method framework that combines doctrinal legal analysis, case law review (145 cases), document analysis (250 texts), and structured interviews (100 participants) with statistical modeling and forecasting techniques. Comparative analysis across multiple jurisdictions evaluates the interaction of customary and statutory legal systems, while mathematical models, including regression analysis, success indices, and conflict reduction probability functions, quantify the influence of customary law on dispute resolution and governance effectiveness. Findings reveal that jurisdictions with stronger integration of customary law resolve 78% of disputes successfully and experience a 33% reduction in land and resource conflicts over a ten-year period. Regression results further show that legal recognition of customary law significantly improves governance indicators, while institutional resistance remains a barrier to broader integration. Inevitably, customary law is a powerful but underused tool in the environmental toolbox. Enhancing legal pluralism, enforcement mechanisms, and policy integration could strengthen its role as a tool of sustainable environmental conflict resolution.

**Keywords:** Customary Law, Environmental Governance, Legal-Statistical Modeling, Conflict Resolution, Sustainable Policy Integration, Mixed-Methods Analysis.

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# Human Trafficking in a Globalized World: Legal Strategies and Social Interventions

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## Abstract

International laws, such as those under the Petro-Agreement, exist, they often remain ineffective due to legal loopholes, jurisdictional conflicts, and corruption. The complexity of trafficking networks, increasing cyber-enabled exploitation, and prosecution challenges posed by victims' complicate enforcement. This article seeks to understand the efficacy of legal frameworks in combatting human trafficking, evaluate enforcement disparities between jurisdictions, and identify key predictors of successful prosecutions. It also discusses emerging policy challenges in digital trafficking and ways to harmonize responses. A mixed-methods approach was applied, combining doctrinal legal research, logistic regression of 80 trafficking cases, and 60 expert interviews. The comparative legal analysis provided insights into jurisdictional differences, while the empirical modeling assessed prosecution outcomes, transnational cooperation, and institutional struggles. The findings show that specialized courts, clear legal definitions, and interagency cooperation improve conviction rates, but jurisdictional issues, weak victim protection, and corruption undermine enforcement. The study calls for comprehensive laws on digital evidence and stronger international legal harmonization to improve human trafficking enforcement and prosecution.

**Keywords:** Human Trafficking, Legal Frameworks, Law Enforcement, Prosecution Rates, Victim Protection, Cross-Border Cooperation.

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# Algorithmic Power and Legal Accountability: AI's Role in Reshaping International Arbitration and Institutional Autonomy

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## Abstract

Artificial intelligence (AI) is increasingly reshaping international arbitration, yet empirical evidence on its procedural, institutional, and normative effects remains limited. This article addresses that gap by presenting a multi-dimensional measurement scheme, referred to as the Algorithmic Accountability Index (AAI), to systematically assess AI-fueled efficiencies, transparency mechanisms, institutional readiness, and algorithmic instantiation across fifty contemporary arbitral cases and five leading arbitration institutions. Using matched case analysis and composite indexing, the study demonstrates that AI tools reduce average case length by approximately one-third, with the greatest time savings occurring during evidence review and award drafting phases. Accuracy metrics show that document review and clause extraction consistently achieve F1-scores above ninety percent, and these improvements can be achieved with modest computational overhead. Survey data further reveal that 71% of arbitrators report high trust and reduced cognitive load when AI outputs are accompanied by explainable rationales, highlighting the necessity of transparency and interpretability for adoption. Bias diagnostic tests indicate uneven model performance across jurisdictions and languages, signaling the need for fairness audits and standardized disclosure practices. Overall, the findings confirm that AI can enhance efficiency and analytical depth in arbitral workflows without compromising procedural quality, when validated controls and governance mechanisms—operationalized through the AAI—are applied.

Keywords: International Arbitration, Artificial Intelligence, Procedural Efficiency, Algorithmic Bias, Explainable AI, Governance Frameworks.

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# Judicial Activism and Climate Litigation: A Comparative Doctrinal and Quantitative Legal Analysis (2015–2024)

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## Abstract

Climate change has increasingly shifted courts into a central role in environmental governance, driving a rapid growth of climate-related litigation across diverse legal regimes. This study examines the evolving role of judicial activism in climate policy enforcement and doctrinal innovation through a comparison-based methodology across ten jurisdictions between 2015 and 2024. The methodology integrates doctrinal legal analysis with a multidimensional judicial analytics model, combining case selection indicators, reasoning intensity measures, judicial influence metrics, doctrinal expansion tensors, and temporal efficiency assessments. The study systematically examines how courts interpret and expand environmental rights, enable transnational jurisprudence, and influence the implementation of policies through court judgments. The findings indicate that in countries with strong institutional infrastructure, such as Germany, the Netherlands and France, judicial mandates are more closely aligned with policy enactments. By contrast, in newer legal systems like Pakistan and Colombia, courts display greater creativity in reasoning despite structural limitations. The reliance on scientific evidence, rights-based claims, and intergenerational justice principles enhances judicial legitimacy and strengthens the adaptability of the process. Differences in enforcement timelines and institutional readiness further demonstrate that the existence of sophisticated doctrinal reasoning alone does not guarantee effective outcomes without supportive legal and administrative frameworks. Overall, the research contributes to the literature by providing a comparative, model-based evaluation of how courts reinterpret environmental law and act as catalysts for legal change in addressing global environmental challenges.

**Keywords:** Climate Litigation, Judicial Activism, Computational Legal Analysis, Quantitative Jurisprudence, Environmental Governance, Climate Justice.

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# Legal Pluralism in Multi-Ethnic Societies: Blockchain, Family Law, and Socio-Legal Integration

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**Abstract**

Blockchain is reshaping how agreements are formed, executed, and enforced, yet plural family-law systems in multi-ethnic states pose unique challenges for legal certainty and access to justice. Using a comparative, multidisciplinary design, this study links legal pluralism in family law with the operational realities of smart-contract platforms. We develop and operationalize five instruments—Legal Compatibility Index (LCI), Smart Contract Operational Robustness Metric (SCORM), Regulatory Readiness Surface (RRS), Fuzzy Composite Literacy Index (FCLI), and Hybrid Arbitration Efficacy Index (HAEI)—and apply them across ten jurisdictions and leading blockchain networks. The results show that jurisdictions with proactive legal modernization and judicial responsiveness (e.g., Singapore, USA) exhibit higher compatibility and clearer enforcement paths, whereas formalist or fragmented systems face interpretive uncertainty and remedial gaps. Technically, platforms with high execution reliability and audit transparency are better suited for legal-grade deployment. Hybrid arbitration models that combine institutional enforceability with code-aware workflows outperform purely decentralized or strictly traditional designs. These findings imply that successful harmonization requires coordinated statutory reform, interpretive convergence, sandboxed experimentation, and targeted legal-tech literacy. The paper contributes a replicable framework to evaluate readiness and to guide policy makers, judges, and developers in integrating smart-contract logic into plural family-law environments while safeguarding rights and coherence.

**Keyword:** Smart Contracts; Legal Pluralism; Family Law; Blockchain Governance; Dispute Resolution; Regulatory Readiness.

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# Sustainability and Corporate Environmental Accountability: A Computational Comparative Analysis of Legal Frameworks in Global Perspective

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## Abstract

Corporate Environmental Responsibility (CER) has evolved from a voluntary ethical principle to a mandatory legal obligation across various jurisdictions, with growing emphasis on leveraging computational methods for environmental governance. The article explores the legal underpinnings and practice of CER in ten countries through a multi-method approach, consisting of statutory analysis, regulatory benchmarking, judicial impact analysis, corporate compliance monitoring, and transparency measurement. By integrating qualitative doctrinal analysis with advanced quantitative modeling, including the Weighted Regulatory Saturation Function (WRSF), the study quantifies the impact of legal systems on corporate environmental accountability. Results reveal that jurisdictions with robust statutory frameworks, timely judicial processes, and high public access to legal data demonstrate significant positive correlations with compliance and corporate environmental investment. Industries such as energy, manufacturing, and logistics face the highest legal sanctions, reflecting targeted regulatory pressure, while issues like biodiversity loss and soil degradation remain underexplored in judicial contexts. This study also emphasizes the role of audit frequency, disclosure accuracy, and availability of public legal data as key factors contributing to successful CER implementation. Rates of legal infrastructure and procedural efficiency vary widely among countries, highlighting the importance of ensuring consistent legal reforms and strengthening institutional capacity.

Through a computational comparative legal analysis, this study contributes to the environmental law and corporate governance literature, demonstrating how data-driven legal frameworks influence corporate environmental behavior globally. The need for environmental imperatives to be integrated holistically within the legal, institutional and corporate architecture, for us to effectively move toward sustainable development goals.

**Keywords:** Corporate Environmental Responsibility, Environmental Law, Computational Legal Analysis, Quantitative Regulatory Modeling, Sustainability Governance, Data-Driven Compliance.

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# ESG Integration as a Catalyst for Global Financial and Regulatory Alignment: Computational Modeling and Data-Driven Insights

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## Abstract

The integration of environmental, social, and governance (ESG) factors into corporate strategy has become a central element of financial decision-making. This study examines how ESG performance influences investor preferences and financial outcomes through a computational and data-driven framework. Utilizing a convergent computational framework, the research combines ESG performance data from 500 publicly listed firms with survey responses from 300 investors, split equally between institutional and individual participants. Using advanced exploratory factor analysis (EFA), correlation analysis, and robust regression modeling (at model level and equation level) the paper investigates the independent and simultaneous effects of the ESG dimensions on investor choices. Results indicate a dominant effect of environmental and governance modules on investor reactions, with a very large increase in preference for environmental factors before the level of initial saliency decreases. Sociological components indicate non-linear effects analyzed through computational models, suggesting that balanced ESG practices are most effective in inducing investment interest. The financial efficiency ratios derived from algorithmic processing also suggest that, beyond absolute financial size advantages accruing to high EG performers, higher per-unit returns were often observed in the mid-portion of the ESG commitment range. Findings highlight the strategic merit of computationally enhanced ESG integration into corporate and investment strategies. Additionally, the paper provides a computational methodology for assessing ESG efficiency and advancing the understanding of how sustainability investments generate marginal return. These findings offer an evidence-based and computationally validated foundation for connecting sustainability performance with long-term financial achievement.

**Keywords:** ESG Performance, Sustainable Finance, Investor Behavior, Corporate Strategy, Computational Modeling, Financial Performance.

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# Computational Governance and Financial Decision-Making in Family Enterprises: Data-Driven Institutional Dynamics and Intergenerational Information Systems

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## Abstract

This study examines financial decision-making in family enterprises through the lens of computational governance and intergenerational information systems. Using data from 150 multi-generational family firms across five industries, it integrates survey results with quantitative financial metrics to analyze how ownership control and governance mechanisms influence capital structure, investment strategies, liquidity management, risk mitigation, and succession planning. The findings reveal a strong preference for conservative financial policies, including equity financing, cautious investment allocation, and stable liquidity management. Firms with structured governance systems—such as advisory boards and real-time financial monitoring—demonstrate higher capital efficiency, reduced financial risk, and improved succession preparedness. Cross-generational involvement, supported by information systems, enhances financial continuity and long-term resilience. The study introduces computational performance metrics to assess governance effects on capital efficiency, liquidity stability, and risk management. Overall, it highlights the critical role of data-driven governance and intergenerational alignment in sustaining financial performance and business continuity. The results offer practical insights for policymakers, family business managers, and researchers seeking to strengthen financial governance and ensure sustainable intergenerational transitions.

**Keywords:** Computational Governance, Family Enterprises, Financial Decision-Making, Capital Structure, Data Analytics, risk management.

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# Computational Analysis of Ethical Risks in Global Business Expansion: A Data-Driven Comparative Study Across Political Contexts

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## Abstract

The expansion of multinational corporations into global markets presents both strategic opportunities and significant ethical challenges. Variations in regulatory frameworks, cultural norms, enforcement capacities, and stakeholder expectations create complex environments in which businesses must navigate issues of labor rights, corruption, corporate governance, and environmental sustainability. This study employs a computational and data-driven multidimensional approach to evaluate ethical performance across ten major industries and ten countries, leveraging advanced composite index modeling that incorporates interaction effects, penalty structures, and statistically normalized transparency scaling. By developing computationally refined models for Ethical Compliance, Corruption Risk, Labor Rights, and Environmental Sustainability, the research identifies sector-specific and region-specific vulnerabilities. High-risk sectors such as manufacturing, energy, and logistics demonstrate recurring deficiencies in labor practices and sustainability efforts, while industries such as pharmaceuticals and finance exhibit stronger governance and ethical alignment. Countries with weaker legal institutions and lower corruption perception scores exhibit elevated exposure to bribery and compliance failures. The findings highlight the need for data-driven ethical governance strategies that extend beyond compliance, embedding computational risk management into operational and strategic planning. This approach enables firms to better respond to stakeholder expectations, reduce reputational risks, and contribute to sustainable global development. The study offers practical implications for corporate leaders, policymakers, and scholars aiming to strengthen ethical standards in international business through computational and analytical frameworks.

**Keywords:** Global Business Ethics, Corporate Governance, Corruption Risk, Environmental Sustainability, Computational Modeling, Data Analytics.

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# Data Sovereignty and International Trade Law: A Comparative Legal-Economic Analysis

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## Abstract

This article explores the intersection of data sovereignty and international trade law, focusing on how national data-localization frameworks impact global trade dynamics and digital market competitiveness. As cross-border data flows become essential for economic growth, countries are increasingly asserting sovereign control over digital assets, which creates tensions with international trade obligations. The study examines how countries balance data sovereignty measures with the need for open trade and free movement of digital services. Drawing on a comparative legal analysis of ten jurisdictions, the research integrates multi-criteria decision modeling to assess the effectiveness of regulatory frameworks, enforcement mechanisms, and the economic impact of data policies on digital trade. The results indicate that countries with low-latency networks, treaty-compatible statutes, and frequent legislative updates achieve the highest digital trade performance scores. In contrast, nations with high-intensity localization measures face elevated risks of trade penalties, reduced foreign investment, and significant technical bottlenecks. The study concludes that institutional agility—measured by frequent statutory revisions—emerges as a stronger predictor of compliance and investor confidence than market size alone. Policy recommendations include the need for data-transfer monitoring systems and firm-level network-performance disclosures to support evidence-based regulation and improve international digital governance. This study provides a reproducible framework for future research and policy evaluation, emphasizing the critical role of data sovereignty in shaping the future of global digital trade.

**Keywords:** Data Sovereignty; Digital Trade; Localization; International Trade Law; Compliance; Investment; Governance Maturity.

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# Technological Disruption and Labor Market Resilience: Strategic Imperatives for Workforce Governance in a Globalized Economy

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## Abstract

The accelerated diffusion of automation technologies such as artificial intelligence (AI), machine learning, or robotics has raised questions about the structure of labor markets and the human capabilities required for work in the future. The article examines how the adoption of automation interacts with workforce resilience, whereby reskilling and job transitions help mitigate risks associated with automation that vary across sectors. Adopting a mixed-methods approach, the study makes use of longitudinal data from 2016 to 2024 across five key industries, combining quantitative models and qualitative theme analysis. Key indicators, such as the Automation Adoption Rate, Job Displacement Rate, Reskilling Effectiveness Ratio, and Workforce Resilience Index, were designed to measure the exposure and response for each sector. The results show that job losses through automation are not preordained but can be almost entirely preempted when proactive measures are taken for reskilling. Industry verticals with strong training infrastructures had a greater degree of stability and continuity of labor compared to those that were more reactionary or fragmented. The regression analysis supported the statistical significance of the reduction of displacement from reskilling, and cross-validation between observed and predicted values also showed model reliability. The article has implications for how efforts to integrate technology should be aligned with the human capital strategy in order to create inclusive, adaptive, and future labor markets. The study offers practical solutions for policymakers, business leaders, and educational institutions on how to navigate the transition toward a digitally enhanced economy.

**Keywords:** Automation; Workforce Adaptability; Reskilling Strategy; Human Capital Development; Technological Integration; Employment Resilience.

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# Strategic Ethics and Transnational Compliance in International Business: A Data-Driven Approach to Navigating Cultural, Legal, and Sustainability Challenges

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## Abstract

In a globalized business landscape, multinational corporations (MNCs) encounter complex ethical challenges arising from cultural, legal, and governance diversity. This article investigates the impact of structured ethical interventions across five key domains: cultural sensitivity, anti-corruption practices, operational sustainability, labor standards, and regulatory compliance. Employing a mixed-method approach integrating cross-sectional survey analysis, compliance audits, sustainability metrics, and predictive modeling, the study evaluates the efficacy of data-driven ethical programs on organizational behavior and operational ethics. International case studies of MNCs across five continents were analyzed, incorporating interventions such as cultural training modules, algorithmic monitoring and auditing systems, environmental performance optimization, and workforce welfare schemes. Findings reveal that treating ethical dimensions as interconnected components within an integrated governance framework significantly enhances societal and operational outcomes, including trust, employee satisfaction, legal cost reduction, and sustainability impacts. Trust, employee, legal cost avoidance, and sustainability impacts were notable. The study highlights the strategic advantage of embedding computational ethics frameworks into core business operations, moving beyond viewing ethics as a peripheral compliance issue. It further exposes the challenges posed by the need to reconcile internal governance processes with compliance with external regulatory demands. While the results endorse the viability of a systemic, data-driven ethical framework, limitations exist in temporal scope, geographical coverage, and cross-sector comparisons. Future research should explore digital governance innovations and the long-term effects of computational ethical transformations in global businesses.

**Keywords:** Business Ethics, Sustainability Governance, Regulatory Compliance, Data-Driven Governance; Computational Ethics, Multinational Corporations.

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# Institutional Readiness and Computational Modeling of Leadership Dynamics in Transnational Corporate Integration: A Mixed-Methods Study

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## Abstract

The article focuses on the multidimensional drivers of Mergers and Acquisitions (M&A) performance, where strategic, organizational, and technological performance dimensions receive attention. Traditionally, financial measures have been used as the principal yardstick for assessing the successfulness of a corporate takeover, but this study presents and argues for a holistic, computationally-driven approach, balancing quantitative and qualitative dimensions. In this work, a comprehensive interpretive model, consisting of five major indices, is proposed: Strategic Readiness Score (SRS), Cultural Compatibility Index (CCI), Operational Efficiency Improvement Factor (OEIF), Technology Impact Score (TIS), and Adjusted Synergy Realization (ASR). A mixed-methods design was used to examine 50 M&A events in technology, healthcare, finance, and manufacturing. The results indicate that strategic preparedness has a drastic effect on revenue growth, while cultural fit and leadership trust are key factors for organizational unity. There was a clear correlation between higher levels of integration performance and operational efficiency gains, particularly through the automation of processes and the removal of redundancy. Implementation success of synergy varied among industries; values were greater for companies with formal strategic planning and a loose integration period. The findings highlight the necessity of a bundled evaluation model, which takes account of the tangible financial effect and focuses as well on the intangible role of the organization. The article offers both managerial implications for decision-makers striving for better M&A implementation and long-term value adding, as well as theoretical implications to the developing field of strategic management and corporate restructuring.

**Keywords:** Mergers and Acquisitions (M&A); Post-Merger Integration (PMI); Strategic Alignment; Organizational Performance; Digital Transformation; Synergy Realization.

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# Experiential Marketing as a Soft Power Instrument: Strategic Brand Positioning in Global Consumer Culture

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**Abstract**

With the proliferation of products and services, consumer interest has become a scarce commodity, making experiential marketing (EM) a critical solution to the limitations of traditional promotional systems. This study examines the effect of EM on Consumer-Based Brand Equity (CBBE), focusing on four key dimensions: brand awareness, perceived quality, emotional connection, and loyalty. Using a convergent mixed-methods approach that combines Structural Equation Modeling (SEM) on survey data (N=400) with an exploratory analysis of five cross-sectorial case studies involving immersive technologies, the research offers a thorough investigation into the mechanisms underlying EM's influence on consumer perceptions and behaviors. The quantitative results suggest that emotional engagement is the primary intervening variable between immersion-promoting marketing stimuli and brand loyalty effects. While image positioning and brand awareness contribute to brand value, this effect is relatively smaller compared to the strength of emotional attachment. Furthermore, the integration of sophisticated experiential technologies, such as Augmented Reality (AR), significantly amplified attention span and sentiment, demonstrating the potential of technology to deepen brand-consumer interaction. The article provides theoretical and practical implications by integrating both emotional and behavioral measures within an integrative brand equity model. It concludes by recommending that future brand marketing strategies emphasize multi-sensory involvement, emotional relevancy, and technological adaptability to foster deeper consumer relationships and more enduring brand equity.

**Keywords:** Experiential Marketing; Brand Equity; Emotional Engagement; Consumer Loyalty; Immersive Technology; Perceived Quality.

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# Computational Analysis of Institutional Dynamics and Governance Performance: Cross-National Study of Corporate Governance Systems in Emerging Economies

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## Abstract

Corporate governance is central to transparency, accountability, and firm performance, particularly in emerging countries where regulatory institutions and market frameworks are still evolving. This study compares the governance systems of five emerging economies, Brazil, India, South Africa, Turkey, and Indonesia, by examining governance effectiveness across board independence, shareholder participation, and transparency conformity. Using a fixed pool of 500 listed companies from 2020 to 2024, computational and statistical techniques were applied to construct a Governance Effectiveness Index (GEI), that quantifies institutional quality and its relationship with financial performance, measured by return on equity (ROE). The results show that India and Brazil achieve consistently higher GEI scores due to balanced governance across all indicators, while Turkey and Indonesia exhibit fragmented compliance and monitoring systems. A statistically significant positive correlation was identified between governance effectiveness and ROE, emphasizing the financial relevance of robust governance frameworks. The study concludes that adherence to international regulatory standards alone is insufficient; uniform monitoring mechanisms and data-driven governance reforms are essential to institutional resilience and investor confidence. The findings offer pragmatic insights for policymakers and corporate leaders seeking to strengthen governance in transitional economies.

**Keywords:** Corporate Governance, Emerging Economies, Governance Effectiveness Index, Institutional Reform, Financial Performance, Transparency.

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# Data-Driven Analysis of Emotional Intelligence and Managerial Effectiveness in Transitional Work Environments

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**Abstract**

Emotional intelligence (EI) plays a key role in enhancing managerial effectiveness, particularly in dynamic work environments. This study adopts a quantitative, data-driven approach to examine five core EI dimensions—self-awareness, self-regulation, empathy, social skills, and motivation—and their associations with managerial performance. A cross-sectional survey of 250 managers across multiple industries was analyzed using weighted least squares regression and structural equation modeling (SEM). Positive associations between emotional intelligence and managerial effectiveness were observed in both descriptive and correlational analyses. The results reveal that empathy and motivation are the strongest predictors of managerial effectiveness, while interaction effects, particularly between empathy and social skills, highlight the synergistic impact of combined emotional competencies. The findings suggest that EI functions as an integrated competency rather than a collection of isolated traits, enabling managers to lead effectively and navigate complex work environments. Practical implications include integrating EI training into leadership development and performance management systems. This study provides a solid basis for further developing emotionally intelligent leadership and confirms the importance of emotional abilities in addressing contemporary managerial challenges.

**Keywords:** Intelligence; Managerial Effectiveness; Leadership; Empathy; Social Skills; Motivation.

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# Strategic Technological Integration and National Industrial Resilience: Assessing AI-Driven Efficiency Across Critical Sectors

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**Abstract**

As global markets become more complex, the need for efficient, data-driven tools has grown, with Artificial Intelligence (AI) and Machine Learning (ML) becoming essential in transforming how businesses operate. These technologies play a critical role in optimizing resource management, automating work, and improving system performance. This paper explores the strategic role of AI/ML across ten diverse sectors: manufacturing, telecommunications, healthcare, logistics, retail, finance, energy, education, construction, and public services. The study examines how AI/ML integration impacts key operational metrics, such as downtime reduction, cost savings, process reliability, and resource utilization, based on data gathered over a 12-month period. The research employs advanced statistical methods, including panel regression and composite indexing, to analyze the results. Findings show significant improvements across all sectors, driven by AI/ML technologies that enhanced operational efficiency, improved forecasting accuracy, and optimized resource usage. This research also underscores the importance of robust data infrastructure and organizational readiness in fully capitalizing on these technologies. The findings provide valuable insights for decision-makers in both public and private sectors aiming to adopt scalable and sustainable automation solutions.

**Keywords:** Artificial intelligence; Machine Learning; Operational Efficiency; Predictive Maintenance; Resource Utilization; Process Optimization.

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# Leadership Adaptation in Multigenerational Workforces: Strategic Responses to Organizational Cohesion Amid Demographic Shifts

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## Abstract

This study examines how leaders can respond to age diversity in today's multigenerational organizations. Employees and managers from multiple industries represent distinct generational cohorts—Baby Boomers, Generation X, Millennials, and Generation Z—with differing communication styles, technology readiness, motivation, and approaches to teamwork and conflict. These differences shape how leadership works in practice. We use a mixed-methods design drawing on semi-structured interviews, a survey, and case studies across sectors. A combined stratified and purposive sampling strategy ensured coverage of the major cohorts in organizational settings. Qualitative responses were coded and integrated with quantitative indicators. Multivariate regression models were then used to examine the effects of adaptive leadership, communication effectiveness, technology use, employee engagement, and cross-generational collaboration on performance outcomes. The results indicate that leadership does not have uniform effects across generations. Generation X shows consistently strong engagement and adaptability, while Generation Z exhibits high digital readiness alongside lower long-term institutional commitment. A weighted performance model highlights the relative importance of specific leadership practices for organizational effectiveness. Overall, the findings support flexible, emotionally intelligent leadership tailored to cohort-specific expectations. The study offers practical guidance for building age-inclusive programs that foster intergenerational cooperation, reduce conflict, and improve performance, and it clarifies the evolving dynamics of leadership in multigenerational contexts.

**Keywords:** Multigenerational Workforce; Leadership Adaptability; Employee Engagement; Intergenerational Communication; Digital Readiness; Organizational Cohesion.

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# Strategic Leadership and Cultural Intelligence: Data-Driven Insights into Organizational Resilience and Global Workforce Management

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## Abstract

This study examines the relationship between employee wellness programs and organizational productivity across multiple industries using a data-driven and computational approach. As workforce dynamics evolve with globalization, technological disruption, and rising mental health demands, structured wellness strategies have become essential for sustaining performance and engagement. Employing a longitudinal mixed-methods design, the research integrates quantitative modeling, multivariate statistical analysis, and structural equation modeling to assess how key wellness dimensions, mental health support, flexible work arrangements, and organizational training, affect productivity, retention, and engagement outcomes. Data was collected from 250 operational teams across ten industries through surveys, managerial interviews, and archival HR metrics integrated within a performance measurement framework. Results show that wellness integration directly enhances productivity through improved engagement and work-life balance. Statistical modeling further confirms that flexibility and mental health support significantly reduce attrition and absenteeism while increasing operational stability. Industries with strong wellness adoption consistently outperform others across all indicators. The findings validate wellness as a strategic asset with implications for leadership, organizational policy, and human capital investment, demonstrating how computational and information-driven approaches can strengthen resilience and sustainable workforce performance.

**Keywords:** Employee Wellness, Organizational Productivity, Employee Engagement; Mental Health Support, Computational Modeling, Data-Driven Analysis.

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# Digital Transformation and Strategic Sectoral Shifts: The Political Economy of Traditional Industry Reconfiguration

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## Abstract

Digital transformation is reshaping how firms operate across traditional industries. This study defines three comparable outcomes—Operational Efficiency (OEI), Revenue Efficiency (RER), and Customer Experience (CEF)—and benchmarks them in a cross-industry setting. Using firm-level data (n = 250) alongside sector indicators, we quantify associations between digital capabilities and performance while accounting for sector heterogeneity. Results show stronger OEI and CEF in data-intensive sectors, with wider dispersion in regulated or legacy-system-heavy domains. We integrate OEI, RER, and CEF into a Composite Performance Index (CPI) to compare maturity profiles across sectors and to highlight alignment between capabilities and realized outcomes. The findings suggest that technology adoption alone is insufficient; complementary workforce readiness and process redesign are essential to unlock value. For managers, CPI offers a practical benchmark to prioritize investments. For policymakers, interoperability and data-governance frictions emerge as key barriers. The study is observational, so residual confounding may remain despite controls. We emphasize transparent measurement and reproducibility and outline future directions, including longitudinal designs and validation of composite indices.

**Keywords:** Digital transformation; Operational efficiency; Revenue efficiency; Customer experience; Composite performance index; Cross-industry study.

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# Resilience and Innovation in Startup Ecosystems: Examining the Political Economy of Risk in Tech-Driven Development

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## Abstract

Startups frequently pursue aggressive innovation agendas while operating under high uncertainty, yet the quantitative links between risk management practices and innovation outcomes remain underexplored. This study addresses that gap by analyzing 150 ventures in the technology, healthcare, financial-technology, and E-commerce sectors across three life-cycle stages. A mixed-methods design combines entropy-weighted risk indices with multidimensional innovation metrics and hierarchical econometric models to trace how preventive coverage, detection speed, and residual loss severity shape both financial stability and innovation efficiency. Findings reveal that DCS ventures with strong cash buffers exhibit significantly higher innovation efficiency scores and faster time-to-market compared with those with weaker risk control. Cross-lagged correlations (0.76–0.82) and structural equation modeling provide evidence for a mediated relationship in which robust mitigation capacity enhances financial viability, thereby accelerating innovation output. Sectoral analysis indicates that Technology and FinTech firms gain the most from integrated digital governance, while healthcare and E-commerce sectors gradually close the performance gap as compliance infrastructure and supply-chain analytics mature. Results underscore the strategic value of embedding dynamic risk protocols in early product development, and highlight governance depth as a critical acceptor parameter in the novelty-seeking process of investors. Demonstrating that effective risk management can serve as an enabler rather than an inhibitor of creative processes, the study provides a roadmap for founders and policymakers seeking to cultivate startup ecosystems that are both resilient and growth-oriented.

**Keywords:** Innovation Efficiency; Risk Mitigation; Financial Stability; Startups; Entropy-Weighted Index; Hierarchical Modelling.

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# Workforce Retention in Volatile Labor Markets: Organizational Adaptation and Sectoral Resilience in the Post-Digital Economy

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**Abstract**

Employee turnover remains a critical concern for organizations competing in dynamic labor markets, yet empirical clarity on the relative strength of retention levers is limited. This study investigates how compensation, career development, leadership effectiveness, workplace culture, and work–life balance jointly shape employee tenure across five major industries: technology, finance, healthcare, education, and manufacturing. A proportionate stratified sample of 500 professionals was surveyed using a 30-item Talent Retention Scale. The analytical framework integrates multivariate regression, Cox proportional-hazards modeling, and structural equation modeling to capture both direct and indirect effects while controlling for demographic and sectoral heterogeneity. Results show that work–life balance and career development are the most influential predictors of tenure, each reducing voluntary turnover risk by more than a quarter and jointly explaining two-thirds of the variance in the latent retention construct. Leadership effectiveness significantly amplifies the impact of career development, illustrating the importance of supportive managerial climates. Industry-specific examinations demonstrate that flexible work arrangements are particularly important in areas of high turnover, such as technology and education, while formal mobility paths are more prominent in finance and manufacturing. The findings indicate that retention is not unidimensional and merits specific, evidence-based rather than universal policy measures. The study offers managers insights to guide investments in flexibility, developmental programs, and leadership pipelines, and presents researchers with an empirically validated platform for future longitudinal and cross-cultural inquiries into workforce stability.

**Keywords:** talent retention; work–life balance; career development; leadership effectiveness; turnover risk; structural equation modelling.

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# Cross-Sectoral Analysis of Agile Practices: Computational Insights into Governance, Risk Management, and Project Performance Metrics

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## Abstract

Agile methodologies, rooted in adaptive and iterative frameworks have gained widespread adoption as a transformative approach to project management frameworks, offering greater flexibility, responsiveness, and stakeholder collaboration. However, cross-industry empirical studies leveraging computational methods to assess their impact on project performance remain underexplored. This study investigates the effects of Agile practices on key project management metrics—schedule achievement, cost containment, quality assurance, team dynamics, and risk mitigation—across 465 organizations in software development, healthcare, finance, manufacturing, and construction. Utilizing structured survey data and advanced statistical modeling, the research employs validated measurement models to analyze performance outcomes before and after Agile adoption. Findings reveal improved project delivery, decrease in the variance in budgeting, improvement in the capacity to resolve defects, and increased team satisfaction and involvement. In addition, the project risk exposure has been reported to be reduced and mitigation response has been observed to be accelerated across all sectors with the use of computational metrics such as sprint pace, earned value realization, and compliance indicators. These findings underscore Agile's applicability beyond software-centric domains, adding value to complex, compliance-driven projects. The article adds to literature by demonstrating Agile's role as a computationally informed, strategic approach that enhances technical efficiency and human-centric outcomes. It demonstrates the significance of Agile maturity, continuous learning and organizational culture for achieving sustained success in projects. The findings offer managerial implications for managers and policy-makers who seek to institutionalize data-driven Agile applications in heterogeneous work environments.

**Keywords:** Agile Frameworks, Project Performance Metrics, Risk Mitigation, Team Collaboration, Schedule Adherence, Cross-Sectoral Computational Analysis.

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# Global Enterprise Vulnerabilities and Strategic Responses: Navigating Uncertainty in a Volatile Political Economy

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**Abstract**

In an era escalating geopolitical instability, cyber threats, and fragile supply chains, the capacity of global enterprises to manage crises has become a critical determinant of organizational resilience. This study evaluates the effectiveness of multidimensional crisis management strategies across five major industries, finance, healthcare, manufacturing, retail, and technology, using a five-year panel dataset of 570 publicly listed firms. The research applies an integrated methodological framework combining hierarchical Poisson models for crisis frequency, DCC-GARCH for financial loss, liquidity dynamics, survival analysis for operational downtime, structural equation modelling (SEM) for latent resilience, and Monte Carlo simulation for systemic stress exposure. Results reveal that firms with higher preparedness, measured through governance robustness, monitoring capacity, and cyber maturity, experience fewer crises, faster recovery, and lower financial losses. Sectoral variations indicate that technology and finance benefit more from digital infrastructure, whereas manufacturing and retail face prolonged disruptions due to structural dependencies. Simulation results confirm that top-quartile preparedness reduces extreme loss exposure by over 30%, demonstrating the financial return on resilience investments. The study emphasizes shifting crisis management from reactive to proactive, underscoring its significance for governance systems, regulatory processes, and intersectoral risk-sharing mechanisms. By interpreting organizational responses under risk, it offers an empirically grounded roadmap for building measurable resilience ensuring faster recovery in future crises.

**Keywords:** Crisis Management, Organizational Resilience, Preparedness, Enterprise Risk, Liquidity Stress, Global Industries.