

IEEE IEEM21 **VIRTUAL**

**2021 IEEE International Conference on
Industrial Engineering and Engineering
Management (IEEM)**

13 – 16 December 2021

www.IEEM.org

Organizers

IEEE Singapore Section
IEEE TEMS Singapore Chapter
IEEE TEMS Hong Kong Chapter

IEEM Secretariat



Partner



Supporting Organizations





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Message from the Organizers



It is a great pleasure to welcome you all to the 2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2021). As a group of about 360 participants from over 40 regions and countries, we represent the IEEM community in its unity as well as its diversity.

Progress in vaccination and boosters has contributed immensely to the tempering of COVID-19 cases. However, burdens and challenges caused by the heightened risk of spreading COVID-19 in shared indoor spaces continued. As a result, we are compelled to deliver this meeting virtually.

Despite the above circumstances, we are very pleased to be able to welcome those of you who have been associated with this conference for a long time as well as those of you who are new to the community. We would also like to express our sincere gratitude to our volunteer reviewers and session chairs. Your contribution allows us to adopt the same rigorous review process as in the past and to conduct each session in a way that leaves everyone a good feeling about it.

New rules will continue to come into force as the world continues its battle against the coronavirus. Infection rates remain stable and many are ready to open. Thus, we look forward to seeing each and every one of you in person and are delighted to announce that IEEM2022 is planned to be held from 07 to 10 December 2022 in Kuala Lumpur, Malaysia.



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Organizing Chair
National University of Singapore



Seung Ki MOON,
Organizing Chair
Nanyang Technological University



Roger JIAO,
Program Chair
Georgia Institute of Technology



Min XIE,
Program Chair
City University of Hong Kong



Committees



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The University of Danang*

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Hendry RAHARJO
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Committees



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National Kaohsiung University of Science and Technology

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Mapua University

Linda ZHANG

IESEG School of Management (LEM-CNRS 9221)



Registrant Only Privilege Access

✘ Simple Actions that You Can Perform in the IEEM Online Portal Mon-13 Dec to 16-Dec 2021

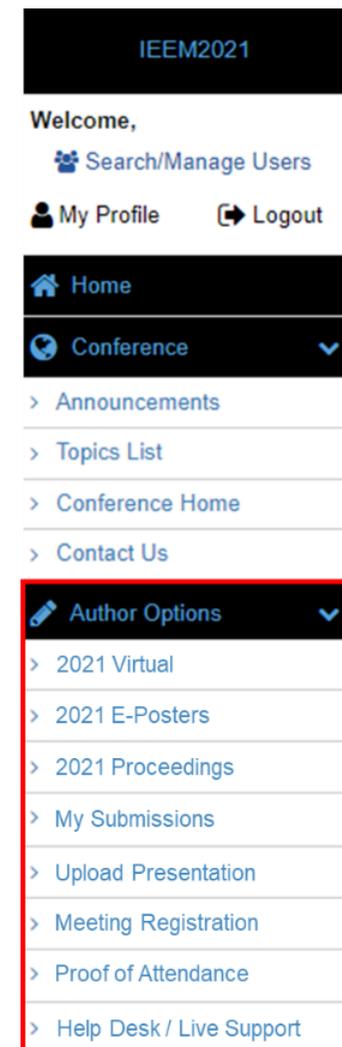
	<u>Under "Author Options"</u>
1 Find and/or Attend Presentations	Click on "2021 Virtual", search the online schedule finder and click "Join Meeting" to enter session zoom room
2 View All Available Display Materials of Poster Presenters	Click on "2021 E-Posters"
3 Locate Your Own Presentation Material	Click on "Upload Presentation"
4 View/Download Conference Proceedings	Click on "2021 Proceedings"
After Thu-16 Dec 2021	<u>Under "Author Options"</u>
5 Obtain Certificate as Proof of Conference Attendance	Click on "Proof of Attendance"

Zoom Room Help Desk & Live Support - Hours in Singapore Time (SGT)

Mon-13 Dec, 10am to 12pm, 3pm to 5pm
 Tue-14 Dec, 7:30am to 6:30pm
 Wed-15 Dec, 7:30am to 6:30pm
 Thu-16 Dec, 12pm to 2pm

Need Assistance?
Click here

ASSISTANCE



Conference Policies



Submission to IEEE Xplore - Conditions

- Only accepted papers that are IEEE compliant are included
- The paper has been presented at the conference by the registered author/co-author

IEEM No Show Policy

Presenters are required to be present for Live Q&A. If pre-recordings are played or posters are displayed, but presenters are absent for Live Q&A, it will be recorded as a No-Show.

Attendee Guide

Language

English is the official language throughout the meeting.

Platform

We will use the Zoom Conference Webinar Platform

Please note that several security features are being utilized to prevent unauthorised access.



Attendee Access to Sessions

Sessions will be presented live at the scheduled time. Though available, the recordings will not be available for public viewing.

Fee Paying Attendee Privileges

- ✓ Presenter Rights
- ✓ Session Charing Rights
- ✓ The Whole Works Participation Rights
- ✓ Conference Proceedings
- ✓ Proof of Attendance (Condition Applies)





Accepted Paper Presentations on 14 & 15 Dec 2021

The two-day virtual presenter event will be conducted via Zoom Meetings and requires a paid registration to attend.

Presenter functions (via ZOOM) are auto-enabled in the IEEM online submission portal (see "Author Options") once paid registration fee is received.

How to Register?

- You will need your user account to log on to [IEEM](#) online portal
- New users can create a user account [here](#)
- Click on "Meeting Registration" under author options on the left menu, and follow the on-screen instructions to register for the conference

Presentation Format

Presenters pre-record their individual presentations. Only the Q&A is conducted live during the scheduled session time.

Each presentation will consist of two parts:

- A pre-recorded presentation of the accepted paper
- Live Q&A for attendees to meet virtually with presenters and ask questions or give feedback

Zoom Room Help Desk & Live Support - Hours in Singapore Time (SGT)

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ASSISTANCE





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Presenter functions (via ZOOM) are auto-enabled in the IEEM online submission portal

IEEE Policy on No Show

Each accepted paper to IEEM2021 must be presented by the registered author/co-author during the online conference. Presenters are required to be present for Live Q&A.

If pre-recordings are played or posters are displayed, but presenters are absent for Live Q&A, it will be recorded as a No-Show.

Presentation Format

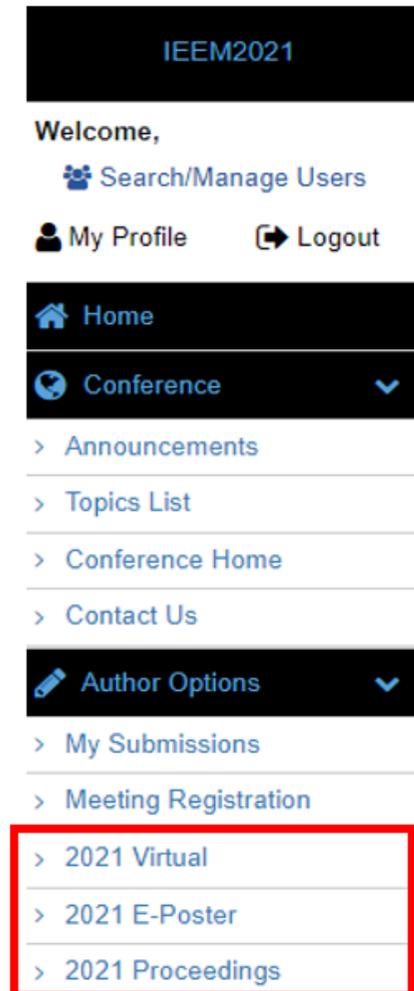
Presenters **pre-record** their individual presentations. Only the Q&A is conducted **live** during the scheduled session time. Each presentation will consist of two parts.

If Oral

- 10-min pre-recorded video of the presentation
- 5-min live Q&A for attendees to meet virtually with presenters and ask questions or give feedback

If Poster

- Pre-uploaded poster on public display from 13 – 16 Dec 2021
- 2-min live presentation and 5-min Q&A for attendees to meet virtually with presenters and ask questions or give feedback





Rehearse Your Presentation

Purpose is for Presenters and Session Chairs to familiarize themselves with the virtual platform and its features. The IEEM Virtual Meeting team will schedule practice sessions with presenters in the week of 20 Nov to 10 Dec 2021. All Presenters will be invited to participate for testing your connections well in advance and check pre-recordings for:

- ✓ Quality sound & video
- ✓ Quality connectivity
- ✓ Quality presentation

Zoom Room Help Desk & Live Support - Hours in Singapore Time (SGT)

Visit here if during the conference you have questions or you want to test your presentation on Zoom, any time even if your presentation is on a later day.

Mon-13 Dec, 10am to 12pm, 3pm to 5pm

Tue-14 Dec, 7:30am to 6:30pm

Wed-15 Dec, 7:30am to 6:30pm

Thu-16 Dec, 12pm to 2pm

*Need Assistance?
Click here*

ASSISTANCE

Oral Presentations

Preparing Your Video

- Speakers are required to submit a 10-min pre-recording of their paper presentation.
- Though not compulsory, it is preferred that you use the standard IEEM [PowerPoint template](#).
- The acceptable file format is MPEG-4 video (*.mp4), and the file size must not exceed 800mb.
- See also [“How to” Guide for Pre-Recording a Video](#)
- The deadline for submitting the pre-recording is **Tue-30 Nov 2021**.
- You can modify/resubmit your uploaded contents anytime but it must be before the submission deadline.



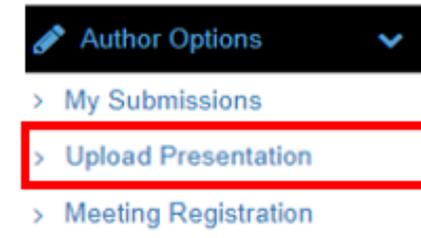
Oral Presentations



Submit Your Pre-Recording to IEEM Submission Portal

Opens Mon-08 Nov 2021

- 1 Log-in with your email & password: <https://ieem.meetmatt-svr.net/>
- 2 On the left menu click on “Upload Presentation” to upload your video
This function is auto-enabled for individuals delivering oral presentations.



Deliver Your Presentation

Please connect to your session room in Zoom at least 15 minutes before the start of your session

- The session host will play your **10-minute pre-recording** at the scheduled time.
- Presenters are required to participate in the live **5-minute Q&A session** to be held immediately after the presentation.
- Questions from the audience will be asked through the Zoom Chat. Alternatively, audience can also use the ‘Raise Hand’ function to ask questions verbally.

Poster Presentations - Upload Your Poster

- Presenters must upload a **PNG** poster of their paper presentation.
- Poster size is A0 in landscape format.
- Though not compulsory, it is preferred that you use the standard IEEM [Poster template](#).
- Please see also [“How to” Guide for Preparing Your Poster](#).
- The deadline for submitting the digital poster is **Tue-30 Nov 2021**.

Public Display - All Posters will be posted publicly for viewing from Mon-13 Dec to Thu-16 Dec 2021.

During the Live Chat – See Final Program for Your Timeslot

Please connect to your session room in Zoom at least 15 minutes before the start of your session

- Presenter delivers a 2-min walkthrough of their poster followed by a 5-min Q&A session.

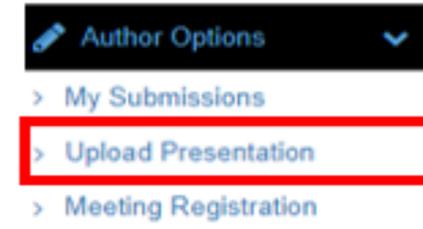


Oral Presentations

- Questions from the audience will be asked through the Zoom Chat. Alternatively, audience can also use the 'Raise Hand' function to ask questions verbally.

Submit Poster to IEEM Submission Portal (opens Mon-08 Nov 2021)

- 1 Log-in with your email & password: <https://ieem.meetmatt-svr.net/>
- 2 On the left menu click on "Upload Presentation" to upload your poster presentations.



Get ZOOM Ready!

All presenters will require a PC or Laptop with

- Camera & Microphone
- Webcam Specifications: Minimum 0.5 Megapixel
- Compatible Browsers – Ensure that they are updated to their latest versions



Lighting/Camera

Diffused light in front of you will usually work best to avoid shadows. Position your camera just above your eye level.

Presentation/Clothing

Darker colour shirts/blouses appear better on camera, avoid busy plaid or patterned outfits.

Audio/Sound

Avoid or minimize sounds in your background. Ensure that your voice can be heard loud and clear.



You are charged with ensuring presenters stay on time and maintaining a professional and insightful dialog among the participants of the session. You will introduce each presenter (name, affiliation, maybe an additional piece of insight, co-authors) along with their paper. A session assistant will be assigned to support you as necessary.

Please connect to your session room in Zoom at least 15 minutes before the start of your session

Session Assistant Roles

1. Oversee presenter check-in
2. Keep track of no-shows & report it to session chairs
3. Provide live technical support during the conference
4. Handling of presentation materials
5. Click on the attendance link to make a record of who has presented at the session

Session Chair Roles

- Introduce presenters in your session
- Ask questions to the presenter based on their presentation
- Keep track of time allocated for each presenter

Before the Session

- Set up Zoom using [the guide](#) given to all participants.
- Before chairing the session you should test your set-up.
- If you have not presented or moderated via Zoom, we strongly recommend doing a rehearsal. Details on the rehearsal will be sent later.
- The [virtual meeting program](#) includes session information, links to presentation materials and, presenter attendance register etc.





Chairing the Session

- 1 Audio Mute/Unmute - Participants will be muted when they join the meeting.
- 2 Remind presenters to unmute themselves to speak when called on in the queue; and then mute themselves when done.
- 3 Zoom 'Chat' – Remind participants to send you questions using this feature. Be sure to check the 'Chat' regularly.
- 4 Introduce yourself, the presentation and authors; mute yourself when done.
- 5 Session assistant will present the pre-recorded materials. Each presenter has to make their presentation in 15 minutes, including 5 minutes of Q & A.
- 6 Unmute yourself. Ask questions to the presenter if there is still time left after the presentation.

Rehearsal

Purpose is for Presenters and Session Chairs to familiarize themselves with the virtual platform and its features. Secretariat will be in touch to arrange a rehearsal. Please confirm which of these time slots works best for you:

Program Uses Singapore Standard Time and is 8 Hours Ahead of GMT (GMT+8)

Date	AM	PM
Thu-02 Dec	9.00am-10.00am	3.00pm-4.00pm
	10.00am-11.00am	4.00pm-5.00pm
	11.00am-12.00pm	5.00pm-6.00pm
Fri-03 Dec	9.00am-10.00am	3.00pm-4.00pm
	10.00am-11.00am	4.00pm-5.00pm
	11.00am-12.00pm	5.00pm-6.00pm



Closing Plenary & Best Paper Award



Free Event Thursday, 16 December 2021 at 2pm Singapore Time (GMT +08)

Celebrating Hard Work, Innovation and Achievements - IEEM welcomes all!

Join Webinar: https://zoom.us/webinar/register/WN_OpAEw55uSBm2voYvLysHpQ



Envisioning the future of Human Centered Product Development in the Digital Age



Keynote Speaker Myung Hwan Yun is a Professor and the Director of Human Interface Systems Laboratory at the Department of Industrial Engineering, Seoul National University, Seoul, South Korea. He is also the current president of the Ergonomics Society of Korea and the Organizing Chair for IEA (International Ergonomics Association)'s triennial conference, the IEA 2024 JEJU.

He received his B.S. and M.S. in industrial engineering from Seoul National University, Seoul, South Korea and a PhD in industrial and manufacturing engineering from Penn State University, USA. His research interests include Human Interface Design, User Experience Research, Affective Product Development and Auditory User Interface.

Professor Yun spent most of his career advising and co-operating with major product/service developers in South Korea including Samsung Electronics (Mobile Products, Home Appliances), Hyundai Motors (Interior Trim, Perceived Quality, Sound Design, Driver Seat) and Hana Financial Group (User Experience, Customer Journey Planning)



Closing Plenary & Best Paper Award



Abstract

In this speech, outstanding developments and trends in human centered product design is presented as we are witnessing the dramatic rise and fall of new products and services synchronized with the mega trends of Digital Transformation. The core of human centered product design has been always on the people-centeredness deeply rooted in human factors throughout the changing nature of our socio-technical systems.

While re-visiting the important innovations and achievements applying UCD (User Centered Design) in South Korea during the past years, the influence and impact of the Digital Transformation and 4th Industrial Revolution on the way of conducting HCD or Human Centered Product Design will also be discussed. Finally, some case studies of the product/services that the speaker was involved in the development will be introduced and discussed.

IEEM2021 Best Paper – Winners Announced!

Attend Awards Ceremony to show your approval and gratitude for each person's good work

Free Event Thursday, 16 December 2021 at 2pm Singapore Time (GMT +08)

Join Webinar: https://zoom.us/webinar/register/WN_OpAEw55uSBm2voYvLysHpQ

Best Paper Awards - Winner Receives A Certificate

[Best Conference Paper](#)

[Outstanding Conference Paper](#)

[Papers That Earned Honorable Mention](#)





IEEE 2022 IEEE International Conference on
Industrial Engineering and
Engineering Management (IEEM)

IEEM2022 KUALA LUMPUR MALAYSIA

07 - 10 December 2022

**Paper/Abstract Submission
by 01 Jun 2022**

www.IEEM.org

Secretariat:



Schedules & Abstracts

SCM-01 Supply Chain Management 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): W.M. Samantha Kamari
WEERABAHU, *Western Sydney University*
Ripon CHAKRABORTTY,
UNSW Canberra at the Australian Defence Force Academy

[Abstracts: see page 25](#)

IEEM21-F-0476/Supply Chain Learning Through the Online Wood Supply Game: A Sri Lankan Case Study

Oshadhi K. Herath¹, Banusha Aruchunarasa¹, H. Niles Perera¹, R.M. Chandima Ratnayake²

¹*University of Moratuwa, Sri Lanka*

²*University of Stavanger, Norway*

IEEM21-A-0128/Application of Decision Analytics Tools and Artificial Intelligence in Supply Chain Risk Predictions

Ripon Chakraborty¹
¹*UNSW Canberra at the Australian Defence Force Academy, Australia*

IEEM21-A-0129/Optimizing Supply Chain Drivers in an Integrated Supply Chain and Project Scheduling Framework

Ripon Chakraborty¹
¹*UNSW Canberra at the Australian Defence Force Academy, Australia*

IEEM21-F-0428/The Delivery Strategy in Cross Docking Operations with Overlapped Temperature Region and Time Windows Constraints

Teng-Sheng Su¹, Thunshun Liao²

¹*Chaoyang University of Technology, Taiwan*

²*Louisiana State University, United States*

IEEM21-F-0516/Economic Evaluation of a Radio Frequency Identification System for a Home Appliance Retail Business

Paula Ferreira¹, Joana Rodrigues¹, Maria do Sameiro Carvalho¹

¹*University of Minho, Portugal*

IEEM21-F-0023/Optimizing a Supply Chain Network Using Metaheuristic for Pre and Post Pandemic Scenario

Soudip Karmakar¹, Anirban Kundu², Bobby John¹

¹*Indian Statistical Institute Bangalore Center, India*

²*DSZ Labs, India*

DAM-01 Decision Analysis and Methods 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): Carman Ka Man LEE,
The Hong Kong Polytechnic University
Cho Yin YIU, *The Hong Kong Polytechnic University*

[Abstracts: see page 26](#)

IEEM21-F-0051/An ADS-B Aided Dynamic Traffic Alert for Robust Safety Assessment in Controlled Airspace

Cho Yin Yiu¹, Tsz Kin Tam¹, Kam K.H. Ng¹

¹*The Hong Kong Polytechnic University, Hong Kong SAR*

IEEM21-F-0070/Application of Analytical Hierarchy Process to Inventory Management Practices in a Food Processing Industry in Lagos State, Nigeria

Akinlo Mogbojuri¹, Oludolapo Olanrewaju¹, Temitope Ogunleye²

¹*Durban University of Technology, South Africa*

²*Yaba College of Technology, Nigeria*

IEEM21-F-0073/Constructing a Composite Indicator for Manufacturing Companies Using Lean Metrics and Analytic Hierarchy Process

Willy Zalatar¹, Eppie Clark¹

¹*De La Salle University, Philippines*

IEEM21-F-0077/A Comparative Analysis of the Impact-Wave Analogy Cyber-Resilience Framework

James K. Osborn¹, Daniel A. Sepulveda-Estay²

¹*University of Exeter, United Kingdom*

²*Technical University of Denmark, Denmark*

IEEM21-F-0114/Using Network Analysis to Evaluate Dynamic Capabilities: A New Concept of Method

Desmond Wong¹, Shan Shan Tan²

¹*University of Hull, United Kingdom*

²*Independent Scholars, Singapore*

IEEM21-F-0382/Hydropower Replacement and the Nexus of Food-Energy-Water Systems: Impacts on Climate Performance

Dor Hirsh Bar Gai¹, Ekundayo Shittu¹

¹*The George Washington University, United States*

MS-01 Manufacturing Systems 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): Dinh Son NGUYEN, *University of Science and Technology, The University of Danang*
Firdaus ALAMSJAH, *Bina Nusantara University*

[Abstracts: see page 27](#)

IEEM21-F-0058/Sustainable Multi-objective Process Plan Generation in RMS: Dynamic NSGA-II vs New Dynamic NSGA-II

Khettabi Imen¹, Mohamed-Amine Boutiche¹, Lyes Benyoucef^{1,2}

¹*USTHB University, Algeria*

²*Aix-Marseille University, France*

IEEM21-F-0098/Addressing the Semantic Gap in the Consumer-to-manufacturer Strategy Using Dual Convolutional Neural Network

Yue Wang¹, Xiang Li²

¹*The Hang Seng University of Hong Kong, Hong Kong SAR*

²*The City University of Hong Kong, Hong Kong SAR*

IEEM21-F-0122/Decision Support by Interpretable Machine Learning in Acoustic Emission Based Cutting Tool Wear Prediction

Arno Schmetz¹, Christopher Vahl², Zhen Zhen¹, Daniel Reibert¹, Sebastian Mayer², Daniel Zontar¹, Jochen Garcke², Christian Brecher³

¹*Fraunhofer-Institute for Production Technology IPT, Germany*

²*Fraunhofer-Center for Machine Learning and Fraunhofer-Institute for Algorithms and Scientific Computing SCAL, Germany*

³*RWTH Aachen University, Germany*

IEEM21-F-0140/An Appropriateness Analysis for Additive Manufacturing Based on a Global Performance Index

Dinh Son Nguyen¹

¹*University of Science and Technology, The University of Danang, Viet Nam*

IEEM21-F-0156/Exploring Barriers for Software Development in Agile and Integrated Development of Production Systems

Julia Trolle¹, Dag Raudberget¹, Carin Rösjö¹

¹*Jönköping University, Sweden*

IEEM21-F-0291/Representing Control Software Functionality as Part of a Modular, Mechatronic Construction Kit

Eva-Maria Neumann¹, Birgit Vogel-Heuser¹, Ibrahim Bayar¹

¹*Technical University of Munich, Germany*

SIM-01 Service Innovation and Management 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): Ehsan VAZIRI GOUDARZI,
Islamic Azad University, South Tehran Branch
Maria de los Angeles GOMEZ,
Universidad Popular Autónoma del Estado de Puebla

[Abstracts: see page 28](#)

IEEM21-F-0498/Framework Development for Sustainable Manufacturing Cloud Service Composition System (SMCS) Based on Axiomatic Design

Ehsan Vaziri Goudarzi¹, Mahmoud Houshmand², Vahidreza Ghezavati³, Shahrouz Bamdad³, Omid Fatahi Valilai^{4*}
¹*Islamic Azad University, South Tehran Branch, Iran*
²*Sharif University of Technology, Iran*
³*Islamic Azad University, Iran*
⁴*Jacobs University Bremen, Germany*

IEEM21-F-0505/Are Older Adults Different in Their Perspectives on Age-friendly City? Evidence From Sunway City

Pei-Lee Teh^{*1}, Shaun Wen Huey Lee¹, Ewilly Jie Ying Liew¹, Elizabeth Lee¹, Qasim Ayub¹
¹*Monash University Malaysia, Malaysia*

IEEM21-F-0097/Modelling Water Network Behaviors: Agent-based Modelling

Chuks Medoh^{*1}, Arnesh Telukdarie^{*1}
¹*University of Johannesburg, South Africa*

IEEM21-A-0070/Universal Design for Disabled Users : Home Appliance Prototypes for Enhanced Accessibility

Joong Hee Lee¹, Minsik Choi^{*1}, Eunjeong Yang¹, Minah Oh¹, Myung Hwan Yun^{*1}
¹*Seoul National University, Korea, South*

IEEM21-F-0174/Procurement System Influences the Size of In-house Team and Effectiveness in Infrastructure Development

Edoghogho Ogbeifun^{*1}, Jan Harm Pretorius^{*1}
¹*University of Johannesburg, South Africa*

PPC-01 Production Planning and Control 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): Danping LIN,
Shanghai Maritime University
Yevheniya VYTRUCHENKO,
Technische Universität München

[Abstracts: see page 29](#)

IEEM21-F-0076/Strategic Sourcing – Selection of Suppliers Using DELPHI-AHP Approach

Amit Kumar Gupta^{*1}, Narain Gupta^{*1}
¹*Management Development Institute Gurgaon, India*

IEEM21-A-0025/Lean Automation Practices and Competences: An Exploratory Research on Their Relationship

Guilherme Tortorella^{*1}, Tarcisio Saurin², Paolo Gaiardelli³, Daniel Jurburg⁴
¹*The University of Melbourne, Australia*
²*Universidade Federal do Rio Grande do Sul, Brazil*
³*Università Degli Studi di Bergamo, Italy*
⁴*Universidad de Montevideo, Uruguay*

IEEM21-F-0297/Resource Allocation in Decentralized, Self-organized, Multi-agent Industrial Systems Using Deep Deterministic Policy Gradient

Yevheniya Vytruchenko^{*1}, Corbinian Nentwich¹, Markus Sauer², Jochen Nickles²
¹*Technische Universität München, Germany*
²*Siemens AG, Germany*

IEEM21-F-0368/Dual-objective Job Shop Scheduling Problem with Skilled Workers

Chantha Sem^{*1}, Ronnachai Sirovetnukul^{*1}
¹*Mahidol University, Thailand*

EBEC-01 E-Business and E-Commerce 1

December 14, 2021 08:00 AM-09:30 AM

Chair(s): Hongrui LIU,
San Jose State University
Christina TAY,
Chinese Culture University

[Abstracts: see page 29](#)

IEEM21-F-0188/Transboundary Cooperation of Environmental Public Welfare Organizations: An Impact Mechanism Model

Xingfang Zhao^{*1}, Yali Zhang^{*1}, Jun Sun²
¹*Northwestern Polytechnical University, China*
²*University of Texas Rio Grande Valley, United States*

IEEM21-F-0254/A Multi-stage Framework for Complex Task Decomposition in Knowledge-intensive Crowdsourcing

Shixin Xie^{*1}, Xu Wang^{*1}, Biyu Yang¹, Mei Long¹, Jiyu Zhang¹, Lei Wang¹
¹*Chongqing University, China*

IEEM21-F-0281/Econometric Models to Estimate the Impact of Social Media Platforms On E-commerce: Pre- and Post-COVID

Christina Tay^{*1}
¹*Chinese Culture University, Taiwan*

IEEM21-F-0332/Designing a Deceptive Comment Detection Platform with a Rule-based Artificial Intelligent Architecture

Arman Toplu¹, Hongrui Liu^{*1}
¹*San Jose State University, United States*

IEEM21-F-0442/The Value of Information: Game Model of Supply Chain Based on C2M

Hou-ping Tian^{*1}, Meng-jiao Yao¹, Qiu-yu Tan¹, Chang-xian Liu²
¹*Nanjing University of Science & Technology, China*
²*Nanjing University of Posts and Telecommunications, China*

SCM-02 Supply Chain Management 2

December 14, 2021 10:00 AM-11:30 AM

Chair(s): Ripon CHAKRABORTTY,
UNSW Canberra at the Australian Defence Force Academy
Abdul Salam KHAN,
National University of Sciences and Technology

[Abstracts: see page 30](#)

IEEM21-F-0016/A Cold Chain Vehicle Routing Problem Embedded with Manufacturing, Re-manufacturing and Product Quality Under Multiple Constraints

Abdul Salam Khan^{*1}, Ali Alarjani²
¹*National University of Sciences and Technology, Pakistan*
²*Prince Sattam Bin Abdelaziz University, Saudi Arabia*

IEEM21-F-0021/Prioritizing Indicators for Measuring Halal Logistics Implementation

Aries Susanty^{*1}, Nia Budi Puspitasari¹, Silviannisa Silviannisa¹, Sumunar Jati²
¹*University of Diponegoro, Indonesia*
²*Lembaga Pengkajian Pangan, Obat-obatan dan Kosmetika Majelis Ulama Indonesia, Indonesia*

IEEM21-F-0060/Selecting Temporary Flood Shelter Locations by P-Center Model

Wichitsawat Suksawat Na Ayudhya^{*1}
¹*King Mongkut's Institute of Technology, Thailand*

IEEM21-F-0093/Optimal Decisions with Supply Disruption and Demand Forecast Updating

Shuangshuang Dong^{*1}, Qingwei Wang¹, Meimei Zheng^{*1}
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0096/Yard Arrangement Problem with the External Truck Arrival

Etsuko Nishimura^{*1}
¹*Kobe University, Japan*

DAM-02 Decision Analysis and Methods 2

December 14, 2021 10:00 AM-11:30 AM

Chair(s): Michel ALDANONDO,
University of Toulouse
Jiage HUO,
Hong Kong Science Park

[Abstracts: see page 31](#)

IEEM21-F-0168/Developing Framework for the Implementation of MSP for Indian Farmers Using Integrated ISM and MICMAC Approach

Narain Gupta^{*1}, Amit Kumar Gupta^{*1}
¹*Management Development Institute Gurgaon, India*

IEEM21-A-0043/Optimal Site of Renewable Energy Projects Under Sustainable Development Perspective

Thi Anh Tuyet Nguyen^{*1}, Shuo-Yan Chou¹, Tiffany Hui-Kuang Yu²
¹*National Taiwan University of Science and Technology, Taiwan*
²*Feng Chia University, Taiwan*

IEEM21-F-0250/Lexical Semantic Analysis to Support Ontology Maintenance Modeling of FMEA

Vahid Ebrahimipour^{*1}
¹*Ecole Polytechnique de Montréal, Canada*

IEEM21-F-0152/A Weighted Subjective Skyline Approach for World University Ranking Systems

Junyi Chai^{*1}, Wenbin Liu¹
¹*Beijing Normal University & Hong Kong Baptist University United International College, China*

MS-02 Manufacturing Systems 2

December 14, 2021 10:00 AM-11:30 AM

Chair(s): Daryl POWELL,
Norwegian University of Science and Technology
Philipp BICKENDORF, WZL
of RWTH Aachen University

[Abstracts: see page 31](#)

IEEM21-F-0164/Increased Efficiency in a Garment Sector by the Integration of Lean Manufacturing Tools

Hilton Flores¹, Lesly Paucar^{*1}, Percy Castro¹, Eloy Marcelo Lastra², Jose C. Alvarez¹
¹*Universidad Peruana de Ciencias Aplicadas, Peru*

IEEM21-F-0180/Digital Lean Manufacturing: A Literature Review

Daryl Powell^{*1}, David Romero²
¹*Norwegian University of Science and Technology, Norway*
²*Tecnológico de Monterrey, Mexico*

IEEM21-F-0189/Process Chain Concept for the Automated Design of Polymer Additively Manufactured Forming Tools

Günther Schuh¹, Georg Bergweiler¹, Falko Fiedler¹, Arne Passgang², Philipp Bickendorf^{*2}
¹*RWTH Aachen University, Germany*
²*Laboratory for Machine Tools and Production Engineering WZL of RWTH Aachen University, Germany*

IEEM21-F-0206/Proposal of Work Standardization to Improve a Metal-mechanical Process

Lucy Casallo¹, Elizabeth Lucero^{*1}, Fernando Maradiegue¹, Jose C. Alvarez¹
¹*Universidad Peruana de Ciencias Aplicadas, Peru*

IEEM21-F-0211/An Iterative Scheme for Hierarchical Production Planning in Semiconductor Wafer Fabrication

Rajarshi Bardhan^{*1}, Chi Xu¹, Zhiguang Cao¹, Puay Siew Tan¹
¹*Singapore Institute of Manufacturing Technology, Singapore*

PPC-02 Production Planning and Control 2

December 14, 2021 10:00 AM-11:30 AM

Chair(s): Sandeep JAIN,
Hewlett Packard Enterprise
Carman Ka Man LEE, The Hong
Kong Polytechnic University

[Abstracts: see page 32](#)

IEEM21-F-0139/Application of Value Analysis and Engineering to the Design and Production of Concrete Barrier

Ma. Janice Gumasing¹, Maria Victorina Rada¹, Mark Anthony Santiago¹
¹Mapúa University, Philippines

IEEM21-F-0202/Analysis and Measurement of Overall Equipment Effectiveness (OEE) Values of the CNC Cutting Machine at PT. XYZ

Decky Antony Kifta^{1,2}, Nilda Tri Putri²
¹Universitas Ibnu Sina, Indonesia
²Universitas Andalas, Indonesia

IEEM21-F-0407/Push Sell Through Surplus Inventory

Sandeep Jain¹, Shyam Bhaskar², Nisha Kumari¹, Suraj Drolia¹
¹Hewlett Packard Enterprise, India
²Hewlett Packard Enterprise, United States

IEEM21-F-0446/Mathematical Modeling of Master Production Schedule with Campaign Planning Constraints

Devanand R¹, Tushar Shekhar², Ashutosh Mahajan¹, N Hemachandra¹
¹Indian Institute of Technology Bombay, India
²Blue Yonder, India

IEEM21-F-0329/Imperfect Preventive Maintenance Scheduling with Partial Outsourcing Option Considering Production Constraint

Danping Lin¹, Minxin Ji¹, Haoran Li¹
¹Shanghai Maritime University, China

EBEC-02 E-Business and E-Commerce 2

December 14, 2021 10:00 AM-11:30 AM

Chair(s): Christina TAY,
Chinese Culture University
Pei-Lee TEH,
Monash University Malaysia

[Abstracts: see page 33](#)

IEEM21-F-0444/The Value of Commitment: Should Weaker Retailer Follow the Price of Dominate Rival?

Hou-ping Tian¹, Qiu-yu Tan¹, Meng-jiao Yao¹, Chang-xian Liu²
¹Nanjing University of Science & Technology, China
²Nanjing University of Posts and Telecommunications, China

IEEM21-F-0515/The Effect of Consumer Traits on Their Intention to Use Luxury Virtual-Reality (VR) Products: The Mediating Role of Status Signaling

Reza Movarrei¹, Mona Masoumzadeh²
¹Hanken School of Economics, Finland
²EU Business School, Switzerland

IEEM21-F-0484/An Explorative Study on the Impact of Antecedent Mood States on Consumers' Evaluation of Hotels Online

Sanchit Pawar¹, Asle Fagerstrøm¹, Gesaneephorn Suaphuk¹, Niklas Eriksson²
¹Kristiania University College, Norway
²Arcada University of Applied Sciences, Finland

IEEM21-F-0008/Measuring Smart Cities: Identification of Smart Society Indicators in Indonesia

Dwitika Pangestuti¹
¹Institut Teknologi Sepuluh Nopember, Indonesia

SCM-03 Supply Chain Management 3

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Aries SUSANTY,
University of Diponegoro
Ahmed EL MAALMI,
Ibn Tofail University

[Abstracts: see page 34](#)

IEEM21-F-0127/A Review of Dual-channel Supply Chain Management Under Asymmetric Information

Wenting Han¹, Jianfeng Cai¹, Chen Nan¹
¹Northwestern Polytechnical University, China

IEEM21-A-0024/Effects of Industry 4.0 to Development of Supply Chain Resilience

Guilherme Tortorella¹, Flavio Fogliatto², Shang Gao¹, Toong-Khuan Chan¹
¹The University of Melbourne, Australia
²Federal University of Rio Grande do Sul, Brazil

IEEM21-F-0173/An Efficient Heuristic for the Two-echelon Multi-vendor Multi-buyer Optimization Problem

Ibrahim Najum¹, Nabil Nahas¹
¹Université de Moncton, Canada

IEEM21-F-0179/Enabling Factors of Digital Manufacturing Supply Chains: A Systematic Literature Review

W.M. Samantha Kamari Weerabahu¹, Premaratne Samaranyake¹, Dilupa Nakandala¹, Hilal Hurriyet¹
¹Western Sydney University, Australia

IEEM21-F-0196/Innovative and Sustainable Supply Chain Model in Industry 4.0 Based on Moroccan Industrial Field

Ahmed El Maalimi¹, Kaoutar Jenoui², Laila El Abbadi²
¹Ibn Tofail University, Morocco
²Moroccan School of Engineering Sciences - EMSI, Morocco

DAM-03 Decision Analysis and Methods 3

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Michel ALDANONDO, *University of Toulouse*
Felix OCKER, *Technical University of Munich*

[Abstracts: see page 34](#)

IEEM21-F-0252/Factors Affecting Consumer Acquisition of Secondhand Smartphone in Indonesia

Diana Puspita Sari^{1,2}, Nur Aini Masruroh², Anna Maria Sri Asih²
¹Diponegoro University, Indonesia
²Universitas Gadjah Mada, Indonesia

IEEM21-F-0294/Prioritization of Pipe-Bending Manufacturing Methods: An AHP-based Techno-Economic Comparison Between Welding and Cold Bending

Ine Skibenes¹, R.M. Chandima Ratnayake¹
¹University of Stavanger, Norway

IEEM21-F-0362/The STIC Analysis: A Decision Support Method for Investments in Automation

Marco Bonini¹, Mert Mete^{2,1}, Tuan Nguyen¹, Augusto Urru¹, Wolfgang Echelmeyer¹
¹Reutlingen University, Germany

IEEM21-F-0367/Automation? Yes ... But Where to Begin?

Tuan Nguyen^{2,1}, Marco Bonini¹, Jasmine Eva Langenbahn¹, Sabrina Moser¹, Eric Alexander Schneeweis¹, Augusto Urru¹, Wolfgang Echelmeyer¹
¹Reutlingen University, Germany

IEEM21-F-0473/Supervised Machine Learning in Detecting Patterns in Competitive Actions

Laura Valtonen^{2,1}, Saku J. Mäkinen¹, Johanna Kirjavainen¹
¹Tampere University, Finland

IEEM21-F-0217/Challenges of Modular Product Families and Product Personalization - An Interview Study

Juliane Kuhl^{2,1}, Selin Üreten¹, Dieter Krause¹
¹Hamburg University of Technology, Germany

MS-03 Manufacturing Systems 3

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Rajesh MATAI, *Birla Institute of Technology & Science, Pilani*
Falko FIEDLER, *RWTH Aachen University*

[Abstracts: see page 35](#)

IEEM21-F-0225/Case Study of Digital Twin-based Human-robot Collaborative Work-cell for Satellite Assembly

Yichen Wang¹, Jindan Feng², Jinshan Liu², Xiaojun Liu³, Junfeng Wang^{2,1}
¹Huazhong University of Science and Technology, China
²Beijing Spacecrafts Limited Company, China
³Southeast University, China

IEEM21-F-0241/Control of Shared Production Buffers: A Reinforcement Learning Approach

Nora Krippendorff¹, Christoph Schwindt^{2,1}
¹Clausthal University of Technology, Germany

IEEM21-A-0051/Condition-based Maintenance of Manufacturing Equipment Using Stochastic Partial Differential Equation

Munwon Lim¹, Suk Joo Bae^{2,1}
¹Hanyang University, Korea, South

IEEM21-F-0301/Adapted IOBPCS Model to Analyze the Impacts of Capacity Scalability on Inventory in a Reconfigurable Manufacturing Environment

Abdelhak Dahmani¹, Lyes Benyoucef¹
¹Aix-Marseille University, France

IEEM21-F-0375/Comparison of Two Concepts for Planned Reuse of Variant-rich IEC

61131-3-based Control Software
Juliane Fischer¹, Birgit Vogel-Heuser¹, Anja Berscheid¹, Simon Parigger¹
¹Technical University of Munich, Germany

IEEM21-F-0513/Towards a Method to Design Production Systems for Fixtureless Production with Component-integrated Fixture Features in Automotive Body Shops

Falko Fiedler^{2,1}, Georg Bergweiler¹, Peter Burggräf²
¹RWTH Aachen University, Germany
²University of Siegen, Germany

BDA-01 Big Data and Analytics 1

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Danni CHANG, *Shanghai Jiao Tong University*
Jiage HUO,
Hong Kong Science Park

[Abstracts: see page 36](#)

IEEM21-F-0029/Industry 4.0 and its Technologies: A Systematic Literature Review

Eman Alaref¹, Sharfuddin Ahmed Khan¹
¹University of Sharjah, United Arab Emirates

IEEM21-F-0066/A Machine Learning Predictive Model for Shipment Delay and Demand Forecasting for Warehouses and Sales Data

Kin Lok Keung^{2,1}, Carman Ka Man Lee¹, Yuk Hin Yiu¹
¹The Hong Kong Polytechnic University, Hong Kong SAR

IEEM21-F-0067/Hand Gesture Recognition with Augmented Reality and Leap Motion Controller

Jiage Huo¹, Kin Lok Keung², Carman Ka Man Lee^{2,2}, Hiu Yin Ng²
¹Hong Kong Science Park, China
²The Hong Kong Polytechnic University, Hong Kong SAR

IEEM21-F-0149/Active Machine Learning in Regression Problems

Juris Lapsins^{2,1}, Sarma Cakula¹
¹Vidzeme University of Applied Sciences, Latvia

IEEM21-F-0230/A Feature Ensemble Model for Material Rate Prediction in Chemical Mechanical Planarization

Rui Wang^{2,1}
¹Harbin Institute of Technology (Shenzhen), China

IEEM21-F-0321/Early Warning Model of Wind Turbine Front Bearing Based on Conv1D and LSTM

Shihui Zhang^{2,1}, Tao Zhang¹, Yajie Liu¹
¹National University of Defense Technology, China

HF-01 Human Factors 1

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Vinay SINGH, *Indian Institute of Information Technology and Management Gwalior*
Syohei Ishizu, *Aoyama Gakuin University*

[Abstracts: see page 37](#)

IEEM21-F-0022/Factors Affecting the Well-being of People Working in Known Smart Cities: UTAUT2 Approach

Yogi Tri Prasetyo¹, Mark Anthony Santiago¹

¹*Mapúa University, Philippines*

IEEM21-F-0032/Cognitive Biases as Clues to Skill Acquisition in Manufacturing Industry

Jun Nakamura¹, Sanetake Nagayoshi², Nozomi Komiya¹

¹*Chuo University, Japan*

²*Shizuoka University, Japan*

IEEM21-F-0050/Structural Framework of Ambidextrous Leadership Behavior Affecting Firm's Innovation

Vinay Singh¹, Nikita Singh², Shraddha Bhadauria³

¹*Indian Institute of Information Technology and Management Gwalior, India*

²*Jiwaji University Gwalior, India*

³*ABV-Indian Institute of Information Technology and Management Gwalior, India*

IEEM21-F-0053/Kansei-based Mining and Robust Design for Internet Service Provider

Markus Hartono¹, Amelia Santoso¹, Dina Natalia Prayogo¹, Aisyah Salsabila¹

¹*University of Surabaya, Indonesia*

IEEM21-F-0078/The Effects of Employee Volunteering on Organizational Loyalty: The Moderating Effects of Perceived Organization Support

Zhenbin Ding¹, Hongling Yang¹, Jianquan Wang¹, Jie Xu¹

¹*Northwestern Polytechnical University, China*

IPE Information Processing and Engineering

December 14, 2021 12:00 PM-01:30 PM

Chair(s): Zhao-Hui SUN, *Shanghai Jiao Tong University*
Shih-Wen KE, *National Central University*

[Abstracts: see page 38](#)

IEEM21-F-0315/A Logical Database Design Methodology for MongoDB NoSQL Databases

Wai Yin Mok¹

¹*The University of Alabama in Huntsville, United States*

IEEM21-F-0471/Stylized Dialog Generation

Shih-Wen Ke¹, Wei-Liang Chen¹

¹*National Central University, Taiwan*

IEEM21-F-0248/A Conceptual Framework of Service Applications Based on Identity Resolution for Home Appliance Industry

Ruirui Wang¹, Ziding Meng¹, Yuguang Bao¹, Xinguo Ming¹

¹*Shanghai Jiao Tong University, China*

IEEM21-F-0327/Research on Dynamic Pricing of Shared Electric Vehicles Based on System Utility Maximization

Lewen Bao¹, Rui Miao¹, Bo Zhang¹, Hao Hu¹, Jiying Zhou¹

¹*Shanghai Jiao Tong University, China*

IEEM21-F-0280/Event Log-based Weaknesses

Detection in Business Processes
Günther Schuh¹, Andreas Gützlaff¹, Seth Schmitz¹, Marco Schopen¹, Florian Bröhl¹

¹*RWTH Aachen University, Germany*

SCM-04 Supply Chain Management 4

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Omid FATAHI VALILAI, *Jacobs University Bremen*
Pei-Lee TEH, *Monash University Malaysia*

[Abstracts: see page 39](#)

IEEM21-F-0208/Exploring Critical Events of Perishable Product Supply Chain Using Fault Tree Methodology to Deal with Impacts of COVID-19

Manisha Bhardwaj¹, Rajat Agrawal¹

¹*Indian Institute of Technology Roorkee, India*

IEEM21-F-0210/Coordination of Supply Chain of a Three-level Fresh Products Based on Conditional Value at Risk

Chen Nan¹, Jianfeng Cai¹, Wenting Han¹

¹*Northwestern Polytechnical University, China*

IEEM21-F-0214/Sustainability Issues of the Coconut Supply Chain in Indonesia

Ivan Gunawan¹, Dian Trihastuti¹, Jaka Mulyana¹

¹*Widya Mandala Surabaya Catholic University, Indonesia*

IEEM21-F-0222/A Conceptual Paper on Supplier Unilateral Specific Investment Antecedent: Social Capital Perspectives

Wulan Permatasari¹, Amin Wibowo¹, Nurul Indarti¹, Rangga Almahendra¹

¹*Universitas Gadjah Mada, Indonesia*

IEEM21-F-0231/Evaluation of Supply Chain Network Resilience Level in Pre-disruption and Post-disruption Scenario

Muhammad Fernanda Luthfiansyah¹, Nur Aini Masruroh¹

¹*Universitas Gadjah Mada, Indonesia*

TKM-01 Technology and Knowledge Management 1

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Elise VAREILLES,
University of Toulouse
Annika HASSELBLAD,
Mid Sweden University

[Abstracts: see page 39](#)

IEEM21-F-0103/Can a Computer-based Knowledge Repository Strengthen Organizational Memory? Evidence from a Japanese Company

Sanetake Nagayoshi^{1*}, Jun Nakamura²
¹Shizuoka University, Japan
²Chuo University, Japan

IEEM21-F-0111/Reasons for Engineering Changes Affecting Part-specific Tools: An Investigation in the Automotive Industry

Markus Johannes Kratzer^{1*}, Lukas Bauch², Torsten Burkert², Blanka Szost², Thomas Bauernhansl³
¹University of Stuttgart / BMW Group, Germany
²BMW Group, Germany
³University of Stuttgart, Germany

IEEM21-F-0192/Improving the Keyword Co-occurrence Analysis: An Integrated Semantic Similarity Approach

Atanu Bhuyan^{1*}, Kamal Sanguri¹, Himanshu Sharma¹
¹Indian Institute of Management Kashipur, India

IEEM21-F-0233/Development of a Balanced Score Card for Knowledge Work in Project-oriented Engineering Organization: KPI Prioritization Using AHP

Daria Larsson^{1*}, R.M. Chandima Ratnayake², Arne Gildseth³
¹University of Stavanger / Blueday Technology, Norway
²University of Stavanger, Norway
³Blueday Technology, Norway

IEEM21-F-0236/The Impact of Covid-19 on Blockchain Adoption Time of Shipowners

Shuyi Pu¹, Jasmine Siu Lee Lam¹
¹Nanyang Technological University, Singapore

IEEM21-F-0081/Identification of Fields of Action for the Realization of a Sustainable Corporate Management

Michael Riesener¹, Maximilian Kuhn¹, Sebastian Schloesser¹, Carsten Boßmann^{1*}, Günther Schuh¹
¹RWTH Aachen University, Germany

OR-01 Operations Research 1

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Ai Chin THOO, *Universiti Teknologi Malaysia*
Miriam BONGO,
De La Salle University

[Abstracts: see page 40](#)

IEEM21-F-0075/Manufacturers Insights on the Implementation of Eco-industrial Park

Ai Chin Thoo^{1*}, Jin Ming Ngang¹, Hon Tat Huam², Mohamed Syazwan Ab Talib³
¹Universiti Teknologi Malaysia, Malaysia
²Universiti Putra Malaysia, Malaysia
³Universiti Brunei Darussalam, Brunei Darussalam

IEEM21-F-0116/Proposal of Work Study and Anthropometric Workstation Redesign to Increase the Productivity on Asparagus Industries

Carolina Garcia^{1*}, Ana Marroquin¹, Iliana Macassi¹, Jose C. Alvarez¹
¹Universidad Peruana de Ciencias Aplicadas, Peru

IEEM21-F-0131/Robust Network Design and Last-mile Delivery in Cold Chain Logistics System

Ying Yang^{1*}, Yongsun Zang¹, Mingyao Qi¹
¹Tsinghua University, China

IEEM21-F-0190/Applying Multiple Stakeholder-based Target-oriented Robust-optimization Approach in the Microbusiness Sector

Miriam Bongo^{1*}, Eunice Cristyl del Pilar¹
¹De La Salle University, Philippines

IEEM21-F-0223/A New Discrete Bi-objective Formulation of Unequal Area Facility Layout Problem

Rajesh Matai^{1*}, R.R.K. Sharma², Vinay Singh³, Surya Singh⁴, Trinika Kaushik⁵
¹Birla Institute of Technology & Science, Pilani, India
²Indian Institute of Technology Kanpur, India
³Indian Institute of Information Technology and Management Gwalior, India
⁴Indian Institute of Technology Delhi, India
⁵Birla Institute of Technology & Science Pilani, India

IEEM21-F-0246/Mixed-energy Fleet Pollution-routing Problem with Time Windows

Xuan Ren¹, Shuo Feng², Xing Wu², Jun Qi²
¹Northwestern Polytechnical University, China
²Chang'an University, China

BDA-02 Big Data and Analytics 2

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Zhiqiang CAI, *Northwestern Polytechnical University*
Kin Lok KEUNG, *The Hong Kong Polytechnic University*

[Abstracts: see page 41](#)

IEEM21-F-0286/Publication Month Bias Evolution Patterns of Highly Cited Papers in Different Disciplines

Pan Zhang^{1*}, Sijie Han¹, Zhiqiang Cai¹
¹Northwestern Polytechnical University, China

IEEM21-F-0310/A Data Mining Approach for Analyzing Dynamic User Needs on UGC Platform

Fanxing Zou^{1*}, Yuning Qian¹, Zhen Zhang¹, Xinyu Zhu¹, Danni Chang¹
¹Shanghai Jiao Tong University, China

IEEM21-A-0062/From American Crime Show to Séries Policières Françaises an AI Toolkit for Genre Prediction in Transnational TV Series Adaptations

Landry Digeon^{1*}, Anjal Amin²
¹University of Maryland, Baltimore County, United States
²The Mobius Trip, United States

IEEM21-F-0324/Proposal of an Onomatopoeia Feature Table Using Cosmetic Reviews

Misaki Murata^{1*}, Takashi Ito¹, Syohei Ishizu¹
¹Aoyama Gakuin University, Japan

IEEM21-F-0348/Creating Transparency on Product Variety Through Data-driven Similarity Analysis

Günther Schuh¹, Andreas Gützlaff¹, Matthias Schmidhuber¹, Marius Krug^{1*}
¹RWTH Aachen University, Germany

IEEM21-F-0441/Comparing Technical Trends Between Industrial Leaders via Video Data

Shino Iwami^{1*}
¹NEC Corporation, Japan

HF-02 Human Factors 2

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Vinay SINGH, *Indian Institute of Information Technology and Management Gwalior*

[Abstracts: see page 42](#)

IEEM21-A-0016/Systems Intelligence in Engineering Management

Raimo P. Hämmäläinen¹, Esa Saarinen¹, Juha Törmänen²
¹*Aalto University, Finland*
²*Inclus, Finland*

IEEM21-F-0118/Situational Awareness and Flight Approach Phase Event Recognition Based on Psychophysiological Measurements

Qinbiao Li¹, Cho Yin Yiu¹, Simon C. M. Yu¹, Kam K.H. Ng²
¹*The Hong Kong Polytechnic University, Hong Kong SAR*

IEEM21-F-0144/Robo Toons: Testing the Use of Animation Principles in Non-anthropomorphic Robots to Improve Human-robot Interaction

Bernhard Schmitt¹, Andrew Prah¹, Ann Li Ho¹
¹*Nanyang Technological University, Singapore*

IEEM21-F-0187/The Influence of Illegitimate Tasks on the Intention to Continue Volunteering: A Moderated Mediation Model

Zhenbin Ding¹, Hongling Yang¹, Jianquan Wang¹, Jie Xu¹
¹*Northwestern Polytechnical University, China*

IEEM21-F-0443/Exploring the Affective Way Leading to Impulse Buying in Social Media Live Streaming

Li-Ting Huang¹
¹*Chang Gung University, Taiwan*

RME-01 Reliability and Maintenance Engineering 1

December 14, 2021 02:00 PM-03:30 PM

Chair(s): Monika TANWAR, *Singapore University of Technology and Design*
Chao FANG, *Xi'an Jiaotong University*

[Abstracts: see page 43](#)

IEEM21-F-0099/Achieving Business Strategic Objectives: The Place of Maintenance Department

Edoghogho Ogbefun¹, Patrick Pasipatorwa¹, Jan Harm Pretorius¹
¹*University of Johannesburg, South Africa*

IEEM21-F-0094/Maintenance Strategy Optimization of a Thermal Power Plant

Tshegofatso Modiba¹, Arnesh Telukdarie¹
¹*University of Johannesburg, South Africa*

IEEM21-F-0359/Belief Reliability Analysis of Traffic Network: An Uncertain Percolation CML Model

Yi Yang¹, Xiao Chen¹, LinHan Guo¹, Si Yu Huang¹, WenShu Xie², Wei Liu¹
¹*Beihang University, China*
²*China Academy of Launch Vehicle Technology, China*

IEEM21-F-0491/The Use of TPM Principles to Measure System Performance

Anup Pradhan¹, Magano Molefe¹
¹*University of Johannesburg, South Africa*

IEEM21-A-0114/Improving the Resilience of Power Distribution Systems Against Typhoons with Data-driven Distributionally Robust Optimization

Zhaoyuan Yin¹, Min Xie¹, Chao Fang², Yiping Fang³
¹*City University of Hong Kong, Hong Kong SAR*
²*Xi'an Jiaotong University, China*
³*CentraleSupélec - Université Paris-Saclay, France*

SCM-05 Supply Chain Management 5

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Omid FATAHI VALILAI, *Jacobs University Bremen*
Carman Ka Man LEE, *The Hong Kong Polytechnic University*

[Abstracts: see page 44](#)

IEEM21-F-0258/Extending the Last Mile Delivery Routing Problem for Enhancing Sustainability by Drones Using a Sentiment Analysis Approach

Elham Ahmadi¹, Hendro Wicaksono¹, Omid Fatahi Valilai²
¹*Jacobs University Bremen, Germany*

IEEM21-F-0264/Application of Value Stream Mapping in Supply Chain: A Case Study on an Amazon Retail

Yanfang Qin¹, Hongrui Liu¹
¹*San Jose State University, United States*

IEEM21-F-0268/Redistribution Problem with Excess and Shortage in Relief Supplies

Etsuko Nishimura¹, Sima Ying¹
¹*Kobe University, Japan*

IEEM21-F-0271/Optimal Consumption Subsidy Strategy of a Green Supply Chain Under the Cap-and-trade Mechanism

Zhimin Li¹, Wen Yang², Yanchun Pan¹, Jianhua Ma¹
¹*Shenzhen University, China*

IEEM21-F-0300/Automated Truck Scheduling Utilizing an AI Expert System: An Innovative Solution for Digital Freight Forwarders and Carriers

Luis Enrique Velázquez¹, Stanislav Chankov²
¹*Jacobs University Bremen, Germany*

IEEM21-F-0383/Supply Chain Management and Resilience During Disruption. Evaluation of the Covid-19 Pandemic on the Supply of Personal Protective Equipment

Marco Cuvero Calero¹, Alan Pilkington¹, David Barnes¹
¹*University of Westminster, United Kingdom*

TKM-02 Technology and Knowledge Management 2

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Ehsan VAZIRI GOUDARZI,
Islamic Azad University, South
Tehran Branch
Elise VAREILLES,
University of Toulouse

[Abstracts: see page 45](#)

IEEM21-F-0257/A Survey of Challenges and Response Strategies of Manufacturing Companies During the Covid-19 Pandemic

S.C. Johnson Lim^{*1}
¹Universiti Tun Hussein Onn Malaysia,
Malaysia

IEEM21-F-0263/The Evaluation Model of Enterprises' Digital Transformation Competence Based on the Grey Cluster Method

Fen Lyu^{*1}, Yuming Zhu¹
¹Northwestern Polytechnical University,
China

IEEM21-F-0285/How to Better Identify and Mitigate Risks in Call for Tenders : Towards a Dedicated Risk Ontology

Michel Aldanondo¹, Elise Vareilles^{*1},
Thierry Coudert¹, Laurent Geneste¹,
Rania Ayachi¹

¹University of Toulouse, France

IEEM21-A-0115/Innovation in Transitional Economies: An Emerging Model

Mariza Tsakalerou^{*1}, Saltanat
Akhmadi^{*1}

¹Nazarbayev University, Kazakhstan

IEEM21-F-0388/Methodology for Organizing Product-service System Provision in Corporate Value Networks

Michael Riesener¹, Maximilian Kuhn¹,
Julian Kress^{*1}, Jakob Tönnis¹, Günther
Schuh¹

¹RWTH Aachen University, Germany

IEEM21-F-0389/Transfer of Industrial Product-service System Specific Risk Effects to Value Network Partners – Concept for an Integrated Risk Assessment and Distribution

Michael Riesener¹, Maximilian Kuhn¹,
Julian Kress^{*1}, Lukas Schild¹, Günther
Schuh¹

¹RWTH Aachen University, Germany

OR-02 Operations Research 2

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Rajesh MATAI, Birla Institute of
Technology & Science, Pilani
Jiage HUO,
Hong Kong Science Park

[Abstracts: see page 46](#)

IEEM21-F-0226/The Least-distance DEA Based Efficiency Improvement Under Multiple Perspectives

Xu Wang^{*1}, Takashi Hasuike¹
¹Waseda University, Japan

IEEM21-F-0237/A Two-stage Robust Model for Urban Food Waste Collection Network Under Uncertainty

Ke Xu^{*1}, Meimei Zheng¹, Xiao Liu¹
¹Shanghai Jiao Tong University, China

IEEM21-F-0242/Challenge and Obstacles to Promote Sustainable Remanufacturing: A Cross Case Analysis

Mohamad Fariz Mohamed Nasir^{*1},
Abdul Rahman Abdul Rahim², Anies
Faziehan Zakaria³, Azfarizal Mukhtar⁴
¹INTI International University, Malaysia
²Universiti Teknologi Malaysia, Malaysia
³Universiti Tun Hussein Onn Malaysia,
Malaysia
⁴University Tenaga Nasional, Malaysia

IEEM21-F-0269/A New Mixed Integer Linear Programming Formulation for Dynamic Facility Layout Problem

Rajesh Matai^{*1}, Surya Singh²
¹Birla Institute of Technology & Science,
Pilani, India
²Indian Institute of Technology Delhi, India

IEEM21-A-0052/A Two-step Method for Just-in-time Routing for Automated Guided Vehicles

Tatsushi Nishi^{*1}, Kosei Nishida², Daiko
Okajima¹

¹Okayama University, Japan

²Osaka University, Japan

BDA-03 Big Data and Analytics 3

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Karthik
SANKARANARAYANAN,
Ontario Tech University
Chao FANG, Xi'an
Jiaotong University

[Abstracts: see page 46](#)

IEEM21-F-0392/Exploratory Data Analysis of the N-CMAPSS Dataset for Prognostics

Supratik Chatterjee¹, Arvind Keprate^{*2}
¹Wipro Limited, India
²Oslo Metropolitan University, Norway

IEEM21-F-0397/Modelling Big Data Analytics Adoption: An Indonesian Case

Jonny Jonny^{*1}, Kriswanto Kriswanto¹
¹Bina Nusantara University, Indonesia

IEEM21-F-0399/Modeling IoT and Big Data Impacts to Business Performance

Jonny Jonny^{*1}, Kriswanto¹, Matsumura
Toshio²
¹Bina Nusantara University, Indonesia
²Osaka University, Japan

IEEM21-F-0509/Contractual Obligations and Vessel Speed: Empirical Evidence from the Capesize Drybulk Market

Vit Prochazka^{*1}, Roar Adland²
¹SNF – Centre for Applied Research at
NHH, Norway
²Norwegian School of Economics, Norway

IEEM21-F-0408/Condition Based Maintenance in Nuclear Power Plants: Limitations & Practicality

Rajinder Khurmi^{*1}, Karthik
Sankaranarayanan¹, Glenn Harvel¹
¹Ontario Tech University, Canada

HF-03 Human Factors 3

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Markus HARTONO,
University of Surabaya

[Abstracts: see page 47](#)

IEEM21-F-0216/Why do Fans Participate in Environmental Public Welfare? A Study on the Participation Driving Forces Based on Value Co-creation

Jie Zhang¹, Yali Zhang¹, Liaoliao Li¹
¹*Northwestern Polytechnical University, China*

IEEM21-F-0221/Carbon Black Based Resistive Strain Gauge Sensor for Penile Measurement

KwonHong Lee¹, JinHyoungh Kim¹,
Hyungmin Lee², Cheolung Cha¹
¹*Korea Electronics Technology Institute, Korea, South*
²*Korea University, Korea, South*

IEEM21-F-0306/Evaluation of Sense of Self-agency and Self-ownership During Mouse Operation Using Gaze and EEG

Koki Shimizu¹, Takashi Ito¹, Syohei Ishizu¹
¹*Aoyama Gakuin University, Japan*

IEEM21-F-0370/Requirements for an Assistance System to Support Human Resource Development in Manual Assembly

Maria Maier¹, Susanne Vernim¹
¹*Technical University of Munich, Germany*

IEEM21-F-0193/Quantifying the Economic and Ergonomic Potential of Simulated HRC Systems in the Focus of Demographic Change and Skilled Labor Shortage

Tobias Rusch¹, Michael Spitzhirm²,
Sumona Sen³, Titanilla Komenda⁴
¹*University of Applied Sciences Augsburg, Germany*
²*imk automotive GmbH, Germany*
³*University of Applied Sciences Niederrhein, Germany*
⁴*Fraunhofer Austria Research GmbH, Austria*

RME-02 Reliability and Maintenance Engineering 2

December 14, 2021 04:00 PM-05:30 PM

Chair(s): Yoshinobu TAMURA,
Yamaguchi University
Yuying LONG, Harbin
Institute of Technology

[Abstracts: see page 48](#)

IEEM21-F-0033/A Method of Vulnerability Assessment Based on Deep Learning and OSS Fault Big Data

Yoshinobu Tamura¹, Hironobu Sone²,
Adarsh Anand³, Shigeru Yamada⁴
¹*Yamaguchi University, Japan*
²*IBM Japan, Ltd., Japan*
³*University of Delhi, India*
⁴*Tototori University, Japan*

IEEM21-F-0056/Performance Evaluation of IoT-enabled Predictive Maintenance

Tatsuya Inaba¹
¹*Kanagawa Institute of Technology, Japan*

IEEM21-A-0045/Selection of Components for Maximizing Reliability of a Load Sharing System

Yujin Hong¹, Kyungmee Kim¹
¹*Konkuk University, Korea, South*

IEEM21-F-0344/A Classified Situations Oriented Adaptive Scheduling Method of Robot-aided Aeroengine Faults Detection

Jiawei Ren¹, Xinyi Song¹, Ying Cheng¹,
Fei Tao¹
¹*Beihang University, China*

SCM-06 Supply Chain Management 6

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Ehsan VAZIRI GOUDARZI,
Islamic Azad University, South Tehran Branch
Seung Ki MOON, Nanyang
Technological University

[Abstracts: see page 49](#)

IEEM21-F-0322/Inter-island Logistics and the Role of an Agile Supply Chain to Achieve Supply Chain Performance: Initial Findings

Firdaus Alamsjah¹, Muhammad Asrol¹
¹*Bina Nusantara University, Indonesia*

IEEM21-F-0377/Degree of Centralization: Impact on the Economic Efficiency by Considering Different Waste Types

Günther Schuh¹, Andreas Gützlaff¹,
Julian Ays¹, Markus Rey², Tino Xaver
Schlosser¹
¹*RWTH Aachen University, Germany*
²*TIME Research Area, Germany*

IEEM21-F-0402/Simulating the Impact of COVID-19 Scenarios on Air Freight Logistics Supply Chain

Rosalin Sahoo¹, Bhaskar Bhowmick¹,
M. K. Tiwari¹
¹*Indian Institute of Technology, Kharagpur, India*

IEEM21-F-0403/Critical Success Factors in Adopting Short Food Supply Chain Practices Under COVID-19: A Sri Lankan Case Study

W.M. Samantha Kamari Weerabahu¹,
Dasun Nirmala Malaarachchi²,
Premaratne Samaranayake¹
¹*Western Sydney University, Australia*
²*Queensland University of Technology, Australia*

IEEM21-F-0499/Developing Game Models for Service Composition to Improve Customization in the Equilibrium State Based on Cloud Manufacturing System

Ehsan Vaziri Goudarzi¹, Mahmoud Houshmand², Vahidreza Ghezavati³,
Shahrouz Bamdad³, Omid Fatahi Valilai^{1,4}
¹*Islamic Azad University, South Tehran Branch, Iran*
²*Sharif University of Technology, Iran*
³*Islamic Azad University, Iran*
⁴*Jacobs University Bremen, Germany*

TKM-03 Technology and Knowledge Management 3

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Carman Ka Man LEE, *The Hong Kong Polytechnic University*
Ling WANG, *Jiangsu Taizhou Bridge Co., Ltd*

[Abstracts: see page 50](#)

IEEM21-F-0307/Innovation Model of Basic Research Teams Oriented to Disruptive Technology

Yi Liu^{*1}, Xin Zheng¹
¹*Northwestern Polytechnical University, China*

IEEM21-F-0340/Integration of Ontologies and Constraint Satisfaction Problems for Product Configuration

Maryam Mohammad Amini^{*1}, Thierry Coudert¹, Elise Vareilles¹, Michel Aldanondo¹
¹*University of Toulouse, France*

IEEM21-F-0351/Utilization of Industry 4.0 During COVID-19 Pandemic in the Targeted (S-Curve) Industries of Thailand

Aunchalee Taweethavornasawas^{*1}, Yotsuda Buranasing¹, Manutchanok Jongprasithporn², Nantakrit Yodpijit¹
¹*King Mongkut's University of Technology North Bangkok, Thailand*
²*King Mongkut's Institute of Technology Ladkrabang, Thailand*

IEEM21-F-0361/Applications of Industry 4.0 During COVID-19 Situation for Thailand's Logistics System in Customer Satisfaction Context

Yotsuda Buranasing^{*1}, Manutchanok Jongprasithporn², Nantakrit Yodpijit¹
¹*King Mongkut's University of Technology North Bangkok, Thailand*
²*King Mongkut's Institute of Technology Ladkrabang, Thailand*

IEEM21-F-0429/To Support or Not to Support the Innovation? A Preliminary Study on the Effect of Family Ownership in Board on Innovation in Taiwan Family Firms

Jung-Ching Lin^{*1}
¹*Southern Taiwan University of Science and Technology, Taiwan*

IEEM21-F-0295/What is Actually Measured? Investigating the Correspondence Among Goals and Performance Indicators in a Swedish Municipality

Annika Hasselblad^{*1}
¹*Mid Sweden University, Sweden*

OR-03 Operations Research 3

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Philipp BAUMANN, *University of Bern*
Canrong ZHANG, *Tsinghua University*

[Abstracts: see page 51](#)

IEEM21-F-0299/Minimizing Paper Waste and Setup Costs in Offset Printing

Philipp Baumann^{*1}, Manuel Kammermann¹, Silvan Elsaesser²
¹*University of Bern, Switzerland*
²*ELAG AST GMBH, Switzerland*

IEEM21-F-0311/An Auction-based Mechanism for the Formation and Scheduling of Heterogeneous Human-machine Teams

Felix Merz^{*1}, Christoph Schwindt¹, Stephan Westphal¹, Juergen Zimmermann¹
¹*Clausthal University of Technology, Germany*

IEEM21-F-0330/The Robust Optimization Approach for the Community Group Purchase Joint Order Fulfillment and Delivery Problem

Xia Yang¹, Wenjia Zeng¹, Canrong Zhang^{*1}
¹*Tsinghua University, China*

IEEM21-F-0336/OR Optimization in the Authorities, Business and Citizens Triangle - Application of Cooperative Game Theory and Spatial Information Modeling

Robert Olszewski¹, Piotr Paika¹, Agnieszka Wendland¹
¹*Warsaw University of Technology, Poland*

IEEM21-F-0347/Determinants of When-to-evacuate Decisions: An Empirical Investigation

Karindra Aulia Rahman¹, Bertha Maya Sopha^{*1}
¹*Universitas Gadjah Mada, Indonesia*

BDA-04 Big Data and Analytics 4

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Shih-Wen KE, *National Central University*
Karthik SANKARANARAYANAN, *Ontario Tech University*

[Abstracts: see page 51](#)

IEEM21-A-0039/Integration of Heterogeneous Traffic Data for Urban Journey Time Estimation

Xinyue Wu¹, S. C. Wong², Andy Chow^{*1}, Li Zhuang¹, William H. K. Lam³, Wei Ma³, Edward Chung³
¹*City University of Hong Kong, Hong Kong SAR*
²*The University of Hong Kong, Hong Kong SAR*
³*The Hong Kong Polytechnic University, Hong Kong SAR*

IEEM21-A-0040/Interval Prediction of Urban Journey Times with Deep Learning

Li Zhuang¹, Andy Chow^{*1}, Xinyue Wu¹, William H. K. Lam², Wei Ma², Edward Chung², S. C. Wong³
¹*City University of Hong Kong, Hong Kong SAR*
²*The Hong Kong Polytechnic University, Hong Kong SAR*
³*The University of Hong Kong, Hong Kong SAR*

IEEM21-F-0290/A Cost Minimization Model for a Multi-Component Product Closed Loop Supply Chain Considering Big Data Dimensions

Pamela Nichole Chuateco¹, Carla Natalia Isabel Del Rosario^{*1}, Ysabel Dominique Reyes¹, Dennis Cruz^{*1}
¹*De La Salle University, Philippines*

IEEM21-F-0331/Sensor Data Prediction in Process Industry by Capturing Mixed Length of Time Dependencies

Wen Song^{*1}, Shigeru Fujimura¹
¹*Waseda University, Japan*

IEEM21-A-0103/SDA - Semantic-based Data Augmentation on Text Classification Tasks

Shih-Wen Ke^{*1}, Hsin-Ju Lee²
¹*National Central University, Taiwan*
²*Cathay United Bank, Taiwan*

IEEM21-A-0092/Methodology for Profile Monitoring and Sensor Fusion for Fault Detection and Classification in Semiconductor Manufacturing

Feng ZHU^{*1}
¹*City University of Hong Kong, Hong Kong SAR*

HF-04 Human Factors 4

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Markus HARTONO,
University of Surabaya
Sheily MENDOZA,
*University of Perpetual
Help – Molino*

[Abstracts: see page 52](#)

IEEM21-F-0256/Production Management in Norwegian Manufacturing Industry: The Implications of "The Norwegian Work Life Model"

Emrah Arica^{*1}, Carl Christian Røstad²,
Bjørnar Henriksen², Einar Hareide¹,
Thale Kvernberg Andersen²
¹SINTEF Manufacturing, Norway
²SINTEF Digital, Norway

IEEM21-F-0418/Assessment of Environmental Noise Annoyance: A Case Study of Industrial Noise in Thailand

Nantakrit Yodpijit¹, Pasit Tinnam^{*2},
Manutchanok Jongprasithporn³,
Suparoek Junsupasen¹
¹King Mongkut's University of Technology
North Bangkok, Thailand
²Bansomdejchaopraya Rajabhat University,
Thailand
³King Mongkut's Institute of Technology
Ladkrabang, Thailand

IEEM21-F-0472/Remote Usability Testing Evaluation on the Most Visited E-commerce Website in Indonesia During Covid-19 Pandemic

Fauzan Firjatullah¹, Julian Tri Haryoko¹,
Rida Zuraida^{*1}
¹Bina Nusantara University, Indonesia

IEEM21-A-0083/An Ergonomic Chair For Business Process Outsourcing Industry

Sheily Mendoza^{*1}
¹University of Perpetual Help - Molino,
Philippines

IEEM21-F-0326/TIKETAP: Designing a Smartphone App for Traffic Violation Tickets Through Design Thinking Process

Mark Anthony Baldoz^{*1}, Eula
Margareth Jabilles¹, Rosemary Seva¹
¹De La Salle University, Philippines

RME-03 Reliability and Maintenance Engineering 3

December 14, 2021 06:00 PM-07:30 PM

Chair(s): Monika TANWAR,
*Singapore University of
Technology and Design*
Aibo ZHANG,
City University of Hong Kong

[Abstracts: see page 53](#)

IEEM21-F-0427/Safety Evaluation of the Time-variant Structure Under Epistemic Uncertainty

Chunyan Ling^{*1}, Jingzhe Lei¹
¹City University of Hong Kong, China

IEEM21-A-0095/Intelligent Compressor Failure Prediction Modeling and Recommendation Engine Framework

Tuhin Mondal^{*1}, Shoban Babu
Balasubramani¹
¹Accenture Solutions Private Limited, India

IEEM21-A-0096/Consideration of Degradation and Production of Wind Turbines

Aibo Zhang^{*1}, Yukun Wang², Min Xie¹
¹City University of Hong Kong, Hong Kong
SAR
²Tianjin University, China

IEEM21-F-0506/Condition Based Maintenance Policy for Crankcase Lubricating Oil in Diesel Locomotives

Monika Tanwar^{*1}, Nagarajan Raghawan¹,
Sidra Khanam²
¹Singapore University of Technology and
Design, Singapore
²Aligarh Muslim University, India

IEEM21-A-0120/Fault Diagnosis and Remaining Useful Life Prediction Using Denoising CNN for Time-series Data Based on Physics Model

Sun Geu Chae¹, Suk Joo Bae¹
¹Hanyang University, Korea, South

SMS-01 Systems Modeling and Simulation 1

December 15, 2021 08:00 AM-09:30 AM

Chair(s): Yaqiong LV, *Wuhan
University of Technology*

[Abstracts: see page 54](#)

IEEM21-F-0112/A Review on Electric Bus Charging Scheduling from Viewpoints of Vehicle Scheduling

Aiyong Rong^{*1}, Shijun Chen¹, Dapai
Shi¹, Minsong Zhang¹, Chengyong
Wang¹
¹Hubei University of Arts and Science,
China

IEEM21-F-0143/Productivity and Human Factors Improvement in Manufacturing Systems. A Systems Modeling and Simulation Approach

Ismail Taleb^{*1}, Alain Etienne¹, Ali
Siadat¹
¹Arts et Métiers Institute of Technology,
France

IEEM21-F-0148/Agent-based Modeling as a Tool for Predicting the Spatial-temporal Diffusion of the COVID-19 Pandemic

Robert Olszewski^{*1}, Piotr Pałka¹,
Agnieszka Wendland¹
¹Warsaw University of Technology, Poland

IEEM21-F-0183/Optimization of AGV Dispatching Based on Petri Net Towards Smart Manufacturing System

Shangjia Xiang¹, Yaqiong LV^{*1}
¹Wuhan University of Technology, China

IEEM21-F-0215/Predicting Dengue Fever Transmission Using Machine Learning Methods

Ali Siddiq^{*1}, Nagesh Shukla¹, Biswajeet
Pradhan¹
¹University of Technology Sydney,
Australia

HSM Healthcare Systems and Management

December 15, 2021 08:00 AM-09:30 AM

Chair(s): Giulia CASELLI, *University of Modena and Reggio Emilia*
Junjie WANG, *Zhongnan University of Economics and Law*

[Abstracts: see page 55](#)

IEEM21-A-0014/Critical Success Factors for New Product Development in the Medical Device Industry

Seetha Raman¹, K Maddulety²,
Hiranmay Dash²
¹*SP Jain Global, Singapore*
²*SP Jain Global, India*

IEEM21-F-0220/PDMS-based RF Resonant Sensor for Measuring the Concentration of Micro-Plastics

JinHyoungh Kim¹, KwonHong Lee¹,
Cheolung Cha¹, Yongtaek Hong²
¹*Korea Electronics Technology Institute, Korea, South*
²*Seoul National University, Korea, South*

IEEM21-F-0302/A Mathematical Formulation for Reducing Overcrowding in Hospitals' Waiting Rooms

Giulia Caselli¹, Daniele De Santis¹,
Maxence Delorme², Manuel Iori¹
¹*University of Modena and Reggio Emilia, Italy*
²*Tilburg University, Netherlands*

IEEM21-F-0378/Analyzing the Interactions Among the Barriers for Safe and Effective Medical Waste Management

Sasikumar Perumal¹, Amal Hamed Aljefri¹, Reem Harib Alsaifi¹
¹*Higher Colleges of Technology, United Arab Emirates*

IEEM21-F-0432/Pre-determined Package Sizes and Large Neighborhood Search Approach for Medical Supplies Vehicle Routing Problem of Primary Care System in Thailand

Sarita Krongyoth¹, Rawinkhan Srinon¹
¹*Mahidol University, Thailand*

IEEM21-F-0450/Application of Simulation Technique in Improvement of Intra-hospital Patient Transfer: A Provincial Hospital Center in Northern Thailand

Tinnakorn Phongthiya¹, Chompoonut Kasemset¹, Sichaphat Poomsuk¹,
Worapol Lertcharoenpaisan¹
¹*Chiang Mai University, Thailand*

OR-04 Operations Research 4

December 15, 2021 08:00 AM-09:30 AM

Chair(s): Zhao-Hui SUN,
Shanghai Jiao Tong University
Huadong MO,
UNSW Canberra at ADFA

[Abstracts: see page 56](#)

IEEM21-F-0357/Time Window Based Genetic Algorithm for Multi-AGVs Conflict-free Path Planning in Automated Container Terminals

Tong Lu¹, Zhao-Hui Sun¹, Siqu Qiu¹,
Xinguo Ming¹
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0420/Literature Review of Risk Communication on Public Perceptions in Responding to Covid-19 with a System Dynamic Approach

Anggraini Saputri¹, Hilya Arini¹
¹*University of Gadjah Mada, Indonesia*

IEEM21-A-0089/Joint Optimization of Spare Parts Inventory and Planned Maintenance Under Uncertain Failures: A Mathematical Model and a Genetic Algorithm

Vincent F. Yu¹, Nabila Yuraisyah Salsabila¹, Nurhadi Siswanto², Kuo Po-Hsun¹
¹*National Taiwan University of Science and Technology, Taiwan*
²*Institut Teknologi Sepuluh Nopember, Indonesia*

IEEM21-A-0093/Solving the Vehicle Routing Problem with Simultaneous Pickup and Delivery and Occasional Drivers by Simulated Annealing

Vincent F. Yu¹, Grace Aloina¹, Panca Jodiawan¹, Aldy Gunawan², Tsung-Chi Huang¹
¹*National Taiwan University of Science and Technology, Taiwan*
²*Singapore Management University, Singapore*

IEEM21-F-0475/Analysis of Renewable Energy Adoption Efficiencies Under Uncertainty Across Electricity Markets in the U.S.

Olawale Ogunrinde¹, Ekundayo Shittu¹
¹*The George Washington University, United States*

PM-01 Project Management 1

December 15, 2021 08:00 AM-09:30 AM

Chair(s): Ripon CHAKRABORTTY,
UNSW Canberra at the Australian Defence Force Academy
Liaoliao LI, *Northwestern Polytechnical University*

[Abstracts: see page 56](#)

IEEM21-F-0186/Key Roles of the Full Life Cycle of the "Internet +" Environmental Public Welfare Projects

Liaoliao Li¹, Yali Zhang¹, Guoying Tang¹, Jun Sun²
¹*Northwestern Polytechnical University, China*
²*University of Texas Rio Grande Valley, United States*

IEEM21-F-0207/How Does the Text Sentiment Tendency Affect the Fundraising Effect of Digital Environmental Protection Public Welfare Projects? — Moderating Effect of Projects' Information

Delin Chen¹, Haixin Zhang¹, Yali Zhang¹
¹*Northwestern Polytechnical University, China*

IEEM21-F-0235/Implementation of Last Planner System to Engineering-to-order (ETO) Organization with a Focus on Office Knowledge Work. Development of a Framework

Daria Larsson¹, R.M. Chandima Ratnayake²
¹*University of Stavanger / Blueday Technology, Norway*
²*University of Stavanger, Norway*

IEEM21-F-0251/Circular Economy Strategies in Civil Engineering: A Brief Literature Review

Sassha Rico¹, Luciana Hazin Alencar¹
¹*Universidade Federal de Pernambuco, Brazil*

QCM-01 Quality Control and Management 1

December 15, 2021 08:00 AM-09:30 AM

Chair(s): Yoshinobu TAMURA,
Yamaguchi University
Aibo ZHANG, City University
of Hong Kong

[Abstracts: see page 57](#)

IEEM21-F-0055/Effectiveness of the Tactics for Small and Medium-sized Toy Factories in China in Dealing with European and US Toy Safety Requirements

C. W. Kwong¹, Shu Lun Mak^{2*}, Chi Ho Li¹
¹The Open University of Hong Kong, Hong Kong SAR

IEEM21-F-0101/A Study on Recycling the Plastic Wastes with Bamboo on Making Wall Tiles

Shu Lun Mak^{2*}, Fanny Tang¹, Chi Ho Li¹, Ming Yan Wu¹, Tsz Wing Chan¹
¹The Open University of Hong Kong, Hong Kong SAR

IEEM21-A-0023/Performance Measurement: An Integral Element of Continued Success

Fikri Dweiri¹, Tazeen Sharif^{2*}
¹University of Sharjah, United Arab Emirates

IEEM21-F-0137/Costs of Quality Management in Global and South African Manufacturing Companies: Similarities and Differences

Bheki Makhanya^{2*}, Hannelie Nel¹, Jan Harm Pretorius¹
¹University of Johannesburg, South Africa

IEEM21-A-0037/Monitoring Percentiles of Proportion Data for Truncated Beta Process

Shovan Chowdhury^{2*}
¹Indian Institute of Management, Kozhikode, India

Poster 01

December 15, 2021 08:00 AM-09:30 AM

Chairs: Pei-Lee TEH,
Monash University Malaysia
Edwin CHEUNG,
Hong Kong Institute of Vocational
Education (Tuen Mun)

[Abstracts: see page 58](#)

IEEM21-F-0150/A Comprehensive Investigation of Knowledge Management Publications

Rodrigo Oliveira de Castro¹, Cesar Sanin^{2*}, Andrew Levula², Edward Szczerbicki³
¹Australian Institute of Higher Education, Australia
²Sydney International School of Technology and Commerce, Australia
³Gdansk University of Technology, Poland

IEEM21-F-0170/Exploring the Hotspots and Trends of the Literature on R&D Networks: Bibliometric and Content Analysis

Yan Wang^{2*}, Naiding Yang¹, Yu Wang¹, Min Guo¹
¹Northwestern Polytechnical University, China

IEEM21-F-0385/Planning of Teaching Contents of Industry-oriented Capstone Course in Technological Colleges and Universities

Jen-Chia Chang¹, Hsi-Chi Hsiao², Feng-Ming Sui^{3*}
¹National Taipei University of Technology, Taiwan
²Cheng Shiu University, Taiwan
³Hwa Hsia University of Technology, Taiwan

IEEM21-F-0072/Crowdsourced Manufacturing for Delivery of Manufacturing as a Service

Xuejian Gong¹, Roger Jiao^{2*}, Amit Jariwala¹, Beshoy Morkos²
¹Georgia Institute of Technology, United States
²University of Georgia, United States

IEEM21-F-0108/Application for Roof Type Analysis and Component Counting from Roof Plan Image

Thanawinn Arphacharas^{2*}, Nagul Cooharajanone¹, Pravee Kruachottikul¹, Peelak Wantanasiri², Dhanawat Mahasiriwattanakit²
¹Chulalongkorn University, Thailand
²SCG Roofing, Thailand

IEEM21-F-0201/A Study of Applying Unsupervised Learning Methods for Document Clustering and Automatic Categorization of Software

Kai-Wen Chen¹, Chin-Yu Huang^{2*}
¹National Tsing Hua University, Taiwan

IEEM21-F-0030/Exact Algorithms for Robust Quay Crane Scheduling Problems

Yitian Li¹, Canrong Zhang¹
¹Tsinghua University, China

IEEM21-F-0031/Sustainability Evaluation of Tobacco Excise Tax Policy to Finance Universal Health Coverage in Indonesia

Teuku Naraski Zahari^{2*}, Akhmad Hidayatno¹, Komarudin¹
¹University of Indonesia, Indonesia

IEEM21-F-0105/Creative Activity Outcomes and Optimal Task Scheduling

Sanetake Nagayoshi^{2*}, Jun Nakamura²
¹Shizuoka University, Japan
²Chuo University, Japan

SMS-02 Systems Modeling and Simulation 2

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Omid FATAHI VALILAI,
Jacobs University Bremen
Huadong MO,
UNSW Canberra at ADFA

[Abstracts: see page 59](#)

IEEM21-F-0265/Potential of Streamlining Warehouse Processes and IT integration to Increase Implementation of Automation

Tine Meidahl Münsberg¹, Lars Hvam^{1*}
¹Technical University of Denmark, Denmark

IEEM21-F-0278/Deadlock-solving Traffic Control Methods for Automated Guided Vehicle Systems

Maoning Chen¹, Yuangen Lu¹, Canrong Zhang¹
¹Tsinghua University, China

IEEM21-F-0334/Onomatopoeia Search System Focused on Attributes Based on Sensibility and Various Sounds

Ryuta Yamada^{2*}, Takashi Ito¹, Syohei Ishizu¹
¹Aoyama Gakuin University, Japan

IEEM21-F-0395/Set of Flexible Models to Support Simulation-based Assembly Planning in SMEs

Maximilian Duisberg^{2*}, Michael Kranz¹, Mostafa Khabbazan¹, Susanne Mütze-Niewöhner¹
¹RWTH Aachen University, Germany

TKM-04 Technology and Knowledge Management 4

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Danping LIN, *Shanghai Maritime University*
Julia BRAUN, *Brandenburg University of Technology Cottbus-Senftenberg*

[Abstracts: see page 60](#)

IEEM21-F-0413/Consideration on Sustainable Development of Companies and Society: Research on an Approach to Creating Shared Value

Haru Suzuki^{1*}, Masaru Ishioka¹
¹*Fukushima University, Japan*

IEEM21-F-0453/Product Development in the Automotive Industry in the Context of Industry 4.0 - A Bibliometric Analysis

Julia Braun^{1*}, Magdalena Missler-Behr¹
¹*Brandenburg University of Technology Cottbus-Senftenberg, Germany*

IEEM21-F-0259/The Current State of EV Readiness in Indonesia: Assessing the Industrial Sector's Perspective with J-TRA Methodology

Andante Hadi Pandiyaswargo^{1*}, Meilinda Fitriani Nur Maghfiroh²
¹*Waseda University, Japan*
²*Universitas Islam Indonesia, Indonesia*

IEEM21-F-0328/Influencing Factors on the Adoption of Face Recognition Technology on Campus Based on SEM

Danping Lin^{1*}, Chan Yuan^{1*}, Zhijian Chen¹
¹*Shanghai Maritime University, China*

OR-05 Operations Research 5

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Bertha Maya SOPHA, *Universitas Gadjah Mada*
Yuying LONG, *Harbin Institute of Technology*

[Abstracts: see page 60](#)

IEEM21-A-0139/Optimization of AGV Balanced Transportation at the Automated Container Terminal

Gao Yinping^{1*}, Songlin Chen¹
¹*Nanyang Technological University, Singapore*

IEEM21-A-0147/An Improved Congestion Areas Model and NSGA2 for the Green Vehicle Routing Problem

Yanping Chen^{1*}, Eishi Chiba¹
¹*Hosei University, Japan*

IEEM21-A-0148/The Nature of an Infection Tree Obtained From the Extended Contact Process

Kazuhiro Suzuki^{1*}, Eishi Chiba¹
¹*Hosei University, Japan*

IEEM21-A-0150/A Methodology Using AHP to Find the Best Solution to Lead Time Reduction in Manufacturing

Longjiang Guo^{1*}, Eishi Chiba¹
¹*Hosei University, Japan*

IEEM21-F-0160/Collaborative Vehicle Dispatching for Resilient and Fair Emergency Response

Yuying Long^{1*}, Ying Sun¹, Gangyan Xu¹, Pengfeng Shu¹
¹*Harbin Institute of Technology, China*

PM-02 Project Management 2

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Ling WANG, *Jiangsu Taizhou Bridge Co., Ltd*
Dingcheng ZHANG, *City University of Hong Kong*

[Abstracts: see page 61](#)

IEEM21-F-0049/Feature Based Statistical Model of Employee Productivity with Real Time Checked Data

Jalaja Shanmugalingam¹, David Lario^{2*}, Yongsheng Ma¹
¹*University of Alberta, Canada*
²*Enigma Design Solutions, Canada*

IEEM21-F-0063/Comparison of Stabilities for Open Source Project

Hironobu Sone^{1*}, Yoshinobu Tamura^{2*}, Shigeru Yamada³
¹*IBM Japan, Ltd., Japan*
²*Yamaguchi University, Japan*
³*Tottori University, Japan*

IEEM21-F-0090/Organisational Learning and Uncertainty Reduction in Innovation Projects: The Moderating Effects of Innovation Project Types

Rola Fanousse^{1*}, Dilupa Nakandala¹, Yi-Chen Lan¹
¹*Western Sydney University, Australia*

IEEM21-F-0136/Analysis on the Cooperative Innovation Behavior and Stability of Inter-organizational R&D Project Based on Evolutionary Game

Xiaoxia Huang^{1*}, Peng Guo¹, Xiaonan Wang¹, Ding Wang¹
¹*Northwestern Polytechnical University, China*

QCM-02 Quality Control and Management 2

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Zhi Lin CHONG, *Universiti Tunku Abdul Rahman*
Chenglong LI, *Northwestern Polytechnical University*

[Abstracts: see page 62](#)

IEEM21-F-0314/A Model to Assess the Impacts of ISO Management Systems Standards

Mónica Cabecinhas^{*1}, Paulo Sampaio¹, Martí Casadesús²
¹*University of Minho, Portugal*
²*Universitat de Girona, Spain*

IEEM21-F-0380/Multiscale Quality: Micro, Meso and Macro Concepts

Catarina Cubo^{*1}, Paulo Sampaio¹, Pedro Saraiva²
¹*University of Minho, Portugal*
²*University of Coimbra, Portugal*

IEEM21-F-0422/Quality Prediction Method by Modeling the Sustained Effects of Irregular Process Disturbances

Qi Xiu^{*1}, Michiko Tanaka¹, Masayuki Sakata¹
¹*Hitachi, Ltd., Japan*

IEEM21-F-0458/Overall Performance Comparison of Homogeneously Weighted Moving Average and Double Homogeneously Weighted Moving Average Schemes

Zhi Lin Chong^{*1}, Kok Ming Chan¹, Junjie Wang², Jean-Claude Malela-Majika³, Sandile C. Shongwe⁴
¹*Universiti Tunku Abdul Rahman, Malaysia*
²*Zhongnan University of Economics and Law, China*
³*University of Pretoria, South Africa*
⁴*University of the Free State, South Africa*

Poster 02

December 15, 2021 10:00 AM-11:30 AM

Chair(s): Min XIE,
City University of Hong Kong

[Abstracts: see page 62](#)

IEEM21-F-0296/Review on the Application of Eye-tracking Technology in Usability Evaluation of E-government Apps

Jingyi Zhang^{*1}, Danni Chang^{*1}, Zhen Zhang¹
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0298/ Eye Tracking-based Usability Evaluation of E-government App Icon Design

Zhen Zhang^{*1}, Danni Chang^{*1}, Jingyi Zhang¹, Renbo Ding¹
¹*Shanghai Jiao Tong University, China*

IEEM21-A-0054/Electric Kick Scooters Risk Issues Analysis from User Perspective Using DMR

Jeong Heo^{*1}, Kyung-Jun Lee¹, Adriance Wilfred¹, Gyungbhin Kim¹, Myung Hwan Yun^{*1}
¹*Seoul National University, Korea, South*

IEEM21-F-0042/Research on Omni-channel Supply Chain Pricing Decision with the Allowance of Cross-channel Return

Shujun Yang^{*1}, Huajun Tang^{*1}
¹*Macau University of Science and Technology, China*

IEEM21-F-0119/A Heuristic-IRM Method on Hard Disk Failure Prediction in Out-of-distribution Environments

Jichao Wang^{*1}, Ran Zhang¹, Guanqiang Qi¹, Lanqing Hong^{*2}
¹*City University of Hong Kong, China*
²*Huawei Noah's Ark Lab, China*

SMS-03 Systems Modeling and Simulation 3

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Dinh Son NGUYEN, *University of Science and Technology, The University of Danang*

[Abstracts: see page 63](#)

IEEM21-A-0118/Semiparametric Modelling of Repairable Systems with Time Varying Heterogeneity Using Multivariate Gaussian Convolution Processes

Di Cui^{*1}, Qiuzhuang Sun², Min Xie¹
¹*City University of Hong Kong, Hong Kong SAR*
²*National University of Singapore, Singapore*

IEEM21-F-0405/A Simulation-based Analysis of the Blood Supply Chain During Covid-19

Desti Pinasti Putri¹, Hilya Arini², Nur Mayke Eka Normasari¹
¹*Universitas Gadjah Mada, Indonesia*
²*University of Gadjah Mada, Indonesia*

IEEM21-A-0080/Airport Check-in Process Analysis Using Modeling and Simulation

Sarika Tyagi^{*1}, Gabriel Lodewijks¹
¹*UNSW Sydney, Australia*

IEEM21-A-0086/Robot Routing Problem with Last-mile Pickup and Delivery in Indoor Environments

Junsu Kim^{*1}, Hosang Jung^{*1}
¹*Inha University, Korea, South*

IEEM21-F-0437/Optimal Sizing and Contracting of Vehicle Fleets Under Uncertainty for Upstream Operations in the Oil and Gas Industry

Demian Presser^{*1}, Vanina Cafaro¹, Diego Cafaro^{*1}
¹*Universidad Nacional del Litoral / (INTEC-UNL), CONICET, Argentina*

IEEM21-F-0412/Leveraging Digital Twins for Compatibility Checks in Production Systems Engineering

Felix Ocker^{*1}, Birgit Vogel-Heuser¹, Hauke Schön², Robert Mieth¹
¹*Technical University of Munich, Germany*
²*ASM DIMATEC Deutschland GmbH, Germany*

TKM-05 Technology and Knowledge Management 5

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Dilupa NAKANDALA,
Western Sydney University
Hirammay DASH,
SP Jain Global

[Abstracts: see page 64](#)

IEEM21-F-0508/Dynamic Service Innovation Capabilities in the Digital Age: An Integrated Research Framework and Key Research Questions

Shun Zhang¹, Jun Zhan¹, Fuhong Wang²
¹Shanghai Maritime University, China
²Shanghai Jian Qiao University, China

IEEM21-F-0104/Failure Knowledge-sharing Motivation with Self Determination Theory – Evidence from a Japanese Company

Sanetake Nagayoshi¹, Jun Nakamura²
¹Shizuoka University, Japan
²Chuo University, Japan

IEEM21-F-0316/Visualizing the Evolution of Reverse Knowledge Transfer Research: A Bibliometric Analysis Based on Citespace

Junlin Zhu¹, Suli Zheng¹, Xiao Sun¹
¹China Jiliang University, China

IEEM21-F-0151/Digital Supply Chain in the Food Industry: Critical Success Factors and Barriers

Meenakshi Subramaniam¹, Sarina Abdul Halim-Lim¹, Siti Fatimah Binti Mohamad¹, Anjar Priyono²
¹Universiti Putra Malaysia, Malaysia
²Universitas Islam Indonesia, Indonesia

IEEM21-F-0110/Big Data Analysis for Predicting Future Skills

Arnesh Telukdarie¹, Megashnee Munsamy¹, Mabatho Gaula¹
¹University of Johannesburg, South Africa

OR-06 Operations Research 6

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Bertha Maya SOPHA,
Universitas Gadjah Mada
Muhammad HANIF, Huazhong
University of Science and
Technology, Wuhan

[Abstracts: see page 65](#)

IEEM21-F-0012/Dynamic Vehicle Routing for Battery Swapping in an Electric Bike-sharing System

Yi Yang¹, Yaoming Zhou¹, Tanmoy Kundu², Suxiu Xu³
¹Shanghai Jiao Tong University, China
²National University of Singapore, Singapore
³Jinan University, China

IEEM21-F-0239/Truck Departure Optimization from Distribution Center to Parcel Locker with Stochastic Demand Arrival

Wenjia Zeng¹, Xia Yang¹, Mingyao Qi¹
¹Tsinghua University, China

IEEM21-F-0369/A Heuristic Algorithm for Time-dependent Bus Scheduling Problem

Yi Zhang¹, Jiguang Wang¹, Xinglu Liu¹, Wai Kin (Victor) Chan², Feng Li³, Zhide Li²
¹Tsinghua-Berkeley Shenzhen Institute, China
²Tsinghua University, China
³Shenzhen Intelligent Public Transportation Technology Co., Ltd, China

IEEM21-F-0102/A Single Non-obnoxious Facility Location Selection for Utility Stores Corporation Using Center of Gravity and P-median Methods

Muhammad Hanif¹, Li Zhang¹, Nasir Mujtaba², Jiacheng Li¹, Abdul Hakim Shah³, Saif Ullah²
¹Huazhong University of Science and Technology, Wuhan, China
²University of Engineering and Technology, Taxila, Pakistan
³Khushal Khan Khattak University Karak, Pakistan

PM-03 Project Management 3

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Luca SILVESTRI, University of
Rome "Niccolò Cusano"
Aibo ZHANG, City University
of Hong Kong

[Abstracts: see page 66](#)

IEEM21-F-0371/Analysis of the Perspectives of the Stakeholders in Sustainability Management in Civil Construction: A Literature Review

Luanda Lima¹, Luciana Hazin Alencar², Marcelo Alencar¹
¹Federal University of Pernambuco, Brazil
²Universidade Federal de Pernambuco, Brazil

IEEM21-F-0384/A Comparative Performance Analysis of Two MILP Formulations for the Re-resource-Renting-Problem

Max Reinke¹, Juergen Zimmermann¹
¹Clausthal University of Technology, Germany

IEEM21-F-0394/Improving Information System Development and Maintainability Factors Through Standardized Processes: An Empirical Study

Younes Benslimane¹, Ziji Yang¹, Eric Liu²
¹York University, Canada
²University of Waterloo, Canada

IEEM21-F-0445/Creating Business Domain Concepts in Regional Projects: In the Case of Japan

Makoto Tanifuji¹, Keisuke Uenishi²
¹Iwate Prefectural University, Japan
²Osaka University, Japan

IEEM21-F-0468/Incorporating the Influence of Risk Factor Interdependencies and Shared Risk Factors into Project Portfolio Risk Assessment

Camilo Mican¹, Gabriela Fernandes², Madalena Araújo³
¹University of Valle, Colombia
²University of Coimbra, Portugal
³University of Minho, Portugal

IEEM21-F-0227/Project-oriented Selection of Agile Methods for the Design of Physical Products

Julian Baschin¹, David Schneider¹, Tobias Huth¹, Thomas Vietor¹
¹TU Braunschweig, Germany

QCM-03 Quality Control and Management 3

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Tahir MAHMOOD, *King Fahd University of Petroleum and Minerals, Saudi Arabia*

[Abstracts: see page 67](#)

IEEM21-F-0477/Evaluation of World Class Operations Perspectives in Postal Organizations

Thabiso Mokoena^{1*}
¹*University of Johannesburg, South Africa*

IEEM21-F-0155/Methodology for a Model-based Traceability of Requirements from Complaints in Business Networks Using e-DeCoDe

Marian Mistler¹, Nadine Schlueter¹, Manuel Loewer¹, Vincenz Rafalczyk¹
¹*University of Wuppertal, Germany*

IEEM21-F-0414/Knowledge Management Embedded in Agile Methodology for Quality 4.0

Monica Leba^{1*}, Raluca Dovleac¹, Andreea Ionica¹
¹*University of Petrosani, Romania*

IEEM21-F-0425/A Hierarchical Graphical Model of Critical Success Factors for Implementing the UAE's Government Excellence

Ola Khalid AlZawati^{1*}, Hamdi Bashir¹, Imad Alsyouf¹
¹*University of Sharjah, United Arab Emirates*

Poster 03

December 15, 2021 12:00 PM-01:30 PM

Chair(s): Jingyi ZHANG, *Shanghai Jiao Tong University*
Linda ZHANG, *IESEG School of Management, Univ. Lille, CNRS 9221*

[Abstracts: see page 67](#)

IEEM21-F-0341/How Effective Vertical Organizational Communication Impacts the Success of Hoshin Kanri Strategy Implementation in Medium-sized Manufacturers

Samuel Brüning Larsen¹, Rasmus Sorth-Olsen¹, Torben Knudby^{1*}
¹*Technical University of Denmark, Denmark*

IEEM21-A-0138/Information Exchange in Ill-structured Decision Making by Teams

Steven Silver^{1*}
¹*San Jose State University, United States*

IEEM21-F-0092/Advance Selling Strategy for Risk-averse Strategic Customers

Xiaowen Sun¹, Limin Sun²
¹*Macau University of Science and Technology, China*
²*Guangdong University of Petrochemical Technology, China*

IEEM21-A-0058/On the Assignment Problem and its Application in Automated Settlement of Receivables

Lukasz Czekaj^{1*}, Robert Olszewski², Robert Kitlowski¹, Tomasz Biegus¹, Stanislaw Raczynski³, Pawel Tomasiak³, Mateusz Olszewski³, Alexander Prokopenya⁴, Ryszard Kozera⁴
¹*Szybkie Składki Sp. z o.o., Poland*
²*Warsaw University of Technology, Poland*
³*PICTEC, Poland*
⁴*Warsaw University of Life Sciences, Poland*

IEEM21-F-0335/From Smart Card to Mobility as A Service (MaaS): A Case Study from Kaohsiung City, Taiwan

Wen-Ping Chao¹, Keng-Chieh Yang¹
¹*National Kaohsiung University of Science and Technology, Taiwan*

IEEM21-F-0141/Product Group Technology Under Multiple Process Paths Based on Genetic Algorithm

Xuerong Luo¹, Bo Li^{1*}, Minmin Liu¹, Tao Hong¹
¹*University of Electronic Science and Technology of China, China*

IEEM21-F-0017/Cyber-physical System-based Workshop

Tongtong Zhou^{1*}, Zhihua Chen¹, Xinguo Ming¹, Yuan Chang¹
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0406/Research on the Lean Logistics System Framework of Tobacco Commercial Enterprises in the Context of Digital Empowerment

Yong Zhao¹, Jiangtao Xia^{2*}, Caihong Liu²
¹*Shaanxi Provincial Tobacco Company Xi'an Branch, China*
²*Northwestern Polytechnical University, China*

IEEM21-F-0363/A Fast Approximate Method for the Large-scale One-source P-median Problem

Runze Zhao^{1*}, YiYong Xiao¹, Rui Luo¹, Yue Zhang¹, Xiaoyuan Liu²
¹*Beihang University, China*
²*University of Wisconsin-Madison, United States*

SCM-07 Supply Chain Management 7

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Bertha Maya SOPHA, *Universitas Gadjah Mada*
Kendrik Yan Hong LIM, *Agency for Science, Technology and Research*

[Abstracts: see page 69](#)

IEEM21-F-0409/A Sustainable Supply Chain Inventory Model with All-units Quantity Discount and Shipping Weight

Ivan Darma Wangsa¹, Iwan Vanany^{1*}, Nurhadi Siswanto¹
¹*Institut Teknologi Sepuluh Nopember, Indonesia*

IEEM21-F-0416/E-Commerce: Challenges That Lies Ahead of the Future Air Cargo Operation

Tipavinee Suwanwong Rodbundith^{1*}, Pornwasin Sirisawat¹, Narat Hasachoo¹
¹*Mae Fah Luang University, Thailand*

IEEM21-A-0091/Lateral Transshipment Scheduling Model in a Distribution System

Gitae Kim^{1*}
¹*Hanbat National University, Korea, South*

IEEM21-F-0440/Blockchain-driven Supply Chain Finance – A Structured Review

Lorenz Trautmann^{1*}, Rainer Lasch¹
¹*Dresden University of Technology, Germany*

IEEM21-F-0349/Smart Retail Adaptation Framework for Traditional Retailers: A Systematical Review of Literature

Muriani Emelda Isharyani^{1*}, Bertha Maya Sopha², Muh. Arif Wibisono², Benny Tjahjono³
¹*Universitas Mulawarman, Indonesia*
²*Universitas Gadjah Mada, Indonesia*
³*Coventry University, United Kingdom*

DAM-04 Decision Analysis and Methods 4

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Tahir MAHMOOD, *King Fahd University of Petroleum and Minerals, Saudi Arabia*
Huadong MO, *UNSW Canberra at ADEA*

[Abstracts: see page 69](#)

IEEM21-F-0372/Extreme Learning Machine for Short and Mid-term Electricity Spot Prices Forecasting

Inês Teixeira¹, Ana Paula Barroso^{2,1}, Teresa Marques²
¹*Universidade NOVA de Lisboa, Portugal*
²*Bondalti, Portugal*

IEEM21-A-0073/Exploring the Cognitive Process of Interviewer During Employment Interview Using Think Aloud Method

Shiyun Zhao¹
¹*University of Strathclyde, China*

IEEM21-F-0387/An Analysis of Social Sustainability Indicators Using FITradeoff Multicriteria Decision Method

George Passos Neto¹, Luciana Hazin Alencar¹, Emilia R. Kohlman Rabbani², Rodolfo Valdes-Vasquez²
¹*Universidade Federal de Pernambuco, Brazil*
²*Universidade de Pernambuco, Brazil*
³*Colorado State University, United States*

IEEM21-F-0460/Comparing Statistical and Machine Learning Methods for Sales Forecasting During the Post-promotional Period

H. Niles Perera¹, Harsha Chamara Hewage¹
¹*University of Moratuwa, Sri Lanka*

IEEM21-F-0486/A Multicriteria Group Decision-making Model for Selecting a Perishable Food Packaging System Using an Outranking Method

Over M. Causil¹, Danielle C. Morais¹
¹*Federal University of Pernambuco, Brazil*

MS-04 Manufacturing Systems 4

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Mohammed DAHANE, *Université de Lorraine*
Subham KUNDU, *Heritage Institute of Technology, Kolkata*

[Abstracts: see page 70](#)

IEEM21-F-0398/Implementation of Lean Production for Achieving Low-cost Product: A Case Study of ABC Company

Jonny Jonny¹
¹*Bina Nusantara University, Indonesia*

IEEM21-F-0419/Management Framework for the Highly Iterative and Integrated Product and Production Process Development (HIP³D)

Günther Schuh¹, Andreas Gützlaff¹, Seth Schmitz¹, Shari Wlecke^{2,1}, Annkristin Hermann¹
¹*RWTH Aachen University, Germany*

IEEM21-F-0455/Development of a Model to Evaluate the Potential of 5G Technology for Latency-critical Applications in Production

Raphael Kiesel¹, Falk Boehm¹, Jan Pennekamp¹, Robert Schmitt¹
¹*RWTH Aachen University, Germany*

IEEM21-A-0101/Quality and Yield Loss Prediction in Polyvinyl Films Manufacturing

Shoban Babu Balasubramani^{1,2}, Tuhin Mondal¹, Debraj Patra¹, Rajesh Rangaswamy¹
¹*Accenture Solutions Private Limited, India*

IEEM21-F-0479/Development of New Univariate Process Capability Index for Multistage Wheel Manufacturing System

Subham Kundu¹, Subhas Chandra Mondal²
¹*Heritage Institute of Technology, Kolkata, India*
²*Indian Institute of Engineering Science and Technology, Shibpur, India*

SIM-02 Service Innovation and Management 2

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Desmond WONG, *University of Hull*
Zhao-Hui SUN, *Shanghai Jiao Tong University*

[Abstracts: see page 71](#)

IEEM21-F-0010/Research on Customer Market Segmentation of Electric Vehicle Rental Sites Based on Latent Class Modeling

Peng Guo¹, Rui Miao¹, Bo Zhang¹, Hao Hu¹
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0115/Wellness Tourism Destination Assessment Model: A Development Indicator in an Emerging Economy—Thailand

Thadathibesra Phuthong¹, Pongpun Anuntavoranich¹, Achara Chandrachai¹, Kerk Piromsopa¹
¹*Chulalongkorn University, Thailand*

IEEM21-F-0125/Research on the Impact of Network Embeddedness on Enterprise Innovation Performance -- Based on the Mediating Role of Business Model Innovation and the Moderating Role of Competition Intensity

Qingfeng Tian¹, Guoqing Li^{2,1}, Rui Xu¹
¹*Northwestern Polytechnical University, China*

IEEM21-F-0154/Smart Product Service Requirements Identification and Evaluation: A Hybrid Method

Ziding Meng¹, Zhihua Chen¹, Zhao-Hui Sun¹, Xinguo Ming¹
¹*Shanghai Jiao Tong University, China*

IEEM21-F-0200/Optimal Pricing for Online Delivery Platforms with Group Buying and Direct Delivery

Lewen Yuan¹, Li Xiao¹
¹*Tsinghua University, China*

CM Crisis Management

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Maria de los Angeles GOMEZ, *Universidad Popular Autónoma del Estado de Puebla*
Aunchalee Taweethavornasawas, *King Mongkut's University of Technology North Bangkok*

[Abstracts: see page 72](#)

IEEM21-F-0159/Leadership for Team Adaptation and Performance During COVID-19 Crisis and Beyond: An Examination of Leader-member Exchange and Leader Humility
Kanupriya Singh¹
¹*University of Missouri, United States*

IEEM21-F-0376/Vehicle Interdiction Strategy in Complex Road Networks - A Simulation Based Approach
Goutam Sen¹, Sukanya Samanta¹, Soumya K. Ghosh¹
¹*Indian Institute of Technology Kharagpur, India*

IEEM21-F-0462/Concept for Enhancing the Contribution of Product Development to Organizational Resilience of Manufacturing Companies
Michael Riesener¹, Maximilian Kuhn¹, Jonas Tittel¹, Günther Schuh¹
¹*RWTH Aachen University, Germany*

IEEM21-A-0119/Project Management in Crisis Era, Using Design Thinking as a Project Development Tool
Maria de los Angeles Gomez¹, Pablo Nuño¹
¹*Universidad Popular Autónoma del Estado de Puebla, Mexico*

EET Engineering Education and Training

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Zhiqiang CAI, *Northwestern Polytechnical University*
Greta BRAUN, *Chalmers University of Technology*

[Abstracts: see page 72](#)

IEEM21-F-0015/Evaluating Undergraduate Students' Feedback Towards Service Quality of Private University: A Structural Equation Modeling Approach
Yogi Tri Prasetyo¹, Lauren Regondola-Bolata¹
¹*Mapúa University, Philippines*

IEEM21-A-0026/Teaching Operations Management Based on Information Technologies During COVID-19
Guilherme Tortorella¹, Gopalakrishnan Narayanamurthy², Vijaya Sunder M³, Paulo A. Cauchick-Miguel⁴
¹*The University of Melbourne, Australia*
²*University of Liverpool, United Kingdom*
³*Indian School of Business, India*
⁴*Federal University of Santa Catarina, Brazil*

IEEM21-F-0289/Engineering Students' Experiences of Digital Remote Learning During COVID-19 Pandemic in OÜAS
Jouni Kääriäinen¹, Ville Isoherranen¹
¹*Oulu University of Applied Sciences, Finland*

IEEM21-F-0343/Technology-mediated Learning in Industry: Solution Space, Implementation, Evaluation
Elisa Roth¹, Mirco Moencks¹
¹*University of Cambridge, United Kingdom*

IEEM21-F-0415/Socio-technical Qualification Modules for the Empowerment of Logistics Employees in the Technological Transition
Markus Kohl¹, Steffi Zierhut², Jens Lopitzsch², Johannes Fottner¹, Susanne Wilpers³
¹*Technical University of Munich, Germany*
²*MAN Truck & Bus SE, Germany*
³*University of Applied Sciences Heilbronn, Germany*

IEEM21-A-0094/Closing the Skill Gap Through Matchmaking
Greta Braun¹, Johan Stahre¹
¹*Chalmers University of Technology, Sweden*

Poster 04

December 15, 2021 02:00 PM-03:30 PM

Chair(s): Seung Ki MOON, *Nanyang Technological University*

[Abstracts: see page 73](#)

IEEM21-F-0502/Health Assessment Method of Integrated Navigation System Based on Operation Data
Jingyue Yang¹, Wei Liu¹, Zhichao Pang¹
¹*Tianjin Navigation Instrument Research Institute, China*

IEEM21-A-0110/The Simulation Optimization Approach and Queue Theory to Analyze the Increase in the Number of Servers Over Patient Waiting Time
Sayda Ben Sghyaier¹, Rafaa Mrahi¹, Arij lahmar²
¹*ESC Tunisia, Tunisia*
²*Dubai University, United Arab Emirates*

IEEM21-F-0391/Evaluation of Home Care vs. Conventional Care Using Parametric Cost Estimation and the Fuzzy Analytical Hierarchy Process: A Case Study in Central Sweden
Jonas Sandstrom¹, Annika Hasselblad¹, Leif Olsson¹
¹*Mid Sweden University, Sweden*

IEEM21-A-0078/A Study on User Characteristics and User Types in Designing Auditory Experience for Electric Vehicles
Yein Song¹, Sungho Kim¹, May Jorella Lazaro¹, Seungyun Ha¹, Myung Hwan Yun¹
¹*Seoul National University, Korea, South*

IEEM21-F-0147/Design and Development of a Digital Twin Dashboards System Under Cyber-physical Digital Twin Environment
Weidong Lin¹, Malcolm Yoke Hean Low¹
¹*Singapore Institute of Technology, Singapore*

IEEM21-F-0142/Scheduling Method of Mixed-flow Assembly Line Based on Complete Kit of Materials
Yang Cao¹, Minmin Liu¹, Bo Li¹, Tao Hong¹
¹*University of Electronic Science and Technology of China, China*

IEEM21-F-0373/Analysis of Housing Prices of Urban with Port and City Integration Taking Kaohsiung Example
Kuei-Chen Chiu¹
¹*Shih Chien University, Taiwan*

SCM-08 Supply Chain Management 8

December 15, 2021 04:00 PM-05:30 PM

Chair(s): Aries SUSANTY,
University of Diponegoro
Daniel MUELLER,
TU Dortmund University

[Abstracts: see page 74](#)

IEEM21-F-0474/The Mechanisms of Co-innovation in the Development of Bioplastic Packaging: Evidence from Practice

Liliani¹, Benny Tjahjono¹, Dongmei Cao¹

¹*Coventry University, United Kingdom*

IEEM21-F-0482/An Integrated Inventory Problem with Transportation in a Single-vendor Multiple-buyer Supply Chain Coordination with Stochastic Demand

Ibrahim A. Alrajeh¹, Mustafa Y. Alabandi¹, Mohammad A.M. Abdel-Aal¹

¹*King Fahd University of Petroleum and Minerals, Saudi Arabia*

IEEM21-F-0485/A Simulative Study of an In-plant Frozen Period for Demand-based Material Supply in Matrix Manufacturing Systems

Daniel Mueller¹, Christoph Ganß¹

¹*TU Dortmund University, Germany*

IEEM21-F-0501/Do Listed Ocean Tanker Companies Have Operational Skill? Empirical Evidence from Fleet and Voyage Data

Roar Adland¹, Tord Engen¹

¹*Norwegian School of Economics, Norway*

IEEM21-F-0503/Improving the Strategic Distribution Performance of the Supply Chain of a Leading FMCG Company: A Case Study

Shady Mostafa¹, Yasmin Adel², Khaled S. Abdallah¹

¹*Arab Academy for Science, Technology and Maritime Transport, Egypt*

²*Université Française D'Égypte, Egypt*

IEEM21-F-0438/Integrated Repair Shop Scheduling and Spare Parts Pooling for Robust Product Regeneration

Torben Lucht¹, Anja Wojcik¹, Peter Nyhuis¹

¹*Leibniz University Hannover, Germany*

DAM-05 Decision Analysis and Methods 5

December 15, 2021 04:00 PM-05:30 PM

Chair(s): H. Niles PERERA,
University of Moratuwa
Desmond WONG,
University of Hull

[Abstracts: see page 75](#)

IEEM21-F-0433/Gamified Learning of Supply Chain Optimization Through the Beer Distribution Game

Thiranjaya Kandanaarachchi¹, H. Niles Perera²

¹*The University of Sydney, Australia*

²*University of Moratuwa, Sri Lanka*

IEEM21-F-0466/Conceptual Model for Understanding the Impacts of COVID-19 Pandemic on Jakarta Mid-term Development Goals Using System Dynamics Approach

Teuku Naraski Zahari¹, Irvanur Rahman², Zahra Zahra²

¹*University of Indonesia, Indonesia*

²*Universitas Indonesia, Indonesia*

IEEM21-F-0085/A Combined Evaluation Model for Competitiveness Assessment of Private Science and Technology Parks in China

Zhuoran Li¹, Yuming Zhu¹, Xiaohai Weng¹, Qingye Han², Fen Lyu¹

¹*Northwestern Polytechnical University, China*

²*Chongqing University, China*

IEEM21-F-0089/A Systematic Way of Crafting Strategies for Private Science and Technology Parks

Lei He¹, Yuming Zhu¹, Xiaohai Weng¹, Qingye Han², Fen Lyu¹

¹*Northwestern Polytechnical University, China*

²*Chongqing University, China*

IEEM21-F-0134/A Hybrid Multiple Attribute Decision-Making Method Based on Mahalanobis-Taguchi System and Choquet integral

Mingzhen Zhang¹, Naiding Yang¹, Xianglin Zhu¹

¹*Northwestern Polytechnical University, China*

IEEM21-A-0117/A Mathematical Programming Approach for a Vessel Scheduling-transportation Problem with Multiple Sources and Destinations, and Normal Daily Demand Distributions

Fatmah Almathkour¹

¹*Kuwait University, Kuwait*

MS-05 Manufacturing Systems 5

December 15, 2021 04:00 PM-05:30 PM

Chair(s): Sandeep JAIN,
Hewlett Packard Enterprise
Jonny JONNY,
Bina Nusantara University

[Abstracts: see page 76](#)

IEEM21-F-0496/A Re-evaluation of the Initial Mathematical Model for Triangular Pocket Machining Strategy

Mochammad Chaeron¹, Apriani Soepardi¹

¹*Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia*

IEEM21-F-0500/Enabling Robust Service Composition in Cloud Manufacturing with Sustainability Considerations

Mohammed Touseif Hyder¹, Carol Lobo¹, Tharun Sai Madupuru¹, Samarth Sudarshan¹, Majid Sodachi¹, Omid Fatahi Valilai¹

¹*Jacobs University Bremen, Germany*

IEEM21-F-0512/A Distinctive Real-time Information for Industries and New Business Opportunity Analysis Offered by SAP and AnyLogic Simulation

Nawadeep Adhikari¹, Tarique Ameer¹, Ganesh Kumar Dhakshinamoorthi¹, Santhosh Ganesan¹, Majid Sodachi¹, Omid Fatahi Valilai¹

¹*Jacobs University Bremen, Germany*

IEEM21-F-0448/Consumer Product Repetitive Production Planning with Color Sequence Wheel to Reduce Total Changeover Time

Thanyalak Boonkanok¹, Rawinkhan Srinon¹

¹*Mahidol University, Thailand*

IEEM21-F-0481/Utilization of the Asset Administration Shell for the Generation of Dynamic Simulation Models

Denis Göllner¹, Thomas Pawlik², Thomas Schulte²

¹*Lenze SE, Germany*

²*OWL University of Applied Sciences and Arts, Germany*

IEEM21-F-0514/Process Plan Generation in Reconfigurable Manufacturing System Composed of Multi-spindle and Modular Reconfigurable Machines

Muhammad Ameer¹, Mohammed Dahane¹

¹*Université de Lorraine, France*

SIM-03 Service Innovation and Management 3

December 15, 2021 04:00 PM-05:30 PM

Chair(s): Vinay SINGH, *Indian Institute of Information Technology and Management Gwalior*
Ewilly Jie Ying LIEW, *Momash University Malaysia*

[Abstracts: see page 77](#)

IEEM21-F-0243/Value Co-creation Building to Sustain Indonesian MSMEs in the New Normal Era

Christina Wirawan¹, Jahja Hamdani Widjaja¹
¹*Maranatha Christian University, Indonesia*

IEEM21-F-0293/Developing an Implementation Framework for Automated Customer Support Service in Collaborative Customer Relationship Management Systems

Richard Li¹, Madeline Tee¹
¹*De La Salle University, Philippines*

IEEM21-F-0305/Hoshin Kanri and Portfolio Kanban Management: A Conceptual Framework for Strategic Management in the Public Sector

Felix P. Santhiapillai¹, R.M. Chandima Ratnayake¹
¹*University of Stavanger, Norway*

IEEM21-F-0319/Business Models and Product-Service System Design – Introducing the Business Model Graph

Christoph Rennpferdt¹, Florian M. Dambietz¹, Dieter Krause¹
¹*Hamburg University of Technology, Germany*

IEEM21-F-0338/Business Model for Post-industrial Tourism from a System Dynamics Perspective

Ionela Samuil¹, Andreea Ionica¹, Monica Leba¹
¹*University of Petrosani, Romania*

IS-01 Intelligent Systems 1

December 15, 2021 04:00 PM-05:30 PM

Chair(s): Linda ZHANG, *IESEG School of Management, Univ. Lille, CNRS 9221*
Daoyi DONG, *University of New South Wales*

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IEEM21-F-0091/Twenty Years of Configuration Knowledge Modeling Research. Main Works, What To Do Next?

Maryam Mohammad Amini¹, Michel Aldanondo¹, Elise Vareilles¹, Thierry Coudert¹
¹*University of Toulouse, France*

IEEM21-F-0172/Developing Integrated Configurators: A Longitudinal Case Study

Linda Zhang¹, Sara Shafiee²
¹*IESEG School of Management, Univ. Lille, CNRS 9221, France*
²*Technical University of Denmark, Denmark*

IEEM21-F-0213/Untrimmed Operator Standard Cleaning Action Parsing Based on Deep Learning Method

Wei-Ling Pan¹, Shuo-Yan Chou¹
¹*National Taiwan University of Science and Technology, Taiwan*

IEEM21-F-0228/System Readiness Level Model of Highway Intelligent Transportation System by Integrating a Value Engineering Process

Ling Wang¹
¹*Jiangsu Taizhou Bridge Co., Ltd, China*

IEEM21-F-0240/Low-entry Barrier Multi-agent System for Small- and Middle-sized Enterprises in the Sector of Automated Production Systems

Fabian Haben¹, Birgit Vogel-Heuser¹, Hicham Najjari², Matthias Seitz¹, Emanuel Trunzer¹, Luis Alberto Cruz Salazar¹
¹*Technical University of Munich, Germany*
²*KNOSPA GmbH & Co. KG, Germany*

SSRM Safety, Security and Risk Management

December 15, 2021 04:00 PM-05:30 PM

Chair(s): Seung Ki MOON, *Nanyang Technological University*
Li GUAN, *University of New South Wales*

[Abstracts: see page 78](#)

IEEM21-F-0178/Prioritizing Project Interdependent Risks: A Network-based Approach

Li Guan¹, Alireza Abbasi¹, Michael Ryan²
¹*University of New South Wales, Australia*
²*Capability Associates, Australia*

IEEM21-F-0219/Task-oriented VR Safety Training in Construction Falls

Ying-Mei Cheng¹, Hsin-Yu Liao¹
¹*China University of Technology, Taiwan*

IEEM21-F-0244/ A Systematic Literature Review on Industrial Fire and Explosion Accidents in the Petrochemical Industry

Sibusiso Desmond Duma¹, Bheki Makhanya¹, Hannelie Nel¹
¹*University of Johannesburg, South Africa*

IEEM21-F-0318/On the Necessity of Assessing Noise Pollution Intensity to Investigate Environmental and Societal Impact

Ruwan Weerasinghe¹, R.M. Chandima Ratnayake², Dunstan Jayarathne¹
¹*Industrial Technology Institute, Sri Lanka*
²*University of Stavanger, Norway*

IEEM21-F-0355/Risk-averse Hazmat Network Design Considering Endogenous Risk and Uncertainty

Pengcheng Dong¹, Guodong Yu¹
¹*Shandong University, China*

IEEM21-F-0261/A Cognitive-based Approach to Construction Safety Management

Zhe Hu¹, Weng Tat Chan², Hao Hu¹, Feng Xu¹, Wen Wang¹
¹*Shanghai Jiao Tong University, China*
²*National University of Singapore, Singapore*

SCM-09 Supply Chain Management 9

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Aries SUSANTY,
University of Diponegoro
Daoyi DONG, University
of New South Wales

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IEEM21-F-0153/Data-driven Planning in the Face of Supply Disruption in Global Agricultural Supply Chains

Marie Pelagie Elimbi Moudio¹,
Cristobal Pais¹, Zuo-Jun (Max) Shen¹
¹University of California Berkeley, United States

IEEM21-F-0266/State of Supply Chain Finance for Micro, Small and Medium Enterprise in India

Hariprasad Ambadapudi¹, Rajesh Matai¹
¹Birla Institute of Technology & Science, Pilani, India

IEEM21-F-0273/Research on the Optimal Strategy of Delivery Packaging Recycling Under Policy Support

Ming Wu¹, Yan Chen¹, Xin Li¹
¹Macau University of Science and Technology, China

IEEM21-F-0292/Supply Chain Vulnerability and Collaborative Management Empowered by Emerging II: An Analysis from China's Practice

Xiaorui Du¹, Zhaojun Yang¹, Jun Sun², Mengdi Wu¹
¹Xidian University, China
²University of Texas Rio Grande Valley, United States

IEEM21-F-0410/The Role of SKU Management in SKU Rationalisation Projects

Aleksandra Staskiewicz¹, Lars Hvam¹, Anders Haug²
¹Technical University of Denmark, Denmark
²University of Southern Denmark, Denmark

IEEM21-F-0199/Logistical Potentials of Load Balancing via the Build-up and Reduction of Stock

Tammo Heuer¹, Janine Tatjana Maier², Tim Daniel Busse³, Matthias Schmidt², Peter Nyhuis¹
¹Leibniz University Hannover, Germany
²Leuphana University of Lüneburg, Germany
³Grean GmbH, Germany

DAM-06 Decision Analysis and Methods 6

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Linda ZHANG, IESEG School of Management, Univ. Lille, CNRS 9221
Rui MIAO, Shanghai Jiao Tong University

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IEEM21-F-0161/Application of the Multistage One-shot Decision-Making Approach to an IT Project in the Central Bank of Oman

Mohammed AlShanfari¹, Peijun Guo¹
¹Yokohama National University, Japan

IEEM21-F-0249/A Reinforcement Learning Approach for Optimization of E-bus Off-normal Schedule with Time Windows

Jiguang Wang¹, Yi Zhang¹, Xinglu Liu¹, Zhide Li², Jinhui Wen³, Wai Kin (Victor) Chan²
¹Tsinghua-Berkeley Shenzhen Institute, China
²Tsinghua University, China
³Shenzhen Intelligent Public Transportation Technology Co., Ltd, China

IEEM21-F-0282/Evaluation of the Innovation Level for Technological Enterprises: Multi-attribute Decision-making Based on Vague Sets

Xianglin Zhu¹, Naiding Yang¹, Mingzhen Zhang¹
¹Northwestern Polytechnical University, China

IEEM21-A-0063/A Goal Programming Model for Assessing the Policy of Carbon Reduction and Economic Development

Heng-Hsun Yang¹, Hsiao-Fan Wang², Yu-Ching Lee²
¹Tsing Hua Master, Department of IIEEM, National Tsing Hua University, Taiwan
²National Tsing Hua University, Taiwan

IEEM21-F-0323/Borrowing Money Matching Model Research in the P2P Platform

Kenan Li¹, Xin Li¹, Yan Chen¹
¹Macau University of Science and Technology, China

MS-06 Manufacturing Systems 6

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Kendrik Yan Hong LIM, Agency for Science, Technology and Research
Yaqiong LV, Wuhan University of Technology

[Abstracts: see page 81](#)

IEEM21-A-0053/Re-sequencing Mixed-model Assembly Line with Limited Linear Buffers

Minjiao Cheng¹, Wenchao Wei¹
¹Beijing Jiaotong University, China

IEEM21-F-0366/A Study of the Inspection Support Tool Development Using the Neural Network

Harumi Haraguchi¹, Riku Akaishi¹
¹Ibaraki University, Japan

IEEM21-F-0435/Sample Extraction of a Quality Inspection Tool for Dental Parts Manufacturing Industry

Riku Akaishi¹, Harumi Haraguchi¹
¹Ibaraki University, Japan

IEEM21-F-0488/Digital Twin-enhanced Approach for Supply Chain Disruption Management in Manufacturing Shop Floors

Kendrik Yan Hong Lim¹, Alejandro Seif¹, Nimisha Agarwal¹, Nam Tuan Le¹
¹Agency for Science, Technology and Research, Singapore

IEEM21-F-0145/Simulation-based Design of a Pull Material Supply System for Low Volume Unpaced Assembly Lines: A Case Study in the Aerospace Industry

Sebastian Eberlein¹, Susanne Schukraft¹, Michael Freitag¹
¹BIBA – Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Germany

SIM-04 Service Innovation and Management 4

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Pei-Lee TEH,
Monash University Malaysia
Desmond WONG,
University of Hull

[Abstracts: see page 81](#)

IEEM21-F-0480/Understanding the Linkage Between Social Innovation and Sustainable Development Goals: Some Insights of Field Research

Jorge Cunha¹, Carla Ferreira¹,
Madalena Araújo¹, Manuel Nunes¹,
Paula Ferreira¹

¹University of Minho, Portugal

IEEM21-F-0493/Thinking Together Industry 4.0 and Social Innovation: How Digital Technologies Impact on Social Change?

Jorge Cunha¹, Wellington Alves¹,
Madalena Araújo¹, Enrique Ares²

¹University of Minho, Portugal

²University of Vigo, Spain

IEEM21-F-0457/An Empirical Study to Scrutinize the Interplay Between Safety and Sustainable Production Performance in the Context of Chemical Industry

Danu Hadi Syaifullah¹, Benny
Tjahjono¹, David McIlhatton¹, Teuku
Yuri M. Zagloel²

¹Coventry University, United Kingdom

²Universitas Indonesia, Indonesia

IEEM21-F-0464/Risk-averse Oil-spill Response Planning

Zhen Liu¹, Hassan Sarhadi¹

¹Acadia University, Canada

IEEM21-F-0011/Redesign of Glasses Customization Service Process Based on Analysis of Influencing Factors in Customer Purchase Decision-making Process

Wen Luo¹, Jingjing Wang¹, Chen Wang¹,
Zhelin Li¹

¹South China University of Technology,
China

IS-02 Intelligent Systems 2

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Dinh Son NGUYEN, *University of Science and Technology, The University of Danang*
Min XIE,
City University of Hong Kong

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IEEM21-F-0272/Model Transformation for Automatic Design of GPON/FTTH Network

Kin Poon¹, Ling Cen¹, Ming Liu¹, Anis Ouali¹

¹Khalifa University, United Arab Emirates

IEEM21-F-0400/Blockchain Application in Halal Supply Chain: Literature Review and Future Research

Dwi Iryaning Handayani¹, Iwan Vanany¹

¹Institut Teknologi Sepuluh Nopember, Indonesia

IEEM21-F-0461/COVID-19 Detection Through Smartphone-recorded Coughs Using Artificial Intelligence: An Analysis of Applicability for Pre-screening COVID-19 Patients in Vietnam

Dinh Son Nguyen¹, Khoa Tran Dang²

¹University of Science and Technology, The University of Danang, Viet Nam

²PHAM NGOC THACH University of Medicine, Viet Nam

IEEM21-F-0124/A Hybrid Approach with Joint Use of Tag and Rating for Vehicle and Cargo Matching

Jiuwu Zhong¹, Zhaojun Yang¹, Jun Sun²

¹Xidian University, China

²University of Texas Rio Grande Valley, United States

IEEM21-F-0262/Understanding Human-machine Collaborative Decision-making

Kajal Bhandari¹, Yan Xin¹, Ville Ojanen¹

¹LUT University, Finland

EECA Engineering Economy and Cost Analysis

December 15, 2021 06:00 PM-07:30 PM

Chair(s): Luca SILVESTRI, *University of Rome "Niccolò Cusano"*
Mathias RIEDER, *Ulm University of Applied Sciences*

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IEEM21-F-0028/Improving Competitiveness Through the Application of Cost Estimation Models in the South African Automotive Industry

Prianca Naicker¹, Oludolapo Olanrewaju¹

¹Durban University of Technology, South Africa

IEEM21-F-0121/Techno-economic Evaluation of a Second-life Battery Energy Storage System Enabling Peak Shaving and PV Integration in a Ceramic Manufacturing Plant

Luca Silvestri¹, Michele De Santis¹, Gino Bella¹

¹University of Rome "Niccolò Cusano", Italy

IEEM21-F-0204/Cost Analysis of Collaboration Interfaces in an Interdisciplinary Engineering Workflow: A Model Based Approach Using BPMN+I

Birgit Vogel-Heuser¹, Tim Konstantin Herrmann¹, Minjie Zou¹

¹Technical University of Munich, Germany

IEEM21-F-0467/Evaluation of Human-robot Order Picking Systems Considering the Evolution of Object Detection

Mathias Rieder¹, Marco Bonini², Richard Verbeet³, Augusto Urru², Norbert Bartneck¹, Wolfgang Echelmeyer²

¹Ulm University of Applied Sciences, Germany

²Reutlingen University, Germany

³Bosch Rexroth AG, Germany

IEEM21-F-0494/Autonomous Deep-sea Shipping – The Economist's View

Roar Adland¹, Siri P. Strandenes²

¹Norwegian School of Economics, Norway

²Norwegian School of Economics (NHH), Norway

Session	SCM-01 Supply Chain Management 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Ripon CHAKRABORTTY ¹ , W.M. Samanthi Kamari WEERABAHU ² ¹ UNSW Canberra at the Australian Defence Force Academy, Australia ² Western Sydney University, Australia

IEEM21-F-0476/Supply Chain Learning Through the Online Wood Supply Game: A Sri Lankan Case Study

Oshadhi K. Herath¹, Banusha Aruchunaras¹, H. Niles Perera¹, R.M. Chandima Ratnayake²

¹University of Moratuwa, Sri Lanka
²University of Stavanger, Norway

This case study presents the impact of game-based learning of supply chain concepts. A cohort of undergraduates studying supply chain management were grouped based on their academic performance for this student-centered learning exercise. We conducted an online wood supply game to understand their perception toward game-based learning while testing their theoretical awareness. We found that game-based learning produced better results in students with average academic performance. Further, this study revealed no significant relationship between academic performance and student behavior. Our results indicate that game-based learning provides a better understanding of theoretical concepts in a more practical manner than does teacher-centered learning. Furthermore, the findings from the feedback survey imply that students have a more optimistic approach toward student-centered learning through gamification than through teacher-centered learning.

IEEM21-A-0128/Application of Decision Analytics Tools and Artificial Intelligence in Supply Chain Risk Predictions

Ripon Chakraborty¹

¹UNSW Canberra at the Australian Defence Force Academy, Australia

This research intends to apply advanced decision analytics tools in predicting supply chain risks, which has been a prevalent concern in this post-pandemic era (since the COVID-19 becomes a worldwide pandemic). There has been a consistent push from industries to implement advanced and digitalized risk identification processes to understand the imminent effect of such pandemic disruptions, so that, the planners can make informed decisions. Thus, the foundation of the proposed research has laid on exploiting many new and recent inventions, such as machine learning (ML), deep learning (DL), and explainable artificial intelligence (XAI). At first, a few DL approaches are proposed to predict supply chain risks. Considering that the existing ML/DL approaches are black box (i.e., they are unable to show the output explaining the interpretability of the model according to the requirements of the risk manager), this research also proposes an automated XAI approach to predict supply chain risks. Unarguably, the aftermath of this work will help the decision-makers to predict supply chain risks proactively to increase the resiliency of the SCs.

IEEM21-A-0129/Optimizing Supply Chain Drivers in an Integrated Supply Chain and Project Scheduling Framework

Ripon Chakraborty¹

¹UNSW Canberra at the Australian Defence Force Academy, Australia

This research is aimed to optimize supply chain drivers (e.g., supplier selection, make or buy decision, subcontracting or overtime option, inventory handling, number of orders, lead times, supply uncertainty, lead time uncertainty, product availability) for an integrated supply chain and project scheduling framework, to maximize overall supply chain profitability. In practice, one fundamental assumption by the project manager is, stable party-demand and stable product fill rate. However, due to many unforeseen factors, raw material availability and resource availability may affect, which consequence to larger activity completion time and then leads to high project makespan or completion time. Moreover, "when to buy" and "how much to buy" are other managerial strategic decisions, which may be convoluted for many financial constraints. Hence, this research derives an optimal make-buy decision to have smooth cash inflows or outflows, which in restoration can bring just-in-time concepts to the practitioners. Some other considerations are: intermediate warehouses and their capacity constraints, delivery times from those warehouses, truck capacity limitations, sustainability factors of the suppliers, capacity limitations of the suppliers and decisions regarding when to acquire resources

IEEM21-F-0428/The Delivery Strategy in Cross Docking Operations with Overlapped Temperature Region and Time Windows Constraints

Teng-Sheng Su¹, Thunshun Liao²

¹Chaoyang University of Technology, Taiwan

²Louisiana State University, United States

In the past decade, the retailer trade shifted from brick-and-mortar store to multi-channel, making time-based logistics strategies a necessity to shorten the delivery time for warm foods, fresh product, and fast-moving consumer goods. In this study, a task dispatching approach is developed to sort and consolidate omni-channel commodities for the purpose of mutual delivery in consideration of time windows constraints. The hidden pattern and correlation of data can be mined from uncertain, incomplete, or vague consumer preferences within channels analyzed by the measurement table and reducts using the rough set theory. As the result, valuable dispatching rules are revealed to simulate the sorting, consolidation, and packing processes of commodities with overlapping region of temperature for delivery. To balance the workload of staff and material handling facilities within zones in the cross-dock, the advanced receiving activities is arranged based on the information decision table and the simulated annealing metaheuristic is used to design goods assignment towards outbound docks. It is our hope that the proposed method from this study can assist e-commerce to run their logistics operation more efficiently in the last mile delivery of commodities.

IEEM21-F-0516/Economic Evaluation of a Radio Frequency Identification System for a Home Appliance Retail Business

Paula Ferreira¹, Joana Rodrigues¹, Maria do Sameiro Carvalho¹

¹University of Minho, Portugal

The paper presents the case of a home appliance retail business that plans to implement a Radio Frequency Identification (RFID) system in the warehouse and stores. The main goal is the economic assessment of the project including the evaluation of the tangible and intangible costs and benefits of implementing this solution. This evaluation showed how the proposed RFID solution is economically feasible and contributes to solving or at least reducing a large part of the logistics problems that arise in a distribution system. Moreover, the paper debates the assumptions required for the calculation of intangible or indirect benefits and points to directions for future research on both RFID technical developments and on the proposed economic model.

IEEM21-F-0023/Optimizing a Supply Chain Network Using Metaheuristic for Pre and Post Pandemic Scenario

Soudip Karmakar¹, Anirban Kundu², Bobby John¹

¹Indian Statistical Institute Bangalore Center, India

²DSZ Labs, India

During the pandemic, the supply chains got highly disrupted and faced a new challenge to sustain service. We have proposed a mathematical model for managing supply chains in a post pandemic situation, also coined as "new normal". We are trying to design a model and simulate different scenarios while optimizing the network to thrive and fulfill customer demand. The model has been supported with scenario analysis and illustrative examples a packaged drinking water supply chain. The objective is to minimize the supply chain operating cost with respect to the changes in capacity due to pandemic. The fill-rate has also been recorded as a performance matrix for the chain. Particle Swarm Optimization (PSO) has been used to optimize the objective function. This research will help supply chain practitioners and researchers to design networks and carry out study in risk management for pandemic or other similar outbreaks situations.

Session	DAM-01 Decision Analysis and Methods 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Cho Yin YIU ¹ , Carman Ka Man LEE ¹ ¹ The Hong Kong Polytechnic University, Hong Kong SAR

IEEM21-F-0051/An ADS-B Aided Dynamic Traffic Alert for Robust Safety Assessment in Controlled Airspace

Cho Yin Yiu¹, Tsz Kin Tam¹, Kam K.H. Ng²

¹The Hong Kong Polytechnic University, Hong Kong SAR

Aircrafts are separated by a specified distance via the instructions of the air traffic control officers, so the trailing aircraft would not suffer from the wake vortex effect nor actual conflicts. However, with the surging air transport volume in the past decades, the current model of terminal manoeuvring area could not satisfy the growing demand. Safety might be compromised by the high workload of the air traffic control officers as they might not be aware of the potential violations. Hence, a novel approach transforming communication-based train control using flight speed is proposed to enhance the efficiency and the safety of air traffic management. This study develops mathematical models and an algorithmic framework for supporting the terminal traffic flow decision with real-time surveillance-broadcast data. The decision quality and situational awareness in air traffic control can be enhanced to facilitate the estimation of incoming traffic in the area control jurisdiction.

IEEM21-F-0070/Application of Analytical Hierarchy Process to Inventory Management Practices in a Food Processing Industry in Lagos State, Nigeria

Akinlo Mogbojuri¹, Oludolapo Olanrewaju¹, Temitope Ogunleye²

¹Durban University of Technology, South Africa

²Yaba College of Technology, Nigeria

Because of the high cost of inventory, inventory management is critical for most organizations' success. This study focused on the application of the analytical hierarchy process (AHP) to inventory management practice in a food processing industry in Lagos State, Nigeria. A questionnaire was developed and administered to fifty (50) food processing industries between the period of September 2019 and November 2019. This was processed and analyzed using Spice Logic Software to the four (4) critical inventory techniques practiced. ABC Model 26.85, Just-In-Time (JIT) 32.3, First-In-First-Out (FIFO) 38.42, and Minimal Stock Level 35.02 have the highest overall priority of each inventory method, according to the results. As a result, in Lagos Nigeria, food processing industry, the preferred inventory technique was decided to be First - In First - Out (FIFO).

IEEM21-F-0073/Constructing a Composite Indicator for Manufacturing Companies Using Lean Metrics and Analytic Hierarchy Process

Willy Zalatar¹, Eppie Clark¹

¹De La Salle University, Philippines

The aim of this study is to construct a composite indicator which can measure the degree of leanness of manufacturing firms using the analytic hierarchy process. The composite lean indicator is based on several lean performance categories which in turn is composed of a number of indicators. Analytic hierarchy process is applied in order to determine the relative importance or weight of each lean performance category and indicator by getting the opinion of lean experts. Results show that Process & Equipment is deemed as most important compared to Supplier & Customer Relationships, Human Resources, and Manufacturing Planning & Control. Furthermore, Error-Proof Equipment, Customer Orders Delivered JIT, Worker Involvement in Continuous Improvement Programs, and Visual Control of the Shop Floor are all considered to be comparatively more important with respect to other lean indicators.

IEEM21-F-0077/A Comparative Analysis of the Impact-Wave Analogy Cyber-Resilience Framework

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A number of different Cyber-Resilience Frameworks have been proposed as a way to guide responses to cyber-attacks. The Impact-Wave Analogy (IWA) is a recently proposed framework that allows for dynamic and hierarchical cyber-resilience analysis. To advance its application, this paper explores how IWA compares to other resilience frameworks. This paper uses Structured Literature Review to identify five cyber resilience frameworks and compared these to IWA. First flexibility and adaptability of the frameworks are compared and then the frameworks are compared to one another based their parameters. The findings indicate the primary weakness of IWA to be insufficient testing and implementation as a proof of its capabilities. On the other hand findings also indicate that the IWA is adaptable, clear, and accounts for every stage in cyber resilience.

IEEM21-F-0114/Using Network Analysis to Evaluate Dynamic Capabilities: A New Concept of Method

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This paper sets out a new concept of method for evaluating dynamic capabilities, based on new perspectives on a value exchange. The 3 steps include how to operationalize a mix of network and narrative analyses, and data hierarchies for richer insights. A dynamic approach to network analysis helps practitioners visualize and understand how an organization has purposefully transformed its resource base and social capital for new change and innovation. In combination with throughput accounting, each unit of account is a unit of value created, and each link reflects a realized exchange. Focus is put back on the right things: Creating value, purpose, evolving boundaries and fitness, and the people who embody change.

IEEM21-F-0382/Hydropower Replacement and the Nexus of Food-Energy-Water Systems: Impacts on Climate Performance

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¹The George Washington University, United States

The nexus of food, energy, and water systems offers a meaningful lens to evaluate hydroelectric dam removal decisions. Maintaining adequate power supplies and flourishing fish populations hangs on the balance of managing the tradeoffs of water resource management. Aside from energy adequacy, substituting hydropower with other renewable energy sources impacts the overall energy dispatch behavior of the grid, including emissions of existing fossil fuels. This study extends earlier work in the literature to evaluate the adequacy impact to the power supply by removing four Lower Snake River dams in the Columbia River Basin in favor of supporting migratory salmon populations. The authors explore the climate performance, i.e., fossil fuel dispatch changes, of simulated renewable substitution portfolios to supplement performance metrics alongside adequacy and initial investment metrics. The study finds that including the climate metric greatly influences the favorability of some alternative portfolios that would otherwise be overlooked, with some portfolios improving climate mitigation efforts by reducing emissions over the baseline scenario. The contribution is in advancing a straightforward and supplementary climate performance method that can accompany any energy portfolio analysis.

Session	MS-01 Manufacturing Systems 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Firdaus ALAMSJAH ¹ , Dinh Son NGUYEN ² ¹ Bina Nusantara University, Indonesia ² University of Science and Technology, The University of Danang, Viet Nam

IEEM21-F-0058/Sustainable Multi-objective Process Plan Generation in RMS: Dynamic NSGA-II vs New Dynamic NSGA-II

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¹USTHB University, Algeria

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Sustainability is becoming more acknowledged as a critical issue and a must. Companies can boost their sustainability and responsiveness in today's ever-changing economic environment by implementing the reconfigurable manufacturing system (RMS) concept. The goal of this work is to apply evolutionary techniques to tackle a multi-objective single unit process plans generation in a reconfigurable manufacturing environment (RME) that is environmentally conscious. We adapt and compare two versions of the well-known non-dominated sorting genetic algorithm (NSGA), namely Dynamic-NSGA-II and New Dynamic-NSGA-II. Along with the conventional total manufacturing cost and time, the total amount of hazardous liquid waste and the total amount of greenhouse gases (GHG) generated are minimized, which are considered innovative criteria. First, we model the problem as a non-linear integer multi-objective program (NL-MOIP). Second, numerous instances of the problem are tested and the resulting data examined to establish the efficacy of the three techniques. Furthermore, the TOPSIS technique is applied to assist the decision makers in evaluating and choosing the optimal process plans.

IEEM21-F-0098/Addressing the Semantic Gap in the Consumer-to-manufacturer Strategy Using Dual Convolutional Neural Network

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Customer-to-manufacturer (C2M) is an emerging smart manufacturing strategy. In C2M, customers are directly connected with manufacturers for tailor-made product development and manufacturing. Thus, the R&D and marketing-driven process in traditional manufacturing evolves into a customer-driven product development process. Product sales using the C2M mode have been one of the highest growth sectors in Chinese ecommerce platforms. However, customers usually lack the necessary domain knowledge. They cannot communicate directly with engineers by indicating the desired technical specifications of the product. A semantic gap exists. This paper presents a dual convolutional neural network- (CNN) -based structure, to automatically address this semantic gap. To mitigate the data sparsity issue in the customer needs domain, we use a massive amount of product review texts which were crawled from ecommerce websites to build a source mapping from reviews to product technical specifications. A small amount of customer needs text was deployed to adapt the source mapping to the target customer needs-product specifications mapping and thus close the semantic gap. Promising experiment results were obtained to show the effectiveness of the method.

IEEM21-F-0122/Decision Support by Interpretable Machine Learning in Acoustic Emission Based Cutting Tool Wear Prediction

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³RWTH Aachen University, Germany

Predictive maintenance is a prominent and active field for applications of machine learning in industry in recent years. The health and wear of equipment directly influences the productivity and quality of the production process. Especially in ultra-precision manufacturing, tool wear has a major impact on the achievable quality while the wear itself cannot be measured directly in-process. In this paper we present a machine learning-based classification of the tool wear in-process using acoustic emission sensors. To increase the interpretability of the process - to open the black box model - we apply a feature importance analysis and use the obtained feature importances to provide augmented data representations to the users. These representations increase the transparency of the model's decision process and assist the users in validating the model's decisions and gain new insight into the phenomenon of tool wear itself.

IEEM21-F-0140/An Appropriateness Analysis for Additive Manufacturing Based on a Global Performance Index

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The appearance of layering manufacturing technologies as called 3D printing or additive manufacturing changed the way we design and fabricate the product. The more complex geometric surfaces of the product are able to be manufactured thanks to these technologies. However, these technologies still have several technological limitations such as materials, thermal deformation, removal of support structures, etc., and they have a strong influence on the manufacturability of the technology. Therefore, a new approach is presented in the paper that allows us to analyze the manufacturability for additive manufacturing based on the global performance index. The index is defined to evaluate the appropriateness of an additive manufacturing technology that we used to fabricate the designed product.

IEEM21-F-0156/Exploring Barriers for Software Development in Agile and Integrated Development of Production Systems

Julia Trolle¹, Dag Raudberget¹, Carin Rösjö¹

¹Jönköping University, Sweden

The amount of software elements that need to be considered and developed for products and production systems require a closer and more agile collaboration between organizational functions and departments since the interface is becoming increasingly merged. Previous research has identified the advantages of closer integration between various functions but has not yet investigated the barriers that emerge within software development for production systems. This paper aims to explain the way of working in agile and integrated production system development by exploring these barriers through a case study within a manufacturing company. The findings identify barriers related to both technological, work-cultural, and organizational aspects.

IEEM21-F-0291/Representing Control Software Functionality as Part of a Modular, Mechatronic Construction Kit

Eva-Maria Neumann¹, Birgit Vogel-Heuser¹, Ibrahim Bayar¹

¹Technical University of Munich, Germany

automated Production Systems (aPS) are highly complex mechatronic systems with lifetimes of up to 50 years. The lack of advanced software engineering methods in industrial automation often causes historically grown legacy code with low quality. Modeling and refactoring of legacy control software are considered as inevitable to manage ever-increasing software complexity and face upcoming challenges in the context of Industry 4.0. However, promising goals such as mechatronic modularization, product line engineering, or variability management have up to now hardly made their way to control software in aPS. To address this gap, the main contribution of this paper is a concept of function-oriented software modeling for aPS. The approach provides three models to map control software in aPS to the implemented system functionalities on code level, by also considering extra-functional software tasks that cannot be directly mapped to the physical modules. The models are implemented using METUS software, i.e., a renowned tool for modeling and optimizing mechatronic system architectures based on a function-oriented construction kit principle. The modeling approach is evaluated with industrial and academic experts with promising results.

Session	SIM-01 Service Innovation and Management 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Ehsan VAZIRI GOUDARZI ¹ , Maria de los Angeles GOMEZ ² ¹ Islamic Azad University, South Tehran Branch, Iran ² Universidad Popular Autónoma del Estado de Puebla, Mexico

IEEM21-F-0498/Framework Development for Sustainable Manufacturing Cloud Service Composition System (SMCS) Based on Axiomatic Design

Ehsan Vaziri Goudarzi¹, Mahmoud Houshmand², Vahidreza Ghezavati³, Shahrouz Bamdad², Omid Fatahi Valilai^{4*}

¹Islamic Azad University, South Tehran Branch, Iran

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⁴Jacobs University Bremen, Germany

A sustainable manufacturing system should consider the main three dimensions of sustainability. The dimensions are economic, social, and environmental impacts. Manufacturers look for more benefits in a manufacturing system. The product development is costly for the manufacturer in the sustainable system based on the dimensions. Also, cloud manufacturing, as a paradigm of Industry 4.0, considers everything as services to develop end products. The main paper contribution is to focus on providing a solution for acquiring beneficial manufacturing services based on all perspectives of sustainability in the cloud manufacturing. The paper develops a novel framework for proposing a Sustainable Manufacturing Cloud Service Composition System (SMCS) based on Axiomatic Design (AD) and game theory. The framework proposes a solution for developing composite services based on the sustainability perspectives in the equilibrium state. Therefore, the sustainable dimensions and manufacturers' benefits are satisfied mutually according to the SMCS framework. Finally, the research proposes an equation for the payoff function in the game structure based on the framework. Also, the results demonstrate the sustainability dimensions and manufacturers' benefits are satisfied mutually based on the framework.

IEEM21-F-0505/Are Older Adults Different in Their Perspectives on Age-friendly City? Evidence From Sunway City

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¹Monash University Malaysia, Malaysia

The world is besieged by challenges pertaining to environmental and social sustainability. Increasingly, contemporary debates in urban sustainability focus on the design and development of age-friendly cities in response to the challenge of global aging. Past literature on the topic of age-friendly cities has largely concentrated on developed countries, with less attention paid to growing age-friendly cities in developing countries. This research gap needs to be filled because creating age-friendly cities is becoming more relevant in society. Additionally, little evidence is available on the perception of age-friendly cities among older men and women and across different age groups. This paper aims to examine the perception of older adults on indicators of an age-friendly city and whether there are differences in gender and age groups. Data were collected from 32 older dwellers of Sunway City. The results reveal that older adults' perceptions of outdoor spaces and building and transportation indicators vary between gender and age groups. The findings of this study offer a fresh insight that could help inform policy and future planning practices in age-friendly cities.

IEEM21-F-0097/Modelling Water Network Behaviors: Agent-based Modelling

Chuks Medoh^{1*}, Arnesh Telukdarie^{1*}

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Technical tools for decision-making and analysis of a water network have significantly advanced. The major challenge highlighted is developing a decision tool suitable to resolve issues related to the interactions of human and water resources systems. This study focuses to understand and predict behavioral patterns involving protocols in a water network, many of which are expansive and complex. This study leverage tools of industry 4.0 specifically simulation (Agent-based models) in addressing this challenge with emphasis on smart metering a subset priority for a sustainable water network. Research indicates Agents-based Models (ABM) have been used as a sustainable decision tool to develop an integrated human and environmental model. The results allow stakeholders in the water sector to test, formulate, and refine knowledge of how an observed pattern in the water network can be recreated. The novelty in this study allows for a given population of households to be captured heterogeneously and connected to interact with a capacity to transmit information and modify the behavioral patterns.

IEEM21-A-0070/Universal Design for Disabled Users : Home Appliance Prototypes for Enhanced Accessibility

Joong Hee Lee¹, Minsik Choi¹, EunJeong Yang¹, Minah Oh¹, Myung Hwan Yun^{1*}

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Despite the progressive development of specialized products for the disabled, it is ironic that this has made users with disabilities differentiated from non-disabled users. Although disabled users do not want to be exceptional, the assistive products have defined a clear boundary. This research, in order to address the issues of disabled users, aims to approach an ergonomic design solution for general home appliances by the Design Thinking (DT) process. Considering the requirements for the three target users (visually impaired, hearing impaired, spinal cord impaired), it provides design suggestions for everyday products in the perspective of Universal Design (UD). As a continuation of the previous persona study conducted for the same users and products for user empathy and problem definitions (earlier phases of DT), this study concentrated on ideation, prototyping, and evaluation (later phases of DT). Three prototypes corresponding to the characteristics of each user were suggested, and the individual prototypes were validated through user testing. Most features of prototypes met the requirements while there were possible improvements to satisfy a wider range of user groups and accessibility issues.

IEEM21-F-0174/Procurement System Influences the Size of In-house Team and Effectiveness in Infrastructure Development

Edoghogho Ogbeifun^{1*}, Jan Harm Pretorius^{1*}

¹University of Johannesburg, South Africa

Several efforts have been dedicated to studying the factors responsible for the successful execution of capital infrastructure projects. Similarly, some researchers have separately studied the influence of the procurement system, the size of in-house professional teams and the process of selecting contractors on the successful execution of capital projects. However, there is limited evidence of studies of the interaction of these three factors on the successful execution of specific capital projects. This leads to the importance of this research. The multiple-site case study method of qualitative research was adopted. The research compared the structure, operation, and success in infrastructure delivery of the capital development units in two higher education institutions in South Africa. The findings revealed that one institution uses the relationship-based procurement system, while the other adopts the traditional procurement system. The conclusions arrived at are that the procurement system influenced the size of the in-house professional team, but the quality of contractors significantly impacted on the success of infrastructure delivery. Therefore, this research recommends that contractor selection processes should be systematically implemented, irrespective of the procurement system.

Session	PPC-01 Production Planning and Control 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Yevheniya VYTRUCHENKO ¹ , Danping LIN ² ¹ Technische Universität München, Germany ² Shanghai Maritime University, China

IEEM21-F-0076/Strategic Sourcing – Selection of Suppliers Using DELPHI-AHP Approach

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The global competitive environment has forced organizations to devise sourcing strategies towards competitive advantage. Vendor selection is critical as the whole organization's sustainability is at stake. This research reviews the existing supplier selection factors and techniques and evaluates their relevancy with the current prevalent business environment. The study also explores the priority of the existing factors and strives for newer prevalent critical factors. A questionnaire-based survey of manufacturing firms was administered to get the critical factors. The study used a hybrid model based on DELPHI-AHP for extracting and assigning weightage to each critical criterion. The result is validated through a case study on a manufacturing firm (M/s DBC Ltd). The study gives an inclusive vision into the criteria and methods for supplier selection and evaluation and to assist decision-makers, select the right suppliers.

IEEM21-A-0025/Lean Automation Practices and Competences: An Exploratory Research on Their Relationship

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This paper examines the pairwise relationships between the Lean Automation (LA) practices and competences. We surveyed 110 practitioners from manufacturing companies and applied multivariate data techniques to assess the dataset. Responses were categorized according to practitioners' Lean experience and Industry 4.0 knowledge. Results indicate that the relationships between LA practices and competences become more apparent as practitioners' Lean experience increases. In turn, the number of significant relationships decrease as practitioners' I4.0 knowledge increases. The commonalities found between these respondents' characteristics were: (i) the significant relationships between LA practices and competences were all positive; (ii) supply chain-related LA practices are more likely to be extensively associated with all competences; and (iii) competences related to the ability of identifying, analyzing and solving problems through computer programming and data analytics were the most likely to support LA practices. The comprehension of this relationship enables companies to foster and develop the adequate competences to sustain the LA implementation.

IEEM21-F-0297/Resource Allocation in Decentralized, Self-organized, Multi-agent Industrial Systems Using Deep Deterministic Policy Gradient

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²Siemens AG, Germany

The fourth industrial revolution has changed how the manufacturing process is organized in the industrial setting. A flexible and dynamic manufacturing environment is vital to this transformation. This includes self-organized, decentralized, multi-agent industrial systems. This work introduces a novel approach for resource allocation in such systems based on current deep reinforcement learning algorithms. A virtual environment is developed in which algorithms can learn and be tested according to global performance measurements. Agents learn their true cost function by interacting with the environment, thus improving their cost estimation accuracy and precision. This, in turn, leads to an increase in the system's global performance by allowing the resources to be distributed more efficiently. When compared to existing distance-based estimation algorithms, it is shown that this approach leads to improved cost estimation accuracy.

IEEM21-F-0368/Dual-objective Job Shop Scheduling Problem with Skilled Workers

Chantha Sem¹, Ronnachai Sirovetnukul¹

¹Mahidol University, Thailand

The Job Shop Scheduling Problem (JSSP) is work allocation on workstations to produce items that have a goal to optimize a few objectives. This research aims to develop the JSSP's model that deals with machines and job sequences by dual objective functions under the new gainful constraints involving types of skilled workers according to the case study of a steel mill. The proposed methodology of this research is applied with the Memetic algorithm (Genetic algorithm and Local Search technique) and the Pareto optimization. The result generated from the proposed idea can help the manager to decide on the assignment of the right worker to operate the right machine with the right job to achieve the objective values of minimum makespan and maximum average utilization of workers.

Session	EBEC-01 E-Business and E-Commerce 1
Date	December 14, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Hongrui LIU ¹ , Christina TAY ² ¹ San Jose State University, United States ² Chinese Culture University, Taiwan

IEEM21-F-0188/Transboundary Cooperation of Environmental Public Welfare Organizations: An Impact Mechanism Model

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With the saturation and maturity of the traditional environmental protection industry, transboundary cooperation has become a new trend, and more parties are required to participate in environmental protection public welfare for value co-creation. Through in-depth interviews, this paper uses grounded theory to explore the impact mechanism of environmental public welfare organizations participating in transboundary cooperation in the context of "Internet +". This study extracts four main categories of transboundary cooperation, including benefit perception, cost perception, environment perception and risk perception. It also constructs a model of the impact mechanism from the perspective of intention and behavior. The findings provide a new perspective on how environmental public welfare organizations participate in transboundary cooperation.

IEEM21-F-0254/A Multi-stage Framework for Complex Task Decomposition in Knowledge-intensive Crowdsourcing

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¹Chongqing University, China

Crowdsourcing is being used by more and more industries, which proves that this model is effective. In the crowdsourcing model, knowledge-intensive crowdsourcing (KI-C) has received widespread attention due to today's knowledge economy. The tasks submitted by consumers in KI-C are complicated and individualized, and it is difficult for one service provider to complete an entire task independently. Therefore, in order to effectively match suitable service providers for the complex tasks submitted by consumers, this paper proposes a multi-stage framework for complex task decomposition in KI-C. The framework contains the decomposition principles, searching similar tasks by word2vec and task packages obtained by genetic algorithm. The practicability and validity of this multi-stage framework are tested by a case study.

IEEM21-F-0281/Econometric Models to Estimate the Impact of Social Media Platforms On E-commerce: Pre- and Post-COVID

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This paper develops econometric models to estimate the impact of social media on e-commerce sales, pre- and post- COVID. We use data from 2009 to 2021 on 21 major types of social media to develop our models and divide our data into four time frames: (1) 2009-2014, (2) 2015-2020, (3) 2009 to 2020, and (4) 2020-2021 (post-COVID). The models will also allow us to compare pre- and post- COVID impact of social media on e-commerce. We expect that the impact of each type of social media platform would differ based upon the above four time frames, and that that some social media platforms would prove to be more effective than others at a specific time frame. This paper concludes with our expected results, along with a discussion of the limitations of social media usage on e-commerce.

IEEM21-F-0332/Designing a Deceptive Comment Detection Platform with a Rule-based Artificial Intelligent Architecture

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One of the most important factors in a purchasing decision nowadays is the evaluation of comments online. Businesses or individuals use deceptive comments to mislead people for the sake of economic gain and thus hurt the benefit of the customers and the welfare of society. In this research, we propose a rule-based artificial intelligence (AI) machine learning (ML) architecture for online review fraud detection. The proposed methodology features an AI and ML hybrid architecture, where ML refers to the common well-developed machine learning models, and the AI part features a rules-based controller that prioritizes and customizes the fraud detection rules based on human intelligence to improve the accuracy of the result and computational efficiency.

IEEM21-F-0442/The Value of Information: Game Model of Supply Chain Based on C2M

Hou-ping Tian¹, Meng-jiao Yao¹, Qiu-yu Tan¹, Chang-xian Liu²

¹Nanjing University of Science & Technology, China

²Nanjing University of Posts and Telecommunications, China

C2M(Customer-to-Manufacturer), a new direct selling format, is adopted by increasing number of manufacturers. Under this format, the manufacturers analyze customers' information provided by the platform (e.g. Amazon, JD, et al.), and directly sell products to the customers more precisely via the platform. However, for the platform, since information gathering will scarify customers' privacy, lead to negative comments and information cost, a challenging problem is that should the platform collect the customers' information and share it to the manufacturers? This paper addresses this issue under three scenarios: no information sharing, information sharing with free, information sharing with cost sharing. The analyses show two main findings: First of all, compared with no information sharing, information sharing can achieve a win-win situation, especially for the manufacturer and the platform while they share the cost of information. Second, the platform has a higher incentive to collect information if it charges the manufacturer a higher commission fee.

Session	SCM-02 Supply Chain Management 2
Date	December 14, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Ripon CHAKRABORTTY ¹ , Abdul Salam KHAN ² ¹ UNSW Canberra at the Australian Defence Force Academy, Australia ² National University of Sciences and Technology, Pakistan

IEEM21-F-0016/A Cold Chain Vehicle Routing Problem Embedded with Manufacturing, Re-manufacturing and Product Quality Under Multiple Constraints

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²Prince Sattam Bin Abdelaziz University, Saudi Arabia

This study considers the quality of produced and delivered products, routing, and customer satisfaction in a quality-driven cold chain vehicle routing problem coupled with manufacturing re-manufacturing decisions (QDCCVRP-MR). The manufacturing and re-manufacturing aspects are analyzed in the presence of disruptive performance of a set of capacitated machines. The vehicle routing and customer satisfaction are analyzed in the presence of imperfect refrigeration, deterioration, and failure of products during transit. A bi-objective model is proposed which considers the objectives of the total cost and the quality of manufactured and distributed products. The model is implemented by using a heuristic combined with the modified version of the Variable Neighborhood Search (VNS) approach. Finally, conclusions are drawn.

IEEM21-F-0021/Prioritizing Indicators for Measuring Halal Logistics Implementation

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This study attempts to assess the priority weight of indicators for measuring the level of halal logistics implementation. Specifically, through a short literature review, the paper plans to propose some indicators for halal logistics implementation and then use the analytical hierarchy process (AHP) to prioritize. Twenty indicators are recognized from extant halal literature of measurement of halal logistics. The twenty indicators can be divided into seven mandatory indicators (may related to the halal concept in Syariah law) and 13 non-mandatory indicators that refer to the cleanliness and hygiene of the product produced (may relate to toyyiban in Syariah law). The mandatory indicators should have a value of priority weight equal to one. Among the 13 non-mandatory indicators that may have a priority less than one, the highest priority is given to the ability of the company to provide clean and hygienic storage facilities that fulfill Syariah Law LPPOM -MUI requirement.

IEEM21-F-0060/Selecting Temporary Flood Shelter Locations by P-Center Model

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¹King Mongkut's Institute of Technology, Thailand

Eastern Special Development Zone (ESDZ) is the key project of Thai government to promote economy. However, a province located in ESDZ zone is prone to suffer from floods because of its geographic position. We study locations of temporary flood shelters. We formulate our problem by using P-Center model since want to select locations of temporary flood shelter so that they minimize the maximum distance from the flooded area (districts) to temporary shelters. We also incorporate the historical data of traveling distance affected by floods and the population of each district into our model. We test our model against real-life data under various scenarios. Our numerical experiment results show that Mueang Chachoengsao and Kabin Buri districts are the key locations for temporary flood shelters.

IEEM21-F-0093/Optimal Decisions with Supply Disruption and Demand Forecast Updating

Shuangshuang Dong¹, Qingwei Wang¹, Meimei Zheng^{1*}

¹Shanghai Jiao Tong University, China

In this study, we analyze the optimal ordering decisions for a retailer, who can order from three suppliers at two stages. At Stage 1, the retailer can place orders from an unreliable but cheap supplier and a perfectly reliable but expensive supplier. The unreliable supplier is subject to a random disruption during production time, and will only supply the quantity produced before the disruption if interrupted. At Stage 2, the retailer can purchase products from a backup supplier when the disruption occurs or the updated demand forecast is high. The optimal ordering decisions from these three suppliers are derived. It is found that the retailer may not place an order from the reliable supplier at Stage 1. However, it is always beneficial for the retailer to order from the unreliable supplier due to its economic advantage. Numerical experiments indicate that the unreliable supplier can be more preferred when the demand forecast is more variant.

IEEM21-F-0096/Yard Arrangement Problem with the External Truck Arrival

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While the cargo handling operation is becoming more sophisticated at container terminals in the world, in a research phase, there are various related studies using an optimization model. This study considers the container arrangement problem at a container terminal. There are some studies for transshipment containers at the container arrangement model in which the planning horizon is about one week. Moreover, the arrangement problem for the containers which arrive from an inland area is, limited within one day in the planning horizon. Therefore this study considers the arrangement problem for transshipment and export containers which arrives from an inland area, and the solution algorithm is proposed. In addition, the difference in the length of one period may affect the yard space utilization. Therefore, we investigate the computation results by the difference in the length of one period.

Session	DAM-02 Decision Analysis and Methods 2
Date	December 14, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Michel ALDANONDO ¹ , Jiage HUO ¹ University of Toulouse, France ² Hong Kong Science Park, China

IEEM21-F-0168/Developing Framework for the Implementation of MSP for Indian Farmers Using Integrated ISM and MICMAC Approach

Narain Gupta¹, Amit Kumar Gupta¹

¹Management Development Institute Gurgaon, India

The farming sector in India is always in the news either due to the farmer suicides, farmer loan waivers, new policies at the state and central level, or Minimum Support Price (MSP). The present study identifies the various barriers that have led to MSP's ineffectiveness in the country based on an in-depth analysis of a few states and districts. The study involved data from various cited research papers, government repositories, and news articles. Two methods have been explored for studying the effect of these factors. One involved the survey-based upon questionnaire, emphasizing the importance and relevancy of each factor, and another was interviewing the subject matter experts to study the dependency among the factors. Conclusively Imperative Structural Modelling (ISM) matrix has been formulated to analyze the inter-relationships between the various variables, i.e., MSP's identified barriers. MICMAC (Matriced' Impacts Croise's Multiplication Applique'e a UN Classement) approach shall be used to establish the most critical driving variables. This study serves as the bridging gap which we have identified across the various papers and brings all the critical barriers to single literature.

IEEM21-A-0043/Optimal Site of Renewable Energy Projects Under Sustainable Development Perspective

Thi Anh Tuyet Nguyen^{1,2}, Shuo-Yan Chou¹, Tiffany Hui-Kuang Yu²

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Renewable energy is considered as one of imperative sources of realizing the sustainable development. However, the development of new renewable energy projects is a complex planning process concerning social, technological, economic, environmental, political aspects. Therefore, the site selection for new renewable energy projects requires an exhaustive assessment of many impact factors. To assist decision-makers of different agents in determining the optimal site of renewable energy projects, this paper propose an efficient approach that integrates both quantitative and qualitative multi-criteria decision-making framework for selection the most feasible location for renewable energy projects. This study considers the impact of different aspects including environmental, economic, technological, and social acceptance aspects. The results revealed that the site with the highest overall performance of financial feasibility is the most feasible location for renewable energy projects. Based on the proposed approach, an appropriate renewable energy site has been successfully selected among the five alternatives. The results indicate that the proposed approach assists a wide range of decision-makers in determining the optimal site of renewable energy projects under sustainable development perspective.

IEEM21-F-0250/Lexical Semantic Analysis to Support Ontology Maintenance Modeling of FMEA

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Our approach constructs a straightforward lexical semantic approach for analyzing the semantic and syntactic features of the contextual structures of maintenance reports, so as to facilitate translation and interpretation for knowledge-based reasoning in the format of an FMEA. Then, the knowledge is converted into a computer-understandable representation with less heterogeneity and ambiguity. First, it maps the argument structure into a causal event structure, in which an event is represented as a group of highly frequent contextual features or words logically linked together to shape structured arguments. Then, Dowty and Van Valin's decomposition model is employed in the format of [Event-State-Activity-Accomplishment-Result] to determine the syntax-semantic interface(s) and linking rules in the causal chain. Finally, the metadata and/or hypernyms of causal events are represented, to accommodate ontology modeling for semantic extraction and cause-effect interpretation. We show how easily the result is converted to a computer-understandable document using Web Ontology Language & Resource Description Framework (W3C), thereby enriching interoperability and data exchange, explicit wording, multidimensional word representation, and contextual meaning extraction in machine processing.

IEEM21-F-0152/A Weighted Subjective Skyline Approach for World University Ranking Systems

Junyi Chai^{1,2}, Wenbin Liu¹

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Multicriteria ranking has been the center of Multicriteria decision making (MCDM) for a long time, which usually assumes a simple structure of criteria and the objective values of evaluations. In this study, we develop a new multicriteria ranking approach that considers people's subjective attitudes on objective rankings and accommodates a hierarchical structure of criteria. Our new approach, called weighted subjective skyline ranking (WSSR), can capture people's tastes (or bias) under a hierarchy of multicriteria. As a unique behavioral feature, this WSSR accounts for the diminishing sensitivity of people. We can quantitatively characterize the influence of people's subjective attitudes in processing multicriteria ranking. We consider the world university ranking as a practical scenario of implementation through this study. Interestingly, using the WSSR uncovers essentials and bias in prevailing world university ranking systems. This study provides a deeper understanding of the influence of the human factor on multicriteria ranking.

Session	MS-02 Manufacturing Systems 2
Date	December 14, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Philipp BICKENDORF ¹ , Daryl POWELL ² ¹ Laboratory for Machine Tools and Production Engineering WZL of RWTH Aachen University, Germany ² Norwegian University of Science and Technology, Norway

IEEM21-F-0164/Increased Efficiency in a Garment Sector by the Integration of Lean Manufacturing Tools

Hilton Flores¹, Lesly Paucar¹, Percy Castro¹, Eloy Marcelo Lastra¹, Jose C. Alvarez¹

¹Universidad Peruana de Ciencias Aplicadas, Peru

The high pre-existing competition in the clothing industry increasingly demands greater efforts from companies; which, wanting to improve their processes, neglect operational aspects, generating low efficiency in production. Therefore, authors have shown that Lean Manufacturing and work standardization tools are effective in various industries in this regard. However, its benefits are rarely sustained. For this reason, the proposal described in this article is based on the integration of the standardization of processes with Autonomous Maintenance applying the 5S tool in an integral way, ensuring its sustainability over time, reducing the variability of the process flow and thus, achieve an increase in productive efficiency. The main result expected from the simulation is an increase in efficiency and a reduction in machine breakdowns. Summarizing, the integration of these three tools not only improves production efficiency in a company in the clothing sector, but also improves the work environment and the satisfaction of both: staff and customers.

IEEM21-F-0180/Digital Lean Manufacturing: A Literature Review

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The purpose of this literature review is to examine how Digital Lean Manufacturing is viewed in the academic literature and how it is being operationalized. We reviewed 100+ scientific articles to identify what has been written about Digital Lean Manufacturing. There appears to have been two waves of scientific research on the theme of Digital Lean Manufacturing covered in the extant literature since the term first appeared in the year 2007. This paper is the first comprehensive literature review on Digital Lean Manufacturing and presents pertinent factors and useful insights into this emergent and intensifying field of research.

IEEM21-F-0189/Process Chain Concept for the Automated Design of Polymer Additively Manufactured Forming Tools

Günther Schuh¹, Georg Bergweiler¹, Falko Fiedler¹, Arne Passgang², Philipp Bickendorf²

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Given the increasing number of vehicle variants and product individualization, design efforts are becoming more and more important due to their share in total costs. The slow and complex design of vehicle components and required tools results in long lead times and high costs. Additive manufacturing is particularly suitable for digital process chains due to its technological characteristics. On the one hand, the suitability of polymer-based additive manufacturing for the production of forming tools for medium-sized sheet metal components is demonstrated. On the other hand, a concept for the automated design of simple additively manufactured forming tools is presented. For this purpose, the required process components, in- and outputs are described. It is shown exemplarily how the experimentally determined data basis can be used for a neural network for automated geometry generation.

IEEM21-F-0206/Proposal of Work Standardization to Improve a Metal-mechanical Process

Lucy Casallo¹, Elizabeth Lucero¹, Fernando Maradiegue¹, Jose C. Alvarez²¹

¹Universidad Peruana de Ciencias Aplicadas, Peru

The importance of offering quality products that meet customer requirements and expectations, and that are delivered on time has increased considerably, due to the high economic impact of late deliveries, which can cause penalties or even loss of customers. Therefore, delays in production processes are a problem that many manufacturing companies face, either due to poor distribution, disorder or lack of cleanliness in the workstations or lack of proper planning. This problem occurs frequently in the metal-mechanic sector of the country, due to the absence of controls to mitigate problems in the production lines. This research was applied in an SME of the metal-mechanic sector dedicated to the manufacture of parts for industrial mills. The tools used for the proposed solution is the standardization of work to reduce the current production time and improve the plant layout; and the application of material planning. The proposal achieves a reduction in product delivery time, which would avoid penalties and will have a better relationship with customers, increasing the company's profits by 45%.

IEEM21-F-0211/An Iterative Scheme for Hierarchical Production Planning in Semiconductor Wafer Fabrication

Rajarshi Bardhan¹, Chi Xu¹, Zhiguang Cao¹, Puay Siew Tan¹

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This paper considers a production planning and scheduling problem in a multi-product semiconductor wafer fabrication facility, which copes with the challenging factors including multiple re-entrant loops and diverse equipment characteristics. This work proposes a hierarchical production planning and scheduling approach that uses an iterative method for refining production plans to solve this problem. A production plan serving multiple objectives is derived by solving a linear programming problem, which is followed by a simulation run with a given scheduling rule to evaluate the performance gap. The planning and the simulation phases are executed in an iterative manner to reduce the performance gap between the planned production level and that from simulation outcome. A scheduling rule is proposed whereby the priority of a wafer is derived from the state of work-in-process (WIP) or production at that instant. The performance of the proposed method is assessed based on numerical simulations carried on Intel mini fab taking due date based demands for multiple products into consideration.

Session PPC-02 Production Planning and Control 2

Date December 14, 2021

Time 10:00 AM-11:30 AM

Chair(s): Sandeep JAIN¹

¹Hewlett Packard Enterprise, India

IEEM21-F-0139/Application of Value Analysis and Engineering to the Design and Production of Concrete Barrier

Ma. Janice Gumasing¹, Maria Victorina Rada¹, Mark Anthony Santiago²¹

¹Mapúa University, Philippines

The Value Analysis and Value Engineering (VAVE) technique is used in this study to reduce the cost of designing and producing the concrete barrier used in the transportation industry. The utilization of the Job Plan in this study is attained through the creativity and different look of the product's functionality. The researchers used five phases in the Value Engineering Job Plan, namely, the information, creative, evaluation, development, and recommendation phases, to systematically implement the analysis to product improvement and reduction to cost. The type of concrete used in this paper is New Jersey with reference to the ASTM C 825 or the Standard Specification for Precast Concrete Barriers. These barriers are essential in the transportation industry to eliminate vehicular collisions and protection to properties.

IEEM21-F-0202/Analysis and Measurement of Overall Equipment Effectiveness (OEE) Values of the CNC Cutting Machine at PT. XYZ

Decky Antony Kifta¹, Nilda Tri Putri²

¹Universitas Ibnu Sina, Indonesia

²Universitas Andalas, Indonesia

The CNC cutting machine installed at PT. XYZ's workshop, was reported with higher downtime, and caused production time losses. The methods used to identify the problems are the measurement of the machine's MTBF, MTTR, downtime and OEE values, while Six Big Losses, Pareto and Cause-and-Effect diagrams methods were used to identify the root causes. The results of the study show that the machine's MTBF value is 8,33 days, MTTR value is 8 hours, downtime value is 7 days and OEE value is 69.55%. This OEE value is still below the World Class Standard of 85%. The Six Big Losses method and Pareto diagram reveal that the machine's idle and minor stoppage, setup and adjustment time and reduced speed losses are the root causes of the problems. While the Cause-and-Effect diagram indicates that the operator indiscipline's, machine slow operation, long idle time, and incorrect working method are the factors contributing to the root causes. The conclusion is that company to perform improvement of machine capability, train the operator, and develop preventive maintenance program to ensure the machine's best performance.

IEEM21-F-0407/Push Sell Through Surplus Inventory

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This paper aims to provide a solution to identify surplus inventory and help the demand steering/sales team to push sell from the surplus inventory. Push sell is a strategy that influences sales team on the specific list of products or Stock Keeping Units (SKU) to sell that can be fulfilled by consuming the surplus inventory. We factor in the availability of inventory at various levels of the product based on product BoM (Bills of Materials), viz., product, sub-assembly, and component levels. The allocation of surplus inventory is done based on various business rules like maximizing the revenue, margin, volume, demand prioritization, and big deals. The solution uses a heuristic method to maximize the objective function subject to various business constraints. The constraints include inventory availability and allowable maximum and minimum volume of demand based on likely salability of each SKU. Based on our initial estimation, this solution will potentially reduce inventory and improve sales effectiveness by approximately 5%.

IEEM21-F-0446/Mathematical Modeling of Master Production Schedule with Campaign Planning Constraints

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¹Indian Institute of Technology Bombay, India

²Blue Yonder, India

Campaign planning plays an important role in the batch production of varieties of products from the same assembly line in manufacturing industries. Its goal is to plan activities in a way so as to reduce unnecessary production overheads, such as changeover time, inventory, etc., while at the same time improving demand satisfaction. Master production schedule (MPS) is one of the main components in the master planning process in manufacturing. It prepares a detailed plan for individual products produced in each period. For some process industries that manufacture their products on production lines, MPS needs to consider campaign planning as it impacts key performance indicators. We propose a mathematical formulation for MPS that takes into account campaign planning constraints. We apply this model to a tire industry and compare it to an existing heuristic.

IEEM21-F-0329/Imperfect Preventive Maintenance Scheduling with Partial Outsourcing Option Considering Production Constraint

Danping Lin¹, Minxin Ji¹, Haoran Li¹

¹Shanghai Maritime University, China

The performance of equipment in workshop will deteriorate gradually with time. This paper presents a multi-stage preventive maintenance strategy model to solve the problem of maintenance scheduling subjected to the production requirement in the workshop. Two types of preventive maintenance were considered. Taking into account the penalty cost due to maintenance overtime and product quality problems, the model aims to minimize the total maintenance cost. Due to the limited resources, current production and maintenance calls for outsourcing to fulfil the demand. A maintenance scheduling model with partial outsourcing consideration is proposed and particle swarm optimization (PSO) algorithm is applied to obtain the optimal production sequence, outsourcing scheme and the preventive maintenance strategy. A case study is discussed to verify the efficiency and effectiveness of the proposed model. The results revealed that partial outsourcing strategy will save 17% of the total cost.

Session	EBEC-02 E-Business and E-Commerce 2
Date	December 14, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Christina TAY ¹ , Pei-Lee TEH ²
	¹ Chinese Culture University, Taiwan
	² Monash University Malaysia, Malaysia

IEEM21-F-0444/The Value of Commitment: Should Weaker Retailer Follow the Price of Dominate Rival?

Hou-ping Tian¹, Qiu-yu Tan¹, Meng-jiao Yao¹, Chang-xian Liu²

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Equal pricing strategy, a strategy that one retailer commits to setting its retail price that equals to its rival, is increasing popular in online retailing. Compared to that, free pricing strategy is still widely used. This confused practice yields a challenging problem: when should a retailer commit to implementing the equal pricing strategy? or keep the classical free pricing strategy? This paper addresses the problem by considering a supply chain which consists of a manufacturer and two competing retailers, where the weaker retailer decides whether it commits to following the dominate retailer and setting equal price or not. The analyses show two main findings: First, the dominate retailer always prefers equal pricing strategy to free pricing strategy. However, for the weaker retailer, it only commits to equal pricing while its market share is not lower than that of the dominate retailer too much, otherwise it prefers free pricing strategy. Second, one may expect that the manufacturer will be benefited from equal pricing strategy as it reduces competitive intensity. However, counter-intuitively, the manufacturer's profit decreases due to monopoly of the retailers.

IEEM21-F-0515/The Effect of Consumer Traits on Their Intention to Use Luxury Virtual-Reality (VR) Products: The Mediating Role of Status Signaling

Reza Movarrei¹, Mona Masoumzadeh²

¹Hanken School of Economics, Finland

²EU Business School, Switzerland

The increasing integration of Virtual Reality (VR) features into social-networking (SN) environments has provided new opportunities for developing virtual-fashion products. These products are intended to be "worn" either on "real" bodies through Augmented Reality features, or on virtual avatars in gaming environments and the like. These virtual clothes are often worn to show-off status, achievement, and purchasing power in these VR environments. We focused on the emerging category of virtual luxury (VL) products and investigated which consumer segments, based on their personality traits, would be more willing to (partially) switch from physical luxury products to their virtual counterparts in their status-signaling activities through SN posts. We found that consumers with (a) higher self-efficacy regarding SN and VR environment, (b) more positive attitude towards SN and VR environments, (c) higher need-for-status, and (d) higher novelty-seeking motives tend to evaluate status-conveying potential of VL products more positively. Age (negatively) and income (positively) affect such evaluations. Moreover, the perceived status-conveying potential mediates the effect of consumer traits on their intention to switch to VL in their SN posts.

IEEM21-F-0484/An Explorative Study on the Impact of Antecedent Mood States on Consumers' Evaluation of Hotels Online

Sanchit Pawar¹, Asle Fagerstrom¹, Gesaneephorn Suaphuk¹, Niklas Eriksson²

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²Arcada University of Applied Sciences, Finland

Many travelers plan their trip using online booking platforms. These often have recommendations for things to do and explore in the target destination. The suggestions could have either positive or negative connotations. This study aimed to investigate if such recommendations can trigger certain mood states that impact consumers' evaluation of hotels online. Web-based mood induction procedures were used to see whether moods as antecedent states had any impact on consumers' evaluations of hotel bookings. The results of the conjoint analysis demonstrate that the impact of location and hotel reviews can change based on consumers' mood. The impact of mood can help online managers in developing more effective hotel marketing and advertising strategies.

IEEM21-F-0008/Measuring Smart Cities: Identification of Smart Society Indicators in Indonesia

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¹Institut Teknologi Sepuluh Nopember, Indonesia

In building Smart City in urban and village supported by information and communication technology and also government or commonly called e-Government. In recent years, there has been a drastic increase in the complexity of the internet, digitization and Artificial intelligence [24]. In the utilization of ICT technology in the region in Indonesia, there are many benefits of technology have positive impacts on Indonesian society. In one dimension Smart City is smart society that depends on human resources owned. In measuring the success of smart society in the smart city, variables and supporting indicators are required. This research aims to identify the variables and indicators of the smart society in the smart city, especially the intelligent technology that becomes the Smart City enabler dimension. Qualitative methods through literature studies, interviews or focus group discussion (FGD). Researchers found of these informants and papers are 4 variables are prioritized in smart society position in smart city concept. The four variables found were community, learning, security, and creativity.

Session	SCM-03 Supply Chain Management 3
Date	December 14, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Aries SUSANTY ¹ , Ahmed EL MAALMI ² ¹ University of Diponegoro, Indonesia ² Ibn Tofail University, Morocco

IEEM21-F-0127/A Review of Dual-channel Supply Chain Management Under Asymmetric Information

Wenting Han^{1,2}, Jianfeng Cai¹, Chen Nan¹
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With the development of e-commerce, more and more companies choose dual-channel structure. However The dual-channel structure has intensified the competition among supply chain members, leading to the widespread existence of asymmetric information in the supply chain and increasing the difficulty of supply chain management. This paper reviews the literature on dualchannel supply chain under asymmetric information from 2015 to 2021, analyzes the structure of dual-channel supply chain, the types of asymmetric information, the way of information interaction, and finally puts forward the prospect of future research directions. To better solve the problem of information asymmetry and serve the practice of dual-channel supply chain management.

IEEM21-A-0024/Effects of Industry 4.0 to Development of Supply Chain Resilience

Guilherme Tortorella^{1,2}, Flavio Fogliatto², Shang Gao¹, Toong-Khuan Chan¹
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This work identifies the effects of Industry 4.0 (I4.0) integration into supply chains (SCs) to the enhancement of their resilience. We conducted a scoping review on the relevant literature on SC resilience and I4.0, summarizing the main findings and proposing three research directions: (i) empirical validation of the contribution of I4.0 ICTs to SC resilience; (ii) explore the role of processing-actuation technologies in enhancing restorative capacity; and (iii) integration between I4.0 ICTs and omni-channel strategy as a means to resilience development at consumer and retail levels. This scoping review organizes the existing information, setting the ground for the development of new theoretical propositions for future empirical testing. The integration of I4.0 technologies can significantly shift the SC management, enabling a more effective adaptation and response to disruptive events. However, the integration of I4.0 technologies into SCs is still incipient, and studies are particularly sparse when considering the contribution of those technologies to the resilience of SCs.

IEEM21-F-0173/An Efficient Heuristic for the Two-echelon Multi-vendor Multi-buyer Optimization Problem

Ibrahim Najum¹, Nabil Nahas¹
¹Université de Moncton, Canada

This paper presents an integrated model to simultaneously solve the multi-vendor multi-buyer and the transportation problems which deals with finding an optimal delivery schedule to the buyers and the corresponding optimal production lot sizes. The objective is to minimize the joint total cost of ordering, inventory holding, set up and transportation. In the integrated model, the vendor transfers a batch to a buyer as soon as its manufacture is finished. Since the problem is formulated into an integer nonlinear programming model, a heuristic based on the non-linear threshold algorithm is proposed to find a pre-optimal solution of the problem. The results show that the pre-optimal solution can be obtained quickly using the proposed heuristic.

IEEM21-F-0179/Enabling Factors of Digital Manufacturing Supply Chains: A Systematic Literature Review

W.M. Samantha Kamari Weerabahu^{1,2}, Premaratne Samaranyake¹, Dilupa Nakandala¹, Hilal Hurriyet¹
¹Western Sydney University, Australia

Organisations are increasingly being compelled to adopt Industry 4.0 (I4) technologies and sustainability practices to achieve higher supply chain performance. The digital manufacturing supply chain (DMSC) is still in its infancy stage. Therefore, exploring enabling factors from technological, organisational, legal, and sustainable perspectives is pursued. This study aims to identify and categorise the enabling factors of digital manufacturing supply chains while providing a holistic view of the I4 adoption in the supply chain context. A systematic literature review (SLR) on the supply chain digitalisation perspective is carried out by analysing journal articles published between 2015 to 2020. Each perspective is supported by well-established enablers, suggesting the need for prioritising each dimension for continuous improvement of SC performance. A digital manufacturing supply chain maturity model guided by enabling factors is proposed as a framework of DMSC adoption across firm-level, supply chain/industry, and ecosystem levels.

IEEM21-F-0196/Innovative and Sustainable Supply Chain Model in Industry 4.0 Based on Moroccan Industrial Field

Ahmed El Maalmi^{1,2}, Kaoutar Jenoui², Laila El Abbadi²
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Moroccan industrial enterprises are leading many changes inside their supply chain to take advantage of industry 4.0 transformation. This optic aims to ensure sustainability and innovation simultaneously. Or, one of the most crucial operations is to enhance innovation inside supply chain processes and to improve supply chain resilience and sustainability regarding the changeable environment. Therefore, in this paper, we develop an integrated business model considering six constructs: supply chain integration, supply chain orientation, competition capability, business continuity management, environmental sustainability, and finally human and social approach. Then we apply and validate the business model to the case of large and medium Moroccan enterprises. The main objective is to study the impact of the considered constructs with the mediation of industry 4.0 technological systems in achieving supply chain innovation and sustainability. Our paper is built of four sections, the first lists previous studies performed in some countries, the second presents the proposed business model, the third describes the experimental data collection, and in the last part, we discuss the results of the data validation process, followed by a conclusion and work perspectives.

Session	DAM-03 Decision Analysis and Methods 3
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Date December 14, 2021

Time 12:00 PM-01:30 PM

Chair(s): Michel ALDANONDO¹, Felix OCKER²

¹University of Toulouse, France

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IEEM21-F-0252/Factors Affecting Consumer Acquisition of Secondhand Smartphone in Indonesia

Diana Puspita Sari^{1,2}, Nur Aini Masruroh², Anna Maria Sri Asih²
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²Universitas Gadjah Mada, Indonesia

Regulation plays an essential role in handling electronic waste. Indonesia's electronic waste management system is still at the lowest level because it is still limited to informal initiatives. When making regulations, we should consider informal channels by collaborating with formal channels. Informal channels are given space for secondhand product sales and repairs, while formal channels focus on waste collection and recycling. Secondhand products still have a potential market. This study aims to analyze the relationship between demographic variables to purchasing decisions of secondhand smartphones and the factors that influence the purchasing decisions of secondhand smartphones. The survey was conducted on 328 smartphone users in Indonesia, in which 143 of them are consumers of secondhand smartphone products. The data was processed using the chi-square test and multiple regression analysis with SPSS version 22 software. Data processing shows that purchasing decisions of secondhand smartphones are related to demographic variables, gender, and education level and are also significantly influenced by product price, income, and product quality. The product diversity factor does not significantly influence purchasing decisions.

IEEM21-F-0294/Prioritization of Pipe-Bending Manufacturing Methods: An AHP-based Techno-Economic Comparison Between Welding and Cold Bending

Ine Skibenes¹, R.M. Chandima Ratnayake¹
¹University of Stavanger, Norway

The welding of bends in the manufacture of bent pipes is a well-known method used worldwide. Cold bending is a competing manufacturing method and has its advantages and disadvantages. Cold bending shows great repeatability and can reduce the number of welds needed to manufacture a bent pipe, which can lead to time and cost savings, but the method has some limitations regarding pipe dimensions and bending radius. It is necessary to qualify the use of cold bending to manufacture piping bends for sour and/or low-temperature systems. Low-temperature carbon steel pipes cannot be cold-bent without subsequent heat treatment, as they lose their low-temperature properties. Techno-economic comparisons between welding and cold bending were carried out to identify the most appropriate manufacturing method. The analytic hierarchy process has been used in the analysis. Analysis and calculations revealed that cold bending has a significantly lower cost and fabrication time per unit than welding to manufacture pipe bends when post-bend heat treatment is not required.

IEEM21-F-0362/The STIC Analysis: A Decision Support Method for Investments in Automation

Marco Bonini¹, Mert Mete^{2*}, Tuan Nguyen¹, Augusto Urru¹, Wolfgang Echelmeyer¹
¹Reutlingen University, Germany

Compared to the automotive sector, where automation is the rule, in many other less standardized sectors automation is still the exception. This could soon hurt the productivity of industrialized countries, where the unemployment is low and the population is aging. Phenomena like the recent downfall in productivity, due to lockdowns and social distancing for prevention of health hazards during the COVID19 pandemic, only add to the problem. For these reasons, the relevance, motivation and intention for more automation in less standardized sectors has probably never been higher. However, available statistics say that providers and users of technologies struggle to bring more automation into action in automation-unfriendly sectors. In this paper, we present a decision support method for investment in automation that tackles the problem: the STIC analysis. The method takes a holistic and quantitative approach tying together technological, context-related and economic input parameters and synthesizing them in a final economic indicator. Thanks to the modelling of such parameters, it is possible to gain sensibility on the technological and/or process adjustments that would have the highest impact on the efficiency of the automation, thereby delivering value for both technology users and technology providers.

IEEM21-F-0367/Automation? Yes ... But Where to Begin?

Tuan Nguyen^{2*}, Marco Bonini¹, Jasmine Eva Langenbahn¹, Sabrina Moser¹, Eric Alexander Schneeweis¹, Augusto Urru¹, Wolfgang Echelmeyer¹
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According to several surveys and statistics, the great majority of companies previously not accustomed to automation are piloting solutions to automate business processes. Those accustomed to automation also attempt to introduce more of it, focusing on automation-unfriendly processes that remained manual. However, when the decision on what and whether to automate is not trivial for evident reasons, even industry leaders may get stuck on an overwhelming question: where to begin automating? The question remains too often unanswered as state-of-the-art methods fail to consider the whole picture. This paper introduces a holistic approach to the decision-making for investments in automation. The method supports the iterative analysis and evaluation of operative processes, providing tools for a quantitative approach to the decision-making. Thanks to the method, a large pool of processes can be first considered and then filtered out in order to select the one that yields the best value for the automation in the specific context. After introducing the method, a case study is reported for validation before the discussion.

IEEM21-F-0473/Supervised Machine Learning in Detecting Patterns in Competitive Actions

Laura Valtonen^{2*}, Saku J. Mäkinen¹, Johanna Kirjavainen¹
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This paper explores possibilities to investigate how patterns of competitive actions could be detected with supervised machine learning (SML) methods. Competitive dynamics and the resource-based view are used as theoretical frameworks for classifying competitive actions. These in turn represent the dynamics of industry evolution from competitive actions point of view. We find promising ways to furthering our understanding of detectable patterns in competitive dynamics and industry evolution. Our results show that standard SML methods can be used in pattern recognition but reporting the methods used in detail are of paramount importance in facilitating peer-review and scientific replication and producing credible results.

IEEM21-F-0217/Challenges of Modular Product Families and Product Personalization - An Interview Study

Juliane Kuhl^{2*}, Selin Üreten¹, Dieter Krause¹
¹Hamburg University of Technology, Germany

Modular product architectures have so far solved the conflict between the differentiation demanded by the customer and the standardization preferred by the company. However, customers are becoming increasingly demanding and individual needs can be met less and less adequately with predefined modules. The interview study presented in this paper examines in more detail whether and in how far companies also consider this as a challenge and whether and in how far the strategy of targeted product personalization is a solution. This study shows, in particular, that the expansion of size series through individual parameterization is indeed often carried out, but is not planned and marketed as product personalization. The two greatest challenges of product personalization are seen in the reorganization of the company's structure, strategy and processes, and the targeted planning of personalization scopes in the product architecture. Personalization only succeeds if it is profitable and the implementation costs can be paid off. However, there has not yet been sufficient support for investigating the potentials of personalization for the own product family. The need for future research is highlighted.

Session MS-03 Manufacturing Systems 3

Date December 14, 2021

Time 12:00 PM-01:30 PM

Chair(s): Falko FIEDLER¹, Rajesh MATAI²

¹RWTH Aachen University, Germany

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IEEM21-F-0225/Case Study of Digital Twin-based Human-robot Collaborative Work-cell for Satellite Assembly

Yichen Wang¹, Jindan Feng², Jinshan Liu², Xiaojun Liu³, Junfeng Wang^{2*}

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²Beijing Spacecrafts Limited Company, China

³Southeast University, China

Satellite assembly has complex structures with both large panels and small connected parts. The adoption of human-robot collaborative assembly (HRCA) can effectively reduce the assembly workloads. As a new assembly mode, HRCA requires deep communication and close collaboration between human and robot, which puts high demands on real-time information acquisition and processing capability. Digital twin, as an emerging technology, points the way to solve the problem. This paper proposes a five-unit human-robot collaborative assembly work-cell framework based on digital twin, where the operation unit, perception & control unit are in physical space and the data unit, model unit, service unit are in virtual space. The functions of all units are described in detail. Taking the satellite assembly as an example, the operation of this framework is discussed and a physical HRCA work cell is constructed based on the digital twin technology. The three important parts of the HRCA processes, task assignment, scene layout and virtual-physical mapping, are elaborated in digital space and physical space.

IEEM21-F-0241/Control of Shared Production Buffers: A Reinforcement Learning Approach

Nora Krippendorff¹, Christoph Schwindt^{2*}

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We consider a buffer control problem arising in stochastic flow lines with shared production buffers. Buffer control relies on decision rules which determine transfers of items between buffers and machines at the release or completion times of parts on the different production stages. We devise a conceptual model of the problem for a basic scenario with one central buffer and explain how general system configurations and a tactical buffer allocation problem can be modeled within this framework. Assuming that the flow line can be represented as a Markovian production system, we provide a formulation as a continuous-time Markov decision problem admitting an optimal stationary policy. By applying a uniformization approach from literature, the Markov decision problem is discretized in time and thus amenable to standard algorithms. We propose a simple Q-learning implementation of reinforcement learning converging to an optimal stationary policy and validate the approach in a numerical experiment with a small toy problem.

IEEM21-A-0051/Condition-based Maintenance of Manufacturing Equipment Using Stochastic Partial Differential Equation

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As a part of the smart factory industries, condition-based maintenance (CBM) is developed for monitoring the status of production systems. While existing maintenance technologies predict a certain period of replacement or repair time, CBM diagnoses the real-time status of objects according to the measurement obtained from sensors. Due to the property of manufacturing facilities that their performance degrades over operating time, the system should be maintained as in-control status. In this paper, we propose CBM methodology based on stochastic partial differential equation (SPDE) for production equipment by monitoring the status of products. By modeling the time-series photography of products into SPDE, the estimated results describe the degrading patterns of images in terms of space and time. The application of images in real industry shows that the proposed approach can be effectively conducted for monitoring and detecting the abnormal status.

IEEM21-F-0301/Adapted IOBPCS Model to Analyze the Impacts of Capacity Scalability on Inventory in a Reconfigurable Manufacturing Environment

Abdelhak Dahmani¹, Lyes Benyoucef¹

¹Aix-Marseille University, France

The scalable design of reconfigurable manufacturing systems (RMSs) allows companies to maintain the manufacturing infrastructure that satisfies current customer demand while still improving production efficiency to react rapidly to new demands. In this paper, a dynamic analysis is conducted to investigate the trade-off between inventory levels and system scalability; by adapting the inventory and order-based production control system (IOBPCS), the dynamic of the linear model is analyzed using the transfer function. Moreover, a controller design is proposed to recover inventory discrepancies and ensure system stability. Finally, a simple example is provided to illustrate the impacts of the system's capacity scalability on the inventory level.

IEEM21-F-0375/Comparison of Two Concepts for Planned Reuse of Variant-rich IEC 61131-3-based Control Software

Juliane Fischer¹, Birgit Vogel-Heuser¹, Anja Berscheit¹, Simon Parigger¹

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In manufacturing systems, control software implements an increasing part of functionality and, thus, its planned reuse is essential to stay competitive at the global market while fulfilling requirements posed by Industrie 4.0. However, despite a variety of available strategies for planned reuse, control software is oftentimes historically grown and developed ad-hoc using copy, paste and modify. One reason for this is the high variability of control software caused for example by influences from the used hardware or customer-specific adaptations. For reuse of variant-rich control software, this paper presents two component-based strategies namely an approach utilizing the object-oriented extensions of IEC 61131-3 and an approach adopting the use of software product lines from the software engineering domain. For evaluation purposes, both concepts are implemented on a lab-sized demonstrator and compared regarding their potentials to support software reuse. Thereby, software characteristics and the usability of both approaches are taken into account.

IEEM21-F-0513/Towards a Method to Design Production Systems for Fixtureless Production with Component-integrated Fixture Features in Automotive Body Shops

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²University of Siegen, Germany

Conventional jig and fixture technology are often limited in product and volume flexibility due to their specific structure. This significantly reduces the adaptability of product changes, such as implementing new product variants or engineering change requests during operation. An overview of alternative jig and fixture concepts is given, with the aim to reduce the effort in engineering, manufacturing, and operation. The current research state of the alternative concept component-integrated fixture feature (CFF) is analyzed and summarized in a research map to identify research gaps. Based on the latter, an integrated methodology with tools, such as a design and production catalog, for designing products and the associated production systems for fixtureless production with CFF in automotive body shops is presented.

Session BDA-01 Big Data and Analytics 1

Date December 14, 2021

Time 12:00 PM-01:30 PM

Chair(s): Danni CHANG¹, Jiage HUO²

¹Shanghai Jiao Tong University, China

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IEEM21-F-0029/Industry 4.0 and its Technologies: A Systematic Literature Review

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In the era of industry 4.0, many manufacturing industries are expected to adopt and implement the fourth industrial revolution. The purpose of this study is to focus on the technologies that helps in increasing the productivity of companies by using Industry 4.0 technologies. Also, industry 4.0 has a big impact on the economic and environment which is trending nowadays. A systematic Literature review was conducted to identify the concept of industry 4.0. Qualitative data was used in this research to understand the literature of Industry 4.0 in all aspects. It was found that Industry 4.0 is a big change in countries, communities and the world. It transforms small firms into medium or large firms. It develops a huge transformation that all firms can benefit from the new technologies. Industry 4.0 has many benefits that affects the companies in a big way. However, there are many challenges that industry 4.0 technologies might face. Through all studies that have been conducted, there are very limited researches about the services or governmental sectors that adopt and implement industry 4.0.

IEEM21-F-0066/A Machine Learning Predictive Model for Shipment Delay and Demand Forecasting for Warehouses and Sales Data

Kin Lok Keung¹, Carman Ka Man Lee¹, Yuk Hin Yiu¹

¹The Hong Kong Polytechnic University, Hong Kong SAR

In the era of Industry 4.0, various technologies have been great assisting tools for different industries to improve their work efficiency and enhance customers' satisfaction and loyalty. This paper discusses the issue of shipment delay and sales prediction by understanding how various attributes, based on data from the retail industry, will impact on their result. It was found that the locational factors and product category have been determining fluctuating sales or prominent delays. The results of machine learning algorithms are also discussed on how a better correlation in forecast and attribute relationships can be attained.

IEEM21-F-0067/Hand Gesture Recognition with Augmented Reality and Leap Motion Controller

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The use of hand gestures is one of the commonly used communication approaches in human daily life, especially for the deaf and dumb communities. Hand gesture recognition can be adopted in human-computer interaction for converting hand gestures into words or sentences. Unfortunately, the same gesture may have diverse meanings in different countries. With the aim of eliminating the communication barriers between hearing-impaired communities and the general people, a real-time interaction user interface created with the augmented reality technique and leap motion controller for hand gesture recognition and translation is proposed in this paper. Five hand gestures captured by a leap motion controller were used for learning and recognizing through machine learning methodologies, including Support Vector Machine, K-Nearest Neighbor, Convolutional Neural Network, Deep Neural Network, and Decision Tree. The experimental results from different classifiers reveal the practicability of employing hand gesture recognition in text translation. The hand gesture recognition system should be capable of reducing the communication gap between hearing disabilities and the public so as to avoid deaf and mute people being isolated from society.

IEEM21-F-0149/Active Machine Learning in Regression Problems

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In the scale of the big data, it is hard to track exact features from which machine learning algorithm has made associations. Moreover, it has no understanding of underlying processes, so it can be overly sensitive to changes in the training data. But as the data amount and complexity of machine learning algorithms are continuously growing, it is crucial to find mechanisms to ascertain their reliability and to reduce the amount of necessary data labeling to train the algorithm. Active machine learning may be one of the solutions. Its main objective is to achieve higher algorithm accuracy with less labeled data for training. But the mechanics by which the active learning algorithm selects the next data sample for labeling might be utilized to gain an understanding of associations created by the machine learning algorithm. This paper describes the development of the active machine learning method for regression problems. It results in a demonstration of the system's prototype which is used to train meta models for computer experiments.

IEEM21-F-0230/A Feature Ensemble Model for Material Rate Prediction in Chemical Mechanical Planarization

Rui Wang^{*1}

¹Harbin Institute of Technology (Shenzhen), China

In semiconductor chemical mechanical polishing, the material removal rate (MRR) is the key indicator of the productivity. It is thus crucial to predict MRR for wafer-to-wafer quality control during the process. In this article, we propose a data-driven model to evaluate the relationship between process variables and the MRR. We consider a feature ensemble model which combines learned features and handcrafted features for MRR prediction. A novel deep learning topology is proposed for representation learning. Also, time and usage neighbor features are extracted to overcome the effects of process degradation. The model is trained to learn the feature representation of the data while performing predictive modelling simultaneously. We demonstrate the effectiveness of our approach through a real data example.

IEEM21-F-0321/Early Warning Model of Wind Turbine Front Bearing Based on Conv1D and LSTM

Shihui Zhang^{*1}, Tao Zhang¹, Yajie Liu¹

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The generator bearing is the key component of wind turbine energy transfer, and its health condition has an important impact on the good operation of the unit. The bearing temperature is an important indicator to reflect the health of the generator bearing. In this paper, the main bearing of direct-drive permanent magnet wind turbine is taken as the research object, and the temperature warning model of generator front bearing is established based on the time-series data of SCADA. Firstly, according to the correlation and wind turbine operation mechanism, five key attributes are selected to participate in the front bearing temperature prediction; Then, the one-dimensional convolution neural network (Conv1D) is used to fuse the information of multiple features at the same time, and the long short-term memory network (LSTM) is used to predict the temperature of the front bearing of the wind turbine in the healthy state; Finally, the statistical threshold of fault warning is designed according to the residual of the validation set. The method is verified by the real historical data of a wind turbine in Hubei Province, China. The experimental results show that the method can capture the abnormal front bearing of wind turbine three months in advance, and reserve enough time for equipment fault handling.

Session HF-01 Human Factors 1

Date December 14, 2021

Time 12:00 PM-01:30 PM

Chair(s): Vinay SINGH¹, Syohei ISHIZU²
¹Indian Institute of Information Technology and Management Gwalior, India
²Aoyama Gakuin University

IEEM21-F-0022/Factors Affecting the Well-being of People Working in Known Smart Cities: UTAUT2 Approach

Yogi Tri Prasetyo^{*1}, Mark Anthony Santiago¹

¹Mapúa University, Philippines

This study discussed the factors influencing people's well-being and living in known Smart Cities worldwide. The conceptual framework of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and the Structural Equation Modeling (SEM) was used for its statistical analysis. The study shows that the facilitating condition significantly influences people's behavioral intention working in smart cities across the globe. This paper indicates that the respondents' behavioral intention to continue their employment, report to their duties every day, and work effectively and efficiently is significantly affected by how the amenities of their working and living environment can do to them.

IEEM21-F-0032/Cognitive Biases as Clues to Skill Acquisition in Manufacturing Industry

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¹Chuo University, Japan

²Shizuoka University, Japan

Although robotization and mechanization are recently increasing in manufacturing plants, small- and medium sized companies are burdened with the costs of introduction and have no choice but to rely on human labor when improving work efficiency. Here, in an effort to improve efficiency in manufacturing industrial parts, we analyzed the visualized gaze data of both an apprentice and a skilled worker using eye-tracking hardware/software. We found that self-recognition of situations where cognitive biases, which are Ease of Recall and Confirmation Trap, was in play would be associated with skill acquisition and attainment of the next learning level for work efficiency.

IEEM21-F-0050/Structural Framework of Ambidextrous Leadership Behavior Affecting Firm's Innovation

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With the help of extant literature, present study attempts to explore and establish the relationship between: (a) opening and closing leadership styles; and temporal flexibility to switch between these behavior of ambidextrous leader, (b) Opening leadership style with stimulating, exploring and learning behavior of a leader, (c) Closing leadership style and exploiter, error handler and goal seeking behavior of a leader, and (d) description of temporal flexibility of switching the behavior based upon temporal flexibility, adaptable behavior and switching behavior of a leader. The model has been empirically examined using structural equation through primary data where all the proposed hypotheses have gained significant support. The study is of great relevance to the industry leaders indulge in innovation management of the firm.

IEEM21-F-0053/Kansei-based Mining and Robust Design for Internet Service Provider

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Customer emotional satisfaction (known as Kansei) and retention is deemed to be vital for all service businesses including for the high-tech services such as Internet Service Providers (ISPs). Functionality and usability attributes such as network quality and connection speed are regarded as basic requirement. However, there has been little attention and academic research to evaluate the importance of perceived ISPs' service quality on customer emotional need and satisfaction (Kansei). Hence, more Kansei-based offerings are required as more service performance and delivery to obtain customer emotional satisfaction. Moreover, due to customer dynamics, more representative Kansei and robust solution are expected. This study discusses how Kansei-based mining design is proposed and enhanced by Taguchi methodology for robustness of improvement strategy. Both theoretical and practical implications are discussed.

IEEM21-F-0078/The Effects of Employee Volunteering on Organizational Loyalty: The Moderating Effects of Perceived Organization Support

Zhenbin Ding¹, Hongling Yang¹, Jianquan Wang¹, Jie Xu¹
¹Northwestern Polytechnical University, China

As an important means of fulfilling social responsibility, the Corporate Volunteer Program (CVP) is increasingly valued by enterprises. Based on the data collected from 261 employees who have volunteering experiences, this paper introduces a conceptual model of the effects of volunteering on organizational loyalty regarding organizational identity as a mediator and perceived organizational support as a moderator. The results reveal that: employee volunteering has a significant positive effect on organizational loyalty; organizational identity has a significant positive effect on organizational loyalty; organizational identity plays a mediation role in the relationship between employee volunteering and organization loyalty; perceived organizational support plays a moderate role in the relationship between organizational identity and organizational loyalty, and also moderates the mediating effect of organizational identity between volunteering and organizational loyalty.

Session	IPE Information Processing and Engineering
Date	December 14, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Shih-Wen KE ¹ , Zhao-Hui SUN ² ¹ National Central University, Taiwan ² Shanghai Jiao Tong University, China

IEEM21-F-0315/A Logical Database Design Methodology for MongoDB NoSQL Databases

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This paper presents a logical database design methodology for a MongoDB NoSQL database. Given a query, the design methodology is able to assist database designers to determine the best set of configurations of data, also known elsewhere as scheme trees, in the database such that the retrieval time of the query can be minimal or reduced. The design methodology first models an application of interest with a conceptual model. Based on our previous researches, the design methodology then generates from the conceptual model as few scheme trees as possible, which will eventually be implemented as MongoDB's collections in the database. To illustrate the design methodology, the COVID-19 data set was downloaded as an example application. The design methodology first conceptualized the data set with an Entity-Relationship model. Multiple queries were then devised to access various parts of the data set, whose executions required retrievals of the attribute values of all or some of the entity types and/or the relationship in the ER model. The design methodology then generated the best sets of scheme trees for the queries.

IEEM21-F-0471/Stylized Dialogue Generation

Shih-Wen Ke¹, Wei-Liang Chen¹

¹National Central University, Taiwan

Dialogue systems such as intelligent online customer services, online chatbots or smart kiosks are becoming increasingly popular. Currently dialogue systems lack personality and ability to respond according to contexts. In this study, we propose an approach to transfer the text into multiple styles when generating dialogue responses. It is especially challenging to build a stylized dialogue system as it combines supervised and unsupervised tasks. In practice, the dialogue data are usually paired, i.e. query paired response while styled text is not. Therefore, we propose using lightweight deep neural network models to bridge the dialogue response generation model and the style transfer model. This structure allows the model to generate responses of different styles to the same query. Our approach will be evaluated against selected state-of-the-art dialogue generation and style transfer techniques.

IEEM21-F-0248/A Conceptual Framework of Service Applications Based on Identity Resolution for Home Appliance Industry

Ruirui Wang¹, Ziding Meng¹, Yuguang Bao¹, Xinguo Ming¹
¹Shanghai Jiao Tong University, China

The application of the industrial Internet, integrating Internet and industrial systems has developed rapidly in decades. The identity resolution system, which serves as the "identity card of the digital world", has become the basis for supporting the interconnection of data inside the industrial Internet. However, the requirements of consistent coding, timely information sharing, and efficient cooperation among different identity resolution systems have not been met at the current stage. To solve these problems, this paper proposes a conceptual framework of service application based on identity resolution for the home appliance industry. The detailed demonstration is carried out in a specific example of the whole life cycle management of home appliances, which proved that the adoption of the identity resolution system makes the convey and sharing of data and information in different service applications smoother and more efficient, showing the feasibility of the conceptual framework.

IEEM21-F-0327/Research on Dynamic Pricing of Shared Electric Vehicles Based on System Utility Maximization

Lewen Bao¹, Rui Miao¹, Bo Zhang¹, Hao Hu¹, Jiying Zhou¹

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Under the background of sharing economy, in order to improve the utilization rate of vehicle resources and the economic benefits of operators for urban governance, this paper studies the dynamic pricing strategy to maximize the system utility. Firstly, the space-time distribution law, time-varying law and influencing factors of shared cars leased by users are analyzed, and the demand characteristics of users' travel are obtained; then, considering various factors such as operation mode, user acceptance, demand price elasticity and operation cost, the supply and demand balance of single-way electric rental vehicle system based on fixed network points is explored and the pricing strategies of each site in different periods are formulated. Finally, the feasibility of the model is verified by taking the 'microbus' electric rental vehicle project in Hangzhou City as an example. The research results can provide theoretical guidance for subsequent promotion and market allocation of urban governance.

IEEM21-F-0280/Event Log-based Weaknesses Detection in Business Processes

Günther Schuh¹, Andreas Gützlaff¹, Seth Schmitz¹, Marco Schopen¹, Florian Brühl¹

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The performance of business processes is a critical success factor for companies on highly competitive markets. The improvement of business processes requires a deep understanding of as-is processes and existing weaknesses that hamper their performance. Traditionally, process mapping and weakness detection are conducted manually based on workshops and interviews with employees involved in the process. Consequently, these practices are not merely time-consuming and costly, but at the same time liable to subjective influences of the interviewed participants. For process mapping, these challenges can be overcome with the data based technology of process mining, that can model as-is-processes based on event log data from companies' information systems. For weakness detection in business processes, however, this technology is not applicable yet since this step requires domain knowledge about process weaknesses, which is not available for processing with process mining. This paper presents an approach to model domain knowledge about weaknesses in business processes to enable their automated and databased detection in event logs with process mining. Thereby, the weakness detection within business process improvement can be conducted more objectively at lower efforts.

Session	SCM-04 Supply Chain Management 4
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Omid FATAHI VALILAI ¹ , Pei-Lee TEH ² ¹ Jacobs University Bremen, Germany ² Monash University Malaysia, Malaysia

IEEM21-F-0208/Exploring Critical Events of Perishable Product Supply Chain Using Fault Tree Methodology to Deal with Impacts of COVID-19

Manisha Bhardwaj¹, Rajat Agrawal¹
¹Indian Institute of Technology Roorkhee, India

This research investigates the impact of pandemic COVID-19, on the perishable product supply chain (PPSC). Thematic analysis for the cause of failure in PPSC has been identified through the NVivo application. It examines the events that cause disruption. Secondly, fault tree methodology has adopted qualitative evaluation using the minimum cut set analysis and importance measures. A case study of the apple supply chain in Shimla, India has been included, collecting data from respondents, research papers, government reports, and newspaper articles published from the period March 2020 to December 2020. The occurrence of failure in the apple supply chain included crop yield loss, unavailability, and inaccessibility of apple products. After analysis, 13 minimum cut sets are obtained. These include critical failure event as: assistance in failure from government and organization, high food prices, labour shortage, and cross border restriction. Potential strategies for resilient PPSC have been proposed for an efficient decision-making process.

IEEM21-F-0210/Coordination of Supply Chain of a Three-level Fresh Products Based on Conditional Value at Risk

Chen Nan¹, Jianfeng Cai¹, Wenting Han¹
¹Northwestern Polytechnical University, China

This paper considers a fresh products supply chain consisting of a supplier, distributor and a retailer. we use CVaR risk measurement tool to build the supply chain model of three-level of fresh products which the retailer under the risk aversion, preference, respectively. At the same time, the loss of fresh products with time is considered and the option contract is applied to the supply chain model. Therefore, the supply chain coordination is realized by adjusting the option contract parameters. The conclusion implies that the purchase price of the option is not affected by the loss value but the execution price of the option is affected by the loss value. In addition, the attitude of aversion and preference about the retailer will not affect the execution price of the option and only affect the purchase price of the option of the distributor and retailer.

IEEM21-F-0214/Sustainability Issues of the Coconut Supply Chain in Indonesia

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Coconut is one of Indonesia's strategic agricultural commodities. However, in the past five years, many issues on the sustainability of the coconut supply chain in Indonesia have been revealed in the mass media. This study aims to explore the issue by exploring discussions that emerge in online news articles. It employs content analysis and binary factor analysis to investigate and construct the information in identifying and narrating the issue of sustainability of the coconut supply chain in Indonesia. The result shows that the sustainability of the coconut supply chain in Indonesia experiences disruptions and requires an immediate long-term strategy for restoration. This will provide insight into the real condition of the coconut supply chain in Indonesia so that could become the basis for further research. Future work should include a simulation study to find the best policy in maintaining the sustainability of the coconut supply chain in Indonesia.

IEEM21-F-0222/A Conceptual Paper on Supplier Unilateral Specific Investment Antecedent: Social Capital Perspectives

Wulan Permatasari¹, Amin Wibowo¹, Nurul Indarti¹, Rangga Almahendra¹
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This conceptual paper proposes to examine why and under what conditions suppliers will make unilateral specific investments for their buyers. We propose that suppliers are more likely to make such investments when the level of relational social capital is high. We also propose that environmental uncertainty will amplify the formation of specific investment from relational social capital. Supplier unilateral specific investment is expected to have a direct effect on relationship performance. In the first part, the paper will describe the development of the theories, and then review previous literature that provides empirical evidence on antecedents of supplier unilateral specific investment.

IEEM21-F-0231/Evaluation of Supply Chain Network Resilience Level in Pre-disruption and Post-disruption Scenario

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Disruption in the supply chain network is unavoidable. Although with a minimal probability, disruption can result in enormous losses due to disruption of flow in an interconnected system. This paper presents a simulation study to evaluate the impact of disruptions. Ten supply chain networks from six different types of industries are used as the case studies. Monte Carlo simulation is used to simulate the randomized disruption scenarios. The resilience is measured using four parameters: density, centrality, connectivity, and network size. The performance of the supply chain networks was evaluated with the mean and CVaR. The result shows that supply chain networks with high initial resilience are not necessarily the most resilient because initial resilience does not correlate with the difference in resilience when exposed to disruption. Furthermore, all networks experience the highest decrease of resilience value due to connectivity parameters. Therefore, the recommendation given is adding new nodes (DC/hubs/manufacturer) as buffer nodes or relationships between existing nodes (between supplier/DC/manufacturer/retailer). Disruption scenarios are not based on each zone and are assumed to have the same characteristics as research limitations.

Session	TKM-01 Technology and Knowledge Management 1
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Elise VAREILLES ¹ , Annika HASSELBLAD ² ¹ University of Toulouse, France ² Mid Sweden University, Sweden

IEEM21-F-0103/Can a Computer-based Knowledge Repository Strengthen Organizational Memory? Evidence from a Japanese Company

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¹Shizuoka University, Japan
²Chuo University, Japan

This study examines whether a computer-based knowledge repository can enhance organizational memory in learning from failure. Although it is generally believed that a computer-based knowledge repository enhances organizational memory, some previous studies have found a paradoxical effect. That is, some have argued that since knowledge information is stored in a computer-based repository, a member of the organization does not need to memorize the information, and thus it may not enhance organizational memory. We conducted a questionnaire survey in a company that has successfully implemented organizational learning from failure while using a computer-based knowledge repository daily. The results showed that (1) the computer repository does not enhance organizational memory directly, but rather (2) mediated through augmentation of both soft and hard memory such as brain memory and documents respectively and that (3) the soft and hard memories augment the organizational memory. Then, based on the results of the analysis, we argued that a computer does not directly enhance organizational memory, but that the organizational routine of utilizing a computer may enhance organizational memory.

IEEM21-F-0111/Reasons for Engineering Changes Affecting Part-specific Tools: An Investigation in the Automotive Industry

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Engineering Changes (ECs) cause significant effort in the automotive industry. With increasing complexity and functionalities of vehicles on the one hand, and decreasing time to market on the other hand, managing ECs becomes more crucial. Especially ECs affecting part-specific tools consume much time and costs in the development of an automobile. To find strategies for reducing this effort, it is important to understand when and why ECs occur. Therefore, this paper first investigates the distribution over time of 3561 EC Orders (ECOs) of three vehicle development projects. A similar pattern with peaks after hardware development phases is observed. Second, the ECOs are categorized according to their reasons. The most frequent reasons are assembly problems, design, and geometric conflicts. Third, the share of reasons over time is analyzed. Whereas some reasons like cost reduction occur early in the development process, others like assembly problems or acoustics appear later. The authors suggest that some ECs with reasons like acoustics should be either done earlier or reduced e.g. through increased virtual validation whereas others with reasons like design should be done more efficiently.

IEEM21-F-0192/Improving the Keyword Co-occurrence Analysis: An Integrated Semantic Similarity Approach

Atanu Bhuyan^{*1}, Kamal Sanguri¹, Himanshu Sharma¹

¹Indian Institute of Management Kashipur, India

Bibliometric studies help yield useful information about the quantity and quality of research works in a particular academic domain. We used the popular bibliometric technique of co-occurrence analysis to explore emergent topical areas in the field of urban mobility. Our work contributes from a methodological perspective to improve the conventional co-occurrence analysis method. The modified co-occurrence analysis is two-fold: firstly, we used the Rapid Automatic Keyword Extraction (RAKE) algorithm to extract keywords from abstracts of documents in a corpus to generate a new co-occurrence matrix. Secondly, we produced "semantic similarity" between each keyword in matrix form, which is combined with the co-occurrence matrix of the extracted keywords from documents in a corpus to yield a weighted co-occurrence matrix. We analyzed the unweighted and weighted matrices in terms of their network structure and cluster quality. We demonstrated that the weighted matrix shows network structures with higher modularity and superior cluster quality than its unweighted counterpart. These observations are consistent in terms of more meaningful content and greater ease of exposition in the emergent themes.

IEEM21-F-0233/Development of a Balanced Score Card for Knowledge Work in Project-oriented Engineering Organization: KPI Prioritization Using AHP

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This paper presents the development of a balanced scorecard (BSC) for engineering organizations providing knowledge work. The BSC was obtained through the selection of Key Performance Indicators (KPIs), using the Analytic Hierarchy Process (AHP). The BSC provides a strategic performance management tool that enables financial and non-financial KPIs to be used, to develop a balanced organizational strategy. Choice of KPI is a multi-criteria decision problem; therefore, the AHP method was used to select the most critical Performance Indicators (PIs). The AHP enabled the knowledge, information and experiences, to be synthesized in prioritizing the KPIs. This manuscript first describes the concepts of KPI and BSC, based on the available literature. Next, a case study in a project-based engineering-to-order (ETO) organization was conducted. The PIs were listed and compared pairwise, the chosen PIs were used to create a complete BSC and to develop a KPI dashboard, employed to monitor performance improvement in the case study company. In this study, it is suggested that implementing the BSC may help organizations providing engineering knowledge to monitor the organization's assets and better execute their strategy.

IEEM21-F-0236/The Impact of Covid-19 on Blockchain Adoption Time of Shipowners

Shuyi Pu^{*1}, Jasmine Siu Lee Lam^{*1}

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The outbreak of Covid-19 has accelerated the need for digitalisation in maritime supply chains. Blockchain is a promising digital technology for post-Covid-19 recovery because of its immutability, transparency, traceability and security. This paper aims to analyse the impact of Covid-19 on blockchain adoption time among shipowners. A game theoretical model is built to solve the problem. In numerical applications, the impact of Covid-19 is observed by comparing the results to those without Covid-19. It is found that Covid-19 has a positive effect on accelerating blockchain adoption for a few small shipowners. This indicates that Covid-19 provides a good business opportunity for blockchain developers to market their products.

IEEM21-F-0081/Identification of Fields of Action for the Realization of a Sustainable Corporate Management

Michael Riesener¹, Maximilian Kuhn¹, Sebastian Schloesser¹, Carsten

Boßmann^{*1}, Günther Schuh¹

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Sustainability is becoming increasingly important for companies in the manufacturing industry. In order to become more sustainable, all relevant activities within a company, beginning with its higher-level corporate management, must be realigned. Among all business units, the department of research and development (R&D) in particular can make a significant contribution to sustainability within a company, as product development plays a key role in determining the use of resources in future products. The importance of sustainable products and the implementation of sustainability aspects in the product development process has already been recognized in research. However, the influence of R&D on sustainable corporate management has not yet been sufficiently explored. To fill this research gap, this paper presents a research framework to identify challenges of sustainable corporate management. Furthermore, potentials and success factors of R&D are derived, which can contribute to sustainable corporate management.

Session	OR-01 Operations Research 1
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Miriam BONGO ¹ , Ai Chin THOO ² ¹ De La Salle University, Philippines ² Universiti Teknologi Malaysia, Malaysia

IEEM21-F-0075/Manufacturers Insights on the Implementation of Eco-industrial Park

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The rapid industrialization has brought wealth to national economy with environmental crisis. The concept of eco-industrial park (EIP) development is emerging globally as a new industrial model to achieve sustainable performance. Thus, the purpose of this study is to examine relationships between attitude, subjective norm, perceived behavioral control and EIP strategic intention. In addition, the linkage between the strategic intention and perceived sustainability performance of Malaysian manufacturing industries on implementation of EIP is investigated. 78 respondents from the manufacturing industry participated in the study. Structural equation modeling (SEM) was employed for data analysis. Findings showed that attitude and subjective norm are not positively related to EIP strategic intention, while perceived behavioral control has a positive and significant relationship with EIP strategic intention. Additionally, EIP strategic intention is related positively to perceived sustainability performance on implementation of EIP. This study is expected to contribute to the Malaysian government, practitioners and academicians about EIP strategic intention and perceived sustainability performance on the implementation of EIP in Malaysia.

IEEM21-F-0116/Proposal of Work Study and Anthropometric Workstation Redesign to Increase the Productivity on Asparagus Industries

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This article aims to analyze the low productivity rate in the packing station of asparagus processing companies for export. The current difference in the rate labor productivity is 18.22%, which is caused by ergonomic problems, inadequate posture and non-standardized working method. In order to confront this problem, an improvement model was developed using the ADKAR Model, Anthropometric Workstation Redesign, Poka-Yoke and a Working Method is proposed. Therefore, the contribution of this model is to give importance to the human factor and combine change management with engineering solutions. In conclusion, a model was proposed where ergonomic assessment and Work Study tools interact with change management using the ADKAR model to confront the problem of low labor productivity, as well as solve the reasons and causes that cause said problem.

IEEM21-F-0131/Robust Network Design and Last-mile Delivery in Cold Chain Logistics System

Ying Yang¹, Yongsan Zang¹, Mingyao Qi¹
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As a new logistics system, cold chain logistics, varying greatly from conventional logistics mode due to the intense sensitivity to time of the fresh product, has attracted significant attention recently. To reduce the losses caused by long transportation time, people have put forward higher management requirements for the cold chain logistics circulation links, which, however, is challenging to meet considering the uncertainty of demand. Therefore, to ensure fresh product quality and improve customer satisfaction, a specific robust network designing problem (RNDP) and last-mile delivery (LMD) technical framework based on a case study is proposed in this paper. Firstly, we apply a two-stage robust model to reasonably locate the warehouse, determine the delivery quantity under the condition of uncertain demands. We adopt two algorithms, Benders decomposition (BD) and column & constraint generation (C&CG), to solve the problem. Then, a vehicle routing problem with soft time window (VRPSTW) is established and solved by variable neighborhood search (VNS) heuristic algorithm to make distribution decisions. What's more, a series of sensitivity analyses are also conducted to study the influence of crucial parameters on decision-making.

IEEM21-F-0190/Applying Multiple Stakeholder-based Target-oriented Robust-optimization Approach in the Microbusiness Sector

Miriam Bongo¹, Eunice Cristyl del Pilar¹
¹De La Salle University, Philippines

In this paper, an optimization model is developed to simultaneously consider the diverse interests of decision-makers and arrive at a satisfying solution. This optimization model is termed as multiple stakeholder-based target-oriented robust optimization (MS-TORO) model. To illustrate the applicability of the proposed model, a case of the microbusiness sector is taken. Specifically, a choice problem among location alternatives is solved using the proposed model. Key results of the model implementation showed that the aggregated solution centers on an alternative that satisfies the interests of decision-makers and presents a deviation metric to which corresponding adjustments must be made in the performance targets to ensure due agreement among decision-maker interests.

IEEM21-F-0223/A New Discrete Bi-objective Formulation of Unequal Area Facility Layout Problem

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This paper presents a new discrete Bi-objective formulation of the Unequal Area Facility Layout Problem (UA-FLP) by extending the Quadratic Assignment Problem (QAP) formulation available in the literature. As far as authors know, in literature, only continuous formulations for UA-FLP exist. In the proposed formulation, along with the conventional objective of material handling cost, weighted fitness cost is also included in the objective function, making it a Bi-Objective formulation. The proposed model is tested for problem sizes of $n = 8, 12, 15, 20, 25$ and 30 using Lingo 19, and optimum results are reported. These results provide a range of solutions to decision-makers to enhance their decision capabilities.

IEEM21-F-0246/Mixed-energy Fleet Pollution-routing Problem with Time Windows

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¹Northwestern Polytechnical University, China
²Chang'an University, China

Transportation activities have caused a large amount of energy consumption and environmental pollution. With increasing emphasis on environmental protection, transportation companies have to pay more attention to social benefits. At the same time, scorching competition has put forward a higher demand for customer satisfaction. This paper studies a pollution-routing problem (PRP) to minimize several pollutants emissions and find maximum improvements in delay time at customers based on soft time windows. The routing model focuses on a mixed-energy fleet, which introduces electric vehicles into a homogeneous combustion engine fleet. A Non-dominated Sorting Genetic Algorithm II (NSGA-II) is adopted to find the Pareto-frontier of the PRP model. We investigate the effect of the electric vehicle's mileage on two objectives by sensitivity analysis to understand the problem better.

Session	BDA-02 Big Data and Analytics 2
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Kin Lok KEUNG ¹ , Zhiqiang Cai ²
	¹ The Hong Kong Polytechnic University, Hong Kong SAR
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IEEM21-F-0286/Publication Month Bias Evolution Patterns of Highly Cited Papers in Different Disciplines

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The publication date and chronological arrangement lead to early published papers having more time and opportunity to be read and cited compared with the later publication papers. To explore the publication month bias phenomenon of highly cited papers published in different disciplines, we selected highly cited papers from all ESI disciplines published between January 1, 2010 and December 31, 2020. The results indicate that the 'head-start' effect of highly cited papers is a widespread phenomenon in all ESI disciplines and the probability published in each month decreases linearly with the increase of months. We adopt the Least square method to quantify the month bias degree in each ESI discipline and all fitting curves are significant under the test level $\alpha = 0.01$ except Multidisciplinary. We also discover that the shorter the citation window length, the more obvious the 'head-start' effect, and it cannot be removed even if the citation window length of up to 11 years.

IEEM21-F-0310/A Data Mining Approach for Analyzing Dynamic User Needs on UGC Platform

Fanxing Zou¹, Yuning Qian¹, Zhen Zhang¹, Xinyu Zhu¹, Danni Chang¹
¹Shanghai Jiao Tong University, China

Nowadays, the official platform for consumer community has become a reliable database for enterprises to mine users' needs. The study aims to develop a dynamic demand mining method based on users' online reviews. To achieve this objective, this research proposes i) a data crawling process of online product reviews; ii) multi-dimensional index system of data processing; iii) dynamic user demand mining and transformation method. Particularly, complete user comments data within about 5 months on Pollen Club (Huawei official consumer community) were collected. After the initial data cleaning, a primary study of 2100 selected pieces of data was put forward. The methods for Chinese natural language processing (e.g., text segmentation, sentiment analysis) were integrated to process the data, and frequency analysis, trend analysis, cluster analysis and user analysis were used to mine the dynamic user data. The improvement suggestions on product features were put forward based on the theory of design knowledge hierarchy (DKH). This research is expected to help enterprises to mine dynamic user data more efficiently, discover the consumer feedback on the product performance, and facilitate further product improvement.

IEEM21-A-0062/From American Crime Show to Séries Policières Françaises an AI Toolkit for Genre Prediction in Transnational TV Series Adaptations

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²The Mobius Trip, United States

Born from a collaboration between a humanities scholar and an artificial intelligence engineer, the Mobius Trip is a deep-learning multimodal toolkit that can predict TV series genre based on the combination of color, light, rhythm, and music. Following the tradition of formalist film theorists concerned with the technical elements of motion pictures, and Cultural Analytics, which focuses on computational, visualization, and big-data methods, we seek patterns in the film-making cultural tradition between the US and France. Our results indicate that Transnational TV series Adaptations, the transfer of a show into another culture, also implies a transfer in genre. Our goal is to offer a potent toolkit that can help TV series adaptors make more intentional decisions when adapting a show and make the adapted show more successful.

IEEM21-F-0324/Proposal of an Onomatopoeia Feature Table Using Cosmetic Reviews

Misaki Murata¹, Takashi Ito¹, Syohei Ishizu¹

¹Aoyama Gakuin University, Japan

Onomatopoeia is a general term for imitative and mimetic words. A situation or event can be expressed in different ways using onomatopoeic words. However, the expresser and reader may interpret the words differently because the usage of onomatopoeic words differs from person to person, especially in merchandise reviews. Therefore, it is necessary to analyze the features of onomatopoeia for interpreting these words accurately. This study proposes a method to characterize onomatopoeic words in merchandise reviews by analyzing their nature and features. The proposed method combines the following analysis techniques: cluster analysis and Latent Dirichlet Allocation for data categorization, correspondence analysis for determining the relationship between the merchandise category and onomatopoeia, and N-gram for searching for the co-occurrence relation between the characteristic words and onomatopoeia. Consequently, we find the features and differences for each onomatopoeia and construct an "onomatopoeia feature table". Using it, a user can determine the difference in the nature of the use of onomatopoeia. The nature of use of the onomatopoeic word can also be correctly interpreted. Some characteristic words in the constructed onomatopoeia feature table were verified.

IEEM21-F-0348/Creating Transparency on Product Variety Through Data-driven Similarity Analysis

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¹RWTH Aachen University, Germany

In recent years, the number of product variants has steadily increased in numerous industries to accommodate customer-specific requirements. At the same time, rapid technological changes have led to shortening product lifecycles and greater volatility in product portfolios. In manufacturing, the high level of product variety is reflected in greater process diversity and material flow complexity, making it harder to exploit economies of scale and utilize resources efficiently. In order to stay competitive under increased cost pressure, manufacturing companies try to counter these effects, but often lack transparency on product variety to successfully implement modular systems and standardization measures. As existing methods for capturing product variety are labor intensive and impractical for larger portfolios, this paper presents a data-driven approach by computing similarities between products based on their geometrical features. To capture product variety and create transparency, the similarities are visualized through a dendrogram and multidimensional scaling methods.

IEEM21-F-0441/Comparing Technical Trends Between Industrial Leaders via Video Data

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¹NEC Corporation, Japan

IT (Information technology) has been rapidly growing. Until early 2000s, IT mainly exists for IT industry. However, IT expands their fields into the outer fields of IT industry such as medical and agricultural industries. It means that the cutting-edge technologies have increased to a level that humanity cannot grasp all. It is difficult for even industrial leaders and followers to grasp all. Thus, in order to grasp and create the cutting-edge technologies, this research provide the latest states from keynotes of some events. These text data for this analysis could be gained because a lot of events have shifted from in-person to online by the impact of COVID-19 (the coronavirus disease 2019). Consequently, this analysis measured the closeness between industries that have available data and found that the changes of topics become more frequent after COVID-19. This analysis is to evaluate the potential in order to compare with confidential data and to discover the gap between international trends and in-company competences in the future.

Session	HF-02 Human Factors 2
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Vinay SINGH ¹
	¹ Indian Institute of Information Technology and Management Gwalior, India

IEEM21-A-0016/Systems Intelligence in Engineering Management

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¹Aalto University, Finland

²Inclus, Finland

The concept of Systems Intelligence (SI) refers to intelligent behavior in the context of complex systems involving interaction and feedback. It is a competence related to the skills needed in the environment of modern industrial engineering and engineering management where people skills and systems are in an increasingly important role. The eight factors of Systems Intelligence relate to perceiving, attitude, thinking and acting. The personal self-evaluation test consists of 32 items which can also be applied in a peer evaluation mode. The concept extends to organizations, and the test and the factors can also be applied to evaluate organizations and teams. An extensive survey based on peer evaluation shows that Systems Intelligence correlates positively with professional performance. People in a managerial role score higher in SI than others. Top performing organizations score higher in all SI factors. The tests can be used as tools for helping self-reflection and learning. There is also a serious card game helping teams to improve in SI.

IEEM21-F-0118/Situational Awareness and Flight Approach Phase Event Recognition Based on Psychophysiological Measurements

Qinbiao Li¹, Cho Yin Yiu¹, Simon C. M. Yu¹, Kam K.H. Ng¹

¹The Hong Kong Polytechnic University, Hong Kong SAR

Situational awareness (SA) is a key parameter for air traffic control officers (ATCOs) when performing complex tasks in ATC. Identifying the potential lack of SA can avoid serious human errors and assist users to make proper decisions in ATC tasks. This paper aims to evaluate the SA of ATCOs by discriminating various SA levels via commonly used dry-sensor electroencephalography (EEG). This research also provides fundamentals and guidance for further research on SA. In this experiment, 10 participants are recruited to imitate ATCOs and perform three tasks accordingly. The results demonstrated a significant increase in the alpha wave while having a low beta wave with a high Beta power spectrum in channels FC6, F7, and T8 when comparing the projection scenario with the perception scenario. This research further reveals the relationship between various SA statuses and the corresponding physiological feedback, with reasonable measures in non-ideal situations.

IEEM21-F-0144/Robo Toons: Testing the Use of Animation Principles in Non-anthropomorphic Robots to Improve Human-robot Interaction

Bernhard Schmitt¹, Andrew Prah¹, Ann Li Ho¹

¹Nanyang Technological University, Singapore

The movement patterns of robots can affect user trust, acceptance, and emotional reactions during interaction. Several principles used in the animation discipline provide promising avenues for designing robot movement. We test the principles of anticipation, ease, exaggeration, and speed. Results show that people expect robots to move quickly, slow movement increases fear. This study also find that moderate levels of exaggeration can increase trust and decrease fear.

IEEM21-F-0187/The Influence of Illegitimate Tasks on the Intention to Continue Volunteering: A Moderated Mediation Model

Zhenbin Ding¹, Hongling Yang¹, Jianquan Wang¹, Jie Xu¹
¹Northwestern Polytechnical University, China

The legitimacy of the tasks has an essential impact on the intention to continue volunteering, but the research of the impact between illegitimate tasks and the intention to continue volunteering is limited. In this study, 424 volunteers in China were surveyed and the relevant hypotheses were tested with the data collected. The results show that: Illegitimate tasks have a negative impact on volunteer engagement and intention to continue volunteering; Volunteer engagement has a mediation effect between illegitimate tasks and the intention to continue volunteering; Self-esteem moderates the mediation effect of volunteer engagement on the relationship between illegitimate tasks and intention to continue volunteering.

IEEM21-F-0443/Exploring the Affective Way Leading to Impulse Buying in Social Media Live Streaming

Li-Ting Huang¹
¹Chang Gung University, Taiwan

Social media live streaming commerce is getting popular and performed by brand companies, channel retailers, and purchasing operators. Utilizing characteristics of social media live streaming commerce results in viewers' immersive and engaging shopping experience, as well as more interpersonal connections. Viewers could be easily attracted by vivid, attractive, immediate stimulus, interaction, a sensation of closeness in spatial, temporal, and social relationship with remote other viewers and so on. Accordingly, impulse buying in social media live streaming commerce could be frequently happened. This study investigates impulse buying in social media live streaming commerce by considering overall contextual and atmospheric factors based on the flow theory and psychological distance. One hundred and sixty records collected by the online survey are analyzed. Results show that interactivity, participation, social interaction and social herding facilitate the vividness and interactive process in social media live streaming and then reduce the psychological distance. Social and spatial psychological distance and social presence as affective organism enhance viewers' flow experience and in turn inducing viewers' impulse buying. Theoretical and managerial implications are listed.

Session	RME-01 Reliability and Maintenance Engineering 1
Date	December 14, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Monika TANWAR ¹ , Chao FANG ² ¹ Singapore University of Technology and Design, Singapore ² Xi'an Jiatong University, China

IEEM21-F-0099/Achieving Business Strategic Objectives: The Place of Maintenance Department

Edoghogho Ogbeifun¹, Patrick Pasipatorwa¹, Jan Harm Pretorius¹
¹University of Johannesburg, South Africa

Many manufacturing industries formulate strategic business plans, sometimes, with little or no input from the maintenance department. However, where a maintenance department is fully recognised, the performance of the department determines how the operations of the unit are aligned towards achieving the strategic objectives of the industry. The single site case study method of qualitative research was adopted. Two interrelated approaches were used for data collection. First, a quantitative survey of responses from selected strategic, tactical, and operational leaders from the maintenance, production, and quality assurance department. The analysis revealed that the performance and operations of the maintenance department were not positively aligned towards achieving the strategic objectives of the industry. Secondly, a focus group session was conducted for the operatives of the maintenance department to discuss the survey outcome, identify problems and develop performance improvement strategies, to be monitored every three months. The outcome of this research provides objective information, which enables the maintenance department to continuously appraise their performance and align it towards achieving the strategic objectives of the manufacturing industries.

IEEM21-F-0094/Maintenance Strategy Optimization of a Thermal Power Plant

Tshegofatso Modiba¹, Arnesh Telukdarie¹
¹University of Johannesburg, South Africa

The South African power generation sector has been under the spotlight in the last decade due to its inability to produce the required load capacity demanded by the grid. The issue of plant availability comes into question, maintenance on Power Stations has been neglected and has not been conducted efficiently and effectively leading to minimal availability of the plant. Breakdowns are more likely to occur frequently with the maintenance on plant equipment not done frequently leading to none generation. This paper aims at improving maintenance strategies by examining the efficiency of the thermal power plant using Key Performance Indicators and World Class Maintenance standards. A quantitative approach is followed with the analysis of secondary data of all the plant failures and stoppages during plant operation. The performance of the power station is investigated with the use of the Overall Equipment Effectiveness standard as the prominent KPI. The study analyses milling plant failures which have the biggest contribution to the Energy Availability Factor and identifies initiatives that will lead to overall increase in availability and reliability which in turn improves efficiency.

IEEM21-F-0359/Belief Reliability Analysis of Traffic Network: An Uncertain Percolation CML Model

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¹Beihang University, China
²China Academy of Launch Vehicle Technology, China

Most research on traffic network reliability considered about aleatory uncertainty but ignored the effect of epistemic uncertainty which may misguide the traffic management. In this paper, we will introduce uncertainty theory and belief reliability theory to propose a belief reliability analysis method for traffic network based on the traffic performance margin. To analyze the belief reliability of roads, a method considering three uncertain factors to get the distribution function of capacity threshold will be proposed. To describe the process of traffic congestion considering both aleatory and epistemic uncertainty, an uncertain percolation coupled-map-lattice (CML) model is constructed, where the uncertain percolation model is utilized to describe the performance degradation of traffic network and the CML model is to represent the process of the load redistribution between nodes. Then, a method combining uncertain simulation and UPC model is put forward to calculate the belief reliability of traffic network. The proposed methods are illustrated with a case study.

IEEM21-F-0491/The Use of TPM Principles to Measure System Performance

Anup Pradhan¹, Magano Molefe¹
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Numerous organizations strive to grow and survive due to increasing competition. Managers are constantly developing strategies that assist organizations to become productive while sustaining organizational growth and goal achievement. Organizational goals are accomplished through performing proper maintenance on plant equipment. Total Productive Maintenance (TPM) is a maintenance program which involves concepts for maintaining plants and equipment effectiveness. This study aims to analyze the root cause of breakdowns within a production line and further use of TPM to prevent system breakdowns. Relevant data were collected using questionnaires, observations, interviews, and company records. The study then adopted and implemented a competitive strategy which is a TPM model. Overall Equipment Effectiveness (OEE) is used as a measure of performance. The results obtained highlight that if TPM is appropriately implemented, OEE can increase, providing the organization a competitive advantage.

IEEM21-A-0114/Improving the Resilience of Power Distribution Systems Against Typhoons with Data-driven Distributionally Robust Optimization

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²Xi'an Jiaotong University, China
³CentraleSupélec - Université Paris-Saclay, France

The increased frequency of natural hazards leads to more disruptions in power distribution systems in recent years, thus attracting growing attention in developing methods to improve the resilience of systems. This paper proposes a data-driven distributionally robust optimization (DRO) model to give the optimal strategy of allocating distributed energy resources (DERs) for power distribution systems against uncertain impacts caused by typhoons. To accurately describe the uncertainty of typhoons, the spatiotemporal impacts of typhoons are first evaluated in terms of the failure probabilities of system components. A data-driven ambiguity set is constructed by using the historical data to include the true distribution of typhoon impacts in a high probability. Then, a resilience-based tri-level DRO model is formulated to determine the optimal strategy of the system resilience enhancement. The combination of duality and column-and-constraints generation algorithm is employed to solve the proposed DRO model. The effectiveness of the proposed model is analyzed and verified by applying the IEEE 13-node reliability test system in the Hong Kong region.

Session	SCM-05 Supply Chain Management 5
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Omid FATAHI VALILAI ¹ ¹ Jacobs University Bremen, Germany

IEEM21-F-0258/Extending the Last Mile Delivery Routing Problem for Enhancing Sustainability by Drones Using a Sentiment Analysis Approach

Elham Ahmadi¹, Hendro Wicaksono¹, Omid Fatahi Valilai^{*1}
¹Jacobs University Bremen, Germany

Last mile delivery is of important stages through supply chains and logistics, which covers the final stage of delivering products to the end customers. With the growth of e-commerce and the increasing desire of people to shopping online, logistics and consequently last mile delivery became very important. One of the biggest challenges is the issue of sustainability and reducing pollution when delivering products to customers, especially in urban surroundings. For this reason, this study presents a new model that considers the issue of sustainability in optimising the problem of vehicle routing problem with drones. For this purpose, a sentiment analysis is used considering Twitter to determine the alignment of customer sentiments on environmental protection and to calculate the net promoter score index. This index is considered as a coefficient in the penalty function added to the base model. According to the results of this study, this new model will be applied to logistics companies that are responsible for the issue of sustainability and can help customers who are willing to participate for improving the sustainability of the supply chain.

IEEM21-F-0264/Application of Value Stream Mapping in Supply Chain: A Case Study on an Amazon Retail

Yanfang Qin^{*1}, Hongrui Liu¹
¹San Jose State University, United States

This study investigates the application of value stream mapping (VSM) in the supply chain of an e-commerce retailer on Amazon to reduce waste and improve customer satisfaction. By visualizing the entire supply chain with VSM, the waste was identified in the delivery process from the retailer to the customer. The five-Whys method was then applied to find the root cause of the waste. Furthermore, a scoring method was developed to evaluate and compare the pros and cons offered by two supply chain operation models to identify an improvement strategy. It was demonstrated in the study that the VSM together with five-whys analysis helps to improve the quality of supply chain management, reduce lead time, and improve customers' satisfaction effectively.

IEEM21-F-0268/Redistribution Problem with Excess and Shortage in Relief Supplies

Etsuko Nishimura^{*1}, Sima Ying¹
¹Kobe University, Japan

The large scale disaster by a seismic hazard etc. has occurred in the world in recent years. After a disaster occurs, disaster survivors' relief and rescue operations are required. After a time period has passed, there is a place where relief supplies arrive more than necessary, and there are places where relief supplies do not arrive and are in short supply. This study considers the redistribution problem of relief supply for a post disaster. In addition, this study also considers to redistribute relief supplies to the elderly care home which may increase near future as places other than a shelter. There is not always more relief supplies than the total amount of shortage. Then, even if the total amount of shortage exceeds the total available supplies, the model which can obtain a solution is needed. Therefore, this study consider to develop the model which can finds the places where relief supplies are not distributed.

IEEM21-F-0271/Optimal Consumption Subsidy Strategy of a Green Supply Chain Under the Cap-and-trade Mechanism

Zhimin Li¹, Wen Yang¹, Yanchun Pan¹, Jianhua Ma¹
¹Shenzhen University, China

The growing concerns about sustainable development have not only imposed heavy burden on the supply chain to reduce emissions, but also brought great challenges to the government to implement sustainable policies. This study analyzes the role of government consumption subsidy and the cap-and-trade (C&T) mechanism, considering the green marketing cost-sharing coordination in supply chain. The optimal subsidy decisions and subsidy level are obtained under the maximization of the social welfare. Results show that consumption subsidy may not be always needed when the carbon price under the C&T mechanism is at a high level. Besides, the green preference of consumers contributes to the green product market expansion and the social welfare improvement. The government should assess the carbon price and the consumers' green preference before implementing the consumption subsidy policy. In addition, it is profitable for supply chain to carry out the cost-sharing cooperation of sustainable marketing. This paper provides a decision-making basis for the government to formulate sustainable policies and the supply chain to make green decisions.

IEEM21-F-0300/Automated Truck Scheduling Utilizing an AI Expert System: An Innovative Solution for Digital Freight Forwarders and Carriers

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Digital freight forwarders have streamlined their operations with instant quoting and automated order offerings for carriers. Nevertheless, automatic bundling and assigning shipping orders to a carrier has not been studied yet. Thus, the purpose of this paper is to investigate the prerequisites and implications of an AI expert system for automated truck scheduling. Using the Design Science Research Guideline, the concept is illustrated and evaluated based on seven expert interviews. Results show that it is a technologically and economically feasible tool to automate order selection and assignment to trucks. Important benefits for carriers, digital freight forwarders, and shippers are identified.

IEEM21-F-0383/Supply Chain Management and Resilience During Disruption. Evaluation of the Covid-19 Pandemic on the Supply of Personal Protective Equipment

Marco Cuvero Calero¹, Alan Pilkington^{*1}, David Barnes¹
¹University of Westminster, United Kingdom

Covid-19 stressed supply for Personal Protective Equipment (PPE) [1]. Lean practices have traditionally been proven to support stability in most operations [2], however, the pandemic highlighted concerns regarding lean system resilience in healthcare [2], [5], [6]. In this paper we evaluate supply chain resilience in the provision of PPE for medical staff in the United Kingdom through a content analysis of online government documents and press releases using a three-phase model: proactive, concurrent, and reactive. We propose a framework for future work on risk management approaches seeking to mitigate the effects of pandemic style disruption resulting from our emerging themes which include the identification and appreciation of critical suppliers, the location of warehouses and distribution centers and the impact of rapid restructuring of healthcare systems. A key recurrent theme is the need to integrate information and collaboration between government and the private sector and our data suggests that contrary to many beliefs, lean approaches are a valid tool.

Session	TKM-02 Technology and Knowledge Management 2
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Ehsan VAZIRI GOUDARZI ¹ , Elise VAREILLES ² ¹ Islamic Azad University, South Tehran Branch, Iran ² University of Toulouse, France

IEEM21-F-0257/A Survey of Challenges and Response Strategies of Manufacturing Companies During the Covid-19 Pandemic

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In the past year, the global COVID-19 pandemic has caused an unprecedented impact on our lives. In manufacturing, strict lock-down due to the pandemic have also disrupted the business operations of manufacturing companies. From literature, there are limited studies that explore the impact of the pandemic towards manufacturing related companies in various aspects. This study attempts to answer what constitute the main challenge for these companies and the associated response strategies to overcome the challenge. A survey was conducted at a manufacturing trade exhibition that involved in-depth interviews with representatives from 22 manufacturing related companies. The outcomes of this study reveal that declining sales and marketing activities, difficulties in performing business meeting and lock-down measures are the top three challenges. Main response strategies for these companies are the adoption of ICT tools for virtual business processes, with proactive business change and diversification measures such as automation. The results of this study indicate the importance of automation and digitalization towards resilience and adaptability of manufacturing related companies against the impacts of the pandemic.

IEEM21-F-0263/The Evaluation Model of Enterprises' Digital Transformation Competence Based on the Grey Cluster Method

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Digital transformation competence is vital for enterprises which are undergoing digitization. For the purpose of identifying dimensions and their indicators of digital transformation competence, this paper uses a grey cluster evaluation model based on the endpoint mixed probability function. After reviewing digital transformation and transformation competence in order to acquire the initial evaluation indicator system, the Delphi method of screening is employed to obtain the final set of indicators, and then the weight of each indicator is determined by the entropy combination weight method. Lastly, an example of evaluation of enterprises' digital transformation competence (EDTC) is used to examine the effectiveness and applicability of the proposed comprehensive evaluation model. By constructing an indicator system and evaluation model, the research furthers understanding of the implications of EDTC while offering suggestions for its assessment.

IEEM21-F-0285/How to Better Identify and Mitigate Risks in Call for Tenders : Towards a Dedicated Risk Ontology

Michel Aldanondo¹, Elise Vareilles^{1,2}, Thierry Coudert¹, Laurent Geneste¹, Rania Ayachi¹

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When preparing a commercial offer concerning technical systems, suppliers working in engineer to order can either make a detailed design job or just decide key solution choices. With a detailed design, if the customer accepts the offer, the supplier has a good confidence in its ability to provide a solution matching offer contents because requirements have been studied in details. With key technical choices, it is not the case, and the supplier takes the risk of not being able to provide an adequate solution because requirements have been just superficially studied. The goal of the communication is to propose and discuss the key knowledge elements in order to manage this kind of supplier risk when preparing the offer. By management we mean, according to ISO 31000, identifying, assessing and processing risk. The proposed key knowledge elements are a risk taxonomy and a risk mitigation action taxonomy. Actually, risk management relies fully on human expertise, these modeling elements will allow companies to design a knowledge-based system that can assist the human in charge and improve commercial offers quality.

IEEM21-A-0115/Innovation in Transitional Economies: An Emerging Model

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Innovation output around the world is concentrated in very few economies that possess the requisite skills, knowledge, and market acumen to capitalize on emerging technologies. In an attempt to draw technology policy implications, different innovation studies have focused on assessing the importance of the obstacles hampering innovation. Most of these studies have shown that the relative importance of the various obstacles varies across discriminants such as firm size, type of industry, type of ownership (private or public), degree of innovativeness, etc. The major limitation of these studies is that they are based on data from market-based economies. In transitional economies, however, where the distinction between private and public ownership is not always clear and where small companies account for most enterprises, the situation may be different. The objective of this paper is twofold: (i) to examine how barriers to innovation differ between market-based economies and transitional ones by comparing the Kazakhstani innovation environment with the prevailing model of the European Union; and (ii) to assess whether these differences are responsible for the significant innovation lag of transitional economies.

IEEM21-F-0388/Methodology for Organizing Product-service System Provision in Corporate Value Networks

Michael Riesener¹, Maximilian Kuhn¹, Julian Kress^{1,2}, Jakob Tönnis¹, Günther Schuh¹

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Companies in the mechanical and plant engineering sector are currently facing increased international competition and rising customer demands for more individual, holistic solutions. Consequently, companies are systematically expanding their portfolio and offer product-service systems (PSS). However, the provision of PSS is a complex and knowledge-intensive process, which cannot be managed by a single company. To overcome this challenge, PSS providers form corporate value networks (CVN) for a joint provision of PSS with partners. Therefore, the providing company has to decide which parts of the PSS will be provided by itself, and which parts are provided by partners within the CVN. This requires a consideration of the relevant competencies during the provision process. In this paper, a methodology is proposed that enables the allocation of different parts of the PSS within the CVN from the perspective of the PSS providing company by systematically considering relevant competencies to guide this decision.

IEEM21-F-0389/Transfer of Industrial Product-service System Specific Risk Effects to Value Network Partners – Concept for an Integrated Risk Assessment and Distribution

Michael Riesener¹, Maximilian Kuhn¹, Julian Kress^{1,2}, Lukas Schild¹, Günther Schuh¹

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Nowadays, companies increasingly provide industrial product-service systems (IPS²) to shift their focus on actual customer requirements and thereby differentiate themselves from an increasing competition. IPS² require various competencies and resources, which lead to their provision by corporate value networks (CVN) rather than standalone companies. IPS² are further provided through innovative business models in which companies assume responsibility over customer processes or guarantee certain outcomes. Together with the application of CVN, the implementation of these business models thereby increases the risk level of the IPS² providing company. Due to its inability to assess and mitigate these risks, the focal company in return remains hesitant to implement IPS². In this paper, a methodology for the integrated assessment and distribution of IPS² specific risk in the context of CVN is proposed. The methodology enables the reduction of significant risks of IPS² projects through a transfer of risk effects to partner companies with the ability to reduce them. The presented methodology consists of three successive steps: Process initiation, risk assessment and risk distribution.

Session	OR-02 Operations Research 2
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Rajesh MATAI ¹ , Jiage HUO ² ¹ <i>Birla Institute of Technology & Science, Pilani, India</i> ² <i>Hong Kong Science Park, China</i>

IEEM21-F-0226/The Least-distance DEA Based Efficiency Improvement Under Multiple Perspectives

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Data envelopment analysis(DEA) is widely used to evaluate and improve the relative efficiency of decision making units(DMUs), which have multiple inputs and outputs. However, the traditional DEA models can only handle a single perspective. In this study, we propose a new approach for efficiency improvement under multiple perspectives based on the least distance DEA. The Nash bargaining game(NBG) theory has been used in extant studies to avoid conflicts and obtain a rational direction of efficiency improvement under multiple perspectives. Because of the practicality of the closest efficient target, we first propose the incorporation of NBG into the least distance DEA model. A numerical experiment is conducted to compare the performance of our proposed approach with that of previous studies. The results reveal that our proposed approach can (1) evaluate the efficiency of DMUs under multiple perspectives; and (2) provide more easy-to-achieve efficiency improvement suggestions for the assessed DMUs. Thus, the proposed approach has remarkable potential applicability in decision making.

IEEM21-F-0237/A Two-stage Robust Model for Urban Food Waste Collection Network Under Uncertainty

Ke Xu^{*1}, Meimei Zheng¹, Xiao Liu¹
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In this paper, the vehicles choosing and routes planning problem in the urban food waste collection network is addressed. Considering service demands uncertainty and traversing costs uncertainty on roads, a bi-objective two-stage binary robust model is formulated to derive cost-effective and public-friendly strategies for collection vehicles. One objective is to minimize the worst-case total cost, while the other minimizes the environmental-disutility. A solution procedure based on the combination of the ϵ -constraint method and the modified column-and-constraint generation algorithm is developed to solve the model. A case study is finally performed to validate the effectiveness of the robust model and the solution procedure.

IEEM21-F-0242/Challenge and Obstacles to Promote Sustainable Remanufacturing: A Cross Case Analysis

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Remanufacturing is an industrial process that restores used products to their original state and it is also one of the methods for reclaiming the value invested in products during manufacturing and thereby lowering their environmental effect over their lifetime. However, only a small percentage of products are designed to be remanufactured. Besides, there is still a debating issue in promoting sustainable remanufacturing. Currently, some remanufacturing companies have faced challenging issues in maintaining their standard quality in terms of organization management, asset strategy, job competency, technology, environment, workplace, etc. This paper aimed to determine common issues faced by remanufacturing companies to meet standard of sustainable remanufacturing quality through case study visit to 25 selected companies. Checklist survey, multiple life cycle product matrix, and participants observation were conducted during the site visit. It was found that there are seven common issues that can act as drivers to successful remanufacturing company (e.g., arrangement of manpower, product knowledge, facilities management, support and troubleshooting, waste management, plant/workspace maintenance, and standard & quality management) using a cross-case analysis.

IEEM21-F-0269/A New Mixed Integer Linear Programming Formulation for Dynamic Facility Layout Problem

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²*Indian Institute of Technology Delhi, India*

The literature has established that the Dynamic facility layout problem (DFLP) is an NP-hard problem and very complex to solve optimally. Therefore, heuristics and metaheuristics are widely used in literature to solve DFLP. However, heuristics and metaheuristics do not give optimal solutions most of the time. Currently, the dynamic programming (DP) approach is used in literature to solve DFLP optimally. No other technique than DP is available in the literature to solve DFLP optimally. Therefore, this paper presents a linearized formulation of DFLP, a mixed-integer linear programming (MILP) model, to solve it optimally. From the author's knowledge, no such prior attempt has been made in the literature so far—two test problems of size five and periods three generated and solved in Lingo 10 software using the proposed model. The comparison of Lingo solutions with lower bounds of both problems shows that deviation is minimal (around 0.09%), suggesting MILP solutions are optimal solutions.

IEEM21-A-0052/A Two-step Method for Just-in-time Routing for Automated Guided Vehicles

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²*Osaka University, Japan*

For increasing e-commerce, multiple automated robots such as automated guided vehicles and drones are widely used for transportation and logistics. It is required to derive a conflict-free routing for dynamic requests to minimize the total traveling time of vehicles. However, in recent manufacturing, it is also required to deliver the products in just-in-time without any delay or any earliness from the specified delivery time. In this paper, we propose a two-stage method for just-in-time route planning problem. A time-space network has been developed for just-in-time routing problem under dynamic transport requests. From numerical experiments, the computation times of the proposed method and the conventional method are compared. It was shown that the 30% of the total computation time can be reduced compared to the conventional method. On the other hand, the difference of the objective function is with an error of 0.01% or less was obtained compared to the conventional method. It demonstrates that the proposed method is effective. Computational complexity of both algorithms is also evaluated.

Session	BDA-03 Big Data and Analytics 3
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Karthik SANKARANARAYANAN ¹ , Chao FANG ² ¹ <i>Ontario Tech University, Canada</i> ² <i>Xi'an Jiaotong University, China</i>

IEEM21-F-0392/Exploratory Data Analysis of the N-CMAPSS Dataset for Prognostics

Supratik Chatterjee¹, Arvind Keprate^{*2}
¹*Wipro Limited, India*
²*Oslo Metropolitan University, Norway*

In the recent years, industries such as aeronautical, railway, and petroleum has transitioned from corrective/preventive maintenance to condition based maintenance (CBM). One of the enablers of CBM is Prognostics which primarily deals with prediction of remaining useful life of an engineering asset. Besides physics-based approaches, data driven methods are widely used for prognostics purposes, however the latter technique requires availability of run to failure datasets. In this manuscript authors have aimed at performing exploratory data analysis (EDA) on the New Commercial Modular Aero-Propulsion System Simulation (N-CMAPSS) dataset published by NASA. Although 8 datasets are publicly available, authors have chosen dataset 3 (DS03) for EDA in this paper which consists of 9.8 million instances and 47 features. The main aim of doing EDA is to gain better understanding of the dataset as it would facilitate in building a deep learning model that can be used for predicting RUL of the aircraft engines.

IEEM21-F-0397/Modelling Big Data Analytics Adoption: An Indonesian Case

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¹Bina Nusantara University, Indonesia

Big Data Analytics (BDA) adoption in Indonesia is modelled in this paper. Lack of knowledge on this field has urged the importance of modeling factors that impact company to adopt BDA as its strategic initiative to win contested market. Thus, knowledge contribution related to factors influencing BDA adoption using TOE framework is the goal of this paper. For this purpose, 206 companies were surveyed using questionnaire as its research instrument. Among these companies, only 124 companies have given their responses. SmartPLS 3.0 was used to process them. There are two significant findings in the result. First, technology savviness (TS), organizational readiness (OR) and environmental change anticipation (ECA) influence the adoption of BDA in Indonesian companies. Second, TS and ECA influence OR. As managerial implications, companies in Indonesia need to promote mainly TS and OR to gain maximum benefits of BDA adoption.

IEEM21-F-0399/Modeling IoT and Big Data Impacts to Business Performance

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With the existence of Internet of Things that have ability to connect various devices through sensors, the growth of data volume is increasing rapidly known as Big Data. Through this Big Data, many companies gained its insights as basis for better decision making to gain competitive advantage. However, past literatures have shown that these empirical results are still fragmented. Therefore, this paper aims to propose a model on how IoT Big Data impacts business performance. For modeling purposes, some elements are included such as: 1) Business Process Improvement, 2) Marketing Strategies, 3) Business Management Innovation, 4) Business Models and Organizational Culture, 5) Privacy and Ethics, 6) Business Performance. Furthermore, sampling of managers in manufacturing industry are gained to answer several questions regarding the model development. For analysis purposes, Smart PLS 3.0 is run to evaluate the fitness of the model with requirement of Goodness of Fit (GoF) above 0.38. After careful conduct, the model is robust and accurate. From this model it can be said that 1) Business Models & Organizational Culture positively influence Business Process Improvement while Privacy and Ethics negatively influence it, 2) Business Process Improvement positively influences Marketing Strategies, Business Management Innovation and Business Performance, and 3) both Marketing Strategies and Business Management Innovation positively influence Business Performance.

IEEM21-F-0509/Contractual Obligations and Vessel Speed: Empirical Evidence from the Capesize Drybulk Market

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The fuel consumption and emissions of ship operation is determined by the vessel speed, loading condition and external environment in which they sail. Vessel speed is subject to certain contractual constraints, notably the requirement that a vessel presents herself for loading within an agreed time window. The objective of this paper is to investigate how such contractual constraints and risk aversion affect empirical vessel speeds. We use ship tracking data from the Automated Identification System (AIS) combined with fixture data to identify the pre- and post-contract speeds as well as variations in sailing speeds throughout the ballast voyage. Our results support the notion that vessels are ordered to change their speed at the point of contracting if it is necessary to meet contractual obligations, and that most are conservative in their adjustment. Our findings are important for the assessment of emission elasticities with regards to market conditions and regulatory changes.

IEEM21-F-0408/Condition Based Maintenance in Nuclear Power Plants: Limitations & Practicality

Rajinder Khurmi^{*1}, Karthik Sankaranarayanan¹, Glenn Harvel¹

¹Ontario Tech University, Canada

Advancements in sensor and IoT technology and Deep Learning algorithms has made Condition Based Maintenance (CBM) a promising maintenance strategy for many industries. However, the use of these technologies can be limited by safety and cost requirements; more so for a highly regulated nuclear industry. CBM in nuclear powerplants can serve to alleviate maintenance bottlenecks such as providing condition analytics between inspection periods and provide better prognostics. Yet, there are many challenges in trying to implement such a system due to limitations imposed from rigorous safety practices and cost considerations, ultimately affecting the practicality. In this paper, we attempt to address the limitations by undertaking a survey of literature to identify such limitations as well as to aid decision makers in the development and implementation of a CBM system in nuclear power plants. By identifying these limitations, it can also aid in the development of more advanced methods of CBM applicable for nuclear power plants.

Session	HF-03 Human Factors 3
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Markus HARTONO ¹

¹University of Surabaya, Indonesia

IEEM21-F-0216/Why do Fans Participate in Environmental Public Welfare? A Study on the Participation Driving Forces Based on Value Co-creation

Jie Zhang^{*1}, Yali Zhang¹, Liaoliao Li¹

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The organic combination of environmental public welfare and fans of economic forms fans' environmental public welfare, and there is still a lack of research on the specific indicators that why fans participate in fans' environmental public welfare. From the perspective of value co-creation, this paper analyzes the motivation of public welfare organizations, stars and fans, and extracts the influencing factors of fans' participation in environmental public welfare. Combined with interviews, we design a questionnaire containing 41 measurement items. On the ground of the exploratory factor analysis of 258 valid responses, this paper proposes a scale containing three motivational indicators: Herd-Driven, Support-Driven and Public Welfare-Driven. The scale organically combines value co-creation theory, fans consumption theory and community status competition theory to explain fans' public welfare behavior from the perspective of the driving force, and also provides guidance for all stakeholders to guide fans' public welfare behavior.

IEEM21-F-0221/Carbon Black Based Resistive Strain Gauge Sensor for Penile Measurement

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The accurate measurement of erection ability of men is important for prognosis of urinary surgery as well as for mental health. However, conventional penile size measurement methods are less accurate, and the intervention of doctor or nurse in the process can cause the patient to feel sexual humiliated. In this paper, in order to measure the erection correctly, the condom type sensor is fabricated with resistive strain gauge using carbon black. The resistive strain gauge is fabricated on the latex condom by spraying the carbon black diluted with the water. In the fabrication process, the pre-stretching technique is also applied to increase the flexibility of the sensor. The performance of the sensor is measured through the experiment with digital multi meter.

IEEM21-F-0306/Evaluation of Sense of Self-agency and Self-ownership During Mouse Operation Using Gaze and EEG

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¹Aoyama Gakuin University, Japan

In interface design, it is important for users to understand how to operate a system. In the cognitive science field, the senses of self-agency and self-ownership are well-studied. These senses occur not only in our bodies, but also in extensions of our bodies, like when driving a car or operating a character in a game. The purpose of this study was to evaluate these senses by measuring gaze and electroencephalography (EEG). If we can obtain new indicators for these senses, interface designers will be able to effectively utilize this information when creating better interfaces. In this study, we focused on operating a mouse cursor as the most popular interface and assessed if these senses could be detected using bio-information by changing the direction of movement of the cursor with respect to the task of dumping dust. When both sensations occurred, the distance between the line gaze and the mouse cursor increased, and the EEG rhythm of the occipital lobe changed.

IEEM21-F-0370/Requirements for an Assistance System to Support Human Resource Development in Manual Assembly

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Social sustainability is becoming an increasingly important part of sustainability reports by enterprises. They consider fields like human rights and leadership, but also the development of employees, which is playing an emerging role in manufacturing companies due to the increased complexity of work tasks. To handle the complexity caused by digitalization and individualized products, for instance, the industry is struggling to qualify its employees in assembly. One possible solution to support qualification is digital assistance systems. In this paper, we present an overview of existing digital assistance systems and identify the research gap in covering all human resource development phases. Most of the actual systems focus solely on supporting humans during their tasks and do not favor a further qualification. We define requirements as a prerequisite for developing an assistance system to support human resource development in manual assembly. It allows individual development for each employee and integrates learning into the daily work by supporting the entire development process, from the selection of development goals in the first step to the performance review at the end of the process.

IEEM21-F-0193/Quantifying the Economic and Ergonomic Potential of Simulated HRC Systems in the Focus of Demographic Change and Skilled Labor Shortage

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Ever since collaborative robotics emerged as one of the most prominent new technologies in the field of Industry 4.0 in the last number of years, current research has mainly been concerned with task allocation, productivity growth and influencing factors to increase the utilization and profit. The most important factor in designing these systems is the safety of the human. After identifying relevant factors in the field of human factors research, this paper provides a brief overview of current research in this area as well as the simulation of such systems. The productivity and allocation scenarios that have already been investigated are described on the basis of a use case. Designing HRC systems based on this use case and its identified factors is thematized in a conclusion at the end. The presented approach with the inclusion of a virtual simulation provides impulses for an extended economic feasibility study taking into account ergonomic aspects for early HRC planning and analysis.

Session	RME-02 Reliability and Maintenance Engineering 2
Date	December 14, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Yuying LONG ¹ , Yoshinobu TAMURA ² ¹ Harbin Institute of Technology, China ² Yamaguchi University, Japan

IEEM21-F-0033/A Method of Vulnerability Assessment Based on Deep Learning and OSS Fault Big Data

Yoshinobu Tamura^{1*}, Hironobu Sone², Adarsh Anand³, Shigeru Yamada⁴

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²IBM Japan, Ltd., Japan

³University of Delhi, India

⁴Tottori University, Japan

Software vulnerability is generally defined as the weakness of security caused by the fault. Waterfall model has been usually used for the software development till recent past. Also, a number of open source components have been implemented in many commercial software. Recently, the open source software have extended to the cloud service and edge computing and the big data. It is thus imperative to consider the impacts from the big data and network access. Various vulnerability assessment methods have been proposed by several researchers. In the typical vulnerability problems, methods of vulnerability assessment considering the fault factors have not been presented. Although, it is difficult to assess many fault factors recorded on the bug tracking system because of the uncertainty. The authors, in this paper, propose an assessment method of vulnerability by using the deep learning. Moreover, actual data to showcase the numerical examples for the estimation method of unknown parameters included in the proposed model for the vulnerability assessment have been presented.

IEEM21-F-0056/Performance Evaluation of IoT-enabled Predictive Maintenance

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Predictive maintenance (PdM) is gathering both researchers' and practitioners' attention in the Industry 4.0 era. Enabling technologies, such as IoT and AI make it feasible to operate PdM that was impossible in the past. However, only general benefits of PdM are presented and pragmatic issues, such as characteristics of failures that suite for PdM, are not addressed. This study evaluates performance of maintenance policies by using an agent-based modeling. This study identifies that the performance of PdM is comparable to preventive maintenance when variations of failure is small and that performance of PdM does not deteriorate significantly when the accuracy of prediction is low. These findings benefit practitioners when they select a maintenance policy.

IEEM21-A-0045/Selection of Components for Maximizing Reliability of a Load Sharing System

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A k-out-of-n load sharing system is a cluster of n components designed to share a system workload, working if no fewer than k components work. When the component is operating at its design rated load, the corresponding failure rate is called the nominal failure rate. When the number of surviving components is greater than k, each component is sustaining a load lower than its design rated load, implying that its failure rate in operation is smaller than the nominal failure rate. Previous research has focused on expressing the system reliability using the accelerated lifetime model to consider the effect of such a derated operation. Very few research has considered the optimal system design. In this research, we consider a k-out-of-n load sharing system in which the components can be selected from two different suppliers having different nominal failure rates. Then we present a model to select the components for maximizing the reliability of a k-out-of-n load sharing system, assuming that components follow Weibull distributions. We discuss the role of the nominal failure rates and the derated operation in the optimal solution.

IEEM21-F-0344/A Classified Situations Oriented Adaptive Scheduling Method of Robot-aided Aeroengine Faults Detection

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Nowadays with the rapid development of aviation industry, the demand for aircraft Maintenance Repair and Operation (MRO) is obviously increasing. Aeroengine fault detection, for its unpredictability and specialization, became a very important issue. In 2018, Rolls-Royce demonstrates the future of engine maintenance with robots. For this issue, considering the future view of robot-aided aeroengine fault detection, this article summarized the fault types of typical civil aeroengine, established the robot-aided aeroengine fault detection rules, and proposed a classified situations oriented adaptive scheduling method. Finally, the performance of the proposed method is compared with other three scheduling methods through experiments with GA, and the feasibility and rationality are verified in this article.

Session	SCM-06 Supply Chain Management 6
Date	December 14, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Ehsan VAZIRI GOUDARZI ¹ , Seung Ki MOON ² ¹ Islamic Azad University, South Tehran Branch, Iran ² Nanyang Technological University, Singapore

IEEM21-F-0322/Inter-island Logistics and the Role of an Agile Supply Chain to Achieve Supply Chain Performance: Initial Findings

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Indonesia consists of 17,000 islands, and this geographical condition presents unique supply chain challenges. Limited research has been conducted to study the impact of inter-island logistics on agile and supply chain performance. Therefore, this research is a pioneering study that analyzes the correlation between these variables. In addition, this research investigates the relationship of ambidextrous, agile, and lean supply chains to supply chain performance while examining the moderating effect of inter-island logistics. A theoretical design was developed to study the above relationship. As an initial analysis, hypotheses were tested with data from 34 manufacturing firms in Indonesia, using SmartPLS with 500 bootstrap samples. This research contributes to the supply chain management literature in three ways. First, it found that an agile supply chain mediates ambidextrous and lean supply chains to improve supply chain performance. Second, inter-island logistics, however, negatively moderates the relationship between an agile supply chain and supply chain performance. Finally, it strengthens the conceptual definition of the relationship between ambidextrous, lean, agile supply chains and supply chain performance.

IEEM21-F-0377/Degree of Centralization: Impact on the Economic Efficiency by Considering Different Waste Types

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²TIME Research Area, Germany

Global production networks (GPN) developed to complex systems. To handle the complexity and be able to react quickly on uncertain changes, the management of production networks becomes increasingly important. Especially the digitalization and the associated transparency offers the opportunity for an active network management and the design of the degree of centralization. The presented paper introduces an approach to describe the influence of the degree of centralization on the economic efficiency by considering different waste types. Therefore, on the one side the waste types for indirect functions are outlined and on the other side relevant economic aspects for the network management. Afterwards, both considerations are combined under regard of the degree of centralization to describe qualitatively how the degree of centralization can reduce the occurrence of waste and enable a more efficient network management.

IEEM21-F-0402/Simulating the Impact of COVID-19 Scenarios on Air Freight Logistics Supply Chain

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The current business environment seeks practice-oriented logistics solutions to sustain the pandemic situation. Increased capacity in the air freight supply chain and cargo freight operations will necessitate simplified methods to improve cargo handling efficiency. We have investigated the impact of covid 19 scenarios on global airfreight handling services. The findings of a simulation study done on a case of an Indian International Airport specialized cargo division are presented in this article. We addressed the influence of the COVID19 pandemic on supply chains by providing recent instances from one of India's biggest international airports in the eastern zone. Using anyLogistix simulation software, we demonstrate how simulation modeling rapidly and accurately simulates and evaluates supply chain interruptions. The findings of this study may help decision-makers predict operational and tactical risk mitigation methods, as well as the effects of pandemic disruptions.

IEEM21-F-0403/Critical Success Factors in Adopting Short Food Supply Chain Practices Under COVID-19: A Sri Lankan Case Study

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The short food supply chain (SFSC) is an emerging sustainable supply chain practice that facilitates a direct connection between farmers and consumers by eliminating several intermediaries of complex supply chains. The impact of the COVID-19 pandemic on the Agri-food supply chain has increased the need to establish more sustainable food supply chains practices for supporting local communities. This study aims to investigate critical success factors (CSFs) in SFSC impacted by the COVID-19 pandemic. CSFs in SFSC was identified from a comprehensive literature review, followed by a selection of eight CSFs, based on inputs from experts in the agriculture sector for analysis. The influential and prominent CSFs in SFSC and their causal relationships are determined using Grey Decision-Making Trial and Evaluation Laboratory (Grey-DEMATEL) approach. Individualised and tailored service offered to consumers, organic production by promoting home garden concepts, and direct and ethical relationships between producers and consumers are the most influencing CSFs to implement SFSC impacted by the COVID-19 pandemic.

IEEM21-F-0499/Developing Game Models for Service Composition to Improve Customization in the Equilibrium State Based on Cloud Manufacturing System

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The Selection of appropriate Quality of Service (QoS) strategies is an important subject for manufacturing service providers. The subject is more important in the Cloud Manufacturing System (CMS) based on the numerous and diversity of Manufacturing Cloud Service (MCS) providers. The direct interference of the consumers in determining the end value of QoS is a novel problem in CMS. Also, the interference of consumers is an aspect of customization in Cloud Manufacturing as an Industry 4.0 paradigm. The research develops two models for service composition to improve the customization in CMS based on game theory. The models are developed based on the Stackelberg game and the non-cooperative game. The consumers and MCS providers are the players in the game models. The players select the strategies to improve their benefits in the games. According to the results, the consumers get better benefits in the Stackelberg game than the non-cooperative game. Also, the MCS providers get appropriate benefits in the Stackelberg game model. The QoS value in the Stackelberg game model is higher than in the non-cooperative game model.

Session	TKM-03 Technology and Knowledge Management 3
Date	December 14, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Carman Ka Man LEE ¹ , Ling WANG ² ¹ The Hong Kong Polytechnic University, Hong Kong SAR ² Jiangsu Taizhou Bridge Co., Ltd, China

IEEM21-F-0307/Innovation Model of Basic Research Teams Oriented to Disruptive Technology

Yi Liu^{*1}, Xin Zheng¹

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There are many and diverse basic research teams facing disruptive technology, and their levels are different. How to collect and sort out successful experiences in different fields and build an original breakthrough model which suits the local context is very important. This research takes the flexible electronics team led by Academician Huang Wei as the research object, and uses a procedurally rooted method to refine the team's original breakthrough model, which divides the whole innovation behavior into three parts: driving layer, behavior layer and supporting layer. It is found that disruptive technological innovation behavior is driven by external environment and subjective will, supported by good resource distribution, excellent strategic leaders and positive team culture, relying on projects, and bringing output through knowledge divergence and aggregation. Feedback mechanism plays an important role in the whole behavior process. The model provides a theoretical basis for basic research teams in the same field.

IEEM21-F-0340/Integration of Ontologies and Constraint Satisfaction Problems for Product Configuration

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In this work, the domain is a product or system configuration. We focus on ontologies, Constraint Satisfaction Problems (CSPs), and their integration. The aim is to capitalize knowledge and define mechanisms that will permit reasoning to find configuration problem solutions regarding customers' requirements. On one hand, an ontology is used to formalize and capitalize knowledge about products or systems structure including concepts, systems, subsystems, components, relationships, attributes, and their possible values. Protégé 5.5.0 is used to create the ontology. On the other hand, we used CSPs to formalize the relationships between attributes values or between concepts that are allowed or forbidden. CSPs (restricted to compatibility tables) are translated into rules to be integrated into the ontology using the SWRL. Therefore, we defined a filtering algorithm based on arc consistency to restrict the domains by removing inconsistent values. First, related works on ontologies, CSPs are presented. The formalization of the ontology, CSPs, and their translation into SWRL rules and their use are presented. Finally, an illustrative application based on the configuration of a simplified bike is presented.

IEEM21-F-0351/Utilization of Industry 4.0 During COVID-19 Pandemic in the Targeted (S-Curve) Industries of Thailand

Aunchalee Taweethavornsawas^{*1}, Yotsuda Buranasing¹, Manutchanok Jongprasithporn², Nantakrit Yodpijit¹

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The first COVID-19 is discovered in December 2019 in Wuhan, China and rapidly spread to millions of people all over the world. COVID-19 heavily affects the industrial business and economy of many countries, including Thailand. This study aims at exploring the effects of COVID-19 on the targeted (S-Curve) industries of Thailand and investigating the ways to improve business operations with the utilization of the appropriate Industry 4.0 technologies. The paper presents (1) Industry 4.0 background and the First S-Curve and the New S-Curve industries of Thailand (2) Data collection and analysis (3) The effects of COVID-19 on business operations. The characteristics of each industry, the requirements of business and operator to cope with Industry 4.0, and the implementations of Industry 4.0 technologies during the situation of COVID-19 are analyzed by using a focus group, online questionnaires and interviews. Results show that customer behavior is a major issue on business operations and IoT is the most critical technology in supporting business operations and reducing the impacts of COVID-19. It has also been found that the functions of technologies depend on the characteristics of each industry. Results from this study can assist companies to obtain a better understanding of the critical functions of technologies that suit their characteristics best and develop operator's skills properly for increasing business competitiveness.

IEEM21-F-0361/Applications of Industry 4.0 During COVID-19 Situation for Thailand's Logistics System in Customer Satisfaction Context

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The COVID-19 outbreak has affected business activities in many industries that can be disrupted by customer behavior. Logistics system plays the major role for response customer satisfaction. This research aims to develop logistics system in customer satisfaction context during COVID-19 situation in Thailand using Industry 4.0 principles. This paper presents the overview of Industry 4.0 and logistics system, the evaluation of customer satisfaction in logistics system during COVID-19 situation, and the applications of Industry 4.0 for logistics system in customer satisfaction context during COVID-19 situation. This study is conducted using focus group and interview with managers from large logistics service providers in Thailand. Results indicate that the use of Industry 4.0 technologies and the development of employees' skills are the potential solutions for reducing the effects of COVID-19 in logistics system. IoT, Cloud, and Big Data support all of customer satisfaction factors. It is also found that the use of appropriate Industry 4.0 technologies and the improvement of the logistics system are the critical aspects for enhancing business competitiveness during the COVID-19 pandemic.

IEEM21-F-0429/To Support or Not to Support the Innovation? A Preliminary Study on the Effect of Family Ownership in Board on Innovation in Taiwan Family Firms

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The uncertainty of outcomes from innovation typically affects related decision-making in family firms. Innovation presents both opportunities for business growth and investment risks, and the relationship between family firms and innovation remains inconclusive. Moreover, the interplay between family firm ownership and control rights may result in agency problems. Ownership by family members can be regarded as a real option for family shareholders. Thus, we combine agency theory and the real option view to argue that ownership structure characteristics among family members in board affect innovation in family firms. Examination of the innovation behaviors of Taiwanese family firms reveals that ownership concentration among family board directors positively influences innovation in family firms. In addition, family board directors without personal ownership in the family firm are more supportive of innovation than those who have such ownership.

IEEM21-F-0295/What is Actually Measured? Investigating the Correspondence Among Goals and Performance Indicators in a Swedish Municipality

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Performance indicators are popular tools for measuring, managing, controlling, and auditing, especially in public sector organizations. However, usage has been facing criticism for missing the context of the data due to the excessive focus on quantitative information. This phenomenon has been identified in the public sector and is investigated in this study by comparing a Swedish municipality's strategic goals with their chosen performance indicators. The study uses value and knowledge management theories in combination and identifies values among the goals for comparison with the indicators. This method enables an analysis of the indicators' capacity to represent the goals. The results indicate that a representation bias exists among the goals and performance indicators and that the goals are formulated on a higher level than the indicators. A suggested solution is to decrease the quantity level of the goals, meaning that the goals could be formulated more specifically, which would make it easier to match them with the representative performance indicators.

Session	OR-03 Operations Research 3
Date	December 14, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Canrong ZHANG ¹ , Philipp BAUMANN ² ¹ Tsinghua University, China ² University of Bern, Switzerland

IEEM21-F-0299/Minimizing Paper Waste and Setup Costs in Offset Printing

Philipp Baumann^{2,1}, Manuel Kammermann¹, Silvan Elsaesser²

¹University of Bern, Switzerland

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Reducing paper waste and increasing resource efficiency has become a priority in the offset printing industry. We consider the production process of a company that prints customer-specific designs on napkin pouches. The planning problem consists of assigning the designs to slots of some printing plates such that the demand for each design is met, all technological constraints are satisfied, and the total production costs, which include setup and waste costs, are minimized. The main contribution of the paper is a matheuristic that takes advantage of the fact that the demands for individual designs are a multiple of a minimum order quantity. In a computational analysis based on real-world problem instances, we compared the proposed matheuristic to an exact approach. The matheuristic consistently outperformed the exact approach in terms of solution quality and running time.

IEEM21-F-0311/An Auction-based Mechanism for the Formation and Scheduling of Heterogeneous Human-machine Teams

Felix Merz^{2,1}, Christoph Schwandt¹, Stephan Westphal¹, Juergen Zimmermann¹

¹Clausthal University of Technology, Germany

Human-machine teams are a key component of future production systems, but formation of the teams is challenging due to uncertain and evolving skills and preferences. We propose a decentralized multi-round auction approach, where job agents specify processing times and workers bid their preferred job execution modes representing possible human-machine teams. The factory assigns jobs to teams while maximizing the number of jobs assigned within the specified planning period. Afterwards, a post-auction mechanism improves the assignment in a fair way without worsening the goal achievement of any party involved. We evaluate our auction and post-auction mechanisms by analyzing the workers' social welfare and the factory's objective for different bidding strategies. It turns out that our mechanism yields efficient assignments and provides incentives for the workers to share true estimations about their capabilities.

IEEM21-F-0330/The Robust Optimization Approach for the Community Group Purchase Joint Order Fulfillment and Delivery Problem

Xia Yang¹, Wenjia Zeng¹, Canrong Zhang¹

¹Tsinghua University, China

Due to the community lockdown caused by COVID-19, people are turning to a new retail method called "Community group purchase" to obtain daily consumer goods. Orders from the entire community are aggregated and sent to the retailer. To reduce orders' turnover time, the retailer needs to decide what time to fulfill and deliver these orders, which have different information from the distribution center. This paper studies a joint order fulfillment and delivery problem and proposes an integer programming model. Due to the uncertain order information, the robust optimization approach is introduced to formulate two uncertain models based on different uncertainty sets. Through a series of formulations, the robust models are transformed to the tractable form that can be solved directly by the solver. The numerical experiments are carried out to show the benefits of the two robust optimization models, and managerial insights related to the problem are also presented.

IEEM21-F-0336/OR Optimization in the Authorities, Business and Citizens Triangle - Application of Cooperative Game Theory and Spatial Information Modeling

Robert Olszewski¹, Piotr Pałka¹, Agnieszka Wendland¹

¹Warsaw University of Technology, Poland

The aim of the article is to develop a methodology for the integration of multi-source spatial, demographic and economic data and their processing with the use of game theory and spatial information modeling methods. The article proposes a method for applying the mathematical theory of cooperative games to analyze various possibilities of shaping the city's spatial policy taking into account the interests of different stakeholders, and shows which one is most profitable locally for a modern smart city and its Authorities (A), Business (B), and Citizens (C). Specially designed sensors were used to detect the level of the content of various elements in the air, and then using game theory, the optimal location of the biogas plant was selected taking into account the interests of all stakeholders. The research was conducted on the illustrative construction of a local biogas plant in the commune of Żuromin, Poland.

IEEM21-F-0347/Determinants of When-to-evacuate Decisions: An Empirical Investigation

Karindra Aulia Rahman¹, Bertha Maya Sopha^{2,1}

¹Universitas Gadjah Mada, Indonesia

Evacuation is a critical process that affects the reduction of loss risk. Previous studies have indicated that evacuation decision-making has significantly affected the effectiveness of evacuation efforts. The present study aims at evaluating the determinants of when-to-evacuate decisions. Analytical Hierarchy Process (AHP) and Multinomial Logistic Regression (MLR) were used to identify the determinants' relative importance and assess the relationship between the determinants and when-to-evacuate decisions. An empirical survey based on a hundred respondents who have experienced the Merapi eruption was conducted. AHP indicates that the most important determinants to the least are perceived hazard, distance to disaster, trust in leaders, disaster experience, ownership of livestock, and cultural belief. Disaster experience and trust in leaders are significant determinants for early evacuation, whereas the distance to disaster and livestock ownership are significant determinants for late evacuation. Avenues for future studies are also discussed.

Session	BDA-04 Big Data and Analytics 4
Date	December 14, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Shih-Wen KE ¹ , Karthik SANKARANARAYANAN ² ¹ National Central University, Taiwan ² Ontario Tech University, Canada

IEEM21-A-0039/Integration of Heterogeneous Traffic Data for Urban Journey Time Estimation

Xinyue Wu¹, S. C. Wong², Andy Chow^{2,1}, Li Zhuang¹, William H. K. Lam³, Wei Ma³, Edward Chung³

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This paper presents a Bayesian framework for integrating heterogeneous traffic data from multiple sensors for estimating journey times and the associate variability. Traffic data are increasingly available for performance measurement and prediction with the advancements in sensing and communication technologies. Nevertheless, processing and integrating data collected from heterogeneous sources remain a challenge in both academia and practice. The proposed framework first consists of a data-driven Density-based Spatial Clustering of Applications with Noise (DBSCAN) filter and a kernel-based Adaptive Smoothing Interpolation Method (ASM) algorithm for filtering and imputing imperfect measurements. The processed data are then integrated via a Bayesian fusion algorithm for journey time estimation. The data fusion framework is applied and tested with real world scenarios in Hong Kong Strategic Road Network under which its accuracy is evaluated with actual GPS-based measurements of probe vehicles. The case study reveals a significant improvement in estimations of journey times and the associated variability generated from the proposed method when compared with the raw and individual measurements obtained from individual sources. This study contributes to the development of reliability-based intelligent transportation systems.

IEEM21-A-0040/Interval Prediction of Urban Journey Times with Deep Learning

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Prediction of journey time distributions plays an important role in building reliable intelligent transport systems. Challenges posed on development of an accurate journey time prediction system include complexity of traffic dynamics, variability in heterogeneous traffic data, and uncertainties in weather and road conditions. This study presents a novel online interval prediction framework for urban journey times with use of deep learning fed by traffic data collected from multiple sources. The proposed framework consists of two main components: a long short-term memory (LSTM) architecture for extracting temporal features and a convolutional neural network (CNN) for extracting spatial features from heterogeneous traffic data. The performance of the prediction algorithm is evaluated jointly by indicators of Prediction Interval Coverage Probability (PICP) and Mean Prediction Interval Width (MPIW), which reflect respectively its accuracy and precision. The proposed framework is applied and tested with traffic data collected from Hong Kong Strategic Road Network. The results reveal that the proposed algorithm outperforms selected established algorithms in terms of accuracy, precision, and computational effort involved in training process over various traffic conditions.

IEEM21-F-0290/A Cost Minimization Model for a Multi-Component Product Closed Loop Supply Chain Considering Big Data Dimensions

Pamela Nichole Chuateco¹, Carla Natalia Isabel Del Rosario^{*1}, Ysabel Dominique Reyes¹, Dennis Cruz^{*1}

¹De La Salle University, Philippines

This paper proposes a mixed integer non-linear programming cost minimization model for a generic multi-component product circulating in a closed loop supply chain system capable of Big Data Analytics (BDA). The model introduces a novel approach of operationalizing the BDA dimensions of Variety, Velocity, and Volume (3Vs) through the activities of Procurement, Demand Management, Collection, and Recovery. The results of the model were compared across 7 systems that featured different combinations of intensity levels in the 3Vs from a predetermined low, medium, and high range. It was found that across all systems with BDA, recycled raw materials were prioritized, demand was maximized, collection and recovery success was increased. Ultimately, it was found that the HMM system holds the best holistic performance across CLSC operations and cost savings.

IEEM21-F-0331/Sensor Data Prediction in Process Industry by Capturing Mixed Length of Time Dependencies

Wen Song^{*1}, Shigeru Fujimura¹

¹Waseda University, Japan

Sensor Data prediction has been an interesting and practical topic in many domains. In the process industry, sensor data prediction can help us detect, diagnose and even predict possible failures to reduce unnecessary losses. Due to the complex relationship among multiple sensors, it is challenging to accurately predict the time series of multivariate sensors. In this research, we aim to solve the problem of predicting the time series of several related sensor data and proposed a novel structure for addressing with this provocative problem. More specifically, several proposed mixed length dilation layers and recurrent cells are used to capture mixed length of time dependencies. Experiments demonstrate that our proposed model indicates competitiveness in predicting comparing with other baseline methods.

IEEM21-A-0103/SDA - Semantic-based Data Augmentation on Text Classification Tasks

Shih-Wen Ke^{*1}, Hsin-Ju Lee²

¹National Central University, Taiwan

²Cathay United Bank, Taiwan

Data augmentation is one widely used techniques for improving the performance of downstream tasks when insufficient training data is present. In this study, we propose a flexible augmentation framework, SDA: Semantic-based Data Augmentation, which aims to improve the classification performance on text classification tasks. The SDA augments the insufficient training documents by sampling external unlabeled documents that are semantically similar to the existing training documents. This study sheds new light on the usefulness of semantics. We employ advanced representation methods into our framework. We first investigate the ability of semantic capturing on different representation methods and then evaluate the effect of adding different quantities of semantically similar texts into the training data. The SDA is conceptually simple and shows promising performance on seven classification datasets. The SDA not only outperforms the data augmentation benchmarks, but also achieves comparable performances where labeled documents are added into the training data. We observed that the SDA can improve the performance of classifiers for a wide range of classification tasks, such as sentiment analysis and opinion polarity detection, even training documents are severely insufficient.

IEEM21-A-0092/Methodology for Profile Monitoring and Sensor Fusion for Fault Detection and Classification in Semiconductor Manufacturing

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In the semiconductor industry, sensor measurement, collected from repetitive operational cycles during the etching process, is called cycle-based profile data. Profile data contains rich information which can be used for fault detection and classification, process monitoring, predictive maintenance, and virtual metrology. However, the sensor-to-sensor correlation always is neglected during data-driven application development. This research develops a novel methodology for fault detection and classification and process monitoring based on multilinear subspace learning. The proposed method can directly operate on the multivariate sensor channels and then extract the specific features using the tensor-to-vector projection. The complex intrinsic correlation among the different sensor channels can be preserved. Based on the extracted features, specific algorithms can be used for FDC model development. Besides, the projection matrix can be used for data reconstruction, facilitating process monitoring, and predictive maintenance. Validation of the proposed method will be based on both open-source datasets and the proprietary datasets from a real etching process.

Session	HF-04 Human Factors 4
Date	December 14, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Markus HARTONO ¹ , Sheily MENDOZA ² ¹ University of Surabaya, Indonesia ² University of Perpetual Help - Molino, Philippines

IEEM21-F-0256/Production Management in Norwegian Manufacturing Industry: The Implications of "The Norwegian Work Life Model"

Emrah Arica^{*1}, Carl Christian Røstad², Bjørnar Henriksen², Einar Hareide¹, Thale Kvernberg Andersen²

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The Norwegian work environments are substantially influenced by the "The Norwegian Work Life Model" characterized by empowered workers with larger autonomy and responsibility, high-level trust, and continuous development of skills and competences. This paper addresses The Norwegian Work Life Model and its importance as the foundation for Industry 5.0 within the scope of Production Management and the selected topics Production Strategy, Production Logistics and Product Development. The benefits and challenges of the model is discussed, providing useful insights and learnings. Six industrial research projects with Norwegian manufacturing companies are listed to exemplify the implications of the model on the production management.

IEEM21-F-0418/Assessment of Environmental Noise Annoyance: A Case Study of Industrial Noise in Thailand

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Environmental noise annoyance has been recognized as one of the major problems in industrial communities. Noise annoyance is generally related to poor work performance, unsafe behavior among operators, and unhappy local residents. The purpose of this study is to analyze the environmental noise characteristics affecting the annoyance level of residents living nearby the factory case study. The assessment methods include acoustical factors analysis focusing on sound pressure and spectrum levels and noise survey reports showing noise nuisance complaints. This study has found that low to medium frequency noise at over 40 dBA has a significant impact on sleep disturbance among local residents. The results obtained from this study can serve as a technical guide for designing active and passive noise reduction systems.

IEEM21-F-0472/Remote Usability Testing Evaluation on the Most Visited E-commerce Website in Indonesia During Covid-19 Pandemic

Fauzan Firjatullah¹, Julian Tri Haryoko¹, Rida Zuraida¹

¹ Bina Nusantara University, Indonesia

During the Covid-19 pandemic, the online shopping platform help fulfill people's needs and it became a hub between the marketers to their customers. From the five biggest e-commerce services in Indonesia, Shopee is the most visited website by Indonesian citizens. The objectives of this study are to evaluate the effectiveness (E1) and efficiency (E2) of the website, and their correlation with website satisfaction rate based on usability variables. The synchronous remote testing technique was applied to 15 respondents to determine E1 and E2 levels. A usability rate perception was measured using a questionnaire to evaluate users' satisfaction (S), based on six usability variables (var 1-6). In this study, based on 18 tasks performed by 15 respondents, the effectiveness and efficiency rate of the website respectively 81%-98% and 73%-94%. The questionnaire result showed that the user satisfaction level of 313 respondents is 80%-84%. The Pearson correlation between E1, E2 with S respectively 0.619 and 0.814 (p-value<0.05). It concludes that Shopee is excellent e-commerce based on its effectiveness and efficiency, and user satisfaction (S) is mainly affected by its efficiency (E2).

IEEM21-A-0083/An Ergonomic Chair For Business Process Outsourcing Industry

Sheily Mendoza¹

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The chair is considered an important element for employees to improve productivity and comfort in their workstations. The ergonomic chair design is therefore considered very important for its usability and comfort point for the employees working for long hours seated. This research study wants to develop an ergonomic chair with the objective of reducing the risk of having a musculoskeletal disorder in the Business Process Outsourcing (BPO) Industry environment. In order to design this proposed ergonomic chair, the researcher uses the DMADV (Define, Measure, Analyze, Design, and Verify) framework that focuses on the development of new products as opposed to the existing ones. Relevant data were collected from the perspective of the BPO employees through face-to-face interviews, Nordic questionnaires surveys, and the gathering of anthropometric data. The proposed ergonomic chair was tested and validated based on the employee's feedback after the user experience seating for hours while doing their work. This research study is concluded with study limitations and future research directions.

IEEM21-F-0326/TIKETAP: Designing a Smartphone App for Traffic Violation Tickets Through Design Thinking Process

Mark Anthony Baldoz¹, Eula Margareth Jabilles¹, Rosemary Seva¹

¹ De La Salle University, Philippines

The current process for issuing and clearing traffic violations in the Philippines is labor-intensive and time consuming. The aim of the study was to identify the underlying pain points of the users, that is, both traffic enforcer and driver, during the ticketing process and to apply a design thinking approach in creating a smartphone application that would help in creating a seamless way to issue violation tickets and pay for the violation fines. Identifying the problems and potential features for the solution was done through empathizing with the users with the aid of empathy maps and personas. Design criteria were then developed to guide in the design of the app's various functions and features. Results showed that the proposed smartphone application, TIKETAP, was easy to use and understand and was able to considerably reduce the time of the entire ticketing process as opposed to the existing method.

Session RME-03 Reliability and Maintenance Engineering 3

Date December 14, 2021

Time 06:00 PM-07:30 PM

Chair(s): Monika TANWAR¹, Aibo ZHANG²

¹ Singapore University of Technology and Design, Singapore

² City University of Hong Kong, Hong Kong SAR

IEEM21-F-0427/Safety Evaluation of the Time-variant Structure Under Epistemic Uncertainty

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The time-variant fuzzy failure possibility (TVFFP) is first defined to evaluate the safety level of the time-variant structure under fuzzy input and fuzzy state. Then, the relation between the TVFFP and the time-variant failure possibility (TVFP) is derived. After that, the estimation of TVFFP is converted to that of a series of TVFPs via leveraging the Gaussian quadrature, on which the adaptive Kriging combined with fuzzy simulation method is proposed to efficiently estimate the TVFFP. The presented example demonstrates the effectiveness of the proposed method.

IEEM21-A-0095/Intelligent Compressor Failure Prediction Modeling and Recommendation Engine Framework

Tuhin Mondal¹, Shoban Babu Balasubramani¹

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Compressor is one of the crucial assets in Oil & Gas industries where the unavailability of the asset could result in significant production loss and relevant costs. The biggest challenge for the maintenance teams is not only to predict the failure but to understand the root causes that include identifying the deteriorating component and its consequence to impact other components in the compressor. Also, understanding the estimated downtime, associated production losses and taking right decision options for maintenance repair actions is another key challenge. In this work, we proposed a Connected Predictive Asset Management solution which uses sensors data from the compressor for modeling. We used machine learning approach to predict the compressor seal failure and as a sequence of events, the nested model predicts the oil leakage and temperature sensor failure as well. The AI rules engine assess the spares inventory, engineers availability and maintenance schedule to recommend the next best actions for preventive maintenance. Keywords - Predictive modeling, Failure prediction, Compressor failure, Machine learning.

IEEM21-A-0096/Consideration of Degradation and Production of Wind Turbines

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Advanced sensing technology enhances the application of condition-based maintenance and operation to many industrial systems. Wind turbines are subject to continuous changing stress levels due to variability of wind speed and the effects of induced loads during power production, leading to the continuous deterioration and even failure. There is a need for dynamic control to balance the power production and the accumulation of degradation in its designed service time. Here, suppose a system vibration keeps increasing due to the accumulated degradation, the system presents several distinguishable degradation levels corresponding to the certain production rate levels, e.g. level 1 to 4. For example, at level 1, the system is in a quite new state with a 100% production output. The production rate level has to adjust to level 2 with 80% capacity for slowing down the degradation when the degradation reaches a specific level 2, which would cause the shift of accumulation speed of degradation process in turn. This study aims at developing an algorithm to optimize the level classification to extend system lifetime and maximize the production outputs.

IEEM21-F-0506/Condition Based Maintenance Policy for Crankcase Lubricating Oil in Diesel Locomotives

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²Aligarh Muslim University, India

Crankcase lubricating oil minimizes friction and wear. It reflects the condition of the components of the system through its physical properties, chemical properties, and contaminants. In the rail industry, its role is significant for locomotives as oil failure may lead to catastrophic system failure. In this paper, the authors consider oil replenishment quantity, replenishment periodicity, and oil degradation as the basis for oil reliability evaluation. The lubricating oil reliability is evaluated using a polygraph approach for chemical properties and contaminants, i.e., viscosity, insoluble, Total Base Number (TBN), and pH. Lubricating oil life cycle data is collected for five different locomotives. The performance parameters are then estimated, considering oil as repairable and non-repairable systems. A condition-based maintenance policy is derived based on the reliability assessment for the five locomotives.

IEEM21-A-0120/Fault Diagnosis and Remaining Useful Life Prediction Using Denoising CNN for Time-series Data Based on Physics Model

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The approach of intelligent prognostic and health management (PHM) technology is becoming important, and one of the most important areas of PHM is estimating remaining useful life of a component. Traditionally, estimating the RUL depends on sufficient prior knowledge of degradation process. However, acquiring the prior knowledge of the component is complicated or even not possible in many cases, thus data-driven approach, which predicts the remaining useful life only by using the acquired data, is applied in many areas. But the accuracy of estimating the lifespan of the component using data-driven approach is still not satisfactory due to overfitting issues and excessive resources usage. To overcome these issues, which affects the accuracy and time gap between off-line training and on-line estimation, a hybrid approach which takes advantage of physics-based model and data-driven model is proposed in this paper. The result of this study suggests that, by approaching the problem of estimating the RUL of bearings using hybrid approach, which enables removing noises to prevent overfitting and to reducing the burden of secondary network, faster and accurate estimation is possible.

Session	SMS-01 Systems Modeling and Simulation 1
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Yaqiong LV ¹ ¹ Wuhan University of Technology, China

IEEM21-F-0112/A Review on Electric Bus Charging Scheduling from Viewpoints of Vehicle Scheduling

Aiyong Rong^{*1}, Shijun Chen¹, Dapai Shi¹, Minsong Zhang¹, Chengyong Wang¹

¹Hubei University of Arts and Science, China

Electric bus based public transportation systems have great potential to mitigate urban traffic congestion caused by increasing growth of urban population and air quality degradation caused by intensively using diesel-based private cars because electric buses operate more efficiently and quietly than diesel buses and contribute significantly to decrease negative impacts on the environment by reducing emissions and noise. However, electric buses suffer from the limited battery range and high charging cost resulting from high charging power demands. Consequently, this poses new challenges for planning and scheduling public electric bus systems because the schedulers need to form reasonable charging strategies to recharge batteries during daily operations so that electric buses become economically viable. This study attempts to provide a new angle to review the latest development of charging scheduling for electric buses from the viewpoints of electric vehicle scheduling problems to facilitate coordination between charging schedules and vehicle scheduling for improving economic attractiveness.

IEEM21-F-0143/Productivity and Human Factors Improvement in Manufacturing Systems. A Systems Modeling and Simulation Approach

Ismail Taleb^{*1}, Alain Etienne¹, Ali Siadat¹
¹Arts et Métiers Institute of Technology, France

Systems modeling, and simulation have been widely used to better understand the behavior of complex systems. Some of the main benefits of these tools are the cheaper and faster way of testing compared to real-life testing, and the flexibility that simulation offers via the tweaking of parameters, variables, and functions. It has drawbacks too, such as precision and accuracy, difficulty of modeling and simulating productivity. In fact, there are multiple ways of defining productivity, either through activities or output or time. This article offers a new definition of productivity and in contrast, non-productivity, and the different levels between them, and we study the possibility to model complex manufacturing systems and simulate them. The main contribution of this research consists in developing a flexible model and tool able to simulate complex manufacturing systems. The goal of this tool is to model productivity and be flexible enough to allow for easier and cheaper alternatives to testing, and complex enough to encompass a large part of possibilities.

IEEM21-F-0148/Agent-based Modeling as a Tool for Predicting the Spatial-temporal Diffusion of the COVID-19 Pandemic

Robert Olszewski^{*1}, Piotr Palka¹, Agnieszka Wendland¹
¹Warsaw University of Technology, Poland

The article presents the original methodology of using agent-based modeling (ABM) for the numerical simulations of the COVID-19 pandemic's development. The proposed solution makes it possible to analyze changes in the number of cases both in space and time. The devised methodology enables considering spatial conditions in terms of population distribution, such as places of work, rest, or residence, and uses multi-agent modeling to consider spatial interactions. Numerical simulations utilize the spatial and demographic data in GIS databases and the GAMA environment that enables the parameterization of the epidemiological model. Testing the developed methodology on a test area also allowed for checking the effects of a potential decrease or increase in social restrictions numerically. The simulations performed show a high correlation between the level of social distancing and the number of COVID-19 cases.

IEEM21-F-0183/Optimization of AGV Dispatching Based on Petri Net Towards Smart Manufacturing System

Shangjia Xiang^{*1}, Yaqiong LV¹
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As the key technique of smart manufacturing, Automated Guided Vehicles (AGV) are widely adopted in automatic material handling systems. How to dispatch AGVs for material distribution so as to support better production has always been a problem for smart factories as there might be different complex constraints in a real practical manufacturing environment. Petri Nets as a powerful system modeling tool is capable to demonstrate the discrete states/events in real systems. Therefore, a Petri net model is established in this paper to describe the workshop production process with AGVs for material delivery, and Platform Independent Petri Net Editor (PIPE) is used to analyze the resource changes via simulation analysis. The invariant analysis is adopted to represent structure characteristics, combined with the simulation result from PIPE, resource utilization can be obtained and a reconfiguration of AGVs will also be suggested. Finally, based on improved AGV configuration the dispatching scheduling is provided.

IEEM21-F-0215/Predicting Dengue Fever Transmission Using Machine Learning Methods

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Dengue Fever (DF) is one of the most common vector-borne diseases that threaten humanity, with more than a third of the world's population being at risk of contracting this disease. The accurate prediction of dengue transmission will assist decision-makers and health authorities to control it in the absence of an effective vaccine and treatment. One linear (linear regression) and three nonlinear models (support vector regression, decision trees regression, and random forest regression) were developed and compared in this study to determine the model with the highest accuracy in predicting DF transmission. The prediction models were based on DF cases reported for Jeddah city, Saudi Arabia, and on the temperature and humidity, which are two features with the greatest correlation to confirmed cases. Of the tested models, the Support Vector Classification (SVC) model has the best performance, achieving 76% of prediction accuracy, while linear regression, random forest regression, and decision trees regression achieved 52%, 55% and 57% prediction accuracy, respectively.

Session	HSM Healthcare Systems and Management
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Giulia CASELLI ¹ , Junjie WANG ² ¹ University of Modena and Reggio Emilia, Italy ² Zhongnan University of Economics and Law, China

IEEM21-A-0014/Critical Success Factors for New Product Development in the Medical Device Industry

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New product development (NPD) in the medical device (MD) industry is complex and unique than other electronics product development due to long life cycle, competition, design complexity, quality and strict regulatory norms. There is a limited reference regarding successful NPD factors in the medical device domain. The major challenge is to find the success factors and explicitly outline success strategy for each factor. This paper is an attempt to find critical success factors based on literature review and experience of authors. NPD process, team, and innovations are identified as internal success factors for product development success. Managing and working closely with customers and regulations are key to success from an external perspective. A balance scorecard is developed to objectively measure the success criteria for future research and continuous improvement of product development process through pure real data analytics rather than survey instrument.

IEEM21-F-0220/PDMS-based RF Resonant Sensor for Measuring the Concentration of Micro-Plastics

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Recently, microplastics have become a big problem, but conventional particle analyzers that can detect microplastics require a lot of time and cost, so in this paper, in order to solve this issue, a low-cost RF sensor was designed to detect microplastics through it. The RF sensor was designed using the L-C-L resonance structure, and the microplastic concentration was detected through the change of the dielectric constant by collecting microplastic in the dielectric space between the capacitors. Through the RF sensor designed in this study, it was confirmed that microplastics as small as 0.1% can be detected, and it was confirmed that a single particle can be distinguished through a readout circuit.

IEEM21-F-0302/A Mathematical Formulation for Reducing Overcrowding in Hospitals' Waiting Rooms

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The COVID-19 pandemic has triggered several new measures in public and private companies to limit the spread of the virus. One of the most effective measures was shown to be social distancing, but such measure is not easy to implement for every entity, especially for hospitals. In this work, we study the case of an Italian hospital whose goal is to find the best layout of outpatient services to reduce overcrowding in the waiting rooms. We propose an Integer Linear Programming model to identify the weekly optimal layout and we test it on a set of real data from the year 2019. The results obtained by our model reduce the overcrowding by 80% on average with respect to the results obtained with the configuration used by the hospital, but such results can only be obtained if the layout is allowed to change every week. We then study the case in which we force the layout to be fixed for two or three consecutive weeks and outline that both the computational time and the solution quality worsen significantly.

IEEM21-F-0378/Analyzing the Interactions Among the Barriers for Safe and Effective Medical Waste Management

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Because of the growing number of hospitals in the country like the United Arab Emirates, huge medical wastes are generated in the hospitals, and managing this medical waste is considered a big challenge. In recent days, COVID 19 pandemic has paved the way for the generation of relatively huge amounts of infectious and hazardous waste in healthcare hospitals, and proper disposal of this heterogeneous mixture of medical waste is the biggest challenge. Improper waste management developed in health care units causes a direct impact on the workers, waste handlers, patients, caregivers, and the community. Also, it is important to manage the medical waste properly so that the environment will not get affected. In order to overcome this problem, both the manufacturer and the medical practitioner should take utmost care in managing the medical waste properly in all stages, starting from collection to the final disposal. The main aim of this research is to understand the different types of medical waste in the hospital and identify the barriers that impede the effective management of medical waste. For analyzing the interactions among the barriers, Interpretive Structural Modelling (ISM) approach is proposed as a solution methodology in this research work. By analysing the interaction among the barriers using the ISM model, we may extract the most influencing barrier that challenges both hospital management and government in managing medical waste safely and effectively.

IEEM21-F-0432/Pre-determined Package Sizes and Large Neighborhood Search Approach for Medical Supplies Vehicle Routing Problem of Primary Care System in Thailand

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¹Mahidol University, Thailand

In Thailand's public healthcare system, public hospitals would act as supporter and medical supplies distributor for health facilities in their district forming primary care network system. Normally, health facility personnel would make an empty trip to hospital to pick up supplies, and drive truck with low cube utilization back to facility. To improve aforementioned medical supplies distribution in primary care network, a combination of pre-determined package sizes and Large Neighborhood Search (LNS) approach for medical supplies vehicle routing problem is proposed. The pre-determined package sizes are done using frequency distribution method. Comparing current practice with proposed approach, the annual transportation cost is reduced by 44.97 percent and the average cube utilization is 84.19 percent.

IEEM21-F-0450/Application of Simulation Technique in Improvement of Intra-hospital Patient Transfer: A Provincial Hospital Center in Northern Thailand

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Worapol Lertcharoenpaisan¹

¹Chiang Mai University, Thailand

Intra-hospital patient transfer is one important aspect of patient care since a delay in transfer can severely affect the patient's treatment. The case study hospital was facing a problem of intra-hospital patient transfer during peak hours (8:00 a.m. to 4:00 p.m.) due to the high number of patients and limited number of staff to provide service. The objective of this study was to propose the strategies to improve the intra-hospital patient transfer process in the case study hospital and to apply the simulation technique using the Arena simulation software to evaluate the proposed strategies. This study evidenced that the suggested strategies could help to reduce intra-hospital patient transfer times and increase the number of patient transfer cases of one staff from 15 to 17 cases (11.8%) at transfer center A and from 16 to 17 cases (5.9%) at transfer center B. This study provides contributions to the existing academic literature as it showed how the healthcare system in Thailand was managed as well as how the Arena simulation software is utilized to evaluate the effectiveness of healthcare management strategies.

Session	OR-04 Operations Research 4
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Zhao-Hui SUN ¹ , Huadong MO ² ¹ Shanghai Jiao Tong University, China ² UNSW Canberra at ADFA, Australia

IEEM21-F-0357/Time Window Based Genetic Algorithm for Multi-AGVs Conflict-free Path Planning in Automated Container Terminals

Tong Lu¹, Zhao-Hui Sun¹, Siqi Qiu¹, Xinguo Ming¹

¹Shanghai Jiao Tong University, China

The continuously increasing demand for containers makes it difficult for traditional ports to bear the heavy workload. As a result, the transformation of traditional ports into automated container terminals (ACTs) has already become a vital trend for the shipping industry. Nowadays, the automated guided vehicle (AGV) is widely used in ACTs. It becomes one of the main handling equipment for the loading and unloading of goods. However, the conflicts that occur among AGVs will influence the operating efficiency of ACTs. To achieve conflict-free path planning, the problem of path planning is modeled as min-max mathematical programming in this paper. Then, the time window-based Genetic Algorithm (TWGA) is proposed to solve the problem. To verify the performance of TWGA, different cases with small-scale and large-scale are used to test the ability to find the optimal solution of the algorithm. Results illustrate that the proposed algorithm could effectively reduce the conflicts among AGVs, and outperforms the compared algorithm.

IEEM21-F-0420/Literature Review of Risk Communication on Public Perceptions in Responding to Covid-19 with a System Dynamic Approach

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Gap of information regarding the risks of Covid-19 conveyed by the government to the public will result in various problems such as socio-economic impacts, loss of trust in the government, and even loss of life. The problem of communicating the risk of Covid-19 is complex because the problems that occur will be interrelated and affect each other. Different perceptions of society and the government in viewing the risk of Covid-19 can hinder the completion of Covid-19 cases. This problem should be seen as a system. Systems dynamics is a discipline that focuses on the research and analysis of information feedback systems. By modeling a risk communication strategy, this study aims to mapping research opportunity of Covid-19 risk communication problems related to soft variables and developing modes for their resolution by using system dynamic.

IEEM21-A-0089/Joint Optimization of Spare Parts Inventory and Planned Maintenance Under Uncertain Failures: A Mathematical Model and a Genetic Algorithm

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¹National Taiwan University of Science and Technology, Taiwan

²Institut Teknologi Sepuluh Nopember, Indonesia

Spare parts inventory tends to receive less treatment in practice because of its low cost and low requirements compared to other stocked items. However, spare part inventory still needs to be managed optimally so that the inventory cost and the damage due to the failures could be minimized. This paper introduces a joint optimization model of spare parts inventory and planned maintenance management with multiple items and multiple periods considering uncertain failures. A Mixed Integer Non-linear Stochastic Programming model is formulated for the problem. We consider a policy where an order must be positioned up to the order-up-to level if the inventory position reaches the reorder point at every review period. This study compares both aggregate and independent inventory policies and then consolidates the results with maintenance schedule. We propose a two-stage Genetic Algorithm (GA) for solving the problem and perform numerical analyses to evaluate its performance. The results show that the proposed GA finds near-optimal solutions for test problems of all sizes within a reasonable computational time.

IEEM21-A-0093/Solving the Vehicle Routing Problem with Simultaneous Pickup and Delivery and Occasional Drivers by Simulated Annealing

Vincent F. Yu¹, Grace Aloina^{2*}, Panca Jodiawan¹, Aldy Gunawan², Tsung-Chi Huang¹

¹National Taiwan University of Science and Technology, Taiwan

²Singapore Management University, Singapore

This research studies the vehicle routing problem with simultaneous pickup and delivery with an occasional driver (VRPSPDOD). VRPSPDOD is a new variant of the vehicle routing problems with simultaneous pickup and delivery (VRPSPD). Different from VRPSPD, in VRPSPDOD, occasional drivers are employed to work with regular vehicles to service customers' pickup and delivery requests in order to minimize the total cost. We formulate a mixed integer linear programming model for VRPSPD and propose a heuristic algorithm based on simulated annealing (SA) to solve the problem. The results of comprehensive numerical experiments show that the proposed SA performs well in terms of solution quality and computational time.

IEEM21-F-0475/Analysis of Renewable Energy Adoption Efficiencies Under Uncertainty Across Electricity Markets in the U.S.

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This study evaluates the efficiencies of renewable energy adoption in different electricity markets in the U.S. Particularly, the study investigates how uncertainties in Renewable Portfolio Standards (RPS) mandates influence the adoption of renewable energy technologies in the markets. A stochastic Data Envelopment Analysis (DEA) method was employed by combining the traditional DEA approach with a Monte-Carlo simulation technique. The study found the regions covered by markets including SPP, MISO and NE-ISO to be DEA efficient. Compared to a deterministic model, the findings reveal further insights on the performance of Decision-Making Units (DMUs) across different scenarios. In addition, the stochastic model is also better able to discriminate among DMUs and more accurately capture the performance of these units over time. For each unit, the model provides a distribution of efficiencies and for those units operating below the efficient frontier, it also provides the average renewable energy capacity addition targets to be attained.

Session	PM-01 Project Management 1
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Ripon CHAKRABORTTY ¹ , Liaoliao LI ² ¹ UNSW Canberra at the Australian Defence Force Academy, Australia ² Northwestern Polytechnical University, China

IEEM21-F-0186/Key Roles of the Full Life Cycle of the "Internet +" Environmental Public Welfare Projects

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²University of Texas Rio Grande Valley, United States

Most of the "Internet +" environmental protection public welfare project team members are recruited temporarily, therefore, there are often chaotic roles and unclear responsibilities within the project team. Considering the behavior is the basis for role classification, this research explores the necessary roles in each stage of the project life cycle based on the actual behavior of "Internet +" environmental public welfare project members. We propose a model using grounded theory, which comprises respectively five, four, and three key roles at each stage. Specifically, the project preparation phase includes entrepreneur, liaison, resource investigator, shaper and implementer; the project execution phase includes disturbance handler, implementer, completer-finisher and coordinator; the project closure phase includes leader, completer-finisher and spokesman. The model provides a theoretical basis for practitioners involved in decisions on recruiting and managing of the "Internet +" environmental public welfare project.

IEEM21-F-0207/How Does the Text Sentiment Tendency Affect the Fundraising Effect of Digital Environmental Protection Public Welfare Projects? – Moderating Effect of Projects' Information

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In recent years, environmental public welfare projects have mushroomed on major online public welfare platforms, reflecting people's strong desire to improve the current environment. However, China's "Internet +" environmental public welfare undertakings started late. The current academic studies on promoting the development of such projects mostly start from the perspective of a single stakeholder and study the factors affecting their participation, without analyzing how the project's text, as the primary information carrier of the project, promotes the success of the project fundraising. This paper takes the environmental public welfare projects of Tencent Charity as the research object, conducts text sentiment tendency analysis on 393 collected data, and then uses a generalized linear model to analyze the influence of different fundraising duration and target amounts on fundraising effects. The results show that positive text is beneficial to the success of project fundraising, negative text is detrimental to the success of project fundraising, and neutral text has almost no effect on the effect of project fundraising.

IEEM21-F-0235/Implementation of Last Planner System to Engineering-to-order (ETO) Organization with a Focus on Office Knowledge Work. Development of a Framework

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²University of Stavanger, Norway

Last Planner System (LPS) is a popular tool among the lean construction community, which aims to reduce waste and improve workflow in order to efficiently run a project. LPS can also be seen as a critical response to traditional project planning and control, as it challenges the traditional way of planning and managing projects. Despite its success in the construction sector, LPS is relatively new within the context of office knowledge work. This paper proposes a framework and guidance for implementing LPS in an engineering-to-order (ETO) organization providing knowledge work, service, and manufacturing. The manuscript firstly demonstrates the basics of LPS then presents the findings regarding project performance in a case study company. It also demonstrates the potential of using LPS to solve the existing challenges observed in engineering projects. Finally, it presents a methodology and guidelines for implementing LPS to improve monitoring and control of engineering activities in the projects.

IEEM21-F-0251/Circular Economy Strategies in Civil Engineering: A Brief Literature Review

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The circular economy is gaining attention in the marketplace due to the benefits it brings to prosperity while supporting sustainability. This strength is seen as a solution to the set of problems encountered by uneducated companies, organizations, and humans concerning the environment, the economy, health, and the quality of the community. Although much had been said about the trend upward in population growth globally, and the projected excessive consumption is not in line with reality, it's necessary to improve the results. Whereby companies must be one of the first to foster strategies to mitigate adversity. In this sense, this study aims to research what are the main circular economy strategies developed in the field of civil engineering. To this extent, a systematic review of the literature was developed, taking the papers published in the last 11 years. In the results, it was possible to find waste management and demolition as one of the most represented strategies by the authors, followed by the management of sustainable materials. The results are important for the industrial sector and researchers and professionals interested in the applicability of circular economy in the labor market.

Session	QCM-01 Quality Control and Management 1
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Yoshinobu TAMURA ¹ , Aibo ZHANG ² ¹ Yamaguchi University, Japan ¹ University of Rome "Niccolò Cusano", Italy ² City University of Hong Kong, Hong Kong SAR

IEEM21-F-0055/Effectiveness of the Tactics for Small and Medium-sized Toy Factories in China in Dealing with European and US Toy Safety Requirements

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¹The Open University of Hong Kong, Hong Kong SAR

There have been more and more customers and regulatory requirements in the toy industry. Small and medium-sized toy factories in China have been facing challenges to deal with European and US toy safety requirements. How to establish an effective management system to avoid product recalls or penalties becomes an important question, especially to small and medium-sized toy factories with limited resources. After literature review and a pilot study in 4 toy factories, a conceptual framework has been proposed. In January 2020, these 4 factories followed the framework and implemented the toy safety improvement schemes. In January 2021, they were interviewed again about their implementation status. The results showed that their capabilities in responding to European and US toy safety requirements had been lifted. Positive contributions from Toy safety assessment, Industry 4.0, and ISO 37301 (It supersedes ISO 19600:2014) were confirmed among the tactics. This study provides a valuable framework for manufacturers in selecting and implementing toy product safety tactics in responding to European and US requirements.

IEEM21-F-0101/A Study on Recycling the Plastic Wastes with Bamboo on Making Wall Tiles

Shu Lun Mak^{1,2}, Fanny Tang¹, Chi Ho Li¹, Ming Yan Wu¹, Tsz Wing Chan¹
¹The Open University of Hong Kong, Hong Kong SAR

Bamboo scaffolding is commonly used in China during the construction of structural buildings. The high consumption of bamboo leads to the problem in the disposal of bamboos materials. Nowadays, most of consumer products are made of polymeric materials. The common engineering plastics are not biodegradable. The recycling of plastics is the important research topics. This paper is to study the recycling the plastic wastes with used bamboo scaffolding on making wall tiles. Firstly, the problem on high consumption of polymeric materials was studied. Secondly, the properties of plastic wastes and bamboo were reviewed. Thirdly, the testing standards of wall tiles were also studied. Finally, the feasibility of recycling plastic wastes and bamboo on making wall tiles were concluded.

IEEM21-A-0023/Performance Measurement: An Integral Element of Continued Success

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Total Quality Measurement (TQM) has been adopted by the manufacturing and healthcare industries in the US, UK and Australia; however, education institutions globally have been slow to recognize the importance of this improved management process. Although, there is an increasing number of universities adopting the principles of TQM in developed countries, very little empirical literature exists that confirm such practices in developing countries. This paper discusses the importance, methodology and limitations of performance measuring techniques via literature review. Furthermore, it draws attention on how Higher Education Institutions (HEI) that have adopted TQM and performance measures created significant success. Since HEI are not just about teaching and incorporate many operations and resources that lead to delivering quality education, measuring performances at all levels can serve as a map to success. Keywords - Total Quality Management (TQM), Performance Measure (PM), Higher Education Institutes (HEI).

IEEM21-F-0137/Costs of Quality Management in Global and South African Manufacturing Companies: Similarities and Differences

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The paper reports the results of the similarities and differences in cost of quality (CoQ) management between global manufacturing companies operating in South Africa and local manufacturers. The survey research method and questionnaires were used to collect primary data for the study. The study received 119 responses from South African manufacturing companies and 19 responses from global manufacturing firms. The two-way analysis of variance revealed that CoQ categories and manufacturer location did not affect CoQ adoption. The findings did not provide enough evidence to claim a statistically significant difference in CoQ adoption between global and South African manufacturers. Global manufacturing companies, on the other hand, had the highest overall mean adoption across all CoQ categories. The study's findings could serve as a starting point for both local and global manufacturers to benchmark their CoQ management processes and learn from one another.

IEEM21-A-0037/Monitoring Percentiles of Proportion Data for Truncated Beta Process

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Beta control charts are used for monitoring proportion data as an alternative to the standard p and np charts. These charts in general use average of proportion data to set up the control limits assuming in-control parameters known. It may be of interest to the practitioners to monitor the top or bottom percentiles of proportion data more than the other percentiles. Specific percentile of proportions may be a key quality performance measure as opposed to average for an effective process monitoring scheme. In this sense, control chart based on distribution truncated suitably over the support of the random variable may be a better choice over the same with complete support. This paper develops control chart for monitoring percentiles of a truncated beta process through parametric bootstrapping when in-control parameters are unknown. Extensive Monte Carlo simulations are carried out with various combinations of the percentiles, false alarm rates and sample sizes to evaluate the in-control and out-of-control performance of the proposed chart. The proposed chart is applied to skewed data sets and one application is provided from healthcare.

Session	Poster 01
Date	December 15, 2021
Time	08:00 AM-09:30 AM
Chair(s):	Pei-Lee TEH ¹ , Edwin CHEUNG ² ¹ Monash University Malaysia, Malaysia ² Hong Kong Institute of Vocational Education (Tuen Mun)

IEEM21-F-0150/A Comprehensive Investigation of Knowledge Management Publications

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Recent trends in knowledge management (KM) have increasingly indicated a lack of agreement, integration and classification between different KM domains. As such, experts are inadequately equipped when attempting to classify KM into their specific areas that could effectively contribute to a technocratic approach behind the organizational strategy. This paper illustrates a method of classifying KM publications by using a scheme that assists technocratic developments to explicitly express knowledge using a clearly defined approach. A classification method is applied using a taxonomy template to perform procedures and as a result offers an alternative approach for the classification and organization of KM publications. A series of 180 KM publications produced over the past 15 years was analyzed using the proposed taxonomy framework. The results highlighted that there were two key categories: Conceptual and Empirical which helps to explain the existing discrepancies found in KM. This enables the reuse and sharing of this new classification approach to provide guidance for academics and practitioners.

IEEM21-F-0170/Exploring the Hotspots and Trends of the Literature on R&D Networks: Bibliometric and Content Analysis

Yan Wang^{*1}, Naiding Yang¹, Yu Wang¹, Min Guo¹

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In the era of the knowledge economy, R&D networks, as a new mode of R&D activities, have gradually become the focus of scholars. There are more and more research achievements and many research themes, but it is still difficult to grasp which are the research hotspots and trends in this field. Therefore, this study uses the methods of bibliometrics, knowledge mapping, and content analysis to analyze the research situation, knowledge base and research hotspots of R&D networks. Finally, we summarize our findings and put forward some future research directions, hoping to provide a reference for the research of R&D networks and promote its research progress.

IEEM21-F-0385/Planning of Teaching Contents of Industry-oriented Capstone Course in Technological Colleges and Universities

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²Cheng Shiu University, Taiwan

³Hua Hsia University of Technology, Taiwan

This study aims to contemplate the pedagogy of the industry-oriented capstone course (IOCC) in technological colleges and universities in order to cultivate students' ability, by project course from real industry problems after an internship and try to alleviate the gap of education-employment. Literature review, expert review and the content analysis were applied to develop a pedagogical model of IOCC. The courses in this model includes a two months off-campus internship, and the capstone course in separate semesters. It includes six stages: before off-campus internship (Week 0), during internship (Week 1~ 8), after internship (Week 9), capstone course preparation (Week 10), and capstone course implementation (Week 11 ~ 37), and capstone course presentation (Week 38-39). The conclusions point out that the teaching contents of IOCC developed by this study can cultivate students' problem-solving ability for industry.

IEEM21-F-0072/Crowdsourced Manufacturing for Delivery of Manufacturing as a Service

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The crowdsourcing environment engages a large population of crowds through a cyber platform on a sharing understanding of delivering manufacturing as a service (MaaS). Crowdsourced manufacturing is envisioned to be a future manufacturing paradigm for fulfilling MaaS tasks. This paper sketches a holistic approach to the symbiosis of crowdsourcing cyber platform technologies to serve intelligent decision support to manufacturing planning for achieving MaaS operational goals. It outlines a technical framework of platform-driven MaaS from a model-based systems engineering perspective. Crowdsourced manufacturing promises to exploit the implicit design and manufacturing knowledge incorporated in the library of previously executed manufacturing tasks, which facilitates the manufacturing process plans generation by parametric adjustment of process plans for similar tasks. Key technical challenges and potential research issues are addressed, along with a case study of crowdsourced orthodontics with 3D printing.

IEEM21-F-0108/Application for Roof Type Analysis and Component Counting from Roof Plan Image

Thanawinn Arphacharas^{*1}, Nagul Cooharajanane¹, Pravee Kruachottikul¹, Peelak Wantanasiri², Dhanawat Mahasiriwattanakit²

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In this paper, an application for analyzing roof types and counting components from roof plan images using Python OpenCV was proposed. The goal of this study is to help users to estimate roof construction costs. The application can determine the type of roof: Hip, Gable, and Dutch; also, predict and count the number of crucial components: Hip valley, Raft valley. Our proposed rule-based technique was used to utilize sub-image in particular coordinates. Regarding the experimental setup, variation of roof plan types as Easy, Normal, and Hard (depending on the number of roof types and sub roof in a single house) were tested. As a result, the accuracy of our proposed algorithm was nearly 100% in Easy and Normal types of images, which is accurate and acceptable to be used for estimating in cost calculation.

IEEM21-F-0201/A Study of Applying Unsupervised Learning Methods for Document Clustering and Automatic Categorization of Software

Kai-Wen Chen¹, Chin-Yu Huang^{2,1}
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Software categorization is the task to group software into categories that briefly represent the behavior of software. However, with the rapid growth of software, manual software categorization has become almost impossible and expensive. Therefore, automatic software categorization has become necessary. In this paper, we propose to utilize two different document clustering methods, nonnegative matrix factorization (NMF) and spectral clustering, to fulfill the automatic software categorization respectively. In our work, we not only compare our performance with an existing automatic software categorization method LACT, but we also make profound analysis on the difference between our both clustering methods. Our methods require only at most about 1/10 execution time of LACT while the fastest one is hundreds of times faster than LACT, achieving at most 26% and 100% better performances based on two criteria, BCubed F1-measure and Adjusted Rand Index.

IEEM21-F-0030/Exact Algorithms for Robust Quay Crane Scheduling Problems

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The processing time of loading and unloading tasks is usually fluctuating due to uncertain factors at container terminals. However, most research treats it as deterministic. This paper proposes a two-stage robust optimization approach to tackle the uncertainty proactively. Two kinds of cuts are proposed to tighten the searching space. Some techniques are applied to linearize the subproblem. Both Benders decomposition and column-and-constraint generation algorithms are adopted to solve the robust model, with the two algorithms compared analytically and numerically. Based on extensive experiments, we validate the effectiveness of the algorithms and find the situations that are suitable to the robust model.

IEEM21-F-0031/Sustainability Evaluation of Tobacco Excise Tax Policy to Finance Universal Health Coverage in Indonesia

Teuku Naraski Zahari¹, Akhmad Hidayatno¹, Komarudin¹
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Universal Health Coverage (UHC) is a public health funding scheme promoted by the World Health Organization (WHO) to achieve equity in healthcare services, including promotive, preventive, curative, and rehabilitation care at an affordable cost. In 2014, Indonesia started the UHC program through its national program Jaringan Kesehatan Nasional (JKN). So far, JKN has faced many issues, with the most never-ending problem is a fund deficit. To counter this issue, the Indonesian government opted to use an earmarking fund from tobacco excise to support JKN. This research aims to provide a structural insight that earmarked funds from tobacco excise are not sustainable in the long run in Indonesia's case using system dynamics. The adverse effects of tobacco use on health, which increases public health expenditure and its socioeconomic impact, are the primary cause of this unsustainability.

IEEM21-F-0105/Creative Activity Outcomes and Optimal Task Scheduling

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Activities that require creativity will continue to be performed by humans in the future because it is difficult to replace creative individuals with artificial intelligence and robots. In contrast to design and production, creative activities such as idea generation do not always produce results in proportion to the man-hours and effort invested in them. It is, therefore, necessary to understand the characteristic of creative activities for their implementation, but their outcomes process has not yet been clarified. The purpose of this research is to improve the quality of the results and the productivity of creative activities through an appropriate schedule when available resources are limited. This study attempts to define the concept of outcomes of creative activities. These outcomes are not always significant because we need to create a new conceptual space or adapt to new rules in the initial stage and only manifest abruptly during the final stage of the process. We will test this concept through a creativity game and demonstrate the results by analyzing the collected data in the future.

Session	SMS-02 Systems Modeling and Simulation 2
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Omid FATAHI VALILAI ¹ , Huadong MO ² ¹ Jacobs University Bremen, Germany ² UNSW Canberra at ADFA, Australia

IEEM21-F-0265/Potential of Streamlining Warehouse Processes and IT integration to Increase Implementation of Automation

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Warehouses are located all around the world, and they are getting bigger and handle more and more material every day. This has increased the need to implement automation in warehouses. To be able to implement automation beneficially, at multiple warehouses with multiple customers owned by the same company, the processes, and the IT systems at the warehouses need to be streamlined and standardized. For this purpose, we suggest modeling an explicit architecture of the warehouses, and study which possible impact to reach from applying the architecture to standardize processes, IT systems, and in the end increase the implementation of automatization solutions. A case study of a logistics company with multiple warehouses around the world shows a big financial and growth potential to implement such an architecture. Based on previous implementations of product architecture the estimated potential of financial savings is up to 400.000 euros for a medium-large size warehouse. Streamlined processes agreed between the different departments and the implementation of similar automation will enable the company to share data and automation parts between the different warehouses.

IEEM21-F-0278/Deadlock-solving Traffic Control Methods for Automated Guided Vehicle Systems

Maoning Chen¹, Yuangen Lu¹, Canrong Zhang¹
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To cope with the challenges arising in the logistics industry, intelligent warehouse systems equipped with Automated Guided Vehicle (AGV) are becoming an attractive choice for enterprises. Such intelligent systems are often deployed in complex working environments where collision and deadlock problems are often inevitable. This paper focuses on designing effective traffic control strategies and algorithms to eliminate deadlocks faced in the system. More specifically, under the Resource Authorization policy, the deadlock is defined based on the graph theory; in order to minimize the occurrence of deadlocks, this paper proposes a Future Path-oriented Planning (FPP) algorithm which considers the future routes that will be traversed by AGVs by simulation; and, moreover, Deadlock Detection and Recovery (DR) strategy is introduced to detect and eliminate deadlocks. Numerical experiments conducted on two typical types of maps demonstrate the effectiveness of the proposed algorithms.

IEEM21-F-0334/Onomatopoeia Search System Focused on Attributes Based on Sensibility and Various Sounds

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In recent years, several onomatopoeias have been used in food advertisements as words to express texture. When consumers observe onomatopoeias in advertisements, they link them to food sales by associating them with the willingness to purchase a particular product. It is important to select onomatopoeias that appropriately express the product image. If the most suitable onomatopoeias that represent the advertised product or review text can be searched, it will be easier for consumers to understand the product better, and the advertisement, as a result, will be successful. The purpose of this study was to identify the attributes that characterize onomatopoeias from user reviews and to analyze the relationship between the sounds of onomatopoeias and each of their attributes to construct a system that can search for onomatopoeias by matching attribute images. In the proposed system, onomatopoeia words were extracted by arranging the onomatopoeias on a plane using principal component analysis and then clicking on this plane using a mouse. In addition, we confirmed whether the extracted onomatopoeias matched the images of the attributes through verification experiments.

IEEM21-F-0395/Set of Flexible Models to Support Simulation-based Assembly Planning in SMEs

Maximilian Duisberg^{1,2}, Michael Kranz¹, Mostafa Khabbazan¹, Susanne Mütze-Niewöhner¹

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Fluctuating market requirements and the trend towards individualization increase the need for assembly planning processes. Due to a lack in economic and time resources, as well as a heterogenic work force, small and medium-sized enterprises often do not have the capacity to conduct simulation studies. In this paper, a structure of assembly organization forms is transferred into a set of simulation models for assembly planning. A conducted clustering allows to derive the logic of flexible simulation models through the combinations of organizational forms. The models greatly reduce the complexity of the planning process and possible alternative planning approaches become easy to find. The use of the approach will finally be demonstrated in an assembly planning case study of a medium-sized enterprise in plant engineering industry.

Session	TKM-04 Technology and Knowledge Management 4
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Danping LIN ¹ , Julia BRAUN ² ¹ Shanghai Maritime University, China ² Brandenburg University of Technology Cottbus-Senftenberg, Germany

IEEM21-F-0413/Consideration on Sustainable Development of Companies and Society: Research on an Approach to Creating Shared Value

Haru Suzuki¹, Masaru Ishioka¹

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In recent years, the widespread recognition that the business activities of corporations are the source of social, environmental, and economic problems has been realized. In this situation, corporations are required to think deeply about the sustainability of society and business. In order for a company to cope with social problems without sacrificing business activities, CSV: Creating Shared Value, is required. Therefore, this research considers how to effectively approach to CSV. Specifically, first, from the perspective of CSV, this paper provides an overview of the knowledge creation methods of organizations in Knowledge Creation Theory and Experiential Learning theory. Next, based on that, this paper presents an effective approach to CSV. This paper then examines the effectiveness of the developed new approach in this research for the sustainable development of companies and society.

IEEM21-F-0453/Product Development in the Automotive Industry in the Context of Industry 4.0 - A Bibliometric Analysis

Julia Braun^{1,2}, Magdalena Missler-Behr¹

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Dealing with new technologies in the context of Industry 4.0, the automotive industry will be confronted with major changes along the entire value chain. These changes are finding their way into a wide variety of corporate areas, such as product development. Machine learning, augmented reality, cyber-physical systems and the Internet of Things are just a few examples of the lasting changes in product development. The conducted research deals with the state of the art in the research field of new technologies in the context of Industry 4.0 in product development in the automotive industry. For this purpose, a bibliometric analysis (text mining) is used to review the current state of research in this research field. The aim is to provide an overview of the entire research field and to derive research gaps.

IEEM21-F-0259/The Current State of EV Readiness in Indonesia: Assessing the Industrial Sector's Perspective with J-TRA Methodology

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²Universitas Islam Indonesia, Indonesia

Electric Vehicle (EV) is a promising technology that can drive the use of Renewable Energy (RE) in the mobility sector. With the fast economic growth and rapid urbanization, it is expected that more people will purchase personal vehicles in Indonesia. Even in the scenario where more people are gradually taking the more convenient public transportation and better infrastructure of mass mobility, the EV can significantly reduce Green House Gas (GHG) emission when the energy supply eventually shifts to higher RE in the energy mix. On the other hand, EV is a relatively new technology, and its diffusion on the broader market needs to go through several stages of development to achieve full readiness in society. Therefore, observing the EV development status is essential to identify and respond to the bottleneck of EV diffusion in Indonesia. This study exercised the Japanese technology readiness assessment (J-TRA) methodology based on an interview with an EV startup company to reveal the readiness level in Indonesia.

IEEM21-F-0328/Influencing Factors on the Adoption of Face Recognition Technology on Campus Based on SEM

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Nowadays, the facial recognition technology (FRT) is gradually being applied in our life. In order to better serve the campus life, this paper tries to understand and study the influencing factors on the adoption of FRT on campus. A structural equation model (SEM) approach is designed to quantify multiple influencing variables and figure out the relationships among each other. The data collection is obtained through questionnaires, and the representativeness of data is analyzed using SPSS software. After that, the data were modeled using the Amos toolkit. The results reveal that the core factors about the adoption of FRT on campus are privacy and promotion.

Session	OR-05 Operations Research 5
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Bertha Maya SOPHA ¹ , Yuying LONG ² ¹ Universitas Gadjah Mada, Indonesia ² Harbin Institute of Technology, China

IEEM21-A-0139/Optimization of AGV Balanced Transportation at the Automated Container Terminal

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The AGV transportation occurs at the storage yard and the quay side, and its process is the key factor to affect the berth time at the automated container terminal (ACT). To address the congestion among AGVs, the task allocation and path planning need to be well provided. The operation process between the storage yard and quay side at ACT can be considered as a simple supply chain. The yard is the supply side which needs to deliver export containers while the quay side is the demand side picking up the export containers and appointing AGV to be the carrier. Meeting the workload of all demanders in a period of time is regarded as a task and the workload of any demander in this period is a subtask. The dynamic allocation model between AGVs and tasks was established and the co-evolution genetic algorithm was designed. AGVs were dispatched to serve various tasks at the optimal path referring to balance the supply and demand. The results show that the proposed algorithm can effectively avoid the congestion for the AGV dynamic transportation.

IEEM21-A-0147/An Improved Congestion Areas Model and NSGA2 for the Green Vehicle Routing Problem

Yanping Chen^{*1}, Eishi Chiba¹

¹Hosei University, Japan

Over the past few years, global warming and climate change have become central issues with regards to sustainable development. There is evidence that transportation sectors play a critical role in reducing carbon emissions. Previous research has demonstrated that proper route planning can help to solve this conundrum. This study investigates a time-dependent traffic congestion areas model and Non-dominated Sorting Genetic Algorithm II (NSGA2) that enables us to minimize distribution cost and carbon emissions for the Green Vehicle Routing Problem (GVRP). This study first analyzes the vehicle speed in different time periods and under different congestion conditions, then improves the congestion areas model. Next, using this new model, this study improves NSGA2. Furthermore, a simulation experiment is carried out to test the improved model and algorithm. The computational results show that vehicles can effectively avoid congested areas and the total amount of carbon emissions can be reduced. The research brings a solution to the GVRP by considering time-dependent traffic congestion.

IEEM21-A-0148/The Nature of an Infection Tree Obtained From the Extended Contact Process

Kazuhiro Suzuki^{*1}, Eishi Chiba¹

¹Hosei University, Japan

Currently, Covid-19 is prevalent all over the world. This pandemic highlights the great importance of understanding more about the nature of infectious diseases and how they spread. The transmission process of an infectious disease can be regarded as a network model. In such a model, the spread of an infection corresponds to a tree, which can be called an infection tree. The nature of infection trees is useful in predicting how infectious diseases spread. The purpose of this research is to investigate the nature of the infection tree. In order to compute an infection tree, we apply an extended contact process as a mathematical model of infectious diseases. Then we show various properties of infection trees obtained from the extended contact process through computational experimentation. Concretely, we show results regarding the number of steps in the extended contact process, the degree distribution of the infection tree, and the degree correlation between the original network and the generated infection tree.

IEEM21-A-0150/A Methodology Using AHP to Find the Best Solution to Lead Time Reduction in Manufacturing

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¹Hosei University, Japan

Nowadays, in the context of economic globalization, there is fierce competition within manufacturing to survive and grow. Short lead time is beneficial in order to gain a bigger market share, so manufacturers try to shorten it wherever possible. In this context, many managers and researchers have investigated various methodologies to shorten the lead time, and many such methodologies have been implemented. However, these methods are not applicable to every area of manufacturing. Analytic Hierarchy Process (AHP) is considered as one of the most effective methods for multi-criteria decision making. Therefore, this study proposes a methodology based on AHP for manufacturers' looking to find the best solution to lead time reduction. Since this methodology does not require a team of experts to make decisions, the necessary expenses and difficulty level to implement it become much lower. Considering suitable alternatives for lead time reduction is important in the methodology, and the alternative with the greatest weight derived from the methodology is deemed the best solution. Furthermore, this methodology may help solve a variety of challenges in the field of business management.

IEEM21-F-0160/Collaborative Vehicle Dispatching for Resilient and Fair Emergency Response

Yuying Long^{*1}, Ying Sun¹, Gangyan Xu^{*1}, Pengfeng Shu¹

¹Harbin Institute of Technology, China

Efficient emergency vehicle dispatching is crucial for emergency response and could reduce human casualties and economic losses. However, during large scale unconventional disasters, rescue demands increase dramatically that traditional vehicle dispatching method cannot well cope with the unbalanced situation, thus bringing about delayed response, uneven treatment, and waste of resources. To address these problems, this paper proposes an effective emergency vehicle dispatching method for resilient and fair emergency response. Firstly, a dynamic emergency vehicle dispatching model is built considering resilience and fairness. Then a collaborative vehicle dispatching method with Tabu Search-based dispatching algorithm is proposed to solve the model. Finally, a simulation case study is carried out to verify the performance of the proposed method.

Session	PM-02 Project Management 2
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Ling WANG ¹ , Dingcheng ZHANG ² ¹ Jiangsu Taizhou Bridge Co., Ltd, China ² City University of Hong Kong, Hong Kong SAR

IEEM21-F-0049/Feature Based Statistical Model of Employee Productivity with Real Time Checked Data

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¹University of Alberta, Canada

²Enigma Design Solutions, Canada

The COVID-19 pandemic has led to a decentralization of the workforce in many industries. Due to the stay-at-home orders to control the spread of the virus, many are working from home. Even though modern technological advancements have helped some companies adapt to this new norm, many others are still scrambling to find the best way to remotely manage employees and accommodate their needs. Our research shows that the current challenges organizations face in managing their human capital are like the ones they face due to workplace demographic changes. This study focuses on analyzing those challenges and how human competency can be unlocked and developed to encourage sustainable autonomous working in an office, at home, or during frequent traveling. This study investigates the challenges faced by both organizations and employees, and presents a new business model that helps with the sustainable use of human resources and improves employee efficiency.

IEEM21-F-0063/Comparison of Stabilities for Open Source Project

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²Yamaguchi University, Japan

³Tottori University, Japan

In recent years, the use of open source software has been increasing, however it is difficult to measure the stability of software development and maintenance because of the different development scales and environments. In particular, the larger scale of the project and the longer period depend on the fault reporting, correction, and commitment, due to the complexity caused by the increase of the number of components. In this research, we propose and derive the methods resolving the cost of each stage in OSS development and maintenance. We verify the practical stability of project by evaluating the estimated results.

IEEM21-F-0090/Organisational Learning and Uncertainty Reduction in Innovation Projects: The Moderating Effects of Innovation Project Types

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¹Western Sydney University, Australia

This study investigates the direct impact of organisational learning in reducing innovation project uncertainty whilst accounting for the moderating effects of the innovation project types (process innovation and product innovation). This paper presents the findings of the empirical examination that tests these relationships within the scope of innovation projects from different industries. Structural Equation Modelling (SEM) analysis on data collected from 249 innovation project professionals to confirm the proposed hypotheses of the study. The findings of the study reveal that organisational learning reduces innovation project uncertainty, and this impact is more pronounced in projects focused on product innovations than process innovations. Therefore, the paper argues that organisational learning is imperative to reduce innovation project uncertainty and accordingly, it reduces innovation project failures that are associated with high project uncertainties.

IEEM21-F-0136/Analysis on the Cooperative Innovation Behavior and Stability of Inter-organizational R&D Project Based on Evolutionary Game

Xiaoxia Huang^{*1}, Peng Guo¹, Xiaonan Wang¹, Ding Wang¹
¹Northwestern Polytechnical University, China

This paper studies the strategies of multi-agent cooperative innovation alliances in inter-organizational R&D projects under the opportunistic behavior of asymmetric enterprises. There are two types of asymmetric enterprises: one is the dominant enterprise with high initial resource endowment, and the other is the member enterprise with low initial resource endowment. Based on evolutionary game theory, it analyzes the multi-agent cooperative innovation behavior of multi-agents and its influencing factors in inter-organizational R&D projects. Construct a game model to observe the cooperative behavior of asymmetric enterprises, and analyze the choice of evolutionary stability strategy combined with the replicator dynamics equation, and verify the theoretical research by simulation. This article proves the positive effects of trust, knowledge complementarity, government rewards, and the negative effects of technology coercive transfer coefficient, technology absorptive capacity, and risk coefficient. The opportunistic behavior of member enterprises will weaken the incentive effect of government rewards and aggravate the negative impact of risk factors. In addition, the fairness of income distribution will also affect the stability of inter-organizational alliances.

Session	QCM-02 Quality Control and Management 2
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Zhi Lin CHONG ¹ , Chenglong LI ² ¹ Universiti Tunku Abdul Rahman, Malaysia ² Northwestern Polytechnical University, China

IEEM21-F-0314/A Model to Assess the Impacts of ISO Management Systems Standards

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²Universitat de Girona, Spain

The most widely diffused ISO standards are ISO 9001 and ISO 14001. The main objectives of those are to demonstrate the capability to satisfy the requirements of the customers and to demonstrate the continuous search to reduce the impacts on the environment, respectively. However, these certifications will not necessarily be reflected in the performance of the company. Through the analysis of the literature, mixed results are observed, showing that not all certified companies could achieve benefits and improve the performance of the organization due to the ISO standards certification. Based on a literature review and a questionnaire survey, this paper defines a model where the main critical success factors which will influence the internalization level of the ISO 9001 and ISO 14001 are presented, and consequently their impacts on the organizations. This model could help researchers and practitioners in the process of evaluating the ISO standards impacts and the possible reasons for different outcomes.

IEEM21-F-0380/Multiscale Quality: Micro, Meso and Macro Concepts

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The quality concept can be defined according to different points of view, dimensions, and characteristics. Quality can be considered as a multiscale concept. This leads to the need of understanding how quality measurements and evaluations are done across products, processes, people, organizations and territories. The aim of this paper is to build a quality holistic view to the problems that arise in different management levels through a measurement system of quality. A preliminary literature review is presented and the main insights that come up from it are shown and explained, resulting in a definition of multiscale quality, as well as a first approach to the characterization of macro, meso and micro dimensions. The added value of this paper is the comprehension and clarification of several terms related to multiscale quality, as the terms micro, meso and macro have been increasingly used in different fields of application and knowledge. The future work intends to develop a model that can be used in companies as it integrates quality measurements of different management levels of an organization in a single integrated and consistent model.

IEEM21-F-0422/Quality Prediction Method by Modeling the Sustained Effects of Irregular Process Disturbances

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In manufacturing domain, there are increasing needs for quality control by utilizing various data collected from on-site. Machine failure, equipment component replacement, and other process disturbances are now collected by various sensors. The analysis of these data can help on-site managers to detect product quality drifts and to cope with them quickly and properly. However, the irregular and sparse nature of process disturbances causes prediction accuracy issue and modeling time issue. In this research, we propose a product quality prediction method using a stochastic process to model the irregular disturbances, and make prediction based on dense, regular matrix of sustained effects sampled from the stochastic process for modeling time reduction. As the result of applying the proposed quality prediction method to actual manufacturing data, the MSE (mean squared error) is reduced by 84.6% and the modeling time can be shortened to within 3 hours for daily update. Therefore, it can be estimated that our quality prediction method can help on-site managers to detect quality drifts at early stage and have a better control of product quality.

IEEM21-F-0458/Overall Performance Comparison of Homogeneously Weighted Moving Average and Double Homogeneously Weighted Moving Average Schemes

Zhi Lin Chong^{*1}, Kok Ming Chan¹, Junjie Wang², Jean-Claude

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²Zhongnan University of Economics and Law, China

³University of Pretoria, South Africa

⁴University of the Free State, South Africa

Control schemes are indispensable tools applied to monitor and control a process. The homogeneously weighted moving average (HWMA) scheme is recently suggested as a competitive alternative to the exponentially weighted moving average (EWMA) in detecting small to moderate mean shifts. Some researchers extended the HWMA scheme by proposing the double HWMA (DHWMA) scheme, and demonstrated the superiority of the proposed scheme. To better understand the run length performance of HWMA and DHWMA schemes, we conducted an in-depth study of their standard deviation of the run length (SDRL) and various percentiles of the run length performances. Moreover, noting that the exact shift size is unknown in practice, we considered the expected average run length (EARL) and expected median run length (EMRL) overall performance measures. Finally, some concluding remarks are presented.

Session	Poster 02
Date	December 15, 2021
Time	10:00 AM-11:30 AM
Chair(s):	Min XIE, City University of Hong Kong, Hong Kong SAR

IEEM21-F-0296/Review on the Application of Eye-tracking Technology in Usability Evaluation of E-government Apps

Jingyi Zhang^{*1}, Danni Chang¹, Zhen Zhang¹

¹Shanghai Jiao Tong University, China

With the development of "E-government service", the construction of government app has become necessary to deliver government service to citizens, and at the same time, it is of positive significance to find the shortcomings, so as to improve the service quality. Eye tracking technology has been increasingly used in the field of usability research; therefore, this study aims to analyze the state-of-art of the eye-tracking application in the field of usability evaluation of E-government App. For the purpose, content analysis was applied, and it is expected to explore the applicability of physiological experiment in government App evaluation and provide references for related experiment organization.

IEEM21-F-0298/ Eye Tracking-based Usability Evaluation of E-government App Icon Design

Zhen Zhang^{*1}, Danni Chang¹, Jingyi Zhang¹, Renbo Ding¹

¹Shanghai Jiao Tong University, China

With the rapid development of "E-government service," People have begun to understand current affairs and politics through mobile terminals. So, the improvement of user experience on E-government app has become important for governments to enhance their service quality. In this regard, qualitative evaluation has been widely practiced; however, evaluation experiments via users' bio data have not been sufficiently applied in this area. This paper thusly aims to explore the usability evaluation of government APP interface design through eye-tracking technology. In particular, the government APP, i.e., Minhang Today, was studied as a case, mainly focusing on the icon design and graphic arrangement. Based on the evaluation results, we also propose new design to improve the user experience of the E-government app further.

IEEM21-A-0054/Electric Kick Scooters Risk Issues Analysis from User Perspective Using DMR

Jeong Heo¹, Kyung-Jun Lee¹, Adriance Wilfred¹, Gyungbhin Kim¹, Myung Hwan Yun¹

¹Seoul National University, Korea, South

Personal mobility (PM) markets such as electric kick scooters have grown rapidly. Electric kick scooter's safety-related issues continue to be raised, but related research from the user's perspective is minimal. This study aims to investigate safety-related issues of electric kick scooters based on a user perspective. To meet our objective, we conducted a diary-based online survey with those involved in accidents while riding electric kick scooters. For two months, a total of 423 risk episodes were collected from 21 users. Those episodes were divided into prominent topics through Dirichlet Multinomial Regression (DMR). DMR is a methodology in which to extract various topics of reviews, identify important words and topic differences among various groups. Based on the result, DMR showed detailed risk issues and found precise user needs of electric kick scooters. This study identifies specific electric kick scooters attributes that cause user risk issues and enhance safety through suitable improvement. This study can be helpful for electric kick scooter developers to design a safe product.

IEEM21-F-0042/Research on Omni-channel Supply Chain Pricing Decision with the Allowance of Cross-channel Return

Shujun Yang¹, Huajun Tang¹

¹Macau University of Science and Technology, China

In the omni-channel supply chain structure, aiming at the phenomenon of non-defective return, the cross-channel return policy models of manufacturer's non-supply and cross-channel return policy were constructed respectively, and the effects of cross-channel return policy on market equilibrium and enterprise profit are discussed. The results show that the supply chain system always favors cross-channel return policy, while the preference of manufacturers and retailers depends on online and offline customer loyalty and online return rate. Furthermore, the online and offline product pricing and wholesale pricing decisions should take into account cross-channel service level, return processing costs and offline channel customer loyalty.

IEEM21-F-0119/A Heuristic-IRM Method on Hard Disk Failure Prediction in Out-of-distribution Environments

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The hard disk drives (HDD) are essential devices lying in primary layers of diverse information infrastructure. Long-term disk failure predictions are crucial to the stability and robustness of storage systems for data centers. In this paper, a domain adaption method is developed to improve prediction performance in out-of-distribution disk datasets. We propose heuristic invariant risk minimization (HIRM) with a new loss function to deal with imbalanced data. The HIRM combined with machine learning models are verified to promote the accuracy and stability in out-of-distribution (OoD) data. When hard disks with new SMART feature distribution are introduced into the data center, the proposed HIRM algorithm achieves better results than vanilla neural networks. A numerical example using the data from the BackBlaze data center is shown to illustrate the application of our HIRM model. The aims of each person are different.

Session SMS-03 Systems Modeling and Simulation 3

Date December 15, 2021

Time 12:00 PM-01:30 PM

Chair(s): Dinh Son NGUYEN¹, Min XIE²

¹University of Science and Technology, The University of Danang, Viet Nam

²City University of Hong Kong

IEEM21-A-0118/Semiparametric Modelling of Repairable Systems with Time Varying Heterogeneity Using Multivariate Gaussian Convolution Processes

Di Cui^{1*}, Qiuzhuang Sun², Min Xie¹

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²National University of Singapore, Singapore

A repairable system receives maintenance that restores the system to an operational state once it fails. The systems' heterogeneity that results from some unobservable factors may affect their failure behavior. Individual random effects are typically introduced to account for these unobservable factors and to avoid the negative effect of system heterogeneity on the inference results. Prior studies considering time-invariant random effects violate the time-varying nature of the repairable systems, since each repair action could change system's physical properties. Therefore, this study proposes a semiparametric model with multivariate Gaussian convolution processes (MGCPs) to tackle the above problem. The baseline trend function is modelled by trend renewal processes. We develop a Bayesian framework for the parameter estimation and the prediction of future events. The proposed method is illustrated by the simulation studies in terms of robustness and estimation accuracy.

IEEM21-F-0405/A Simulation-based Analysis of the Blood Supply Chain During Covid-19

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Based on interviews at Indonesian Red Cross in Yogyakarta, there has been a 30% decrease in blood supply since the Covid-19 pandemic occurred. This study aims to create system dynamics model of the blood supply chain, analyze the fulfillment of blood demand, create policy scenarios to significantly increase blood supply, and provide recommendations. The research stages consist of dynamic hypothesis, system dynamics model, policy scenarios, comparative analysis, and conclusions. There are many requests for blood from hospitals and blood transfusion units that have not been fulfilled. Policy scenarios that can significantly increase blood supply are made, namely: socialization of blood donation through short message applications, collaboration with agencies to donate blood, combined scenarios of socialization of blood donation and collaboration with agencies. Based on the capacity of Indonesian Red Cross in Yogyakarta, it can be concluded that the combined scenario with the combination of targets number 5 (contacting 14,723 people and collaborating with 5 agencies), 6 (contacting 17,667 people and collaborating with 4 agencies), and 7 (contacting 20 people and collaborating with 3 agencies) is recommended to apply.

IEEM21-A-0080/Airport Check-in Process Analysis Using Modeling and Simulation

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As the use of technology is increasing for various services at the airports, it is important to assess the impact of technology on the passenger process to avoid constraints like unwanted queues, long waiting times, congestion and unused facilities. Therefore, the aim of this paper is to study the check-in process at an airport to analyse the impact of self-service technology on the passenger flow through the process. The study uses CAST software for modeling and the Australian airport dataset. The model analyses the waiting time at traditional and modern check-in facilities using different scenarios on the basis of a flight schedule database.

IEEM21-A-0086/Robot Routing Problem with Last-mile Pickup and Delivery in Indoor Environments

Junsu Kim¹, Hosang Jung¹
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In this research, we introduce a robot routing problem with last-mile pickup and delivery in indoor environments. This problem typically applies to logistics and retail companies interested in robot-based delivery in multi-story buildings, where the actual last-mile services happen. Two issues need to be solved to provide reliable services with robots in indoor environments. The first is to calculate the reasonable travel time considering the vertical/horizontal move of robots in indoor environments, and the other is to optimize the robot routing problem using a problem-specific heuristic. By solving these two issues, we can generate an optimized pickup and delivery route that incorporates the characteristics of both robot and indoor environments. A numerical experiment with an illustrative example shows that the proposed method provides more realistic route plans. Furthermore, the proposed heuristic approach generates quick and good quality route plans in various problems, offering great potential for future practical adoption.

IEEM21-F-0437/Optimal Sizing and Contracting of Vehicle Fleets Under Uncertainty for Upstream Operations in the Oil and Gas Industry

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The supply of materials, equipment and services is an important logistic process for upstream operations in the oil and gas industry. Sizing fleets to timely supply resources is critical to keep rigs running and wells producing. This work presents a novel mixed integer linear programming formulation to address the fleet sizing and contracting problem under uncertainty. A two-stage stochastic optimization approach is proposed, providing a rigorous treatment of the uncertainty associated with the demand of vehicles and availability from suppliers. The mathematical formulation aims to determine the optimal fleet size and contract agreements such that the service level accomplished over the time horizon meets the minimum expected total cost, including contract fees and penalties for the unsatisfied demand. A real-world study case is solved and discussed to draw interesting conclusions.

IEEM21-F-0412/Leveraging Digital Twins for Compatibility Checks in Production Systems Engineering

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In a world driven by short times to market, inconsistencies are highly problematic because they lead to delays. However, the complexity of production systems and the number of disciplines involved increase, resulting in a higher likelihood for inconsistencies. Especially the compatibility between modules is an issue relevant for both design and maintenance. While designers have to integrate appropriate modules into a system, maintenance engineers have to quickly find appropriate replacements if modules fail. Approaches for managing inconsistencies, e.g., using Semantic Web Technologies, have the potential to support both design and maintenance by checking the compatibility of modules. So far, it was cumbersome to aggregate the necessary information for these approaches, but Digital Twins have the potential to resolve this limitation. This paper presents an approach for automating compatibility checks and thus accelerating design and maintenance processes for production systems using a combination of Semantic Web Technologies and Digital Twins. After transforming the systems' Digital Twins into Semantic Digital Twins, Semantic Web Technologies are applied to check compatibility between the production system's modules. The approach is demonstrated via an industrial use case from the special purpose machinery industry.

Session	TKM-05 Technology and Knowledge Management 5
Date	December 15, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Dilupa NAKANDALA ¹ , Hiranmay DASH ² ¹ Western Sydney University, Australia ² SP Jain Global, India

IEEM21-F-0508/Dynamic Service Innovation Capabilities in the Digital Age: An Integrated Research Framework and Key Research Questions

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The dynamic capability view (DCV) has been developed and considered one of the most promising approaches to research service innovation (SI) and the competitive advantage of firms. Extending on the existing works of service innovation and DCV, this paper proposed an integrated model of dynamic service innovation capabilities (DSICs). More specifically, the research framework is created by consolidating earlier works on DCV and SI. And this theoretical model incorporated both antecedents and consequents of DSICs. It also presents broad insights on the environmental factors as the contingency effect.

IEEM21-F-0104/Failure Knowledge-sharing Motivation with Self Determination Theory – Evidence from a Japanese Company

Sanetake Nagayoshi¹, Jun Nakamura²
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²Chuo University, Japan

This study clarified how the three basic needs that influence intrinsic motivation in organizational learning from failure, namely, autonomy, competency, and relatedness, relate to the willingness to participate in organizational learning-from-failure activities. This paper discusses the self-determination theory in organizational learning from failure and the willingness to participate in such activities. Many previous studies have studied the relationship between self-determination theory and knowledge sharing behavior. However, there has not been sufficient discussion of cases in which knowledge sharers are disadvantaged by knowledge sharing, or at the very least, are negatively psychologically burdened and fearful. For this reason, this paper limits itself to knowledge sharing in "learning from failure" and discusses the motivations in such knowledge sharing activities. Among these needs, autonomy and competency promote willingness to participate in organizational failure learning activities when the activities are consistent with organizational direction, whereas relatedness may not.

IEEM21-F-0316/Visualizing the Evolution of Reverse Knowledge Transfer Research: A Bibliometric Analysis Based on Citespace

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In recent years, interest in reverse knowledge transfer (RKT) is increasing. Using bibliometric software citespace, this paper was conducted based on data from web of science's 2000-2021 sample of RKT. Then the number of articles published, the author's collaboration network, the keyword map and the co-citations are combed. We found that: (1) The number of publications continues to grow rapidly overall, and researches in Western developed countries such as Britain are in a leading position. (2) Scholars represented by Mehmet Demirbag have gradually formed a core research group centered on British universities. (3) The researches focus on the absorptive capacity and the innovation performance of RKT, especially in emerging economies, using questionnaires and case analysis methods for research. This paper sorts out the development path of RKT, extends our understanding of its research hotspots and provides directions for future research.

IEEM21-F-0151/Digital Supply Chain in the Food Industry: Critical Success Factors and Barriers

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The global interest in the digital supply chain (DSC) has progressively increased due to the recent industrial revolution and pandemic demand for digital technologies. As a result, the implementation of DSC is highly critical; however, the implementation guidelines are still scarce and vague, especially on the standard implementation components such as critical success factors (CSFs) and barriers in the DSC implementation. The current study shows a systematic literature review of 72 articles on DSC implementation in the food supply chain (FSC) through technology, operation, and managerial dimension. The result shows the top three CSFs are the market pressure of an organisation, the knowledge, and training about the technology implementation and existing infrastructures. In contrast, expensive initial costs, a lack of skills, and a lack of inspiration are common barriers to implementing DSC in the food industry. This research will facilitate academics and food industry practitioners better understand how to adopt digital supply chains before investing in and planning supply chain (SC) digitalisation.

IEEM21-F-0110/Big Data Analysis for Predicting Future Skills

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The ability to predict skills of the future is fundamental in this rapidly changing global environment. The ability to predict and invest in the appropriate skills could prove to be a key differentiator for country specific growth. Global competitiveness, employment, technological investments, and social-economic dependencies are drivers to capacity development to predict future skills. The current approaches include a combination of expanding on current skill demand, adoption of economic indicators or survey-based forecasting. The challenge is the inclusion of future trends, specifically the ability to forecast new skills or combinations of existing skills. This research explores a novel method in adopting research publications to predict new/undetermined skills requirements. This study downloads 700 000 papers, develops a multilayer data analysis protocol, screens and provides insights into the adoption of research publications analysis for the prediction of future skills.

Session	OR-06 Operations Research 6
Date	December 15, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Bertha Maya SOPHA ¹ , Muhammad HANIF ² ¹ Universitas Gadjah Mada, Indonesia ² Huazhong University of Science and Technology, Wuhan, China

IEEM21-F-0012/Dynamic Vehicle Routing for Battery Swapping in an Electric Bike-sharing System

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In the daily operation of the emerging electric bike-sharing system, timely and efficient battery swapping is essential as there are no charging facilities at e-bike stations. This paper deals with the path planning of the trucks for battery swapping, considering dynamic battery demands at different stations. This problem is modeled as a vehicle routing problem with intermediate stops and soft time windows. A new solution method combining a dynamic planning strategy and a multiple neighborhood search algorithm is proposed to solve the problem. Numerical results on benchmark instances and a real-world case prove the effectiveness of our model and method.

IEEM21-F-0239/Truck Departure Optimization from Distribution Center to Parcel Locker with Stochastic Demand Arrival

Wenjia Zeng¹, Xia Yang¹, Mingyao Qi¹

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Alongside the rising of e-commerce logistics, parcel locker starts to shine its commercial talent for its flexibility and safety. Parcel locker can help trucks avoid long waiting times during deliveries and allow customers to pick up packages flexibly. However, it also left challenges on when to send parcels from the distribution center to the lockers, so that the turnover time of parcels can be reduced and the customer satisfaction improved. This paper constructs an integer programming model for a truck departure problem where parcels are delivered from the distribution center to the parcel locker. Then, we reformulate the model and propose a Sample Average Approximation (SAA) method to solve the problem that involves the uncertainty of parcel arrival time. Numerical experiments reveal that our algorithm can save 6.785% of the parcel turnover time compared with the traditional method. The average turnover time per parcel will be saved by more than 0.25 hours.

IEEM21-F-0369/A Heuristic Algorithm for Time-dependent Bus Scheduling Problem

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The travel time of buses is highly relevant to traffic conditions in real-world schemes. Typically, departing at different times will generally bring travel time changes for a given road segment, i.e., so-called time-dependent. Furthermore, over-flexible schedules are likely to be less satisfying for passengers. Thus, time-dependent-aware bus schedules are essential for bus operators to enhance practicability, resist uncertainty of traffic conditions. In this paper, a heuristic algorithm is developed to create a time-dependent bus schedule (i.e., timetables and fleet schedules). Based on a real dataset from the Shenzhen Eastern Bus company, we first generate initial timetables operating between two terminals, Base station, and Vice station, with respect to minimum trip counts requirements by the government. Assign operational tasks (i.e., timetable) to buses under consideration of time-dependent and fleet size, and then bus schedules are obtained. Results of numerical experiments reveal that our proposed algorithm can handle this problem efficiently.

IEEM21-F-0102/A Single Non-obnoxious Facility Location Selection for Utility Stores Corporation Using Center of Gravity and P-median Methods

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The locational analysis is an important and strategic decision of any supply chain and logistic system. An efficient and adequate supply of goods from warehouses to stores or customers is critical to meeting service-level requirements in today's competitive environment. Many consumer goods organizations operating their business in different regions usually have one central warehouse and several stores. With the dynamic and abrupt increase in customers' demand, a warehouse's optimized location is crucial. This paper determines an optimal location of a warehouse intending to minimize transportation costs. For analysis, the Center of gravity and p-median methods are applied to a case study of utility stores to optimize the warehouse location. Results show that the location achieved for the new warehouse is robust to two optimization criteria, i.e., the CoG and the p-median. Existing and new warehouse locations are compared in terms of transportation costs as well as a truckload. Moreover, the contour line technique is used to draw cost contour lines around an optimal location. The clubbing mechanism was also done for the timely delivery of goods to each store.

Session	PM-03 Project Management 3
Date	December 15, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Luca SILVESTRI ¹ , Aibo ZHANG ² ¹ University of Rome "Niccolò Cusano", Italy ² City University of Hong Kong, Hong Kong SAR

IEEM21-F-0371/Analysis of the Perspectives of the Stakeholders in Sustainability Management in Civil Construction: A Literature Review

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The civil construction industry has negative impacts on the environment. Thus, the management of stakeholders must be analyzed since the narrow relationship between the actors of the decision-making process and construction projects has been presented as an alternative with a view to managing sustainability better. Therefore, this article analyzed 29 documents published in the Web of Science - Main Collection database (Thomson Reuters Scientific) between 2000 and December 2020. Thus, the aim was to conduct a qualitative analysis on the perception of stakeholders regarding the implementation of sustainable development. This study revealed the main contributions found in the literature, such as: the government is the most common type of stakeholder when compared to other actors. The public-private model of project delivery is the one most commonly addressed in the literature. This is because of the need to mitigate the impact of economic crises and to keep within the budget set for projects. Also, it was verified that stakeholders have identified several drivers for implementing green practices, which are correlated to the pillars of sustainability.

IEEM21-F-0384/A Comparative Performance Analysis of Two MILP Formulations for the Re-source-Renting-Problem

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¹Clausthal University of Technology, Germany

In this paper, we consider the RRP/max, an extension of the well-known resource availability problem (RAP). The RRP/max does not only consider procurement costs but also time-dependent renting costs for resources used in a project. The objective of the RRP/max is to determine time-feasible starting times for all activities while minimizing the total resource cost to execute a project with general temporal constraints. We present two time-indexed MILP formulations as well as some new restrictions for the domains of the variables. To compare the presented models, we devised an extensive computational study where we compare the performance of the two formulations for benchmark instances from the literature.

IEEM21-F-0394/Improving Information System Development and Maintainability Factors Through Standardized Processes: An Empirical Study

Younes Benslimane^{*1}, Zijiang Yang¹, Eric Liu²

¹York University, Canada

²University of Waterloo, Canada

This paper examines how standardized processes affect information systems (IS) development project performance, key maintainability factors and the maintainability of the IS delivered. Main findings from a survey of 97 information technology (IT) professionals show that software process improvement models (SPIM), project management maturity models (PMMM) and formal development methodologies (FDM) can (i) improve the chances of success of IS projects and (ii) reduce key IS development problem factors that lower the maintainability of the IS delivered. Important findings also include a list of the top 10 specific issues affecting the maintainability of IS. Implications for research and practice are presented.

IEEM21-F-0445/Creating Business Domain Concepts in Regional Projects: In the Case of Japan

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Creating a project that can lead to a new industry in a region is possible today through the collaboration of many organisations. However, to make the project successful, it becomes important to set the project's domain concepts. Using the introduction to a series of new regional projects in northern part of Japan, Hokkaido as a case study, this paper reveals how to set an organisation's domain concepts with different specialities, such as an industry-academia-government collaboration, based on the concept of Ba in knowledge creation management. It also clarifies the relationship between the entrepreneurs who form the project and the concept of Ba.

IEEM21-F-0468/Incorporating the Influence of Risk Factor Interdependencies and Shared Risk Factors into Project Portfolio Risk Assessment

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The project portfolio expected results are generally affected or influenced by the materialization of risk factors. Therefore, risk management plays an undeniable role in the decision-making process. Project portfolio risk assessment is oriented to provide information on the importance of risks, giving decision-makers the information to support their risk management strategies. In this paper, the 'Impact Matrix Cross-Reference Multiplication Applied to a Classification' (MICMAC) approach was used to develop a proposal focused on analyzing the drive and dependence powers of risk factors based on the interdependencies between them. Therefore, the adjusted influence that each risk factor has on the project portfolio considering the shared influence derived from a risk factor on two or more projects can be calculated. Finally, a representative example is provided to illustrate the way in which the proposed model can be implemented and how the results can be analyzed.

IEEM21-F-0227/Project-oriented Selection of Agile Methods for the Design of Physical Products

Julian Baschin^{*1}, David Schneider¹, Tobias Huth¹, Thomas Vietor¹

¹TU Braunschweig, Germany

Agile methods can support the work in engineering design projects in order to react quickly to new boundary conditions such as changing product requirements. However, the use of agile methods is not established in mechanical engineering yet. It is useful to support the project manager in selecting a suitable agile method for the project's needs, because there is a large variety of agile methods in the literature and industry. Therefore, this paper presents a concept for the project-oriented selection of agile methods. The concept was applied to four different design projects in four companies. The results of the application are also shown in this paper.

Session	QCM-03 Quality Control and Management 3
Date	December 15, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Tahir MAHMOOD, <i>King Fahd University of Petroleum and Minerals, Saudi Arabia</i>

IEEM21-F-0477/Evaluation of World Class Operations Perspectives in Postal Organizations

Thabiso Mokoena¹

¹*University of Johannesburg, South Africa*

This study evaluated various perspectives about World Class Operations in the postal industry. World Class Operations include a combination of some of the key concepts, practices and philosophies derived from Japanese manufacturing systems, Operations Management and Process Engineering which have expanded and become applicable across various industries over the past few years to date. This study reveals based on perspectives from subject areas related to world class operations, that the industry consists of postal organizations that have shown improvements in certain regions, while there is significantly much work to be given attention to by the majority of the industry to become world class competitive postal organizations.

IEEM21-F-0155/Methodology for a Model-based Traceability of Requirements from Complaints in Business Networks Using e-DeCoDe

Marian Mistle¹, Nadine Schlueter¹, Manuel Loewer¹, Vincenz Rafalczyk¹

¹*University of Wuppertal, Germany*

The traceability of requirements is an enormous challenge for business networks (BN). To achieve a fast processing of customer complaints in BN, we present a methodology for a model-based traceability of requirements from complaints in BN using the e-DeCoDe approach. The methodology shows how the causes of errors in the product development of BN can be identified based on requirements from complaints. In addition, the methodology shows how the organization of the company is affected in the context of the product development and can contribute to finding solutions for the fulfilment of requirements. The development of such a model-based methodology holds a multitude of possibilities for finding the causes of errors and solutions, as well as the potential to automate the complaint process for the entire BN. This potential is currently not sufficiently exploited by companies because there is a lack of a consistent model-based methodology that considers the entire context of the BN with systems thinking. In order to face this problem, the developed methodology links two German Research Foundation projects for the first time through e-DeCoDe modeling.

IEEM21-F-0414/Knowledge Management Embedded in Agile Methodology for Quality 4.0

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Quality 4.0 evolved as a response to the Industry 4.0 trend, in order to help establish the role and implications of quality in the Industry 4.0 era. While at the current time there is still uncertainty regarding the full implications of quality in Industry 4.0 and the ways in which quality will help complement it, it is however essential to focus on trying to find answers to some of these questions. The paper proposes an agile type development approach for the implementation of Quality 4.0 tools through a Knowledge Management life cycle. In the paper, the authors have identified the key particularities of Quality 4.0 and the relationship between Quality 4.0 and Industry 4.0 and have highlighted the role of Knowledge management in Quality 4.0.

IEEM21-F-0425/A Hierarchical Graphical Model of Critical Success Factors for Implementing the UAE's Government Excellence

Ola Khalid AlZawati¹, Hamdi Bashir¹, Imad Alsyounf¹

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The study aims at identifying the key success factors of the government Excellence Model (GEM) that is implemented by the public sector of the United Arab Emirates (UAE). The GEM, specifically designed for public sector organizations, was launched by the UAE federal government in 2015 and was adopted by the Dubai Government Excellence Program in 2016. However, there are no studies made yet to identify its critical success factors (CSFs) to assure or augment its successful implementation. Hence, the objective of this study is to define and structure the CSFs that are affecting the implementation of the GEM. In this piece, 28 factors were identified through the literature and expert review from a UAE public sector organization. Interpretive structural modeling is used to understand the complex relationships and portray it in a simplified model. The result shows that "top management commitment" is a key success factor for implementing the GEM by the public sector. Sense of belonging and reputation have been found to be the ultimate factors resulting from the implementation of the GEM.

Session	Poster 03
Date	December 15, 2021
Time	12:00 PM-01:30 PM
Chair(s):	Jingyi ZHANG ¹ , Linda ZHANG ² ¹ <i>Shanghai Jiao Tong University, China</i> ² <i>IESEG School of Management, Univ. Lille, CNRS 9221, France</i>

IEEM21-F-0341/How Effective Vertical Organizational Communication Impacts the Success of Hoshin Kanri Strategy Implementation in Medium-sized Manufacturers

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¹*Technical University of Denmark, Denmark*

Implementing a new strategy is the perhaps most important task of any firm's top management. Lean manufacturing and the Toyota Production System refers to the development and implementation of a new strategy as Hoshin Kanri. Success in Hoshin Kanri is influenced by many factors. This study examines how vertical organizational communication in and around the Hoshin Kanri effort impacts the effort's chances of successful completion. The study researches two cases within one firm, a medium-sized manufacturer of medical devices. Each of the two cases constitutes 'one effort of developing and implementing a new strategy using Hoshin Kanri'. The first effort was unsuccessful, and the second effort builds on the learnings from the first effort. The study develops a set of five researchable propositions that connect vertical organization communication with Hoshin Kanri implementation success. The two cases reveal that effective vertical communication has profound effects on Hoshin Kanri success. In particular, the clarity of the effort's key targets, the credibility of current baselines, a broad and early involvement of middle managers and specialists, and the use of internal process facilitators.

IEEM21-A-0138/Information Exchange in Ill-structured Decision Making by Teams

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Applications of technology that contribute to managing decision-making teams for their objectives benefit from an explicit account of micro-processing in the information exchange of team members. This is especially the case for ill-structured decisions that have little or no analytic basis. While negative evaluations are well recognized as a key information type in this exchange, the micro-processing that underlies its exchange has not been well defined. Negative evaluations will be proposed to differ from other information types because of their dual properties as information and affect. We examine dynamics that are implied by the duality in negative evaluations and report empirical studies that test abstract generalizations. We then give an explicit form to exchange of negative evaluations in a numerical model of information exchange and use the model in exercises that directly demonstrate the proposed properties of negative evaluations in information exchange. Finally, we review contributions that the discourse offers to the design of AI-supported GDSSs for managerial objectives in the exchange of information in ill-structured decision making. Keywords- Ill-structured decisions, Information exchange, Negative evaluation, GDSSs.

IEEM21-F-0092/Advance Selling Strategy for Risk-averse Strategic Customers

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In recent years, the advance selling strategy has been gradually applied to the sales of goods in various industries, including consumer electronics, fashion, travel, ticketing, and seasonal goods. Compared to traditional sales methods, retailers can use an advance selling strategy to attract consumers to order goods in advance, thereby mitigating the uncertainty of demand and increasing profits. As the advance selling strategy will make it impossible for consumers to accurately perceive the value of the product during the advance selling period, there may be a bias in the valuation of the product, which may result in consumers' decision not to book products in advance. The thesis studies a single advance selling strategy for storable goods. Based on consumer arrival rate and the distribution of product valuation, the thesis offers the optimal advance selling price for the single advance selling strategy that maximises consumers' expected profit.

IEEM21-A-0058/On the Assignment Problem and its Application in Automated Settlement of Receivables

Lukasz Czekaj¹, Robert Olszewski², Robert Kitlowski¹, Tomasz Biegus¹, Stanislaw Raczynski³, Pawel Tomasiak³, Mateusz Olszewski³, Alexander Prokopenya⁴, Ryszard Kożera⁴

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This paper covers automated settlement of receivables in non-governmental organizations. The problem concerns assignment payments (bank transfer) to receivables (e.g. membership fee). The assignment is many-to-many relation: single transfer may cover many receivables and single receivable may be covered by many transfers. However, we expect that assignment relation splits into many small and sparse components. Here we utilise this knowledge to improve quality of automated assignment. We tackle the problem with entity matching techniques. First, we match transfer to organisation member, then we match transfers and receivables for given member. We consider setup, where base algorithm is used for preliminary ranking of matches, then we apply several novel methods to increase matching quality of base algorithm. Proposed methods base on greedy assignment and optimal linear assignment. The methods presented here contribute to automated settlement of receivables and entity matching. We evaluate our approach on real world operational data which come from company providing settlement of receivables as a service: proposed methods boost recall from 70% (base model) to >77% at precision 90% for given member.

IEEM21-F-0335/From Smart Card to Mobility as A Service (MaaS): A Case Study from Kaohsiung City, Taiwan

Wen-Ping Chao¹, Keng-Chieh Yang¹

¹National Kaohsiung University of Science and Technology, Taiwan

This study applied Latent Class Analysis (LCA) to analyze smart card and mobile payment behavior in Kaohsiung City, Taiwan. Smart card has been used in many areas, especially in transportation, banking, government, and electronic commerce. Mobility as a service (MaaS) has been widely introduced in European city and North America. However, this needs more justification to understand how to transform from smart card to MaaS. This study uses Kaohsiung City bus passenger dataset to analyze the payment behavior. The findings indicate that four classes have been discovered and revealed different payment behaviors. The study further concludes with managerial implications and future directions.

IEEM21-F-0141/Product Group Technology Under Multiple Process Paths Based on Genetic Algorithm

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Frequent setup activity during production affects the production efficiency which is caused by multi-variety and small-batch production mode, Group Technology can effectively shorten the setup time. Different process paths are formulated for each workpiece to increase scheduling flexibility by considering the dynamic information of the workshop. In this paper, a method based on Genetic Algorithm (GA) is proposed for workpiece grouping under multiple process paths. Firstly, the representation method of the product process path is determined, and then a mathematical model is established with the workpiece similarity as the objective function. Moreover, the improved Genetic Algorithm is used to find the optimal process path scheme of the workpiece. The multi-part segmented coding method, the crossing, and the mutation operation of the process path are designed. Finally, the workpiece grouping scheme is solved by constructing the process-workpiece correlation matrix to obtain the workpiece similarity matrix and the similarity fuzzy equivalence matrix. Various process paths of 8 kinds of electronic products are used to prove that the proposed method is effective.

IEEM21-F-0017/Cyber-physical System-based Workshop

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Oriented by mass customization in recent years, manufacturing enterprises need to transform their traditional workshops to smart workshop. Cyber-physical system (CPS), as a core of industry 4.0, plays an essential role in smart manufacturing. By applying CPS, the traditional workshop will shift into a new paradigm with intelligence and flexibility. However, the implementation of CPS in workshop is a complex task, which is still in its infancy. Thus, this paper presents a comprehensive perspective on CPS-based workshop, which can facilitate the implementation CPS-based workshop in industry. Firstly, a conceptual model of CPS-based workshop is developed, which presents the three fundamental elements and closed-loop mechanism of CPS-based workshop. Secondly, seven features of CPS-based workshop are identified, including self-sensing, self-awareness, self-assessment, self-optimization, self-adjustment, self-configuration, and self-control. Finally, a case study of Chinese machinery manufacturing company illustrates the feasibility of implementing CPS-based workshop in industry.

IEEM21-F-0406/Research on the Lean Logistics System Framework of Tobacco Commercial Enterprises in the Context of Digital Empowerment

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As the last key link in the tobacco industry chain before the consumer terminal, the management level of tobacco commercial enterprises in the context of the digital economy and new logistics is a critical factor in determining the effectiveness of the digitally enabled tobacco industry's high-quality development. Guided by system theory and based on the operational logic of the skeletal system, this paper constructs a research framework of "14566" lean logistics system for tobacco commercial enterprises in the context of digital empowerment. The framework is divided into five subsystems, and the implementation of each subsystem is discussed to provide reference for the construction of lean logistics system for tobacco commercial enterprises and promote the high-quality development of tobacco commercial enterprises.

IEEM21-F-0363/A Fast Approximate Method for the Large-scale One-source P-median Problem

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The p-median problem (PMP) involves determining p locations among a set of candidates on which for building q facilitates to best serve the customers scattered around. In real industrial applications, the scales of the problems may be large, with hundreds of candidate locations and thousands of demanding customers, such that solving directly the PMP using a mixed-integer programming (MIP) solvers may consume a lot of CPU time. In this paper, we presented a fast clustering-based method with continuous optimization model for the large-scale one-source PMP, where a two-stage strategy is applied to obtain the globally optimized solutions. Computational experiments were conducted on two groups of synthesized datasets to test the performances of the proposed method. The experimental results showed that optimal results could be obtained with much higher efficiencies, even hundreds of times faster than that of the traditional way.

Session	SCM-07 Supply Chain Management 7
Date	December 15, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Bertha Maya SOPHA ¹ , Kendrik Yan Hong LIM ² ¹ Universitas Gadjah Mada, Indonesia ² Agency for Science, Technology and Research, Singapore

IEEM21-F-0409/A Sustainable Supply Chain Inventory Model with All-units Quantity Discount and Shipping Weight

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 In this article, we study an integrated inventory model for a single-seller and a single-buyer by considering the emission and quantity discount. The type of discount policy offered by the seller to the buyer is an all-units quantity discount. The emissions are generated by seller-buyer activities, loading-unloading, and transportation activities. We consider lead-times that depend on the production, transportation, loading-unloading, and in-transit activities. The objective is to minimise the integrated total cost considering all-units quantity discount. We optimize the decision variables, such as: the lot size, number of deliveries, safety stock, lead-time, and carbon emissions. Numerical example is used to illustrate the proposed model.

IEEM21-F-0416/E-Commerce: Challenges That Lies Ahead of the Future Air Cargo Operation

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¹Mae Fah Luang University, Thailand
 Air cargo is growing exponentially and can become one of the main revenues for aviation sector. With the COVID-19 crisis, air cargo plays an important role for deliver much-needed products such as vaccine or medical supplies. Moreover, E-commerce is also affecting the growth of air cargo industry. The purpose of this study is to explore the current state of air cargo industry and explore the challenges that air cargo industry will meet after the pandemic ends. The result shows that capacity shortage is the most significant challenges that air cargo need to consider in order to cope with rapid demand. The second factor is speed which is also important since customers demanding for the fast delivery.

IEEM21-A-0091/Lateral Transshipment Scheduling Model in a Distribution System

Gitae Kim¹
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 In a distribution center with one distribution center and multiple retailers, inventory management is an important issue. Due to the uncertainty of demand at retail sites, the inventory in retailers can be sufficient or insufficient depending on demand. To resolve the unbalance of inventory in retail sites, the lateral transshipment between locations is used. However, we consider the cost of transshipments. In this paper, we formulate a mathematical model to find optimal schedule of transshipments to minimize total costs including stockout cost and transshipment cost. From the numerical results, we can determine when to and how often transship inventory between retail sites.

IEEM21-F-0440/Blockchain-driven Supply Chain Finance – A Structured Review

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 The use of blockchain technology in supply chain finance promises to solve existing inefficiencies of conventional supply chain finance methods. With the help of a systematic literature review, these issues are uncovered, showing how blockchain could solve them. The main problems include the non-transparency of complex networks, insufficient risk control, information asymmetries, and inefficient processes. Blockchain-based SCF platforms can solve these problems with key features such as decentralization, transparency, traceability, and automation capability.

IEEM21-F-0349/Smart Retail Adaptation Framework for Traditional Retailers: A Systematical Review of Literature

Muriani Emelda Isharyani¹, Bertha Maya Sopha², Muh. Arif Wibisono², Benny Tjahjono³
¹Universitas Mulawarman, Indonesia
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 The application of smart retail in traditional retail requires adaptation, rather than adoption to make it affordable both in terms of cost and capabilities. This study proposed a framework of smart retail adaptation in traditional retailers drawn from a systematic literature review. The adaptation processes consist of three stages, that are visioning, design, and implementation and evaluation, which are iterative. The iterative processes ensure that technological innovations are continuously evaluated to avoid the risk of out-of-use and out-of-date. Eventually, the framework is useful in implementing adaptation stage-specific strategies to promote smart retail adaptation for traditional retailers, particularly in developing countries.

Session	DAM-04 Decision Analysis and Methods 4
Date	December 15, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Tahir MAHMOOD ¹ , Huadong MO ² ¹ King Fahd University of Petroleum and Minerals, Saudi Arabia ² UNSW Canberra at ADEFA, Australia

IEEM21-F-0372/Extreme Learning Machine for Short and Mid-term Electricity Spot Prices Forecasting

Inês Teixeira¹, Ana Paula Barroso¹, Teresa Marques²
¹Universidade NOVA de Lisboa, Portugal
²Bondalti, Portugal
 In a deregulated electricity market, market participants define trading strategies and models to assist the decision-making process. Companies whose operation is heavily dependent on this market are increasingly adopting electricity price forecasting models to identify sales and purchase contracts with the best price. This paper intends to contribute to the improvement of the decision-making process for purchasing electricity in the Iberian Electricity Market. The purpose is to develop a forecasting model for electricity spot prices based on prices established on the derivatives markets. The model uses Artificial Neural Networks trained with the Extreme Learning Machine algorithm to determine the monthly average spot prices for the next six months and provides a tool for making trading decisions considering the risk of exposure to spot market volatility. The forecasting model was applied in two scenarios: pre-pandemic and pandemic. The results prove that its application can contribute to improving decision-making for trading electricity in the short/medium term. Experimental results considering both scenarios show that the proposed model can provide month-ahead forecasts with an RMSE up to 6.38 €/MWh.

IEEM21-A-0073/Exploring the Cognitive Process of Interviewer During Employment Interview Using Think Aloud Method

Shiyun Zhao¹
¹University of Strathclyde, China
 The decision making of employment interview has received wide interest from both practitioners and researchers. Most previous research have focused on correlation analysis between interviewers' final decisions and various factors, while there is a lack of investigation into the decision makers' cognitive process at an individual level. To address the gap, this research introduces a psychological methodology termed "think aloud" to explore interviewers' thoughts when making decisions. A set of scenario experiments simulating employment interview process are conducted, and the verbal protocols collected are analysed to address four research questions: (1) what decision-making actions and strategies interviewers adopt, (2) what information they concentrate on to facilitate their reasoning processes, (3) how various factors lead to differences in interviewers' decision-making behaviour, and (4) how behavioural-based measurements could be developed to evaluate interviewers' decision-making performance. This study also provides direct protocol evidence that helps verify some of the well-known propositions generated through traditional controlled trials, such as similar-to-me effect, halo/horn effect, etc. Besides, the results can be expected to support the development and application of computer-based tools in employment interview.

IEEM21-F-0387/An Analysis of Social Sustainability Indicators Using FITradeoff Multicriteria Decision Method

George Passos Neto¹, Luciana Hazin Alencar¹, Emilia R. Kohlman Rabbani², Rodolfo Valdes-Vasquez³

¹Universidade Federal de Pernambuco, Brazil

²Universidade de Pernambuco, Brazil

³Colorado State University, United States

The social sustainability pillar receives the least attention compared to the other pillars: environmental and economic. Nevertheless, the social pillar is fundamental to achieve the long-term objectives of construction projects. Thus, this study aims to support implementing social sustainability indicators in construction companies, contributing to more sustainable decisions. The GRI Standard's social sustainability indicators were classified in this study in three categories: (i) mandatory, (ii) which could or not be applied by the company, according to its priority, and; (iii) those not applicable for the region analyzed. For those that could be applicable, the FITradeoff method was applied to create a priority ranking accordingly to four criteria defined by the company's decision-maker: return over investment, marketing, the capacity of implementation, and team engagement. As a result, a company can implement these social indicators according to the obtained rank, enabling them to make more sustainable decisions.

IEEM21-F-0460/Comparing Statistical and Machine Learning Methods for Sales Forecasting During the Post-promotional Period

H. Niles Perera¹, Harsha Chamara Hewage¹

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Retail sales promotions lead to complexity in the retail supply chain. Generally, sales promotions consist of three types of periods: a normal period, a promotional period, and a post-promotional period. However, research on forecasting with sales promotions has focused specifically on promotion effects and the subsequent sales uplift due to the promotion. Often, they are not incorporating post-promotional periods with the sales forecasts. Thus, we model sales forecasts at the stock keeping unit level using popular univariate and machine learning models to investigate their performance in the presence of the post-promotional period. Our study shows that machine learning models can identify the post-promotion effect in the presence of the right features and perform better than univariate methods. We believe our findings will help retailers plan future sales promotions effectively.

IEEM21-F-0486/A Multicriteria Group Decision-making Model for Selecting a Perishable Food Packaging System Using an Outranking Method

Over M. Causil¹, Danielle C. Morais¹

¹Federal University of Pernambuco, Brazil

Because most decisions in the agribusiness environment are making in a group and supplier selection of package system is a crucial problem to be solved in this context, thus it is presented a multicriteria group decision-making model which having into consideration judgment preferences from several specialists and a beneficent supra decision-maker. The proposed model is the result of the integration of the main advantages of renowned multi-criteria techniques. Its principal benefit is the effortless manner as to obtain the criteria value without having to do a pair-wise comparison among criteria. The PROMETHEE II and PROMETHEE GDSS are implemented to obtain individual and collective ranking and the ROC is utilized to estimate the criteria weight values only providing a ranking of the attributes by DMs. A case study was conducted satisfactorily in the food industry and a recommendation of a packaging system was provided.

Session MS-04 Manufacturing Systems 4

Date December 15, 2021

Time 02:00 PM-03:30 PM

Chair(s): Subham KUNDU¹, Mohammed DAHANE²

¹Heritage Institute of Technology, Kolkata, India

²Université de Lorraine, France

IEEM21-F-0398/Implementation of Lean Production for Achieving Low-cost Product: A Case Study of ABC Company

Jonny Jonny¹

¹Bina Nusantara University, Indonesia

In today's highly competitive industry, achieving highest Process Cycle Efficiency (PCE) is a must for any company to gain competitive advantage including ABC company. This company has implemented Lean Production throughout the company's manufacturing facilities. In this initiative, a research is conducted using Value Stream Mapping (VSM) to follow all processes used by producing product A as one of the company's line of products. Through this tool, waste was able to be carefully identified and eliminated to gain low-cost product. By doing this, PCE of the company experienced an 56% increase from 15.60% to 29.60% and 44% pricing index. Thus, the implementation of this initiative has given insight that low-cost product can also be gained by improving PCE.

IEEM21-F-0419/Management Framework for the Highly Iterative and Integrated Product and Production Process Development (HIP³D)

Günther Schuh¹, Andreas Gützlauff¹, Seth Schmitz¹, Shari Wlecke¹, Annkristin Hermann¹

¹RWTH Aachen University, Germany

The increasing technological progress and global competition are leading to a changing market environment. To remain competitive, companies must meet customer requirements as quickly and individually as possible. Accordingly, products must be developed faster, more cost-effectively, and in a customer-centric way. However, this cannot be achieved by plan-driven development approaches since sequential development of product and production process leads to long lead times and increases the effort to integrate late changes into the development. Agile approaches provide initial solutions for customer-oriented product development but neglect the integration of production process development. An approach that considers both is the highly iterative and integrated product and production process development (HIP³D). It presents a possibility to enable shorter development cycles, greater customer involvement, and a reduction of time-to-market. However, this approach requires a change in organizational structure and lacks a management framework. Accordingly, characteristics of the HIP³D are derived, central positions in the company are identified, and an organizational structure is presented. Additionally, an overview of the tools and methods in the framework and relevant KPIs are presented.

IEEM21-F-0455/Development of a Model to Evaluate the Potential of 5G Technology for Latency-critical Applications in Production

Raphael Kiesel¹, Falk Boehm¹, Jan Pennekamp¹, Robert Schmitt¹

¹RWTH Aachen University, Germany

Latency-critical applications in production promise to be essential enablers for performance improvement in production. However, they require the right and often wireless communication system. 5G technology appears to be an effective way to achieve communication system for these applications. Its estimated economic benefit on production gross domestic product is immense (\$740 billion Euro until 2030). However, 55% of production companies state that 5G technology deployment is currently not a subject matter for them and mainly state the lack of knowledge on benefits as a reason. Currently, it is missing an approach or model for a use case specific, data-based evaluation of 5G technology influence on the performance of production applications. Therefore, this paper presents a model to evaluate the potential of 5G technology for latency-critical applications in production. First, we derive requirements for the model to fulfill the decision-makers' needs. Second, we analyze existing evaluation approaches regarding their fulfillment of the derived requirements. Third, based on outlined research gaps, we develop a model fulfilling the requirements. Fourth, we give an outlook for further research needs.

IEEM21-A-0101/Quality and Yield Loss Prediction in Polyvinyl Films Manufacturing

Shoban Babu Balasubramani^{1,2}, Tuhin Mondal¹, Debraj Patra¹, Rajesh Rangaswamy¹

¹Accenture Solutions Private Limited, India

Polyvinyl films are most used materials in packaging, home interiors, solar panels, aircraft interiors, etc. This type of products are produced through extrusion process, which is complex and highly supervised in nature. Quality issues in PVFs may result into remanufacturing and wastages which in turn cause into yield loss. A predictive cum prescriptive model can help the operators to foresee the expected outcome during the production process itself and can help them with suitable operating regime to minimize the same. This paper proposes a ML based Simulation approach for defect prediction, so that operators can not only get the predicted defect but also can check how, changing one parameter's setpoint can affect the different defects type in the production and how the process throughput and yield varies based on setpoint. The simulation approach relies business and/or process input and AI developed through ML based approach. This approach gives the right amount of visibility to the operators regarding the end outcome of the manufacturing process and gives flexibility to enhance productivity. Keywords - Quality analytics, Yield analytics, Predictive modeling, Machine learning

IEEM21-F-0479/Development of New Univariate Process Capability Index for Multistage Wheel Manufacturing System

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²Indian Institute of Engineering Science and Technology, Shibpur, India

Process capability indices (PCI) are widely appreciated nowadays to measure the performance of a process. They are used to evaluate single or multiple quality characteristics of the process output such as a product or service according to their specifications. Univariate process capability indices are used to analyse a single quality characteristic of a product. Cp, Cpk, Cpm and Cpmk are widely used univariate process capability indices that required significant statistical knowledge to analyse. In this paper, a new univariate process capability index [Ca, A_{dev}, AI] is developed to measure the performance of a multiple-stage locomotive wheel manufacturing system. This index is based on a simple geometric formula and using a process performance monitoring chart. It is less complicated, user friendly and quite suitable for products with one-sided specification limits.

Session	SIM-02 Service Innovation and Management 2
Date	December 15, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Desmond WONG ¹ , Zhao-Hui SUN ² ¹ University of Hull, United Kingdom ² Shanghai Jiao Tong University, China

IEEM21-F-0010/Research on Customer Market Segmentation of Electric Vehicle Rental Sites Based on Latent Class Modeling

Peng Guo¹, Rui Miao¹, Bo Zhang¹, Hao Hu¹

¹Shanghai Jiao Tong University, China

With the increasing expansion of customer groups at electric vehicle (EV) rental sites, there are large differences in customer needs, while operators cannot meet the diverse needs of customers through the existing service system. Based on the latent class modeling (LCM), effective customer market segmentation (CMS) for customer groups at EV rental sites is performed to improve the service system. First, probability parameterized expression and probability parameterized estimation are carried out to establish the explicit variables of customer market segmentation. Then, spectral clustering method is applied to conduct market segmentation of LCM. Through multiple iterations and calculations, 5 stable types of customer market are obtained and corresponding decision support are provided. Finally, the model fitness test proves the feasibility and effectiveness of CMS based on LCM. This research helps to realize the EV rental service optimization and increase the profit, which is of great significance to the urban governance and the sustainable development of the EV rental industry.

IEEM21-F-0115/Wellness Tourism Destination Assessment Model: A Development Indicator in an Emerging Economy-Thailand

Thadathibesra Phuthong¹, Pongpun Anuntavoranich¹, Achara Chandrachai¹, Krerk Piromsopa¹

¹Chulalongkorn University, Thailand

At present, the affluent, medical and wellness tourism industry in Thailand is facing challenges in global tourism competitiveness that includes assessment of the country's potential and readiness to become the leading in wellness tourism and sustainable restoration of world-class quality. This research developed indicators for assessing the potential of wellness tourism destinations, in which affluent, medical and wellness tourism is among the main target industries that are important to the economic development of Thailand. This research was preliminarily conducted by using systematic literature review. The results of the study reveal that potential wellness tourism destination assessment in the Thailand context consists of seven factors and 50 indicators. Based on the results, recommendations for future research are provided. In an empirical research, a questionnaire was used as the tool for data collection and component analysis confirmation. Then, the generated factors and indicators were used to develop innovative systems for assessing the potential of wellness tourism destinations and to be tested on stakeholders of the same in Thailand.

IEEM21-F-0125/Research on the Impact of Network Embeddedness on Enterprise Innovation Performance -- Based on the Mediating Role of Business Model Innovation and the Moderating Role of Competition Intensity

Qingfeng Tian¹, Guoqing Li¹, Rui Xu¹

¹Northwestern Polytechnical University, China

Based on the empirical study of 175 high-tech enterprises in China, this paper finds the path relationship among network embeddedness, business model innovation and innovation performance. The results show that both relational embeddedness and structural embeddedness have a significant positive impact on firm innovation performance. Business model innovation plays a mediating role in the relationship among relational embeddedness, structural Embeddedness and firm innovation performance, but the effect is different. Competition intensity negatively moderates the relationship between embeddedness and business model innovation. The results provide new guidance for enterprises to identify and optimize the relationship network and structure network, and match the network structure with business model innovation to improve innovation performance.

IEEM21-F-0154/Smart Product Service Requirements Identification and Evaluation: A Hybrid Method

Ziding Meng¹, Zhihua Chen¹, Zhao-Hui Sun¹, Xinguo Ming¹

¹Shanghai Jiao Tong University, China

Identification and evaluation of smart product service requirements (SPSRs) are considered to be the critical steps for smart product service system (smart PSS) designing. However, there are few studies on the SPSRs identification and lack of service evaluation methods that comprehensively consider multiple uncertain factors. Therefore, this paper proposes a framework for SPSRs identification, which innovatively considers the characteristics of smart PSS and helps to elicit SPSRs from the logic of data value creation. Furthermore, considering the effects of individual semantic vagueness and individual subjective preference, a method based on the rough-fuzzy number is proposed, which helps service designers obtain subjective and accurate evaluation results. The case of the smart maintenance service of smart cars is used to prove the flexibility and feasibility of the identification and evaluation method.

IEEM21-F-0200/Optimal Pricing for Online Delivery Platforms with Group Buying and Direct Delivery

Lewen Yuan¹, Li Xiao¹

¹Tsinghua University, China

Group buying is an emerging business model innovation in online delivery industry. In this paper, we model a platform which provides products and delivery service, including direct delivery and group buying. We study the behavior of customers and pricing strategy of platforms. The results show that: (1) Customers tend to choose group buying for low-price products and direct delivery for high-price products. (2) For platforms, the optimal price is first decreasing and then increasing in delivery fee. (3) The platforms could choose to become mid-end or high-end platform. Mid-end platforms would provide both services with low price and delivery fee while high-end platform would only provide direct delivery service with high price and high delivery fee.

Session	CM Crisis Management
Date	December 15, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Maria de los Angeles GOMEZ ¹ , Aunchalee TAWEETHAVORNSAWAS ² ¹ Universidad Popular Autónoma del Estado de Puebla, Mexico ² King Mongkut's University of Technology North Bangkok, Thailand

IEEM21-F-0159/Leadership for Team Adaptation and Performance During COVID-19 Crisis and Beyond: An Examination of Leader-member Exchange and Leader Humility

Kanupriya Singh¹

¹University of Missouri, United States

With the outbreak of the COVID-19 crisis, organizations have had to move into virtual teamwork settings overnight which had been daunting for the employees as they were not mentally prepared and trained for the change. As a consequence, employee turnover increases, if leadership is not skilled and trained for an effective transition and establishment of virtual work settings during the COVID-19 crisis. Theoretical and empirical evidence suggest leader-member exchange (LMX) and leader humility as effective leader behaviors for team adaptation and performance. The proposed study will conduct a longitudinal investigation of the effect of LMX and leader humility on team adaptation and performance during the COVID-19 crisis and as organizations come out of it. The expected results of this study will be useful for the leadership and teams in industries and organizations as they transit out of the COVID-19 crisis.

IEEM21-F-0376/Vehicle Interdiction Strategy in Complex Road Networks - A Simulation Based Approach

Goutam Sen¹, Sukanya Samanta¹, Soumya K. Ghosh¹

¹Indian Institute of Technology Kharagpur, India

The dynamic crimes like kidnapping, bank robbery, ATM loot must get special attention from police as the static crime removal techniques are insufficient to contain this type of crime. Here, the criminal changes his location with time. Thus, the decisions should be made rapidly within a certain amount of time. Again, the city roadnetworks are complex, and the police resources are also limited. Therefore, an effective resource allocation strategy for police vehicles needs to be developed to catch the criminal. We propose a simulation-based approach using the Simulation of Urban MObility (SUMO) simulator to develop interdiction strategies. The developed simulation approach is tested with a case study in the IIT Kharagpur road network with 123 nodes and 281 edges.

IEEM21-F-0462/Concept for Enhancing the Contribution of Product Development to Organizational Resilience of Manufacturing Companies

Michael Riesener¹, Maximilian Kuhn¹, Jonas Tittel¹, Günther Schuh¹

¹RWTH Aachen University, Germany

In times of unpredictable business environments, manufacturing companies are increasingly exposed to rising internal and external disturbances. In terms of sustainable corporate management, the resilient design of a company and its corporate functions is gaining importance. Companies are attempting to increase the resilience of their corporate functions. Crisis-resistant product development is of particular importance in this context, as innovative products offer a promising opportunity to create competitive advantages and thus secure the company's existence in the event of a crisis. Against this background, this paper presents a concept for enhancing the contribution of product development to organizational resilience of manufacturing companies. In this context, the relationship of organizational resilience to corporate strategy, the bundling of disturbances into crisis scenarios, the design features of product development, and the preventive design of product development are included.

IEEM21-A-0119/Project Management in Crisis Era, Using Design Thinking as a Project Development Tool

Maria de los Angeles Gomez¹, Pablo Nuño¹

¹Universidad Popular Autónoma del Estado de Puebla, Mexico

Facing a serious and decisive situation such as COVID-19 in more than a year has in many cases endangered the economic development of the company and runs the risk of having to do without many employees even when they have long working careers in it. For this reason, skills and knowledge must be put into practice for the development of innovative and creative projects that face the economic crisis so as not to

stop the expansion of the company within the industry and the creation of wealth in a country. The development of projects in an innovative and effective way with scarce available resources is an important key to develop collaboratively with all personnel. Using tools such as Design Thinking can be the key to face these times of crisis.

Session	EET Engineering Education and Training
Date	December 15, 2021
Time	02:00 PM-03:30 PM
Chair(s):	Zhiqiang CAI ¹ , Greta BRAUN ² ¹ Northwestern Polytechnical University, China ² Chalmers University of Technology, Sweden

IEEM21-F-0015/Evaluating Undergraduate Students' Feedback Towards Service Quality of Private University: A Structural Equation Modeling Approach

Yogi Tri Prasetyo¹, Lauren Regondola-Bolata¹

¹Mapúa University, Philippines

Student feedback is an important part of service quality of a private university. The purpose of the study was to evaluate undergraduate students' feedback towards service quality of private university. A total of 1555 questionnaires and a total of 201 negative comments were collected from one private university in the Philippines during one academic year. For questionnaire data, structural equation modeling (SEM) was utilized to derive the causal relationships between different services to the overall service quality. SEM indicated that Registrar's Office was found as the most service that contribute to the overall service quality followed by Treasury Office, Library, Scholarship Office, Department of Information Technology, Health Clinic, and Department Office. SEM was found as a powerful tool to evaluate the students' feedback towards service quality. Finally, this approach can be applied and extended to analyze students' feedback in different private universities worldwide.

IEEM21-A-0026/Teaching Operations Management Based on Information Technologies During COVID-19

Guilherme Tortorella¹, Gopalakrishnan Narayanamurthy², Vijaya Sunder M³, Paulo A. Cauchick-Miguel⁴

¹The University of Melbourne, Australia

²University of Liverpool, United Kingdom

³Indian School of Business, India

⁴Federal University of Santa Catarina, Brazil

The objective of this study is to identify the main teaching practices and information and communication technologies (ICTs) used to teach Operations Management (OM) in during the COVID-19 pandemic. We also investigated the effect of contextual characteristics on the adoption level of those teaching practices and ICTs. We surveyed OM lecturers located in emerging economies that have been teaching during the pandemic. Data was analyzed through multivariate techniques. Findings indicate that lecturers have been adopting specific practices and ICTs to teach OM. However, the adoption level of those practices and ICTs may vary, especially depending on the subject type and teaching experience of the lecturer. This research provides OM instructors guidelines to better plan their subjects in face of extreme disruptive moments, such as the COVID-19 pandemic. Understanding how the concurrent utilization of ICTs and teaching practices helps OM programs to continue developing their activities is particularly important for universities located in emerging economies.

IEEM21-F-0289/Engineering Students' Experiences of Digital Remote Learning During COVID-19 Pandemic in OUAS

Jouni Kääriäinen¹, Ville Isoherranen¹

¹Oulu University of Applied Sciences, Finland

The COVID-19 pandemic transferred engineering education at Oulu University of Applied Sciences (OUAS), Oulu, Finland, in the School of Engineering and Natural Resources to digital remote learning in the middle of spring semester 2020. This study describes engineering students' experiences and perceptions of the digital remote learning during COVID-19 pandemic in OUAS. Findings show that rapid transformation to remote education mode happened successfully, however, it highlights the development needs for some of the courses as not all subjects were ready to digital remote learning from pedagogical point of view. The importance of continuous support, well-structured classes, and engagement via digital learning environments with the students during remote teaching is essential for a successful learning experience.

IEEM21-F-0343/Technology-mediated Learning in Industry: Solution Space, Implementation, Evaluation

Elisa Roth¹, Mirco Moencks¹

¹University of Cambridge, United Kingdom

The Fourth Industrial Revolution is changing the nature of work, shifting the skill sets required in industry. Yet, many organizations struggle to prepare their workforce for future jobs. Traditional training settings seem to fall short to address this challenge, often being rigid and resource-intensive. This gives rise to novel forms of workforce development, such as technology-mediated learning. Technology-mediated learning in industry refers to applications that enable integrated lifelong learning within production systems. This concept promises scalable, personalized learning journeys with real-time feedback. However, research on how to effectively integrate technology mediated learning in industry is still at an early stage. To address this gap and inform future research, this paper builds upon a qualitative multimethod study, encompassing 17 interviews and 10 workshops. As a result, 3 building blocks for realizing technology-mediated learning are identified and conceptualized: 1) a solution space for technology-mediated learning, 2) a practitioner guideline to realize the concept, and 3) a guideline for evaluating technology-mediated learning. As a broader implication, this paper suggests integrating workforce empowerment as a key pillar for organizations to thrive in future production.

IEEM21-F-0415/Socio-technical Qualification Modules for the Empowerment of Logistics Employees in the Technological Transition

Markus Kohl¹, Steffi Zierhut², Jens Lopitzsch², Johannes Fottner¹, Susanne Wilpers³

¹Technical University of Munich, Germany

²MAN Truck & Bus SE, Germany

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Industry 4.0 is bringing about fundamental changes in logistics processes because of new technologies. This includes the role of logistics employees, their tasks and necessary skills, and requires that they be comprehensively qualified. For the derivation of qualification requirements in operational and dispositive logistics, existing research lacks methodological support that sufficiently considers process, technology, and competency. Therefore, the aim of this work is to develop a method for the derivation of socio-technical qualification modules. The design of the generic solution is based on literature as well as workshops and expert interviews within industry. Application and evaluation was carried out in the logistics department of a commercial vehicle manufacturer. The four-step method provides specific qualification modules per employee profile, which consist of modular content for fundamentals, technologies, and methods. The modules can then be used to empower logistics employees for medium and long-term technology transformation.

IEEM21-A-0094/Closing the Skill Gap Through Matchmaking

Greta Braun¹, Johan Stahre¹

¹Chalmers University of Technology, Sweden

The rapidly growing skill gap in manufacturing industry can be seen as an effect of fast technology and sustainability development. The resulting lack of technical and managerial knowledge may have critical impact on a company in a competitive market. In a report from 2020, the World Economic Forum claims that 50% of the global workforce will need upskilling by 2025 to remain attractive in their working roles. Despite a vast range of educational initiatives available on the global market, too few employees are developing new skills. A smart process for matching skill needs with educational offerings could bridge the gap and address challenges e.g., motivation to learn, time and priority issues, and career planning. This study proposes a functional matching process, leading to individually tailored learning and upskilling paths for employees, where courses offered can also be scaled to efficiently fit a broader audience. This study also focuses on matching for bridging skill gaps to increase industrial competitiveness. Results include a typology of matching strategies and sets of requirements on upskilling, analyzing challenges and opportunities for strategy categories.

Session

Poster 04

Date

December 15, 2021

Time

02:00 PM-03:30 PM

Chair(s):

Seung Ki MOON

Nanyang Technological University, Singapore

IEEM21-F-0502/Health Assessment Method of Integrated Navigation System Based on Operation Data

Jingyue Yang¹, Wei Liu¹, Zhichao Pang¹

¹Tianjin Navigation Instrument Research Institute, China

Integrated navigation system is an important part of warship operation, and it is the important safeguard information to achieve taking off and land of aircraft, radar and weapon operation. The capability of precision strike is closely related to the effectiveness of navigation system. Aiming to the ship remains operational capability, its status information should be hold in time. The paper discussed and analyzed the meaning and influencing factors of availability, reliability, navigation capacity of the navigation system, designs a health assessment method based on operation data. Considering the difficulty of comprehensive evaluation of multidimensional index, the paper applies the fuzzy mathematics theory converting the metric to satisfaction. Combining with the demands of ship borne weapon equipment for navigation information, the basis evaluation model was corrected properly and the health assessment index system for ship borne navigation system was built. The judgment value is modified by wavelet neural network compared with avionics effectiveness evaluation under specific capability, the evaluation system has more abundant index system, and has good correction effect of index weight, which provides tool support for navigation system.

IEEM21-A-0110/The Simulation Optimization Approach and Queue Theory to Analyze the Increase in the Number of Servers Over Patient Waiting Time

Sayda Ben Sghyaier¹, Rafea Mrahi¹, Arij lahar²

¹ESC Tunisia, Tunisia

²Dubai University, United Arab Emirates

The health sector is qualified as an essential service which contributes significantly to improving the quality of life of citizens if it is well managed, well planned and well operated by the public authorities. It is a strategic sector which the State must take into account because it is highly capital-intensive, thus benefiting from economies of scale and which generates direct and indirect positive effects on the economic power of the country. Optimization methods are used to obtain the possible combination of resources that can reduce the average patient wait time and increase the number of patients served. This is done using the optimization function named OptQuest which is available on the Arena simulation software. On the other hand, we applied an algorithm to simulate M / M / n queuing systems, during the simulation of a real queuing theory system in order to analyze, on the one hand, the 'increase in the number of server on patient waiting time. On the other hand, the objective is to control the behavior of this system and improve performance metrics.

IEEM21-F-0391/Evaluation of Home Care vs. Conventional Care Using Parametric Cost Estimation and the Fuzzy Analytical Hierarchy Process: A Case Study in Central Sweden

Jonas Sandstrom¹, Annika Hasselblad¹, Leif Olsson¹

¹Mid Sweden University, Sweden

Sweden is experiencing a demographic transition contributing to the rise in care-related costs. This study aims to evaluate whether home care is a better choice than conventional care from an economical and quality standpoint for people over the age of 65. The costs of the two care models were estimated using parametric cost estimation. The fuzzy analytic hierarchy process was used to determine which of the two care models was the most beneficial. The cost estimation implied that conventional care is less expensive than home care. However, the sensitivity analysis indicates that a minimal improvement in efficiency is sufficient enough for home care to become the least expensive option. In addition, the fuzzy analytic hierarchy process revealed that home care should be the prioritized option, even after a sensitivity analysis was conducted. Therefore, from an overall perspective, home care is the preferable care model. This paper evaluated a healthcare management problem using conventional methods, introducing new insight on how to perceive complex problems in today's healthcare environment.

IEEM21-A-0078/A Study on User Characteristics and User Types in Designing Auditory Experience for Electric Vehicles

Yein Song¹, Sungho Kim¹, May Jorella Lazaro¹, Seungyun Ha¹, Myung Hwan Yun¹

¹Seoul National University, Korea, South

The auditory experience of driving sound is regarded as an important design factor that help users understand the vehicle condition and enhance user satisfaction. However, previous studies have either focused only on combustion engine vehicles or neglected the role of user characteristics in investigating the auditory experience for electric vehicles (EV). Therefore, this study aims to investigate the user preference and evaluations for auditory experience in EV, considering user characteristics and user types. 40 drivers were recruited for a real driving experiment. After conducting a preliminary survey, the participants drove an actual EV on predetermined course for 1.5 hours and evaluated the driving sounds that they experienced while driving. As a result, user characteristics and user types were analyzed through confirmatory factor analysis and k-means clustering. Affective sound properties were derived using exploratory factor analysis and preferences and evaluations by user types were analyzed through Mann-Whitney's U test and Friedman test. The results of this study identified the differences in preferred sound characteristics and evaluations among user types, which can be reflected in designing concepts of auditory experience for EV.

IEEM21-F-0147/Design and Development of a Digital Twin Dashboards System Under Cyber-physical Digital Twin Environment

Weidong Lin¹, Malcolm Yoke Hean Low¹

¹Singapore Institute of Technology, Singapore

This paper researched the design and development of a digital twin dashboards system for manufacturing systems. The digital twin dashboards system serves critical functionalities such as visibility and visualization of the various component modules under a cyber-physical digital twin system architecture. The digital twin dashboards system is required within the cyber-physical digital twin architecture environment based on the industry requirements. The key feature of the digital twin dashboards system is switching between a physical production database and a cyberspace simulation database connected seamlessly. A proof of the concept prototype was developed to illustrate the concept design and implementation of the digital twin dashboards system.

IEEM21-F-0142/Scheduling Method of Mixed-flow Assembly Line Based on Complete Kit of Materials

Yang Cao¹, Minmin Liu¹, Bo Li¹, Tao Hong¹

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With the increasing popularity of mass customization, most manufacturing companies begin to assemble and manufacture products in a mixed-flow production model. To solve the problem of global complete kit extending start time of order, the complexity of complete kit of materials is getting higher and higher, no correlation between learning and forgetting effects, and MOGA algorithm convergent speed is slow in a manufacturer company, a classified complete kit method is put forward first. Then, an improved learning forgetting effect model that learning factor is associated with forgetting parameter is established. Based on the classified results, the cross and mutation operator of the MOGA algorithm is improved. A product launch rule is designed to improve the convergent speed of the algorithm. Finally, an example is used to verify the feasibility of the improved model and the improved MOGA algorithm.

IEEM21-F-0373/Analysis of Housing Prices of Urban with Port and City Integration Taking Kaohsiung Example

Kuei-Chen Chiu¹

¹Shih Chien University, Taiwan

Mortgage is an important part in the housing market, it cause a clear and strong relationship between monetary policies and housing market. The release of growing commodity causes the diversification of housing investment. Actually, the Financial Tsunami was cause by subprime-mortgage crisis in U.S. in 2007. A lot of models have been proposed to predict housing price over the course of decades of research, but some new models should be proposed to suitable the situation in the post era of financial tsunami and COVID-19. The subprime- mortgage crisis damaged the housing market of San Francisco, directly. The housing market in a port is different from in a city, shipping is an important factor to urban development, the paper build the system dynamic model of Kaohsiung housing market, which is a port the same as San Francisco, to predict Kaohsiung housing price. This study aims to extract the related factors to the housing prices of Kaohsiung by correlation analysis, find out the critical factors of the housing prices of Kaohsiung by regression analysis.

Session	SCM-08 Supply Chain Management 8
Date	December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Aries SUSANTY ¹ , Daniel MUELLER ² ¹ University of Diponegoro, Indonesia ² TU Dortmund University, Germany

IEEM21-F-0474/The Mechanisms of Co-innovation in the Development of Bioplastic Packaging: Evidence from Practice

Liliani¹, Benny Tjahjono¹, Dongmei Cao¹

¹Coventry University, United Kingdom

This study aims to explore the mechanisms of co-innovation in developing bioplastic packaging. We illustrate the co-innovation process in developing bioplastic packaging and identify the key co-innovation elements and their mechanisms, conceptualizing the mechanisms into a framework. This study explored eight cases representing the biopolymer producer, converter and product manufacturer. Data were collected using semi-structured interviews. The findings reveal that co-innovation consists of two stages (developing the packaging prototype and further developing the packaging for a specific application) and three key elements (co-innovation comprising joint activities, joint resources and relationship management). This study contributes to co-innovation literature, particularly the mechanisms and conceptualization.

IEEM21-F-0482/An Integrated Inventory Problem with Transportation in a Single-vendor Multiple-buyer Supply Chain Coordination with Stochastic Demand

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¹King Fahd University of Petroleum and Minerals, Saudi Arabia

In this paper, we propose an integrated inventory model with transportation of a single-vendor multi-buyer supply chain coordination where stochastic demand is considered. We discuss the synchronized cycles model (SSYN) coordination policy, in which the buyers' ordering cycles are synchronized with the vendor's production cycle. That is, buyers will choose their optimal replenishment intervals, and the vendor schedules the delivery of products accordingly. Then, we develop the joint total expected cost per unit time for the integrated SSYN with transportation assuming a normally distributed demand. We propose a state-of-the-art two-phase iterative approach to solve the model, where the SSYN model is first solved assuming direct shipment, and then the routes are determined by solving a vehicle routing problem. Finally, a numerical example is solved and its results are shown.

IEEM21-F-0485/A Simulative Study of an In-plant Frozen Period for Demand-based Material Supply in Matrix Manufacturing Systems

Daniel Mueller¹, Christoph Ganß¹

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Matrix manufacturing systems (MMS) are increasingly being discussed to deal with complexity and dynamics in assembly areas. MMS enable a highly flexible and reactive material flow. However, job routing in MMS cannot be realized completely flexible in time as there is still a significant amount of demand-based supplied materials, which needs at least a minimum of pre-planning in routing. Therefore, this work presents a concept for an in-plant frozen period, which sequences a defined set of tasks dynamically. As a central key finding, it is shown by means of a simulative study that the duration of the in-plant frozen period has an approximate logarithmic relationship with the logistical performance of a MMS. Implications for factory design and logistics processes are presented.

IEEM21-F-0501/Do Listed Ocean Tanker Companies Have Operational Skill? Empirical Evidence from Fleet and Voyage Data

Roar Adland¹, Tord Engen¹

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We investigate the drivers of quarterly reported average earnings from the fleet of listed tanker shipping companies. Using the trading pattern of individual vessels and freight market data, we derive new variables that attempt to capture the level of operational skill in terms of timing the entry into new contracts and dynamically allocating the fleet to economically favorable routes. We also assess whether differences in performance between companies are statistically significant. Our empirical results suggests that a large proportion of the observed average earnings are determined by overall market conditions and fleet-specific variables such as vessel age. We also do not find evidence of skill in terms of timing new contracts within the quarter. However, the results provide some evidence that spatial fleet allocation affects economic performance. Our results are important for the understanding of spatial and temporal freight market efficiency on tanker shipping.

IEEM21-F-0503/Improving the Strategic Distribution Performance of the Supply Chain of a Leading FMCG Company: A Case Study

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²Université Française D'Égypte, Egypt

Fast moving consumable goods require good supply chain operation. In this paper, a leading Egyptian FMCG is considered. The company wants to optimize its distribution network design considering several supply chain strategic objectives. The company wants to determine the number of warehouses to build, their sizes, customers assigned to each warehouse, and their layout. The objective is to reduce the distribution cost taking into consideration the company's strategic decision such as giving higher priority to important customers and assigning the nearest warehouse to each customer, and also the real live applicability of the suggested solution. We first segment the customer according to different strategic factors. Then a non-linear model is proposed for solving the problem. A hybrid heuristic is proposed that solves the problem by iterating between the optimal suggested location and the possible locations available for business in the real life according to availability and other strategic factors. Different layouts for the selected locations are evaluated using Monte-Carlo Simulation.

IEEM21-F-0438/Integrated Repair Shop Scheduling and Spare Parts Pooling for Robust Product Regeneration

Torben Lucht^{1*}, Anja Wojcik¹, Peter Nyhuis¹

¹Leibniz University Hannover, Germany

The regeneration of complex capital goods is subject to significant information uncertainty with regard to the capacity and material demand to be expected from a regeneration order. One suitable measure to prevent losses in capacity utilization or delays caused by missing material supply is pooling of spare parts over several pool stages. In order to make optimal use of the mostly scarcely available pool components (due to their high price) in terms of increasing the robustness of the logistics processes, material management and production planning and control (PPC) require close coordination. This paper presents an approach to integrate multi-stage spare parts pooling and repair shop scheduling for the regeneration of complex capital goods using mathematical modeling. In addition to various logistics interdependencies, this approach also takes into account typical uncertainties and dynamics drivers in regeneration. Finally, the logistics potential of this approach is demonstrated by integrating it into an event-driven, rolling planning approach and its application to an exemplary use case.

Session	DAM-05 Decision Analysis and Methods 5
Date	December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	H. Niles PERERA ¹ , Desmond WONG ²
	¹ University of Moratuwa, Sri Lanka
	² University of Hull, United Kingdom

IEEM21-F-0433/Gamified Learning of Supply Chain Optimization Through the Beer Distribution Game

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¹The University of Sydney, Australia

²University of Moratuwa, Sri Lanka

This study examines the behaviour of sixty supply chain students at two different Beer Distribution Game trials to identify student performance under carefully designed contextual settings. Based on the findings, this paper illustrates the effectivity of the Beer Distribution Game as a self-learning tool for supply chain students. The paper also finds the differences in decision-making patterns of high performing and low performing students in face of lifelike problem-solving situations. Further it gives new insights on improving the efficacy of the Beer Distribution Game as a teaching tool to support the low performing students to learn faster and effectively while overcoming language impediments.

IEEM21-F-0466/Conceptual Model for Understanding the Impacts of COVID-19 Pandemic on Jakarta Mid-term Development Goals Using System Dynamics Approach

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²Universitas Indonesia, Indonesia

The vast impacts of the COVID-19 pandemic have consequences for populous service cities, like Jakarta, in maintaining economic and social development. Despite several countermeasures to limit the impacts that have been rolled out, understanding of the overall effects remains limited as some of the strategies taken are counterproductively affecting economic growth and resulting in loss of jobs. This paper aims to explore a dynamic interrelationship between the impacts of the COVID-19 pandemic on Jakarta's city structure using the qualitative causal-loop approach of systems dynamics modeling. The conceptual model takes productivity, capital, and consumption rate as input variables towards endogenous process structures that represent the scope of the city system under study. The model uses two macroeconomic indicators as model output, namely gross regional domestic product (GRDP) and unemployment rate. Travel restrictions, social distancing, and direct cash transfer are policies under evaluation that is expected to leverage endogenous developed structure and improve the output indicators. The model result presents a causal-loop diagram that consists of five modules: Gross Regional Domestic Product, Government Expenditure, Producer Transaction, Labor Force, and Household Consumption. The interactions obtained from these interrelationship highlights key leverage points for decision-maker for further policy development in offsetting productivity loss due to pandemic and short-term efforts needed to ensure Jakarta is still on the path of achieving mid-term development plan goals in 2022.

IEEM21-F-0085/A Combined Evaluation Model for Competitiveness Assessment of Private Science and Technology Parks in China

Zhuoran Li^{1*}, Yuming Zhu¹, Xiaohai Weng¹, Qingye Han², Fen Lyu¹

¹Northwestern Polytechnical University, China

²Chongqing University, China

This paper established a combined evaluation model to assess the competitiveness of Private Science and Technology Parks (PSTPs) in China to support their scientific development. More specifically, the evaluation index system is identified according to the previous study. Three commonly used methods, including Grey Relational Analysis (GRA), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Principal Components Analysis (PCA), are utilized to obtain each evaluation result. Considering the inconsistency of the above results, this paper conducted a combined evaluation method to gain a more scientific and reasonable result. Finally, a numerical example was taken to show the effectiveness of the proposed model.

IEEM21-F-0089/A Systematic Way of Crafting Strategies for Private Science and Technology Parks

Lei He^{1*}, Yuming Zhu¹, Xiaohai Weng¹, Qingye Han², Fen Lyu¹

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A novel research framework is proposed to support development strategies crafting of Private Science and Technology Parks (PSTPs) using the Theory of Inventive Problem Solving (TRIZ). The key issues are first generated according to the key success factors from previous empirical research and expert interviews. Then, a contradiction matrix and inventive principles are utilized to seek for specific solutions to the key issues. The five aspects of the long-term, medium-term and short-term development strategies are proposed, such as park scale, financing and financial services et al.. The framework proposed in this study is based on a more scientific and transparent decision-making process. The results can support the development of PSTPs. Furthermore, other types of science and technology parks can also adopt this research framework to develop useful strategies.

IEEM21-F-0134/A Hybrid Multiple Attribute Decision-Making Method Based on Mahalanobis-Taguchi System and Choquet integral

Mingzhen Zhang^{*1}, Naiding Yang¹, Xianglin Zhu¹
¹Northwestern Polytechnical University, China

A hybrid multi-attribute decision-making model with unknown attribute weight is studied. To simplify the calculation, the interval number and linguistic variables are transformed into crisp numbers to get the standard decision matrix. Considering the fuzziness and correlation between attributes, the importance of attributes is represented by fuzzy measure. To ensure the decision-making results are more scientific, Analytic Hierarchy Process (AHP) is used to calculate the subjective weight of attributes, and then the subjective weight is modified by Mahalanobis-Taguchi System (MTS) to obtain the fuzzy measures of attributes. Then, using Choquet integral to calculate the comprehensive values of alternatives. Finally, taking supplier selection as an example, the feasibility and effectiveness of this method are verified. This method can effectively solve the multi-attribute decision-making problem with different forms of evaluation information and completely unknown attribute weight information.

IEEM21-A-0117/A Mathematical Programming Approach for a Vessel Scheduling-transportation Problem with Multiple Sources and Destinations, and Normal Daily Demand Distributions

Fatmah Almathkour^{*1}
¹Kuwait University, Kuwait

This research effort is to investigate a stochastic vessel scheduling problem to transport a product (crude oil) from multiple sources to various destinations. In this vessel operation, a vessel is fully loaded at a source and is fully unloaded at a destination. In this research, we focus on normally distributed daily demands at the destinations based on which different penalties are imposed on the shortages/excesses in daily storage levels at the destinations. We aim to employ a mathematical modeling approach to simultaneously optimize the fleet schedules and maintain desirable daily storage levels to meet the stochastic demand requirements at the destinations with acceptable reliability levels. The proposed problem is formulated as a stochastic optimization model to minimize the expected total cost of the studied vessel operation. Our computational results are presented for a set of test problems to a) demonstrate the efficacy of the proposed modeling approach and b) examine the effect of the variations in demands and the probabilities of satisfying demands on the overall vessel operation and cost components.

Session	MS-05 Manufacturing Systems 5
Date	December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Sandeep JAIN ¹ , Jonny JONNY ² ¹ Hewlett Packard Enterprise, India ² Bina Nusantara University, Indonesia

IEEM21-F-0496/A Re-evaluation of the Initial Mathematical Model for Triangular Pocket Machining Strategy

Mohammad Chaeron¹, Apriani Soepardi^{*1}
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In this paper, we aim to compare the tool path lengths that produced by the direction-parallel or zigzag or staircase strategy and contour-parallel strategy using a single cutter in the triangular pocket machining. The pocket geometry is chosen in such a way that the machining strategy can be carried out by single chisel. The mathematical model for chisel path length of machining process is developed then is used to contrast the chisel path length of two strategies. The specific purpose is to select the strategy that take a shorter chisel path. Based on the two numerical examples, the contour-parallel machining strategy gives the tool path length shorter than the zigzag strategy.

IEEM21-F-0500/Enabling Robust Service Composition in Cloud Manufacturing with Sustainability Considerations

Mohammed Tousif Hyder¹, Carol Lobo¹, Tharun Sai Madupuru¹, Samartha Sudarshan¹, Majid Sodachi^{*1}, Omid Fatahi Valilai²
¹Jacobs University Bremen, Germany

Sustainable development is progressing through all aspects of businesses. Sustainability assessment is considered as a significant appraisal evaluation approach that observes a system performance based on its three pillars criteria in the strategical layer standpoint. Also, there are various uncertainties for having a decent and cost-efficient supply chain network. This paper's goal is to overcome uncertainties by

focusing on cloud manufacturing technology from one side and ensuring sustainability through the entire supply network from the other side. The paper has investigated to discover existing and upcoming tools and technologies that complement cloud manufacturing to enhance supplier and customer relations with the manufacturer. The paper has proposed a Collaborative Cloud Service Platform (CCSP) for proposing the best solution considering both sustainability and robust cloud service composition.

IEEM21-F-0512/A Distinctive Real-time Information for Industries and New Business Opportunity Analysis Offered by SAP and AnyLogic Simulation

Navadeep Adhikari¹, Tarique Ameer¹, Ganesh Kumar Dhakshinamoorthi¹, Santhosh Ganesan¹, Majid Sodachi^{*1}, Omid Fatahi Valilai²
¹Jacobs University Bremen, Germany

Nowadays, the Industry 4.0 paradigm creates a very dynamic environment for businesses with its various technological tools such as Digital Twins, Cyber-Physical Systems, Cloud Computing, Internet of Things, Big Data Analytics, etc. The focus in this paper is on the impact of the Digital Twins in businesses considering its definitions and its practical usage from a business perspective. For showing Digital Twins prominence from a practical standpoint, the paper has applied two prominent simulation software such as SAP and Anylogic for real-time data interaction. SAP is utilized real-time data integration issues of digital twin from physical aspect and virtual aspect of digital twin can be accomplished with the aid of AnyLogic through multiple simulation models.

IEEM21-F-0448/Consumer Product Repetitive Production Planning with Color Sequence Wheel to Reduce Total Changeover Time

Thanyalak Boonkanok^{*1}, Rawinkhan Srinon¹
¹Mahidol University, Thailand

In manufacturing, every minute a process is stopped to carry out changeover is one less minute of productive time. Therefore, reducing changeover time is a golden opportunity to unlock more productive time. Changeover time reduction increases operational efficiency for production and reduces waste. This research aims to improve production planning by applying the sequence wheel method to repetitive production. The focus is to find a new pattern by writing an algorithm in Visual Basic for Applications (VBA) on Microsoft Excel and propose a standard changeover color sequence wheel. In the analysis, two production conditions were set. First, loading process time was calculation only for the first job, loading times of the following processes were omitted. Second, the mixing process time was not included if two consecutive jobs with the same color were produced. This process consisted of eight jobs, and each work had eight steps. The analysis results found that a new pattern with two proposed conditions could reduce total changeover time by 22.22 percent, and the sequence should start from light to dark color with package sizes consideration.

IEEM21-F-0481/Utilization of the Asset Administration Shell for the Generation of Dynamic Simulation Models

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²OWL University of Applied Sciences and Arts, Germany

Dynamic simulation models are widely utilized to evaluate complex technical components and systems like electric drives or machines. They can support the development process of a production machine by avoiding an inadequate layout of components or an erroneous control design. However, the effort for building them is often too high for this purpose (lot size one). An automated model generation can be utilized to overcome the gap between efforts and advantages of dynamic simulations. This contribution presents an approach for simplifying the dynamic model generation of production machines by using the so-called Asset Administration Shell defined by the initiative Platform Industrie 4.0. The Asset Administration Shell was developed to aggregate all data necessary for maintaining the product across its life cycle. This includes component data and models as well as structural information about a machine. The generation process is performed by using the common FMI standard and a two-step procedure which allows the linkage of different simulation tools. The model generation is demonstrated by an example layout of a machine's internal direct current grid.

IEEM21-F-0514/Process Plan Generation in Reconfigurable Manufacturing System Composed of Multi-spindle and Modular Reconfigurable Machines

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The design problem of a reconfigurable manufacturing system is considered, for the selection of machines to perform the process plan of the single part. The process plan for the part consists of a set of operations respecting the precedence constraints, while for each operation performance machine is selected. There are operations in the process plan which can be performed in parallel. As well there are MS-RMTs that can perform more than one operation at a time. In this work, an attempt is made to select two types of RMTs, so that the process plan of the part can be executed efficiently. For differentiation of RMTs, the configurational capability of the machine is defined. The selection of the type of RMT for the process plan is based on the configurational capability of the machine. A genetic algorithm-based proposed approach is developed to solve the problem. An example is presented to show the validity of the proposed approach for the design problem of RMS. Finally, the work is concluded with future work remarks.

Session	SIM-03 Service Innovation and Management 3
Date	December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Vinay SINGH ¹ , Ewilly Jie Ying LIEW ² ¹ Indian Institute of Information Technology and Management Gwalior, India ² Monash University Malaysia, Malaysia

IEEM21-F-0243/Value Co-creation Building to Sustain Indonesian MSMEs in the New Normal Era

Christina Wirawan^{2,1}, Jahja Hamdani Widjaja¹

¹Maranatha Christian University, Indonesia

Micro, Small, and Medium Enterprises (MSMEs) play an important role in a country's economy. However, the pandemic of Corona Virus Disease 19 (COVID-19) and numerous changes in the general business environment have compelled MSMEs to embrace open innovation. However, due to their low digital literacy, Indonesian MSMEs are still having difficulty conducting open innovation. The goal of this research is to provide solutions for Indonesian MSMEs to address these issues. Therefore, we conducted a qualitative study and gathered data through in-depth interviews with a variety of stakeholders. This research provides a value co-creation model between Indonesian MSMEs, university, students, and consumers.

IEEM21-F-0293/Developing an Implementation Framework for Automated Customer Support Service in Collaborative Customer Relationship Management Systems

Richard Li¹, Madeline Tee¹

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Collaborative Customer Relationship Management (CCRM) has developed Automated Customer Support Services (ACSS), where it focuses on providing more efficient and immediate customer service. Through chatbots, virtual customers, internet routing, and automated responses, technology has evolved to aid the customer support sector through automations trained by Artificial Intelligence (AI), Machine Learning (ML), and other advancements in technology. However, ACSS is relatively new with various implementation frameworks in choosing ACSS platforms developed by CRM experts for organizations. The study aims to cover the research gaps of integrating the customer perspective in terms of behavioral trends, data security issues, engagement and responses, and proper maintenance and evaluation of the ACSS performance based on the customer relationships and experience, through the development of a new implementation framework for ACSS in an organization. Through a rating-questionnaire answered by CRM experts on three (3) different ACSS based on different frameworks and the developed one by the study, the findings show that the developed framework enhances customer relationships and experiences more than the existing frameworks, thereby validating the effectiveness of the implementation framework in the study.

IEEM21-F-0305/Hoshin Kanri and Portfolio Kanban Management: A Conceptual Framework for Strategic Management in the Public Sector

Felix P. Santhiapillai^{2,1}, R.M. Chandima Ratnayake¹

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There is an increasing focus on strategic management and an expectation of continuous improvement (CI) through the implementation of management systems, such as Lean thinking, in public organizations. The gap between strategy formulation and execution is argued as a major reason for the failure of strategies and their improvement initiatives. The Hoshin Kanri (HK) approach and Portfolio Kanban Management can be a powerful basis for the effective deployment and execution of strategic CI initiatives as they contribute to bridge this gap and eliminate the waste that comes from poor communication and direction. The necessity to develop related and underpinning managerial processes is found present in the Norwegian public sector. Based on the HK approach and Kanban principles, this paper presents a conceptual framework that can support strategists in public organizations and their adaptation and implementation of Lean thinking as a means to pursue CI on a system level. Further research is needed to test and pilot the presented framework to develop, validate and generalize its overall functionality in practice.

IEEM21-F-0319/Business Models and Product-Service System Design – Introducing the Business Model Graph

Christoph Rennpferdt^{2,1}, Florian M. Dambietz¹, Dieter Krause¹

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Due to global megatrends, manufacturing companies are supplementing their existing products with services and are thus transforming themselves into providers of so-called Product-Service Systems. This can open up new business models and new market segments. This paper shows that the identification and subsequent selection of suitable business models is not yet sufficiently supported by existing methods. After pointing out this research gap, the Business Model Graph (BMG) is presented, which shows the solution space of existing business models and enables a systematic analysis of the solution space based on company-specific boundary conditions. Finally, the BMG is applied in a case study.

IEEM21-F-0338/Business Model for Post-industrial Tourism from a System Dynamics Perspective

Ionela Samuil¹, Andreea Ionica¹, Monica Leba¹

¹University of Petrosani, Romania

The research in this paper uses system dynamics in proposing a business model in post-industrial tourism that aims to create a Theme Park in a mining perimeter in Romania. The proposed model can contribute to a better understanding of how the tourism business works and creates value for stakeholders, as it shows the causal relationships between the variables of the business system. The simulation adds value to this model, as it allows experimentation with alternative growth strategies and, as a result, the identification of those performance patterns that lead to sustainable development. The current hyper-competitive business environment requires tourism organizations to be agile and to adapt quickly to the ever-changing environment.

Session	IS-01 Intelligent Systems 1
Date	December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Linda ZHANG ¹ , Daoyi DONG ² ¹ IESEG School of Management, Univ. Lille, CNRS 9221, France ² University of New South Wales, Australia

IEEM21-F-0091/Twenty Years of Configuration Knowledge Modeling Research. Main Works, What To Do Next?

Maryam Mohammad Amini¹, Michel Aldanondo^{2,1}, Elise Vareilles¹, Thierry Coudert¹

¹University of Toulouse, France

A configuration software (configurator) associates a knowledge base (KB) with a knowledge processing unit (PU). The KB describes all possible combinations of components while the PU overlays this knowledge with the customer requirements. Our work deals with the KB and the approaches, models, or tools for modeling configuration knowledge. Our goal is to present a small quantitative literature survey highlighting two work streams: the first one gathers modeling works dealing with constraint-based approaches while the second deals with ontologies, description logic, or object-oriented modeling approach. We will also consider hybrid approaches. We will present a quantitative analysis of published materials in Web of science over the last twenty years. The keywords occurrence versus time will also be studied in detail to identify tendencies in configuration knowledge modeling.

IEEM21-F-0172/Developing Integrated Configurators: A Longitudinal Case Study

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Despite configurators' positive impacts on Engineering-To-Order (ETO) companies' operations and strategies, there is a paucity of empirical studies examining the development processes and practices of integrated configurators. Thus, we carry out a longitudinal case study in a large ETO company to study the characteristics and dynamics of the development process of an integrated sales and technical (IST) configurator. The IST configurator is developed based on a framework that we propose by drawing on literature analysis and extensive discussions with the case company. The findings highlight i) project team formation, ii) the complex and difficult interactions among team members, and iii) how team members react and interpret the unexpected events/changes, among others. Performance evaluation contributes to a holistic picture of the development process of the IST configurator. We further shed light on managerial implications related to business process changes associated with the application of the IST configurator. Our study is expected to broaden ETO companies' understanding of the development processes of integrated configurators and to guide them in development.

IEEM21-F-0213/Untrimmed Operator Standard Cleaning Action Parsing Based on Deep Learning Method

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¹National Taiwan University of Science and Technology, Taiwan

For the process in the clean room, small particles will not only cause environmental pollution, but also lead to the decrease of product yield. Therefore, it is important to clear away the particles from the body before entering the clean room. This paper described an existing approach for automated monitoring cleaning action on real-time camera. The current method of performing action recognition uses 3D convolutional neural network (3DCNN) and real-time object detection which uses You Only Look Once (YOLO) as backbone. To achieve untrimmed standard cleaning action parsing, our research proposes a new approach by combining the two methods with proposed mechanisms. In addition to considering coarse-grained analysis of different actions, this paper also proposed a fine-grained measure of action completion.

IEEM21-F-0228/System Readiness Level Model of Highway Intelligent Transportation System by Integrating a Value Engineering Process

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Emerging technologies, like cloud computing, artificial intelligence (AI), and internet of things (IOT), are advancing the evolution of intelligent transportation systems (ITS). For successful technology integration, researches on ITS engineering often apply theories and tools of system engineering, among which system readiness level (SRL) is a fitting tool for system development. This paper built a model based on SRL analysis for highway ITS engineering. Further, the author analyzed the spatiotemporal features of highway ITS, including distributed computing resources and network capabilities, unbalanced development of existing information and communication technologies (ICT), and inherited architectural limitations of existing ITS infrastructures. The analysis indicated the need for economic consideration on highway ITS engineering. Therefore, this paper improved the SRL-based engineering model with a value engineering process. The effectiveness of the model was verified by the deployment of 5.8GHZ ambiguity path recognition technology, from aspects of system development and economic efficiency.

IEEM21-F-0240/Low-entry Barrier Multi-agent System for Small- and Middle-sized Enterprises in the Sector of Automated Production Systems

Fabian Haben^{*1}, Birgit Vogel-Heuser¹, Hicham Najjari², Matthias Seitz¹, Emanuel Trunzer¹, Luis Alberto Cruz Salazar¹

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Multi-Agent Systems (MAS) are becoming increasingly popular in the field of automated production systems (aPS). This is due to the new requirements the Industry 4.0 puts on an aPS like modularity, scalability, or versatility. However, for creating MASs, special hardware and software are often necessary, making it hard for small and middle-sized enterprises (SME) to start developing such systems. To overcome this challenge, this paper proposes a new approach for MASs, which lowers the entry barriers of their development for SMEs. For this purpose, a concept is developed, which uses open and free software protocols.

Furthermore, it enables the use of standard automation hardware and Internet of Things (IoT) hardware. For evaluation purposes, the concept is subsequently implemented and tested utilizing a plant for creating individualized cosmetic products.

Session Date	SSRM Safety, Security and Risk Management December 15, 2021
Time	04:00 PM-05:30 PM
Chair(s):	Seung Ki MOON ¹ , Li GUAN ² ¹ Nanyang Technological University, Singapore ² University of New South Wales, Australia

IEEM21-F-0178/Prioritizing Project Interdependent Risks: A Network-based Approach

Li Guan^{*1}, Alireza Abbasi¹, Michael Ryan²

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Projects are usually exposed to numerous and interdependent risks both internally and externally, making the project risk management process essential to the successful realization of project objectives. Instead of analyzing project risks individually, this paper presents a network-based approach to capturing complex risk interdependencies while prioritizing project risks, which is grounded in the theoretical framework of social network analysis and considers two typical dimensions (i.e., risk occurrence probability, and risk impact) of risk modeling. The concept of the design structure matrix is used to facilitate the establishment of a project risk interdependency network. Five risk indicators (e.g., risk degree centrality, risk betweenness centrality, risk closeness centrality, risk local influence, and risk global influence) are tailored and proposed to prioritize project risks, which can provide project decision makers with a more comprehensive understanding of the project risk profile. Appropriate risk mitigation actions can then be formulated to mainly control critical project risks. An application example is presented to illustrate the utility and validity of the proposed approach.

IEEM21-F-0219/Task-oriented VR Safety Training in Construction Falls

Ying-Mei Cheng^{*1}, Hsin-Yu Liao¹

¹China University of Technology, Taiwan

Construction is a dangerous profession. Among the occupational accidents, falls are leading cause of death. Conventional approach for raising safety awareness among workers usually involves print materials or videos for workers to review, which makes it difficult for workers to gain realistic assessment of on-site conditions. Virtual reality (VR) provides an alternative that offers an interactive format to provide information essential for workers during training. By simulating the actual job site, the training allows workers to identify actual risks in the field within a safe environment to avoid accidents and disasters in reality. This study establishes a simulation of construction workplace that is task-oriented. The case scenario is chosen by screening cases of workplace falls in Taiwan. After users experienced the VR simulation, a questionnaire is administered to assess workers' understanding of VR and clarify whether the VR experience changes workers' perception of unsafe behaviors. According to the results, the use of VR is generally well accepted and the VR experience does affect the workers' perception of unsafe behavior.

IEEM21-F-0244/ A Systematic Literature Review on Industrial Fire and Explosion Accidents in the Petrochemical Industry

Sibusiso Desmond Duma^{*1}, Bheki Makhanya¹, Hannelie Nel¹

¹University of Johannesburg, South Africa

Accident investigation and risk management are integral components of industrial accident prevention initiatives. The objectives of this research were to identify major causes and recommend mitigation strategies to prevent industrial fire and explosion accidents. A systematic literature review was applied to eighteen (18) peer-reviewed articles published between 2015 and 2020. The results show that a series of events are responsible for fire and explosion accidents in the petrochemical industry; however, human error, lack of knowledge, and inadequate application of regulations were amongst the most frequently cited major causes. Based on the identified causes, mitigation strategies to curb the occurrence of accidents were found to be a commitment to safety culture, hazards and risks awareness, management of risk, and learning from previous experiences. The study contributed by identifying the causes of fire and explosion and recommended the strategies which could be used to mitigate risk.

IEEM21-F-0318/On the Necessity of Assessing Noise Pollution Intensity to Investigate Environmental and Societal Impact

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¹Industrial Technology Institute, Sri Lanka

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Noise pollution associated with wind turbines results in a significant level of environmental and societal impact. The effect of noise pollution intensity on residential locations varies depending on the surrounding activities. Therefore, wind power generation asset owners should consider the surrounding environment before setting up the wind farm to avoid public inconvenience. Even the demands by regulatory authorities to take noise-level measurements to determine the environmental and societal impact of noise pollution from wind farms do not take into account the low-frequency noise. A study was initiated to collect noise data from wind turbines located in residential areas in Sri Lanka, to investigate the environmental and societal impact. Two wind farms were selected in the north-central region of Sri Lanka, and the study was conducted during the southwest-, northeast-, and inter-monsoon seasons. The variation in daytime and night-time wind turbine noise was studied. The measurements were taken over four consecutive years during the day and at night. According to the findings, when the turbines generated full power the noise generation also increased irrespective of the time of day or night.

IEEM21-F-0355/Risk-averse Hazmat Network Design Considering Endogenous Risk and Uncertainty

Pengcheng Dong¹, Guodong Yu¹

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We consider a hazmat network design problem where designer selects a feasible set of facility locations and flow assignments so that the total cost and transportation risk are minimized. While hazmat carriers choose preferred routes to transport, in particular, the route-choice is uncertain and depends on the available facilities and travel links. To improve service reliability under uncertainty, we incorporate risk-averse measures based on Conditional value-at-risk (CVaR). We model the problem as a mixed-integer trilinear optimization problem, then an equivalent linearization reformulation and a Benders decomposition algorithm with several acceleration strategies are proposed to solve this model. Numerical experiments demonstrate the effectiveness of proposed model and algorithm and give management insights.

IEEM21-F-0261/A Cognitive-based Approach to Construction Safety Management

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²National University of Singapore, Singapore

Safety on the construction site has always been an important issue. Although various safety measures have been taken, the injury rate still remains high. Worker's unsafe behavior has been found to be the major causation of accidents and influenced by cognitive-related factors. To this end, this paper proposes a cognitive-based approach based on cognitive psychology and the Fogg Behavior Model. The approach not only considers the influential factors in the worker's cognitive process but suggests customized safety interventions based on a behavioral model. The approach facilitates a personalized approach to safety management with the goal of improving the level of occupational health and safety for construction workers.

Session	SCM-09 Supply Chain Management 9
Date	December 15, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Aries SUSANTY ¹ , Daoyi DONG ² ¹ University of Diponegoro, Indonesia ² University of New South Wales, Australia

IEEM21-F-0153/Data-driven Planning in the Face of Supply Disruption in Global Agricultural Supply Chains

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¹University of California Berkeley, United States

The intricacies of global food networks have been exacerbated by increased globalization, advances in farming/logistics technology, and a rising agricultural exchange between countries. Certain economies, especially regions with low agricultural yield, rely on food imports and are susceptible to food insecurity due to potential negative disruptions to the global food network. These rising complexities in global food networks result in increased dependencies between countries, rendering the overall network extremely vulnerable. Local disruptions to production levels could entirely cripple the food network and lead to

longterm reduced food access worldwide. Understanding the impact of different disruptions and potential mitigation strategies at the country level on agricultural supply chains becomes important in the analysis of the global allocation of agricultural products. We model a stochastic resource allocation problem with non-linear connectivity costs to capture trade dynamics between countries. We compare model recommendations to historical trade flow data including coffee import/export between countries, unveiling the value of centralized planning under potential disruption scenarios against the current practices.

IEEM21-F-0266/State of Supply Chain Finance for Micro, Small and Medium Enterprise in India

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¹Birla Institute of Technology & Science, Pilani, India

This paper examines the state of adoption of Supply Chain Finance (SCF) in India's Micro, Small, and Medium Enterprise (MSME) sector. Statistical techniques are applied to the critical parameters from publicly available information to ascertain the level of adoption of SCF specific to the Automotive Industry. Results indicate that the health of working capital management as understood by the cash conversion cycle (CCC) days are different across different tiers within the supply chain, leaving the deep tier suppliers vulnerable to financial risks. This study is limited to Automotive Industry within the Indian MSME sector. Extensive research covering other industries and services is needed to derive a common trend. The current research contributes a suggestive framework and critical strategies to fast-track the coverage and adoption of SCF for Indian MSME. Current research helps to exploit the untapped opportunity and propel economic prosperity. Further, the extended impact of pricing, risk, and profitability within the supply chain networks due to SCF adoption are to be explored.

IEEM21-F-0273/Research on the Optimal Strategy of Delivery Packaging Recycling Under Policy Support

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Cainiao Network has had a recycling plan of waste express packaging since 2016. From the practical results, the recycling plan has not achieved the expected results. This paper considers the incentive policy in the two recovery scenarios and constructing a Stackelberg model with a carton factory and an express delivery enterprise. We analyze the effect of the recovery scenario on the supply chain profit and how the consumers' recycling willingness affects the recovery reward. We find that compared with the direct recovery (DR) scenario, the input cost under the intelligent express recovery cabinet (IERC) scenario is higher. But the high cost does not directly affect the optimal the IERC recovery reward.

IEEM21-F-0292/Supply Chain Vulnerability and Collaborative Management Empowered by Emerging IT: An Analysis from China's Practice

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¹Xidian University, China

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The development of emerging IT helps supply chain management achieve a higher degree of digitization and intelligence. The focus of this research is to use emerging IT to improve the vulnerability and collaborative management of supply chains. Based on network media reports about emerging IT and supply chain vulnerabilities, this study develops a grounded theory. Through separate coding of collected network data, it identifies existing problems of vulnerability and collaborative management, and explores how emerging IT are used to address such issues. Based on the results, this study puts forward suggestions and guidelines for using emerging IT to alleviate the vulnerability of the supply chain so as to realize the collaborative management of the supply chain. The findings from China's practice provide managers insights into the development of supply chain under the emerging IT.

IEEM21-F-0410/The Role of SKU Management in SKU Rationalisation Projects

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The increased demand for product variety implies that many manufacturing companies are struggling with the negative effects of stock keeping unit (SKU) proliferation in product portfolios. This implies that many companies implement SKU rationalisation programmes to deal with product and process complexity. However, many industry companies report that they do not gain the financial benefits that they expected from optimizing their portfolios. To improve the understanding of this phenomenon, this paper studies an unsuccessful SKU rationalisation project at a hearing healthcare company. The case study revealed that what appeared to be a great potential for reducing inventories through SKU rationalisation turned out to be more of an SKU management problem. Specifically, analyses showed that 19% of the hearing devices' product portfolios had multiple SKUs for the same product variant, and that SKU rationalisation would only produce minimal inventory-related benefits. The case study therefore demonstrates the importance of proper SKU management in identifying fruitful SKU rationalisation projects.

IEEM21-F-0199/Logistical Potentials of Load Balancing via the Build-up and Reduction of Stock

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³Grean GmbH, Germany

Fluctuations in demand pose a significant challenge for manufacturing companies. As fluctuations increase, an imbalance between capacity availability and capacity requirements more likely occurs. This can lead to scattering load in production and consequently result in low logistical performance. Capacity synchronisation must be carried out to reconcile load and capacity. On the one hand, available capacity can be adjusted to fit the scattering load using capacity flexibility. However, capacity flexibility is limited. On the other hand, load balancing can be carried out to achieve a lower load variation. This can be done, for example, by building up and reducing stock. During periods of low load, stock orders are generated and higher stocks are built up to keep utilisation high. At times of high demand, stock is reduced by releasing fewer stock orders to ensure a stable operating state of the production system. This balances utilisation in the production system and keeps the work in process and throughput times at the planned level. Therefore, this paper examines the logistical potential that results from load flexibility through finished goods stock.

Session	DAM-06 Decision Analysis and Methods 6
Date	December 15, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Linda ZHANG ¹ , Rui MIAO ² ¹ IESEG School of Management, Univ. Lille, CNRS 9221, France ² Shanghai Jiao Tong University, China

IEEM21-F-0161/Application of the Multistage One-shot Decision-Making Approach to an IT Project in the Central Bank of Oman

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¹Yokohama National University, Japan

Decision-makers always have to make an appropriate sequence of decisions in a relatively long period, from the start of the project to its completion. Conventional decisionmaking models under uncertainty are based on expected utility theory and do not sufficiently reflect the one-time nature of decisions. Research has shown that salience (attention-grabbing) information plays a critical role in human decision-making. Furthermore, studies recognized obstacles in applying scientific decision-making methods in real-world scenarios. In this paper, we apply the multistage one-shot decision-making approach (MOSDMA) to a real IT project decision problem from an internal audit department (IAD) in the sultanate of Oman. The proposed approach is a fundamental alternative for multistage decision-making under uncertainty because it is scenario-based instead of lottery-based as in the other existing methods. This study is the first contribution in applying the proposed approach to solving real-world business decision-making under uncertainty problems. The results exhibit the effectiveness of the proposed model in aiding the decision-makers in solving such a one-shot optimal stopping problem in actual practice.

IEEM21-F-0249/A Reinforcement Learning Approach for Optimization of E-bus Off-normal Schedule with Time Windows

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The lack of traffic capacity during peak hours is an emerging problem of modern urban transportation. This has prompted some bus companies to propose E-bus service model. E-bus was originally intended to serve the commuting tasks of employees of other companies. However, the trips of E-bus are relatively fixed and single-trip, so e-bus is idle most of the time. Therefore, we put forward the off-normal schedule strategy to improve the transport efficiency and reduce the transport pressure on busy lines. In this work, we first propose an off-normal schedule problem with time windows. The objective of this problem is to determine the optimal shared bus scheduling, reducing empty trips, increasing the total revenue. By defining state characteristics, action space and reward function, the proposed scheduling problem is formulated as Markov decision process, and a scheduling method based on multi-agent reinforcement learning is developed. Simulation results show that this method learns the optimal or near-optimal solution from previous experience and improves the revenue significantly.

IEEM21-F-0282/Evaluation of the Innovation Level for Technological Enterprises: Multi-attribute Decision-making Based on Vague Sets

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Innovation is the key to the progress of enterprises, and the level of innovation can directly reflect the core strength of technological enterprises. This paper took technological enterprises as the research object and comprehensively constructed an evaluation index system for the innovation level of technological enterprises. The weight of evaluation index was determined by the Analytic Hierarchy Process (AHP), and the innovation level of enterprise was evaluated based on the multi-attribute decision-making method of Vague sets. The method is helpful to conduct horizontal comparative analysis of the innovation level among enterprises, and find out the ways to improve the innovation level of enterprises.

IEEM21-A-0063/A Goal Programming Model for Assessing the Policy of Carbon Reduction and Economic Development

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With the increasing warming of the earth, the United Nations has formulated relevant treaties which require countries to put forward carbon reduction targets, but countries could not take into account both economic development and carbon reduction goals simultaneously, because the economic development often increased additional carbon emissions and there was a lack of objective adjustment between the two. Therefore, this study intends to resolve this dilemma based on a two-stage goal programming approach. At the first stage, an ideal production value of each industry is provided to meet the set carbon reduction and economic growth goals. At the second stage, the individual values of renewable and non-renewable energies will be determined. Through this production of each industry, we can pursue the goal of carbon reduction while develop economic growth. Based on this result, relevant policies are formulated to help industrial transformation to achieve a low-carbon economy and sustainable development. A preference realization mechanism with weighting and priority tools will be provided to facilitate the decision support and policy assessment procedure.

IEEM21-F-0323/Borrowing Money Matching Model Research in the P2P Platform

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We investigate the profit maximization of P2P online lending platform. We construct a stochastic model to study the fund matching between fund-raisers and investors in a P2P platform. The raising time is assumed to be a random variable, then there is a successful transaction probability that the fund matching is realized. Meanwhile, the interest and the commission rate that the platform earns affects the value of the probability. The platform maximize its revenue by adjusting the commission rate. We find that the optimal commission rate increases in the probability of borrower default, but decreases in the loan duration. The platform should choose some small loans as far as possible. The loans with smaller amount are easier for the platform to complete fund raising.

Session	MS-06 Manufacturing Systems 6
Date	December 15, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Kendrik Yan Hong LIM ¹ , Yaqiong LV ² ¹ Agency for Science, Technology and Research, Singapore ² Wuhan University of Technology, China

IEEM21-A-0053/Re-sequencing Mixed-model Assembly Line with Limited Linear Buffers

Minjiao Cheng¹, Wenchao Wei¹
¹Beijing Jiaotong University, China

This paper addresses the scheduling problem in five successive processes in car production including the welding/body shop, white body storage (WBS), the painting shop, painted body storage (PBS), and the assembly shop. The welding/body shop considering minimizing the car models' switching is connected to the painting shop that aims to reduce the color changes. After that is the assembly shop, where work-intensive options should be evenly dispersed. Limited linear WBS and PBS consisting of parallel line segments are set between shops to change the sequence from the upstream shop to the downstream. This joint re-sequencing problem is formulated as a mixed integer linear programming (MILP) model, which uses static technology to describe the dynamic process. It is trial that the problem is NP-hard. We divide the joint re-sequencing problem into two sub-problem and then propose a two-phase algorithm that combines the Tabu search with the large-scale variable neighborhood search. Numerical experiments validate the quality of the proposed algorithms.

IEEM21-F-0366/A Study of the Inspection Support Tool Development Using the Neural Network

Harumi Haraguchi¹, Riku Akaishi¹
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Much of the quality inspection work in the manufacturing industry is automated. However, there are many products for which inspection work cannot be automated. For example, the tip of a rotating tool (Diamond bar) is attached with diamond particles. The same thing does not exist as one diamond bar. In this study, we will develop a tool to replace manual inspection. As a basic research, we constructed a model using neural network and convolutional neural network. The model was evaluated under various conditions. As a result, the accuracy was about 75% for the neural network model and about 85% for the convolutional neural network model.

IEEM21-F-0435/Sample Extraction of a Quality Inspection Tool for Dental Parts Manufacturing Industry

Riku Akaishi¹, Harumi Haraguchi¹
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Recently, almost all the quality inspection work in the manufacturing industry has become automated. However, there are many products for which inspection cannot be automated. For example, because the tip of a dental treatment rotating tool (Diamond bar) is attached to diamond particles, all parts are slightly different. In addition, judgments of the inspection are different by the operator. Our previous studies challenged the development of the inspection support tool. However, the precision of the tool did not improve even if the various parameter adjustments were performed. In this study, we focused on the dependability of the sample data. The sample data were re-labeled by three kinds of operators. And the distinction models are structured and inspected performance. As a result, the multi-operator model was the highest performance.

IEEM21-F-0488/Digital Twin-enhanced Approach for Supply Chain Disruption Management in Manufacturing Shop Floors

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¹Agency for Science, Technology and Research, Singapore

The recent global pandemic has exposed vulnerabilities in manufacturing and amplified prevailing concerns towards the development of resilient systems from a supply chain (SC) perspective. Industries are often faced with supply and demand-related disruptions, leading to production lines unable to cope with material shortage and demand spikes, resulting in missed opportunities or wastage. As a prevailing technology in the manufacturing domain, Digital twins (DT) has the potential to support SC disruption management with real-time connectivity, simulation, and decision support functionalities. Thus, this paper proposes a DT system designed to mitigate SC-related disruptions, and facilitates end-to-end visibility, process streamlining, and solution generation to meet these challenges. A case study featuring an individualized production shop floor is further explored to validate the effectiveness of this DT system in disruption management within the FMCG domain. This explorative study hopes to align manufacturing resilience concepts with industrial practices to suit today's academic and industrial environment.

IEEM21-F-0145/Simulation-based Design of a Pull Material Supply System for Low Volume Unpaced Assembly Lines: A Case Study in the Aerospace Industry

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To stay competitive, many industries have adopted the principles of lean manufacturing. A key principle is to implement pull control in production and material supply. In aerospace manufacturing, the large product size and low volumes result in significantly longer total task times and greater material demands in fewer overall stations. Consequently, the impact of material supply control is high, and its detailed evaluation is imperative. This paper presents a case study of the development of a pull principle for the material supply at a manufacturer of landing flaps, which comprised two major phases. First, a pull principle that enables minimization of work in process (WIP), particularly on the shop floor, was developed. Second, through the application of a discrete-event simulation study, optimal parameter settings were identified, and the developed concept was validated on a detailed operational level. Concept development has shown that the CONWIP principle is suitable for low volume environments with similar material demand characteristics as the landing flap assembly. The simulation study showed that a significant reduction of WIP without additional demands on logistics processes is possible.

Session	SIM-04 Service Innovation and Management 4
Date	December 15, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Pei-Lee TEH ¹ , Desmond WONG ² ¹ Monash University Malaysia, Malaysia ² University of Hull, United Kingdom

IEEM21-F-0480/Understanding the Linkage Between Social Innovation and Sustainable Development Goals: Some Insights of Field Research

Jorge Cunha¹, Carla Ferreira¹, Madalena Araújo¹, Manuel Nunes¹, Paula Ferreira¹
¹University of Minho, Portugal

Recent literature on social innovation highlights its conceptual ambiguity and fragmentation. Addressing this call, this paper examines how social innovation initiatives or projects fit in the sustainable development goals and in what way empowers citizens and communities towards serving their needs. Thus, 210 cases studies were analyzed across three domains in which social innovation can be understood: content, process and empowerment. For this a content analysis was performed. The results obtained demonstrate that the sustainability challenges more frequently addressed where those promoting social support at a regional level. Non-governmental organizations emerge as the main social innovators, in order to address the identified social needs. The results highlight the generation and provision of new services as the main output of the innovation process. Using the SDGs as a classification system of social innovation projects seems to be very suitable.

IEEM21-F-0493/Thinking Together Industry 4.0 and Social Innovation: How Digital Technologies Impact on Social Change?

Jorge Cunha¹, Wellington Alves¹, Madalena Araújo¹, Enrique Ares²
¹University of Minho, Portugal
²University of Vigo, Spain

In the last years, a growing debate about the impact of what has become known as Industry 4.0 on the production processes and systems emerged among scholars. However, less attention has been paid to its impact in other spheres of the society. Namely, how the process of digitization of societies can help to overcome important societal challenges. In this paper, based on a review of some case study examples, we focus specifically on the role of digital social innovation to address important societal changes in different contexts. Our major conclusion is that it can help to overcome barriers that prevent a more just path for social development of communities.

IEEM21-F-0457/An Empirical Study to Scrutinize the Interplay Between Safety and Sustainable Production Performance in the Context of Chemical Industry

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²Universitas Indonesia, Indonesia

The chemical industry is a fundamental component of how countries function. Despite its importance, less consideration has seemingly been given to the roles of safety in sustainable production. This paper reports an ongoing study to scrutinize the relationship between safety performance and sustainable production performance. The underlying foundation of the empirical study is a conceptual framework developed from a Systematic Literature Review (SLR). Five propositions from the conceptual framework would be verified with practitioners in the industry. Nine companies were interviewed, and cross-case analysis was then performed. Preliminary findings suggested that out of the five propositions from the framework, the first three are found consistent with the framework, hence the extant literature. Our future work will continue to corroborate the other two propositions.

IEEM21-F-0464/Risk-averse Oil-spill Response Planning

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Extensive reliance on marine oil transportation imposes significant risks to local environments, economies, and local communities across the globe. To improve preparedness against the imposed risks, this paper develops a risk-averse two-stage stochastic mixed-integer linear programming model with Conditional Value-at-Risk (CVaR) as a risk measure to optimize response activities to the oil spills. The use of CVaR allows the decision makers of oil-spill response to incorporate different risk attitudes when making relevant response decisions. Through numerical analyses, this paper shows that the risk attitude of the decision makers plays a critical role in determining the optimal oil-spill response activities.

IEEM21-F-0011/Redesign of Glasses Customization Service Process Based on Analysis of Influencing Factors in Customer Purchase Decision-making Process

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¹South China University of Technology, China

Based on the mapping relationship among customer demand, purchase decision-making process, and customization service process, the glasses customization service process was redesigned. From the customer's perspective, it focused on purchase tendency and post-purchase evaluation, which are two important parts of the purchase decision-making process. Through online comment crawling, questionnaire surveys, the influencing factors of glasses purchase decision-making were integrated into three dimensions of customer demand, glasses element, and purchase experience. Interpretation Structure Model was used to obtain the hierarchical relationship of these influencing factors. Compared with the traditional glasses service process, a customization service relationship network was proposed, which was driven by demand internally and by service externally. The redesigned glasses customization service process integrated the customer, designer, and manufacturer, guiding the improvement to glasses customization services and reference for the optimization to other products' customization service process.

Session IS-02 Intelligent Systems 2

Date December 15, 2021

Time 06:00 PM-07:30 PM

Chair(s): Dinh Son NGUYEN¹

¹University of Science and Technology, The University of Danang, Viet Nam

IEEM21-F-0272/Model Transformation for Automatic Design of GPON/FTTH Network

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In the literature, automatic design and planning of Gigabit Passive Optical Network/Fiber-To-The-Home (GPON/FTTH) have been addressed by many different approaches including meta-heuristics and Mixed Integer Linear Programming (MILP). The FTTH network design can be formulated as a Binary Integer Programming (BIP) problem with Boolean variables. However, many well-defined optimization approaches for BIP problems developed in the literature cannot be directly applied in network planning due to the complexity of planning model. To address this, the model of GPON planning has been transformed with a standard structure, and the resultant model can be solved efficiently based on the Lagrangian Heuristic method. In addition, the correlations of constraints are considered during optimization process. This helps to reduce the computational cost in different cases considered in the experiments.

IEEM21-F-0400/Blockchain Application in Halal Supply Chain: Literature Review and Future Research

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Blockchain application in supply chain and halal has risen in recent years. This can be seen by increasing the number of papers published. The purpose of this paper was to review and analyze the previous papers on blockchain application in supply chain and halal supply chain using a systematic literature review based on the Scopus database from 2017-2021. The findings indicate that the literature review methods the most of research method used, manufacturing is the most blockchain application of industry type, trust is the most benefits achieved of blockchain application, traceability system is the most function of blockchain application. The main contribution of this paper is the systematic classification of the relevant literature on blockchain application on supply chain and halal. Therefore, academics might find the helpful review and discussion for further research.

IEEM21-F-0461/COVID-19 Detection Through Smartphone-recorded Coughs Using Artificial Intelligence: An Analysis of Applicability for Pre-screening COVID-19 Patients in Vietnam

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²PHAM NGOC THACH University of Medicine, Viet Nam

The Covid-19 pandemic is one of the most serious global health epidemics in recent decades. Its consequences have affected hundreds of millions of people in countries around the world because of the high contagiousness and mortality rate of the virus. Since the fourth wave of Covid-19 infections broke out and spread to many cities and provinces in Vietnam, there were over 10,000 infected cases in the community within two months by the Delta coronavirus variants. Therefore, it is very necessary to have a faster and more effective method to prescreen and isolate infected patients as soon as possible. That is why the paper proposes a method using artificial intelligence techniques to detect covid-19 infected patients based on smartphone-recorded cough sounds. The learning models are built using the publicly available data as COUGHVID and Coswara. An analysis of the applicability of the learning models for prescreening Covid-19 patients in Vietnam is also mentioned in the paper.

IEEM21-F-0124/A Hybrid Approach with Joint Use of Tag and Rating for Vehicle and Cargo Matching

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This study develops and evaluates the joint use of improved methods to pair trucks with cargo on a vehicle-cargo matching (VCM) platform. The improved content-based VCM method recommends trucks to cargo owners based on their requirements. Meanwhile, a hybrid tag-based and collaborative-filtering (CF) approach accurately predicts shipper's ratings of drivers. Then the two methods are combined to obtain the final preference-based VCM (PVC) model to make recommendations for shippers. The results of experiments indicate that proposed methods are competitive to typical cosine and CF methods in terms of Matching degree and Preference.

IEEM21-F-0262/Understanding Human-machine Collaborative Systems in Industrial Decision-making

Kajal Bhandari^{1*}, Yan Xin¹, Ville Ojanen²

¹LUT University, Finland

The inclusion of Intelligent systems in industries has resulted in various opportunities as well as some unforeseen concerns. It has brought complexity in team dynamics, communication, and decision-making structure. Therefore, transforming the structure of the organizations into a collaborative space where both humans and intelligent machines work together as partners is challenging. This paper delves into these complexities elaborating on the impact of incorporating intelligent machines on decision-making and decision-makers. The paper explores the novel research area by the means of a systematic review of the literature in this field. The review process resulted in 37 carefully selected articles from Scopus and Web of Science databases. The results show the increasing number of publications in this interdisciplinary research area. As findings of the paper, four major concepts of human-machine collaborative systems in industrial decision-making have been derived, and applications within these conceptual areas are introduced in this paper. Finally, emerging, and potential future research are presented, as well as the essential areas to be paid attention to as managerial implications of the findings.

Session	EECA Engineering Economy and Cost Analysis
Date	December 15, 2021
Time	06:00 PM-07:30 PM
Chair(s):	Luca SILVESTRI ¹ , Mathias RIEDER ² ¹ University of Rome "Niccolò Cusano", Italy ² Ulm University of Applied Sciences, Germany

IEEM21-F-0028/Improving Competitiveness Through the Application of Cost Estimation Models in the South African Automotive Industry

Prianca Naicker¹, Oludolapo Olanrewaju¹

¹Durban University of Technology, South Africa

Optimal sourcing decisions have become a critical factor to maintaining and improving the competitiveness of organizations operating in a globally competitive environment. This research utilized a case study approach to determine the impact of cost estimation models on the competitiveness of organizations in the South African automotive industry. A parametric cost estimation model was adopted and applied to the sourcing processes at an automotive manufacturer situated in Durban, Kwa-Zulu Natal to support the introduction of the next generation passenger vehicle. Additionally, the sourcing process was redesigned to incorporate the parametric cost estimation model. The model was generated on Microsoft Excel, making it cost effective and user friendly. It was shown that the application of the cost estimation yielded favorable results and significantly improved the competitiveness of the organisation studied.

IEEM21-F-0121/Techno-economic Evaluation of a Second-life Battery Energy Storage System Enabling Peak Shaving and PV Integration in a Ceramic Manufacturing Plant

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The possibility to use second-life spent batteries represents a global challenge for protecting the environment and promoting economic development. The present study aims to present an overview of available options for reusing EV batteries as storage system in a factory environment and to evaluate the techno-economic feasibility of a second-life battery energy storage system (BESS) enabling the electricity peak shaving strategy and/or the storage for standalone photovoltaic system in a modern ceramic manufacturing plant. Results show that spent batteries, derived from electric vehicles, can be used to store enough energy as BESS for a small-scale industrial application; furthermore, due to their low cost, spent batteries represent a favorable option in economic terms.

IEEM21-F-0204/Cost Analysis of Collaboration Interfaces in an Interdisciplinary Engineering Workflow: A Model Based Approach Using BPMN+I

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In multi-team engineering projects with multi-team collaborations and frequent changes, decision-makers can hardly keep an overview of cost. Standard decision support in industry focuses either solely on workflow cost or the performance of multi-team labor, leaving out a holistic view. This paper proposes an approach to analyze cost at multi-team work interfaces using the Business Process Modeling Notation (BPMN). Such interfaces are crucial for the success of an interdisciplinary engineering effort, representing frequent interactions of different teams (multi-team systems) during one working tasks like the interaction of mechanical and electrical engineering teams choosing sensors fulfilling both the mechanical and electrical requirements. The approach is evaluated using an industrial use case with two different multi-team interface alternatives: a human expert versus an IT-based assistance system. To support decision-making whether the IT-based solution with its software license costs is beneficial the interface cost of both alternatives are assessed exemplarily.

IEEM21-F-0467/Evaluation of Human-robot Order Picking Systems Considering the Evolution of Object Detection

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The automation of intralogistic processes is a major trend, but order picking, one of the core and most cost-intensive tasks in this field, remains mostly manual due to the flexibility required during picking. Reacting to its hard physical and ergonomic strain, the automation of this process is however highly relevant. Robotic picking system would enable the automation of this process from a technical point of view, but the necessity for the system to evolve in time, due to dynamics of logistic environments, faces operations with new challenges that are hardly treated in literature. This unknown scares potential investors, hindering the application of technically feasible solutions. In this paper, a model for the evaluation of the additional cost of training of automated systems during operations is presented, that also considers the savings enabled by the system after its evolution. The proposed approach, that considers different parameters such as capacity, ergonomics and cost, is validated with a case study and discussed.

IEEM21-F-0494/Autonomous Deep-sea Shipping – The Economist's View

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For the past decade, autonomous ships have been touted as the next revolution in maritime transport, on par with the switch from sail to steam. Yet, despite large research funding and effort, technological progress remain slow and commercial uptake is largely non-existent. In this paper we go through some of the key arguments for the introduction of autonomous ships in deep-sea trades and highlight some of the challenges in the business case for unmanned autonomous ships.

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