IEEM returns once more to Macau and we, at the organizing committee welcome industrial engineering and engineering management enthusiasts from all over the world participating in this year’s conference. IEEM2019 brings together some high profile keynote speakers and workshop leaders, several sessions covering nineteen different topics on different aspects of industrial engineering and engineering management. A campus tour will be organized to the only public comprehensive University in Macau, the University of Macau, for visiting its State Key Laboratories and characterised Residential Colleges.

We live in challenging times. According to the world economic forum survey, climate change is top concern for the third year in a row. Large scale conflict, wars, and inequality is the other major concern. Engineering knowledge is relied upon to provide innovation and inventions that shape our society and improve the way we work and live. Hence, industrial engineering is one of the key influences that shapes our society. Please take this opportunity to listen to a talk, and imagine your contribution to the future.

Wishing you a successful conference to catch up on the latest developments in your field, forge new friendships and seek inspiration to use engineering management knowledge towards the solution of societal challenges. And while you are doing this enjoy the sounds, sights and culinary delights of Macau.

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Georgia Institute of Technology
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Contact IEEM Secretariat
Email: info@ieem.org
Thank you for excellent support in organizing IEEM2019, the IEEE 2019 International Conference on Engineering and Engineering Management

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MON-16 DEC 2019 HIGHLIGHTS
09:00 – 09:45
Parisian #7103
KEYNOTE
"THE NEW FOXCON IE WAY"
Jacob Jen-Gwo Chen
Vice Chairman, Hon Hai/ Foxconn Technology Group

09:45 – 10:30
Parisian #7103
KEYNOTE
"ADVANCES IN AUTONOMOUS DRIVING"
Yaqing Zhang
President, Baidu Inc

11:00 – 12:30
Parisian #7301
PANEL SESSION
"MEET-THE-EDITORS"
Chair: Michael Y. Wang
Editor-in-Chief, IEEE Transactions on Automation Science & Engineering
Chair Professor, Department of Mechanical & Aerospace Engineering and Department of Electronic & Computer Engineering Director, HKUST Robotics Institute Director, HKUST-BRIGHT DREAM ROBOTICS Joint Research Institute Hong Kong University of Science and Technology
ACTIVITY LOCATOR 5th Floor, Parisian Macao

SELF CHECK-IN Parisian Ballroom North Foyer
- Print Name Badge & Collect Conference Issues
  - Sun – 15 Dec: 12:30 to 17:30
  - Mon – 16 Dec: 08:00 to 17:30
  - Tue – 17 Dec: 08:00 to 16:30

Sun-15 Dec, 2019
- Workshop “HOW TO PUBLISH YOUR RESEARCH”
  Bordeaux Room #7.3
- WELCOME RECEPTION (All Are Welcome!)
  Parisian Ballroom North Foyer

Mon-Tue, 16 – 17 Dec, 2019
- OPENING & KEYNOTE
  Parisian Ballroom #7103
- BREAKOUTS (ORAL)
  Parisian Ballroom #7001, #7002, #7101, #7102, #7201, #7301
  Bordeaux Room #7.2, #7.3
- AM/PM COFFEE/TEA, DAILY LUNCH BUFFET
  Parisian Ballroom #7203

Tue – 17 Dec, 2019
- POSTER SESSION
  Parisian Ballroom #7202
- CLOSING & BEST PAPER AWARD
  Parisian Ballroom #7103
- CONFERENCE BANQUET (TICKETED EVENT)
  Parisian Ballroom #7203

Location Plan 5th Floor, Parisian Macao
Program Highlights

Sun-15 Dec 2019
Bordeaux Room # 7.3
Workshop (Requires Advance Registration/Payment). Please enquire at Registration

13:30 – 15:30
"HOW TO PUBLISH YOUR RESEARCH"
A WORKSHOP FOR EARLY CAREER RESEARCHERS

Good research deserves to be published, to be widely read, and to be recognized by fellow researchers and the community. The current research (and funding) climate makes it necessary that you are successful in being published: “Publish or Perish”. This then raises the question, how can you achieve that goal? The aim of this workshop is to enable the early career researchers to impart the basic framework for the development of a good publication skill and technique.

Dr Michael Y. Wang is the Founding Director of the Robotics Institute and a Chair Professor of Mechanical and Aerospace Engineering and Electronic and Computer Engineering of HKUST. He has numerous professional honors—National Science Foundation Research Initiation Award; Ralph R. Teetor Educational Award from Society of Automotive Engineers; LaRoux K. Gillespie Outstanding Young Manufacturing Engineer Award from Society of Manufacturing Engineers; Chang Jiang (Cheung Kong) Scholars Award from the Ministry of Education of China and Li Ka Shing Foundation (Hong Kong); Research Excellence Award of CUHK. He is Editor-in-Chief of IEEE Trans. on Automation Science and Engineering. His main research interests are in robotic manipulation, manufacturing automation, and topology optimization. Before joining HKUST in 2015, he served on the engineering faculty at University of Maryland, Chinese University of Hong Kong, and National University of Singapore. A recipient of ASME Design Automation Award, Professor Wang is a fellow of ASME, HKIE, and IEEE.

Sun-15 Dec 2019
Parisian Ballroom North Foyer

15:30 – 17:00
WELCOME RECEPTION
(All Are Welcome!)
As the leader of manufacturing services and No.1 in numbers of producing 3C products, e.g., smartphone, tablet, notebook, PC, TV, printer, server, networking, set-top box, gaming console, communication equipment, Foxconn has been known as “the King of EMS” and it has been transformed to the leader of intelligent industrial internet. Indeed, the first listed company in China market in industrial internet is the Foxconn Industrial Internet Co Ltd., a subsidiary company of Foxconn. The presentation will cover the vision, chronicle of development including organization and systems, and applications of Industrial Engineering (IE) in SCM, Productivity, Quality and other areas in Foxconn and IE’s important and irreplaceable role in Foxconn’s intelligent industrial internet development and implementation.

Dr. Jacob Chen is the Vice Chairman of Hon Hai/Foxconn Technology Group and the Founding President of the Foxconn University (Foxconn IE Academy, Corporate University of Foxconn). After receiving his Ph.D. degree in Industrial Engineering from the University of Oklahoma, he accepted a faculty position at the Department of Industrial Engineering, the University of Houston and served as department chairman for few years before taking the Deanship of the College of Science and Engineering at the University of Texas – Pan American in 1998. He joined with Hon Hai/Foxconn in 2001 as the Special Assistant to Chairman. With the rapid growth of Hon Hai/Foxconn, Dr. Chen was promoted to Vice President, Senior Vice President, General Manager of different Business Groups and current position as Vice Chairman of Hon Hai/Foxconn Group.

Dr. Chen has published more than 120 referred articles and supervised 25 Ph.D., 33 M.S. students during his academic career. For professional service, Dr. Chen served as the President of the International Society of Industrial Ergonomics and Occupation Safety in 1996, received the Institute of Industrial Engineers (IIE) Excellence in Productivity Improvement Award in 2006, and is the Fellow of the IIE and the World Academy of Productivity Science. Dr. Chen also served as the adjunct professor at various universities, such as, Tsing Hua University, Huazhong University of Science and Technology, TianJin University, and ChongQing University. Dr. Chen takes a new initiative to work with leading universities and colleges establishing degree programs in the Foxconn University since 2001. Foxconn employees could continue their study toward Associate, B.S., M.S., and Ph.D. Degrees. More than 25,000 Foxconn employees have received their degrees and have more than 25,000 still study.
Program Highlights

Mon-16 Dec 2019
Parisian Ballroom #7103

Ya-Qin ZHANG
President, Baidu Inc.

09:45 – 10:30
KEYNOTE “ADVANCES IN AUTONOMOUS DRIVING”

The automotive and transportation industry is going through a tectonic shift in the next decade with the advent of Connectivity, Automation, Sharing, and Electrification (CASE). Autonomous driving presents a historical opportunity to transform the academic, technological, and industrial landscape with advanced sensing and actuation, high definition mapping, new machine learning algorithms, smart planning and control, increasing computing powers, and new infrastructure with 5G, cloud and edge computing. Indeed, we have witnessed unprecedented innovation and activities in the past five years in R&D, investment, joint ventures, road tests and commercial trials, from auto makers, tier-ones, and new forces from the internet and high-tech industries. Baidu has been in the frontier of this transformation with its leadership in AI and search technology, cloud and mega-scale computing infrastructure and data centers, high definition mapping and big data capabilities, and first commercial trials. More importantly, Baidu spearheaded Apollo in 2017 with an open, inclusive, and collaborative approach to solve the most challenging and complex problem in our industry. Apollo has since become the largest and most vibrant commercial platform and ecosystem in the world with over 130 global partners and tens of thousands of developers.

In this talk, I will speak about this historical opportunity and challenges from technological, industrial and policy perspectives. I will address some of the core controversial and critical issues in the advancement of autonomous driving: open vs closed, Lidar vs cameras, progressive L2-L3-L4 vs new L4, autonomous capabilities vs V2X, Robotaxi vs vertical, China vs global, automakers vs new players, and the evolutional path and end game.

Dr Ya-Qin Zhang serves as the President of Baidu Inc. for 5 years (2014.09-2019.10). Baidu (NASDAQ: BIDU) is a leading Internet company in search, mobile Internet, cloud computing, and artificial intelligence, providing internet services to over 2 Billion people around the world, employs over 40,000 people in 15 countries.

Prior to joining Baidu in 2014, Zhang served as Microsoft’s Corporate Vice President in Redmond, USA and Beijing, China. Over his 16 year tenure at Microsoft, he has taken various key positions, including the Managing Director of Microsoft Research Asia (MSRA), Chairman of Microsoft China, Corporate Vice President of Mobile and Embedded Products, and Microsoft Asia-Pacific R&D Chairman. He built one of the world premier R&D centers with over 3000 scientists and engineers, in multimedia, computer vision, AI/machine learnings, speech recognition and machine translations. He was the Director of Multimedia laboratory of Sarnoff Corp in Princeton, NJ (now SRI) from 1995-1998, and a Senior member of technical staff for the GTE Labs (now Verizon) in Waltham, MA (from 1990-1994)

Zhang was recently inducted to the American Academy of Arts and Sciences in 2019, one of the highest distinctions in the fields of arts and natural/social sciences. He was inducted to the Australian Academy of Technology and Engineering (ATSE) as the only foreign Fellow in 2017, and became an IEEE Fellow in 1997 at age 31 as the youngest Fellow of the organization’s 100+ year history at the time. He is one of the top scientists in digital video and multimedia, with 558 papers in leading international conferences and journals, 62 granted US patents, and 12 books. His research and invention in video coding, motion estimation, rate control, and media streaming has been widely used in commercial HDTV products, internet video services, and MPEG/H.26X international standards. He has received many prestigious academic, technological, and industrial awards, including the IEEE centennial medal, IEEE industry pioneer award, IEEE Richard Merwin Medal, over a dozen best paper awards of various IEEE transactions and journals.

Zhang runs one of the largest technology companies in the world. He was named one of the top 10 CEOs in Asia, 50 global shapers, Executive of the year, IT innovator leader award by IT Times, Business Week, CNBC, Global business and Vision magazine. He served on the Board of Directors of five public companies. He is on the industry board of United Nation Development Program (UNDP), and received UN’s special award for sustainable development in 2016. He is the Chairman of world’s largest open autonomous driving platform “Apollo” alliance with over 130 global partners. He has been a leading champion of innovation and globalization, and a frequent feature speaker in global forums including APEC, Davos World Economic Forum, United Nations, and Bo’Ao Asia Forum.
Program Highlights

Mon-16 Dec 2019
Parisian Ballroom #7301

11:00 – 12:30
PANEL SESSION “MEET-THE-EDITORS”
Chair, Michael Y. WANG
Editor-in-Chief,
IEEE Transactions on Automation Science and Engineering
Chair Professor, Department of Mechanical & Aerospace Engineering
and Department of Electronic and Computer Engineering
Director, HKUST Robotics Institute
Director, HKUST-BRIGHT DREAM ROBOTICS Joint Research Institute
Hong Kong University of Science and Technology

Dr Michael Y. Wang is the Founding Director of the Robotics Institute and a Chair Professor of Mechanical and Aerospace Engineering and Electronic and Computer Engineering of HKUST. He has numerous professional honors–National Science Foundation Research Initiation Award; Ralph R. Teetor Educational Award from Society of Automotive Engineers; LaRoux K. Gillespie Outstanding Young Manufacturing Engineer Award from Society of Manufacturing Engineers; Boeing–A.D. Welliver Faculty Summer Fellow, Boeing; Chang Jiang (Cheung Kong) Scholars Award from the Ministry of Education of China and Li Ka Shing Foundation (Hong Kong); Research Excellence Award of CUHK. He is Editor-in-Chief of IEEE Trans. on Automation Science and Engineering. His main research interests are in robotic manipulation, manufacturing automation, and topology optimization. Before joining HKUST in 2015, he served on the engineering faculty at University of Maryland, Chinese University of Hong Kong, and National University of Singapore. A recipient of ASME Design Automation Award, Professor Wang is a fellow of ASME, HKIE, and IEEE.

Tue-17 Dec 2019
Parisian Ballroom #7203

18:30 – 20:30
CONFERENCE BANQUET (Ticketed Event)
Please enquire at Registration

Wed-18 Dec 2019
09:00 – 12:00
Technical Visit

Highlights
This tour covers the Central Campus, Library and the State Key Laboratory of Internet of Things for Smart City

Program
The tour departs from the Parisian Macau (IEEM2019 Venue) 09:00 sharp. Participants need gather at 08:45. Please see registration desk to find out exact location
## Presentations

**MON – 16 DEC**

**08:30**  
**Official Opening**

**09:00 – 09:45**  
**Keynote “THE NEW FOXCON IE WAY”**

**09:45 – 10:30**  
**Keynote “ADVANCES IN AUTONOMOUS DRIVING”**

**10:30 – 11:00 AM Coffee/Tea**

**11:00 – 12:30**

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**12:30 – 13:30 Lunch Buffet**

**From 12:30 Authors Put Up Posters**  
(*Must Be Completed by 12:30 on Tue-17 Dec*)
## Presentations

### 13:30 – 15:30   MON – 16 DEC

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### 15:30 – 16:00 PM Coffee/Tea

### 16:00 – 17:30

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### Presentations

#### 16:00 – 17:30 (Cont)

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**Presentations**

**TUE – 17 DEC**

**Parisian Ballroom, 5th Floor**

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**08:30 – 10:30**

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**10:30 – 11:00 AM Coffee/Tea**
### Presentations

**Parisian #7103**
15:30 – 16:00

**Closing Ceremony & Best Paper Awards**

**Parisian #7202**
16:30 – 18:00

**Poster Presentations**

**(Authors Put Up Posters Latest by 12:30)**

**Parisian #7203**
18:30 – 20:30

**Conference Banquet (Ticketed Event)**

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**Authors Put Up Posters - Must Be Completed by 12:30**

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**TUE – 17 DEC**

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### Poster Presentations

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### Conference Banquet (Ticketed Event)

**16:00 - 16:30 PM Coffee/Tea**
**Presentations**

**TUE – 17 DEC**

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**Closing Ceremony & Best Paper Awards**

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**Poster Presentations**

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**Conference Banquet (Ticketed Event)**

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<td>TUE 16:30 – 17 DEC</td>
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<td>Engineering Education &amp; Training</td>
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<td>Technology &amp; Knowledge Management</td>
<td>Human Factors</td>
<td>Manufacturing Systems</td>
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Parisian #7203

18:30 – 20:30 Conference Banquet (Ticketed Event)
Presenter Guides

Oral

1. **Prepare Your Presentation**
   Length of presentation material should be in accordance with your time allotted. Total duration including Q&A and speaker changeover is 15 minutes for each talk. Please refer to the Final Schedule for actual presentation times. You are kindly requested to be at the presentation room at least 15 minutes before the session starts.

2. **Determine Your Audio-Visual Needs**
   Each meeting room comes equipped with a laser pointer and clicker, computer, LCD projector and screen. The computers in the meeting rooms are being provided to Windows-based PC users. The PC will be configured with Microsoft Windows operating system. Please bring your presentation files in Thumb drives only. For MAC-laptop users, please bring your own VGA adapter cable.

3. **Create a Backup Copy of Your Presentation**
   We recommend that you bring at least 2 copies of your presentation to the meeting for backup purposes. Only thumb drives are acceptable.

4. **Give Your Presentation**
   Be considerate to the other speakers and audience by staying within your allocated time. The allocated time for your presentation includes a discussion and a changeover to the next speaker. Session Chairs will hold you to the allotted time. This is essential to ensure adequate time for questions and discussion as well as adherence to the schedule. Please discuss the same material as reported in your abstract submission. At the end of the meeting, all presentation files will be destroyed.

Poster

Poster boards are pre-assigned and marked with your Paper ID. At least one author of your paper is expected to be present during the poster session.

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<th>Authors Put Up Posters (Parisian Ballroom #7202)</th>
<th>From 12:30 on Mon-16 Dec 2019 Must be Completed by 12:30 on Tue-17 Dec</th>
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<td>Poster Presentation (Presenter Attendance Required)</td>
<td>Tue-17 Dec 2019, 16:30 to 18:00</td>
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<td>Latest By 18:30 latest on Tue-17 Dec After this time, posters left on the board will be discarded</td>
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Each presenter is provided with a 1m x 2m high poster panel. The presentation must cover the same material as the paper submitted. The poster should be 1 x A0 size in vertical/portrait format, measuring 841 mm length x 1189 mm height maximum.

a. Place your Paper ID, Paper Title and Authors’ names prominently at the top of the poster to allow viewers to identify your abstract easily. **Presenter’s name must be underlined and in bold letterings.**

b. Author’s names, e-mails and address information must be provided in case the viewer is interested in contacting you for more information.

c. You have complete freedom in displaying your information in figures, tables, text, photographs, etc. in the poster.

d. A successful poster presentation depends on how well you convey information to an interested (but not expert) audience. You may wish to structure your poster by including the background of your research followed by results and conclusions.
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<td>Case Study: A Semi-Supervised Methodology for Anomaly Detection and Diagnosis</td>
<td>A. MORALES-FOREBO, Samuel BASSETTO, Ecole Polytechnique de Montreal, Canada</td>
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<td>Fault Prediction of Fan Based on Failure Window Period</td>
<td>Bin YAN1, Qiaoqhen NING1, Xianpeng WANG1, Dongpeng YU1</td>
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<td>Investigating a Breast Cancer Gene Expression Data Using a Novel Clustering Approach</td>
<td>Leila NAJEN, Amir SALEHIPOUR, University of Technology Sydney, Australia</td>
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<td>Application of Feature Selection Method to Error Factor Extraction of Multifunction Peripheral</td>
<td>Myungsok KO1, Tahuya INAGI1, Masaaki TAKADA1, Toru YANO1, Toshiba Corporation, Japan</td>
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<td>A Hierarchical Feature Fusion-based Method for Defect Recognition with a Small Sample</td>
<td>Yiping GAO1, Liang GAO2, Xinlu LI, Huazhong University of Science and Technology, China</td>
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<td>Predicting Commercial Real Estate Rent: An Empirical Study</td>
<td>Usha ANANTHAKUMAR1, Rishita SINHA1, Indian Institute of Technology Bombay, India</td>
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<td>Efficient Compression and Preprocessing for Facilitating Large Scale Spatiotemporal Data Mining – A Case Study based on Automatic Identification System Data</td>
<td>Hai-Yan XU1, Vasundhara JAYARAMAN, Xiujie FU1, Nastrin Bin OTHMAN1, Wanbing ZHANG1, Xiao Feng YIN1, Dqing ZHAI1, Rick Snow Mong GÖH</td>
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Decision Analysis and Methods 1
16/12/2019 11:00 - 12:30
Room: Parisian #7002
Chairs: Hao YU U/I The Arctic University of Norway
Yaqiong LV Wuhan University of Technology
Abstracts: see page 41

Decision Analysis and Methods 2
16/12/2019 16:00 - 17:30
Room: Parisian #7002
Chairs: Yaqiong LV Wuhan University of Technology
Anders THORSTENSON Aarhus University
Abstracts: see page 55

Decision Analysis and Methods 3
17/12/2019 08:30 - 10:30
Room: Parisian #7002
Chairs: Hao YU U/I The Arctic University of Norway
Mei-Chen LO National United University & China
Medicine University
Abstracts: see page 62
IEEEM19-P-1106
A Decision Analysis of Conspicuous and Non-Conspicuous Consumption Behavior
Jianghan GU
Northwestern Polytechnical University, China

IEEEM19-P-1137
Planning an Urban Postal Service Network by Using a Location-based Hybrid Optimization-Simulation Method: A Real-World Case Study
Xu SUN, Hao YU, Wei Dong SOLVANG
University of Tromsø – The Arctic University of Norway, Norway

IEEEM19-P-1078
Applying BPN to Build the Prediction Model for Site Selection
Huan-Fin FU, Hsiao-Feng YEH, Tien-Hsiang CHANG, Cheng-Chang TSAI
National Kaohsiung University of Science and Technology, Taiwan

IEEEM19-P-0140
A Composite Indicator for Supply Chain Performance Measurement: A Case Study in a Manufacturing Company
Rui OLIVEIRA1, Catarina CUBO2, Rui ESTRADA1, Ana FERNANDES1, Paulo AFONSO1, Maria do Sameiro CARVALHO1, Paulo SAMPADO1, João ROQUE2, Marcio RIBEIRO1
1University of Minho, Portugal
2Bosch Car Multimedia, Portugal

IEEEM19-P-1172
An Integrated Decision Support System for Sustainable Supplier Selection, Evaluation, and Benchmarking Using a FIS and MOLP Approach
Dua WEAIKA1, Sharuddin Ahmed KHAN1
1Rochester Institute of Technology, United Arab Emirates
2University of Sharjah, United Arab Emirates

IEEEM19-P-1169
The Initial Study of Behavioral Diagnosis on Qian Yi's Xiao-Er-Yao-Zheng-Zhi-Jue
Mei-Chen LO1, Su-Tso YANG1, Tung-Ti CHANG2, Lu-Hai WANG2
1National United University & China Medicine University, Taiwan
2China Medicine University, Taiwan

IEEEM19-P-0074
Corporate Responses to Internet Flaming: Evidence from Japan
Ketsu MÖR1, Fumiko TAKEDA
The University of Tokyo, Japan

IEEEM19-P-0194
What Will Influence Customer's Engagement the Strategies and Goals of Tweet
Dongying YANG, Shuozo FUJIMURA
Tokyo Institute of Technology, Japan

IEEEM19-P-0206
Social Media Marketing Activities and Customers' Purchase Intention: The Mediating Effect of Brand Image
Haixin ZHANG, Yali ZHANG, Anastasia RYZHKOVA, Chrissie Diane TAN, Feng LI
Northwestern Polytechnical University, China

IEEEM19-P-0214
Digital HRM Model for Process Optimization by Adoption of Industry 4.0 Technologies
Megashnee MUNSAMY1, Arnesh TELU KDARIE2
1University of Johannesburg, South Africa
2Vellore Institute of Technology, India

IEEEM19-P-0063
Towards a Metric Between Engineering to Order and Assemble/Make to Order Products in Configuration Situations
Abdoarrahim SYLLA1, Rania AYACHI2, Michel ALDANONDO1, Elise VAREILLES3, Yvan BEAUREGARD3, Paul PITROT4
1Université Grenoble Alpes, France
2Université de Toulouse / IMT Mines Albi/ ENI Tarbes, France, Metropolitan
3Université de Toulouse / IMT Mines Albi, France, Metropolitan
4École de Technologie Supérieure, Canada

IEEEM19-P-0452
Green Entrepreneurship Model Utilising the System Dynamics Approach: A Review
Dineo DHALE1, Makondesile KANAKANA2, KATUMBA1, Wilson MALADZIHF1
1Rhodes University, South Africa
2University of South Africa, South Africa

IEEEM19-P-0284
Factors Affecting Customer Acceptance of Mobile Payment
Daniel TSE1, Tianjia WEN1, Ru WU1, Ge YIN2, Xinlu ZHAI3
1City University of Hong Kong, Hong Kong SAR
2National Central University, Taiwan
3National Central University, Taiwan

IEEEM19-P-0451
Exploring Followers' Intentions of Donating Online Game Streamers
Li-Ting HUANG1, Yu-Shiang WU1, Jun-Der LEU2
1Chang Gung University, Taiwan
2National Central University, Taiwan

IEEEM19-P-1151
Industrie 4.0 in Practice: An Empirical Study in Germany and Taiwan
Jun-Der LEU1, Joerg PUCHAN2, Yi-Wei HUANG3
1National Central University, Taiwan
2National Central University, Taiwan
3Munich University of Applied Sciences, Germany

IEEEM19-P-0306
Environmental Impact of Last Mile Deliveries and Returns in Fashion E-Commerce: A Cross-Case Analysis of Six Retailers
Regina VELAZQUEZ, Stanislav CHANKOV Jacobs University Bremen, Germany

IEEEM19-P-0362
E-Commerce: Stock Market Analysis Blended With Mining and Ann
Yan-Ling CAI1, Kumar KANNAN2, Yan-Hang XIE1, Liang ZHAO1
1City University of Hong Kong, Hong Kong SAR
2National Central University, Taiwan

Chairs: Mei-Chen LO National United University & China Medicine University
Anders THORSTENSON Aarhus University

Abstracts: see page 70

Chairs: Michel ALDANONDO Toulouse University / IMT-Mines Albi
Yan-Ling CAI Zhengzhou University

Abstracts: see page 48

Chairs: Stanislav CHANKOV Jacobs University Bremen
Yan-Ling CAI Zhengzhou University

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Chairs: Michel ALDANONDO

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Abstracts: see page 84

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17/12/2019 16:30 - 18:00
Analysis
Engineering Economy and Cost

Chairs: Jinyu FAN Guangdong University of Finance & Economics
Om Prakash YADAV North Dakota State University

Abstracts: see page 84

IEM19-P-0232
From Product to Service Business: Productization of Product-Oriented, Use-Oriented, and Result-Oriented Business
Enro MUSTONEN, Janne HARKONEN, Harri HAAPASALO
University of Oulu, Finland

IEM19-P-0265
Design of Inventory Pledge Financing Model Based on Internet of Things Technology and Operational Risk Management
Di WANG1, Daozhi ZHAO2, Baosen WANG3, Jun WU4
1Tianjin University, China
2Beijing Wuzzi University, China
3Bubi (Beijing) Network Technology Co., Ltd, China

IEM19-P-1135
Forecasting the Diffusion of New Competitive Technologies Based on Evolutionary Game Theory: Battery Electric Vehicle and Fuel Cell Electric Vehicle
Yeongjeong LEE, Deok-Joo LEE
Seoul National University, South Korea

IEM19-P-0507
Calculation and Allocation of Complexity Costs Using Process Data Mining
Michael RIEDENER, Christian DÖLLE, Alexander MENGES, Günther SCHÜH
RWTH Aachen University, Germany

IEM19-P-0295
Benefits Management in Infrastructure Projects: Towards a Best Practice Framework
Supriya MEHTA1, Senevi KIRIDENA2
1University of Wollongong, Australia

IEM19-P-0040
The Use of Customized YouTube Videos and Internet to Enhance the Academic Performance of Non-Engineering Students Registered in the Faculty of Engineering at a South African University
Sambul Charles MUKWAKUNGU, Eric Mikobi BAKAMA, Charles MBOHWA
University of Johannesburg, South Africa

IEM19-P-0301
Factor Analysis of Cost of Quality to Determine the Adoption of Economics of Quality as a Measure of Quality Management Performance in South African Companies
Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
University of Johannesburg, South Africa

IEM19-P-0279
A Research on the Application of Cooperative Education in the Capstone Project Course of Technical Universities and Colleges in Taiwan
Jen-Chia CHANG, Hsiao-Fang SHIH
National Taipei University of Technology, Taiwan

IEM19-P-0337
Do Emotions Determine Rumors and Impact the Financial Market? The Case of Demonetization in India
Madhuri PRABHALA, Indranil BOSE
Indian Institute of Management Calcutta, India

IEM19-P-0089
Are We Ready for the Agenda 2030 for Sustainable Development?
Per ÅHAG1, Lisa HED2, Per HAKAN3
1Lund University, Sweden
2Leif OLSSON1, Romalyn GALINGAN
3Technological Institute of the Philippines

IEM19-P-0186
Teaching Fundamental Concepts of Industrial Engineering and Management by Using Examples from the Video Game Industry
Leif OLSSON1, Romalyn GALINGAN
1Mid Sweden University, Sweden

IEM19-P-0545
Research Output on the Usage of Artificial Intelligence in Indian Higher Education – A Scientometric Study
Kalyani Kumar BHATTACHARJEE
Indian Institute of Technology Delhi, India

IEM19-P-0065
Quality Analysis and Improvement of Rear Axle Assembly Line of G Motor Company
Hongying SHAN, Chaung WANG, Lina LI, Yu YUAN
Jilin University, China

IEM19-P-0002
Engineering Meaningful Computing Education: Programming Learning Experience Model
Sin-Ban HO1, Swee-Ling CHEAN2, Ian CHAI1
1Multimedia University, Malaysia
2Universiti Tunku Abdul Rahman, Malaysia

IEM19-P-0333
Online Learning Approaches for Science, Engineering and Technology in Distance Education
Mukondeleli KANAKANA-KATUMBA1, Wilson MALADZII2
1University of South Africa, South Africa
2National Taipei University of Technology, Taiwan

IEM19-P-0396
Modelling Student Satisfaction Through I-E-M Method for Improved Learning Experience of Selected Generation Y and Z
Engineering Students
Romalyn GALINGAN
Technological Institute of the Philippines, Philippines
Abstracts: see page 52

Chairs: Budi SANTOSA
Technology Sepuluh Nopember
Yoshiki KURATA
Technological Institute of the Philippines Quezon City

Room: Bordeaux #7.2
16/12/2019 16:00 - 17:30
Management 1
Healthcare Systems and Management 2
17/12/2019 16:30 - 18:00
Room: Bordeaux #7.2
Chairs: Budi SANTOSA
Technology Sepuluh Nopember
Seung Ki MOON
Nanyang Technological University
Yoshiki KURATA
Technological Institute of the Philippines Quezon City

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IEEM19-P-0064
A Benders Decomposition Approach for Appointment Scheduling of Unpunctual Patients in a Multi-Server Setting
Yangwei PAN, Na GENG, Xiaolan XIE
1Shanghai Jiao Tong University, China
2Université Clermont Auvergne, France

IEEM19-P-0121
Welfare Technology Policy and Practice – A Conceptual Analysis
Annika HASSELBLAD
Mid Sweden University, Sweden

IEEM19-P-0122
A Conceptual Model to Evaluate Technology Implementations: A Home Care Case Study
Annika HASSELBLAD1, Leif OLSSON1, Madeleine BLUSI2
1Mid Sweden University, Sweden
2Förd Västerbottland, Sweden

IEEM19-P-0134
A Two-stage Stochastic Programming Model for Outpatient Appointment Scheduling
Shuang MA1, Songlin CHEN1, Xiaotian CAI
1University of Science & Technology Beijing, China
2Nanyang Technological University, Singapore

IEEM19-P-0227
How to Make a Medical Error Disclosure to Patients?
Xiuzhu GU1, Mingming DENG2
1Tokyo Institute of Technology, Japan
2Shanghai University of Science and Technology, China

IEEM19-P-0250
Inventory Replenishment Policy for Medicines with Non-Stationary Stochastic Demand: The Case of a Newly Opened Hospital in Thailand
Narat HASACHOO, Porwansin SIRISAWAT, Thunwa KAEWKET
Mae Fah Luang University, Thailand

IEEM19-P-0251
Forecasting Lumpy Demand for Planning Inventory: The Case of Community Hospitals in Thailand
Phattaraporn KALAYA, Preecha TERMUKSAWAD, Thananya WASUSRI
King Mongkut’s University of Technology Thonburi, Thailand

IEEM19-P-0262
Investigation and Prioritization of Performance Indicators for Inventory Management in the University Hospital
Porwansin SIRISAWAT, Narat HASACHOO, Thunwa KAEWKET
Mae Fah Luang University, Thailand

IEEM19-P-0383
A Sensitivity Analysis for The Derived Micromort Value of Life and Death Decisions Using Two Methods for Constructing Utility Functions
Ahmed A. ALZANKI, Ali E. ABBA5
University of Southern California, United States

IEEM19-P-0314
An Approach for Severity Prediction of Autism Using Machine Learning
Min CHE1, Liya WANG1, Lin HUANG1, Zhibin JANG
Shanghai Jiao Tong University, China

IEEM19-P-0429
Solving Deficit Funding Issues in Indonesian Health Insurance Systems
Divya KURNIAWANTYAS, Budi SANTOSA, Nurhadi SISWANTO
Institut Teknologi Sepuluh Nopember, Indonesia

IEEM19-P-0067
Virtual Team Performance Factors: A Systematic Literature Review
Derek CLARK, Annlize MARNEWICK, Carl MARNEWICK
University of Johannesburg, South Africa

IEEM19-P-0448
Function Allocation Design of Subway Automatic Train Supervision System’s Alarm Unit
Jiayun WANG1, Weining FANG2, Beixuan GUO3, Ke NIU4
1Beijing Jiaotong University, China
2Shanghai Jiao Tong University, China
3Zhengzhou Railway Vocational & Technical College, China

IEEM19-P-0275
What are the Sentiments About the Autonomous Delivery Robots?
Hio Nam KO, Chang Boon LEE
University of Macau, Macau

IEEM19-P-0110
Eye Gaze Accuracy in the Projection-based Stereoscopic Display as a Function of Number of Fixation, Eye Movement Time, and Parallax
Yogi Tri PRASETYO, Retno WIDYANIANGRUM, Chihsiang Joe LIN
1Mapua University, Philippines
2Sepuluh Nopember Institute of Technology, Indonesia
3National Taiwan University of Science and Technology, Taiwan

IEEM19-P-0310
Postural Analysis Among Machinists Experiencing Work-related Musculoskeletal Disorders in the Philippines
Arianne NECIO, Nicole Emanuelle BATAc, Triehia May ODIAS, Jan Luigi RICAFORD, Rafael SALAZAR, Yoshiki KURATA
Technological Institute of the Philippines Quezon City, Philippines

Human Factors 1
16/12/2019 13:30 - 15:30
Room: Bordeaux #7.2
Chairs: Yoshiki KURATA
Technological Institute of the Philippines Quezon City
Yogi Tri PRASETYO School of Industrial Engineering and Management, Mapua University

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**Human Factors 2**

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<td>Markus HARTONO</td>
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**Abstracts:** see page 67

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**Information Processing and Engineering 1**

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<td>Arnesh TELUKDARIE, Bin ZHANG</td>
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**Abstracts:** see page 57

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**Information Processing and Engineering 2**

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<td>11:00 - 12:30</td>
<td>Parisian #7</td>
<td>Bin ZHANG, David VALIS</td>
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**Abstracts:** see page 72

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**IEEM19-P-0047**

**Analysis of the Relationship Between Motivation for “Work for Non-core Business” and Organizational Commitment of Young Employees**

Kontaro TAKASHIMA, Tomoya NISHICAKI, Tomouki TAKESHITA  
1Japan Advanced Institute of Science and Technology, Japan  
2Seison Business Co., Ltd., Japan

**IEEM19-P-0246**

**Impact of Investing Characteristics on Financial Performance of Individual Investors: An Exploratory Study**

Poompak KUSAWAT, Nopadol ROMPHO  
Thammasat University, Thailand

**IEEM19-P-0316**

**Factors that Influence Sharing Behaviors in Sharing Economy Based on the Theory of Social Capital and Social Exchange: Example of Taiwan-Based USPACE**

Chung-Lun WEI, Y.-C. CHANG, W.-X. WANG, H.-M. CHOU, K.-J. CHEN  
National Kaohsiung University of Science and Technology, Taiwan

**IEEM19-P-0111**

**Biopsychosocial Assessment and Ergonomics Intervention for Sustainable Living: A Case Study on Flats**

Markus HARTONO, A. J. TJAHJOANGGORO, Marselius SAMPETONDOK, Indri HAPSARI  
University of Surabaya, Indonesia

**IEEM19-P-0035**

**In Search of an Optimizer Matrix for Affordance Design**

Chien-Sing LEE  
Sunway University, Malaysia

**IEEM19-P-0487**

**Transfer and Commercialization of Technologies from Universities to Small Companies in South Africa**

Sinothi MAPHUMULO, Hannohle NEL  
University of Johannesburg, South Africa

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**IEEM19-P-0019**

**Enterprise Service Bus Solution for an Efficient Development of Geodesic Monitoring Systems**

Alina ITU  
Transilvania University of Brasov, Romania

**IEEM19-P-0112**

**Developing Bulk-Liquid Traceability in Indonesian Coconut Oil Company**

Ivan GUNAWAN, Iwan VANANY, Ervin WIDODO, Iq. Jaka MULYANA, Kevin CORNELIUS  
1Institut Teknologi Sepuluh Nopember, Indonesia  
2Induha Mandula Catholic University, Indonesia

**IEEM19-P-0378**

**Enhanced MORE Algorithm for Fully Homomorphic Encryption Based on Secret Information Moduli Set**

Kamaldeen Jimoh MUHAMMED, Kazeem Aliagbe GROLAGADE  
1University of Iburu, Nigeria  
2Kivara State University, Nigeria

**IEEM19-P-0230**

**Productization and Product Structure as the Backbone for Product Data and Fact-based Analysis of Company Products**

Janne HARKONEN, Erno MUSTONEN, Hannu HANNILA  
University of Oulu, Finland

**IEEM19-P-0189**


Photo NTHUTANG, Arnesh TELUKDARIE, Chuks MEDOH, Nickey JANSE VAN RENSBURG  
University of Johannesburg, South Africa

**IEEM19-P-1115**

**The Research on Industrial Maintenance Management Platform Based on Microservice Architecture**

Jia Wei SUN, Qing XUE, Jia HAO, Min XIA LIU  
Beijing Institute of Technology, China

**IEEM19-P-0386**

**Effective Implementation of Last Planner System® in Construction Projects: A Case Study**

Ragbhashi GJERDE, R.M. Chandima RATNAYAKE, Samindi SAMARAKOON  
University of Stavanger, Norway

**IEEM19-P-0481**

**Full Factorial Experiment Approach to Quantify the Effect of Forming Parameters on Wrinkling Effect of Deep Drawn Cylindrical Cups**

Lakshitha MERAGALCE, Pramila GAMAGE, Manjula NANAYAKKARA  
University of Peradeniya, Sri Lanka

**IEEM19-P-0348**

**Hierarchical Classification and Regression with Feature Selection**

Shih-Wen KE, Chi-Wei YEH  
National Central University, Taiwan

**IEEM19-P-0303**

**Research and Design on Key Technologies of Spatial-Temporal Cloud Platform Construction**

Bin ZHANG, Riji YU, Dingzhao FEP, Baichuan HUANG, Yao SONG, Ling PENG, Yuhuai ZENG  
1Wuhan University, China  
2Beihai University, China  
3The Hong Kong Polytechnic University, Hong Kong SAR  
4Huazhong Land and Resources Bureau, China  
5Guangzhou Institute of Geography, China

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**City University of Hong Kong**

**Military University of Hong Kong**

**David VALIS University of Defence in Brno Faculty of Military**

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<tr>
<td>Chairs: Zhao-Xu YANG Xi’an Jiaotong University Mahmood ALI Institute of Business Management</td>
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<td>Room: Parisian #7002</td>
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<td>Chairs: Mahmood ALI Institute of Business Management Zhao-Xu YANG Xi’an Jiaotong University</td>
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<td>Room: Parisian #7002</td>
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<td>Intelligent Systems 2</td>
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<tr>
<td>Chairs: Romeo MARIAN University of South Australia Dinh Sen NGUYEN University of Science and Technology</td>
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<td>Room: Parisian #7201</td>
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<td>16/12/2019 11:00 - 12:30</td>
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<td>Manufacturing Systems 1</td>
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Manufacturing Systems 2
16/12/2019 13:30 - 15:30
Room: Parisian #7201
Chairs: John LIU National Taiwan University of Science and Technology
Xin LI Shenzhen University
Abstracts: see page 50

IEEM19-P-0157
Practical Framework for Advanced Quality-based Process Control in Interlinked Manufacturing Processes
Jacqueline SCHMITT1, Florian HÄHN2, Jochen DEUSE3
1TU Dortmund University, Germany
2University of Technology Sydney, Australia

IEEM19-P-0176
A Reusable Scheduling Problem Decomposition Framework for Smart Factories
Che Han LIM1, Seung Ki MOON2, Evans OKPOT2
1Namngang Technological University, Singapore
2Hanyang University, South Korea

IEEM19-P-0220
Development and Application of MES Based on Cloud Platform for Steel Structure Enterprises
Kun WANG, Peng LIU, Anran ZHAO, Qixun ZHANG, Lei WANG, Yiming XUE, Xiuyi GAO, Dawei GAO
Jilin University, China

IEEM19-P-0198
Digital Twins for Industry 4.0 and Beyond
Yuling HSU1, Jing-Ming CHIU2, John S. LIU3
1Institute for Information Industry, Taiwan
2National Taiwan University of Science and Technology, Taiwan

Manufacturing Systems 3
16/12/2019 16:00 - 17:30
Room: Parisian #7201
Chairs: Ali SIADAT Arts et Metiers ParisTech
Romeo MARIAN University of South Australia
Abstracts: see page 58

IEEM19-P-0222
Process Management of Customized Quality Manufacturing for Steel Structures
Anran ZHAO, Peng LIU, Qixun ZHANG, Kun WANG, Lei WANG, Yiming XUE, Xiuyi GAO, Dawei GAO
Jilin University, China

IEEM19-P-0272
Industry Related Requirements for Tools for Planning Energy Efficient Factories
Uwe DOMBROWSKI, Christoph IMDAHL, Alexander REISWICH
Technische Universität Braunschweig, Germany

IEEM19-P-0280
Applying Lean Techniques to Reduce Defective Products: A Case Study of an Electrode Manufacturing Company
Andrea HUARHU-MACHILCA, Victor NUNEZ-PONCE, Ernesto ALTAMIRANO-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0283
Application of Lean Manufacturing Techniques in a Peruvian Plastic Company
Ivonne PÓVÉS-CALDERNO, J. RAMIREZ-MENDOZA, Victor NUNEZ-PONCE, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0282
Application of Lean Manufacturing Tools to Reduce Downtime in a Small Metalworking Facility
Flor DE-LA-CRUZ-ARCÉLA, Jhonatan MARTINEZ-CASTILLO, Ernesto ALTAMIRANO-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0293
Critical Infrastructure for Industry 4 Laboratories and Learning Factories in Academia
Romeo MARIAN1, Duncan CAMPBELL1, Ziyue JIN1, Markus STUMPTNER1, Jaaan CHAI1
1University of South Australia, Australia
2University of South Australia/ Defence Science and Technology Organisation, Australia

Manufacturing Systems 4
17/12/2019 08:30 - 10:30
Room: Parisian #7201
Chairs: Junfeng WANG Huazhong University of Science and Technology
Keng-Pei LIN National Sun Yat-sen University
Abstracts: see page 65

IEEM19-P-0188
A Review on Flexible Forming of Sheet Metal Parts
Günter SCHUH, Georg BERGWEILER, Falko FIEDLER, Philipp BICKENDORF, Can COLAG
RWTH Aachen University, Germany

IEEM19-P-0339
A Two-Phase Relax-and-Fix Heuristic for Multi-Level Lot-Sizing and Facility Location Problems
Mingyuan WEI, Hao GUAN, Canrong ZHANG
Tsinghua University, China

IEEM19-P-0392
New Product Development (NPD) Process in the Context of Industry 4.0
B.A. PATIL1, Makarand KULKARNI2, P.V. M. RAO2
1Indian Institute of Technology Delhi, India
2Indian Institute of Technology Bombay, India

IEEM19-P-0407
A Study on Operator Allocation Method Considering the Productivity and the Training Effect in Labor-Intensive Manufacturing System
Harumi HARAGUCHI
Ibaraki University, Japan

IEEM19-P-0532
Reverse Logistics Barriers: A Case of Plastic Manufacturing Industries in Zambia
Bupe MWANZA1, Charles MBOHWA1
1University of Zambia, Zambia
2University of Johannesburg, South Africa

IEEM19-P-0398
Simulation Based Capacity Optimization of a General Assembly Line with Extremely Unbalanced Station Process Time
Wei ZHOU, Shiqi Lü, Yaqin HUANG, Junfeng WANG
Huazhong University of Science and Technology, China
### Manufacturing Systems 5

**17/12/2019 11:00 - 12:30**  
**Room: Parisian #7201**

**Chairs:** Dinh Son NGUYEN  
*University of Science and Technology*

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**IEEM19-P-0416**  
**Development and Application of Kanban and Milk-Run in Production Process of a Metalworking Company**  
Alessandra CABALLEO-BARRERA, Jhamile VALDIVIA-CASTILLO, Juan QUIROZ- FLORES, Jose C. ALVAREZ-MERINO  
*Universidad Peruana de Ciencias Aplicadas, Peru*

**IEEM19-P-0437**  
**Reduction of Nonconformities in Galvanized Process Using Model Based on Lean Manufacturing Tools**  
Brigite FARAN-MEZA, Carmen VEGA-VILLASANTE, Fernando MARADEGUE-TUESTA, Jose C. ALVAREZ-MERINO  
*Universidad Peruana de Ciencias Aplicadas, Peru*

**IEEM19-P-0449**  
**Analysis of User Groups for Assistance Systems in Production 4.0**  
Benedikt Gregor MARKI, Luca GUALTIERI  
*Fraunhofer Italia Research s.c.a.r.l., Italy*

**IEEM19-P-0476**  
**Determining the Process Choice Criteria for Selecting a Production System in a Manufacturing Firm Using a Delphi Technique**  
Vishwas DOHALE, Milind AKARTE, Priyanka VERMA  
*National Institute of Industrial Engineering, India*

**IEEM19-P-0513**  
**A Study on Skip Flow Shop Scheduling Considering with a Cutting Process in Reinforcing Bar Manufacturing**  
Hiroshi ARAI, Harumi HARAGUCHI  
*Baraki University, Japan*

**IEEM19-P-0454**  
**A Method for Generation of Random Lattice Structure for Additive Manufacturing**  
Dinh Son NGUYEN  
*The University of Danang, Viet Nam*

### Manufacturing Systems 6

**17/12/2019 16:30 - 18:00**  
**Room: Parisian #7201**

**Chairs:** Xin LI Shenzhen University  
*Jun-Der LEU National Central University*

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**IEEM19-P-1142**  
**Transient Analysis of Flexible Production Lines: Bernoulli Reliability Model**  
Mengyne WANG, Hongxuan WANG, Jinghan LI  
*Tongji University, China*

**IEEM19-P-0311**  
**Proposal of a Reconfigurability Index Using Analytic Network Process**  
Isabela MAGANA, Cristovao SILVA, Luis FERREIRA, Matthias THUBER, Erzo FRAZZON, Marco SILVESTRI  
*University of Cimbra, Portugal*

**IEEM19-P-0148**  
**Approach for Implementing Industry 4.0 Framework in the Steel Industry**  
Essendon COVENDER, Ahmed ELKHADARI, Michael SISSI  
*University of Johannesburg, South Africa*

**IEEM19-P-0078**  
**Optimal Scheduling of the Reentrant Multi-Degree Cyclic Multi-Heist Scheduling Problem**  
Xin LI, Yanchun PAN, Richard Y. K. FUNG  
*Shenzhen University, China*

**IEEM19-P-0529**  
**How to Achieve the Supply Chain Performance of Small and Medium-Sized Enterprises?**  
Jun-Der LEU, Yi-Wei HUANG, Larry Jung-Heing LEE  
*National Central University, Taiwan*

### Operations Research 1

**16/12/2019 16:00 - 17:30**  
**Room: Parisian #7301**

**Chairs:** Philipp BAUMANN  
*University of Bern*

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**IEEM19-P-0278**  
**Stochastic Nonlinear Programming Model for Power Plant Operation via Piecewise Linearization**  
Tomoki FUKU, Tetsuya SATO, Takayuki SHIBAI, Ken ichi TOKORO  
*Waseda University, Japan*

**IEEM19-P-0288**  
**L-shaped Method for the Stochastic Vehicle Routing Problem**  
Shaichi IOMURA, Tetsuya SATO, Takayuki SHIBAI, Jun IMAIZUMI  
*Waseda University, Japan*

**IEEM19-P-0204**  
**Quality-Oriented Network DEA Model for the Research Efficiency of Philippine Universities**  
Wiza MÁDRA, Angelimarie MIGUEL, Richard LI  
*De La Salle University, Philippines*

**IEEM19-P-0165**  
**Optimizing Customer Assignments to Direct Marketing Activities: A Binary Linear Programming Formulation**  
Mario GNÄGI, Norbert BAUMANN, Manuel KAMMERMANN  
*University of Bern, Switzerland*

**IEEM19-P-0015**  
**Simulation Model to Evaluate Effectiveness of Queue Management Tool in Supermarket Retail Chain**  
Michelle Lee Fong CHEONG, Yong Qing WIRA MADRIA, Angelimarie MIGUEL, Richard LI  
*University of Bern, Switzerland*

**IEEM19-P-0382**  
**A Continuous-Time Mixed-Binary Linear Programming Formulation for the Multi-Site Resource-Constrained Project Scheduling Problem**  
Mario GNAGI, Norbert TRAUTMANN  
*University of Bern, Switzerland*
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IEEM19-P-0123
Mobile Robots Charging Assignment Problem with Time Windows in Robotic Mobile Fulfilment System
Kin Lok KEUNG, Carman Ka Man LEE, Ping JI
The Hong Kong Polytechnic University, Hong Kong SAR

IEEM19-P-0494
The Effects of Memes on Memetic Algorithms for Solving Quadratic Assignment Problem
Pimpapai THAINIAM
King Mongkut’s Institute of Technology Ladkrabang, Thailand

IEEM19-P-1154
Simulated Annealing for the Share-a-Ride Problem with Adjustable Compartment
Agus Yudisuda Indrakarna PUTU1, Vincent F. YU1, Aidy GUNawan2
1National Taiwan University of Science and Technology, Taiwan
2Singapore Management University, Singapore

IEEM19-P-0942
A Mathematical Programming Model for the Green Mixed Fleet Vehicle Routing Problem with Realistic Energy Consumption and Partial Recharges
Vincent F. YU1, Panca JOHJAWAN1, Aidy GUNAWAN2, Audrey TEDJA WRJAAJ1
1National Taiwan University of Science and Technology, Taiwan
2Singapore Management University, Singapore

IEEM19-P-0125
A Hybrid Differential Evolution with Cuckoo Search for Solving Resource Constrained Project Scheduling Problems
Karazm M. SALLAM, Ripon K. CHAKRABORTTY, Michael J. RYAN
University of New South Wales Canberra at the Australian Defence Force Academy, Australia

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IEEM19-P-0057
Network Model Approach for Fuel Transportation Business
Manop DONMUAN, Komkrit PITHIUEK
Khun Kaen University, Thailand

IEEM19-P-0328
Optimization Model on Peak-Valley Time Electricity Consumption
Yun HUANG, Rachael K.F. IP, Fan GAO
Macau University of Science and Technology, China

IEEM19-P-1112
Dynamic Vehicle Refueling Planning in Transportation Networks
Shieh-Hong LIN
Bida University, United States

IEEM19-P-0354
Enhancing the Dimensional Accuracy of Components Fabricated Using Rapid Prototyping Technique by Optimizing Machine Parameters of a 3D Printer
Duminda BANDARA HERATH, Shiron THALAGALA, Pramila GAMAGE
University of Peradeniya, Sri Lanka

IEEM19-P-1093
Reliability Optimization Design for Multi-State k-out-of-n Systems Using Optimal Strength and Redundancy Strategies
Jianchun ZHANG, Yu ZHAO, Xiaobing MA
Beihang University, China

IEEM19-P-2009
A New Mathematical Model for the Traveling Repairman Problem
Lesia NAENI, L’Moslemi NAENI, Amir SALEHIPOUR
University of Technology Sydney, Australia

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IEEM19-P-0043
A Goal Programming Approach for a Fuzzy Single-Source Capacitated Facility Location Problem
A. Shoqei BARIJOL91, Abbas BARABADI1, Reza TAYAKOLI-MOGHAADAMP
University of Tramr – The Arctic University of Norway, Norway
1University of Tehran, Iran

IEEM19-P-0066
A Reactive GRASP Heuristic Algorithm for Vehicle Routing Problem with Release Date and Due Date Incurring Inventory Holding Cost and Tardiness Cost
Jaikishan T. S., Rahul PATIL
Indian Institute of Technology Bombay, India

IEEM19-P-0524
Solving the Twin Yard Crane Scheduling Problem in Automated Container Terminals
Andrew OLADUGBA, Mohamed GHEITH, Amr ELTAWIL
Egypt-Japan University of Science and Technology, Egypt

IEEM19-P-0131
Pricing the PHEV Considering CVs of the Same Model as PHEV
Xu HU1, Zhaojun YANG2, Jun SUN1
1Xi’an University, China
2University of Texas Rio Grande Valley, United States

IEEM19-P-1153
A Model for Inventory Management and Replenishment Policy for Automated Teller Machines in India
Ajinkya TANKSALE, Ankush KAMTHANE
Indian Institute of Technology (BHU) Varanasi, India

IEEM19-P-1026
Fuzzy Customer Response Model in the Last Mile Logistics
Gatae KIM
Hanbat National University, South Korea
Production Planning and Control
17/12/2019 13:30 - 15:30
Room: Parisian #7201
Chairs: Zhe ZHANG Nanjing University of Science and Technology
Jinyu FAN Guangdong University of Finance & Economics
Abstracts: see page 80

Project Management 1
16/12/2019 16:30 - 17:30
Room: Bordeaux 47.3
Chairs: Yoshinobu TAMURA Tokyo City University
Markus HARTONO University of Surabaya
Abstracts: see page 53

IIEEM19-P-0041
Non-Preemptive Open Shop Scheduling Considering Machine Availability
Abbas BARADAR1, A. Shojaei BARJUEI1, Reza TAVAKKOLI-MOGHADDAM2
1University of Tehran – The Arctic University of Norway, Norway
2University of Tehran, Iran

IIEEM19-P-0417
Waste Reduction Using Lean Manufacturing Tools: A Case in the Manufacturing of Bricks
Brenda AREVALO-BARRERA, Fatima PARRON-MARCOS, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IIEEM19-P-0444
On Two New Dynamic-programming Procedures as Efficient as the Wagner-whitin Regeneration-point Type in Dynamic Lot Sizing
Eiji MIZUTANI, Brigitte TRISTA
National Taiwan University of Science and Technology, Taiwan

IIEEM19-P-0457
Kanban-CONWIP Hybrid Model for Improving Productivity of an Electrostatic Coating Process
Carlos GUETH-SALAZAR, Freddy SEGURA-CHAVEZ, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IIEEM19-P-0531
A Sparse Leading-Eigenvalue-Driven Control Chart for Phase I Analysis of High-Dimensional Covariance Matrices
Jinyu FAN1, Lianjie SHU2
1Guangdong University of Finance and Economics, China
2University of Macau, Macau

IIEEM19-P-0546
Order Acceptance and Scheduling Considering Lot-Spitting in seru Production System
Lili WANG1, Zhe ZHANG2, Yong YIN3
1Nanjing University of Science and Technology, China
2Nanjing University of Science and Technology, China
3Doshisha University, Japan

IIEEM19-P-0532
Assessing the Complexity of Large-Scale Engineering Projects
Asahori GAUTAM, Senevi KIRIDENA
University of Wollongong, Australia

IIEEM19-P-0239
Defining Effort Indicators to Retrospectively Assess Engineering Change Information
Niklas KATTNER, Sylvia HU, Udo LINDEMANN
Technical University of Munich, Germany

IIEEM19-P-0249
Set-based Design in Agile Development: Developing a Banana Sorting Module – A Practical Approach
Daniel SAAD, Sebastian RÖTZER, Markus ZIMMERMANN
Technical University of Munich, Germany

IIEEM19-P-0130
A Method of Fault Identification Considering High Fix Priority in Open Source Project
Hiro nobu SONE1, Yoshinobu TAMURA2, Shigeru YAMADA2
1Tokyo City University, Japan
2Tottori University, Japan

IIEEM19-P-0268
An Earned Duration Management Model Integrating Quality Management and Resource Performance Monitoring
Jayne Lois SAN JUAN, Ronaldo POLANCOS
De La Salle University, Philippines

IIEEM19-P-1035
Main Paths of Research in Software Development Management
Jamie LO1, John S. LIU1, Mei HO2
1National Taiwan University of Science and Technology, Taiwan
2University of Macau, Macau

Project Management 2
17/12/2019 13:30 - 15:30
Room: Bordeaux 47.3
Chairs: R.M. Chandima RATNAYAKE University of Stavanger
Seung Ki MOON Stavanger University of Applied Sciences, Norway

IIEEM19-P-0205
Integration of Environmental Public Welfare Projects and Internet Platforms: Survey of Environmental Public Welfare Organizations
Feng LI, Yali ZHANG, Christos Diane TAN, Haixin ZHANG, Zhanlong MA
Northwestern Polytechnical University, China

IIEEM19-P-0156
Engineering Effort Estimation for Product Development Projects
Zeyyep OZTURK YURT1, Corn ILYGUI2, P. BAKAL3
1FNSS Sarawun Sistemleri A.Ş., Turkey
2Middle East Technical University, Turkey

IIEEM19-P-0170
An Investigation of Estimation Techniques for Information Technology Projects
James PRATER1, Konstantinos KRYTOSULOS1, Tony MA4
1University of South Australia, Australia
2National Technical University of Athens, Greece

IIEEM19-P-0190
The Roles of Functional Managers and Project Managers in a Matrix Organization
Nishanka KISHORE1, Jan Harm PRETORIUS2, Copinath CHATTOPADHYAY2
1University of Johannesburg, South Africa
2Federation University Australia, Australia

IIEEM19-P-0149
On the Need for Effective Lean Daily Management in Engineering Design Projects: Development of a Framework
Daria BISKUPSKA, R.M. Chandima RATNAYAKE
University of Stavanger, Norway

IIEEM19-P-0231
Product/Process Configuration Evolutionary Optimization: A Multibjective Clustering in Order to Reduce Inconsistencies During Crossover
Paul PITIOT, Michel ALDANONDO, Elise VAREILLES, Paul GABORIT
Université de Toulouse IUT Mines Albi, France, Metropolitan
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IEEM19-P-0434
Managing Information Systems Requirements Volatility in Development Projects: Mapping Research and Surveying Practices
Faraz KHAN, Younes BENSUMANE, Zijiang YANG
York University, Canada

IEEM19-P-0471
Recognition of Barriers in Brownfield Redevelopment PPP Project
Meng YANG, Yuming ZHU, Hongli LIN, Naveed AHMAD
Northwestern Polytechnical University, China

IEEM19-P-0489
The Development of a Roadmap for Project Management Framework and Processes
Moazgan PAKDAMAN, Vahid DOKHTZEYNAL, Alireza ABBASI, Ripon CHAKRABORTTY
University of New South Wales at the Australian Defence Force Academy, Australia

IEEM19-P-0415
Effective Antidotes to Address Adverse Situations During Multi-Stakeholder Engagement: The Case of International ICT Projects
Krishnan MYSORE, Konstantinos KIRYTOPOULOS, Tony MA, Seungjun AHN
1University of South Australia, Australia 2National Technical University of Athens, Greece

IEEM19-P-0399
Digital Twin-based Cyber Physical System for Sustainable Project Scheduling
Ripon K. CHAKRABORTTY, Mohammad Humyuan Fuad RAHMAN, Huadong MO, Michael J. RYAN
University of New South Wales at the Australian Defence Force Academy, Australia

IEEM19-P-0073
Application Research of On-line Quality Control Method to Metallurgical Products
Gang XU, Min LI, Jinwu XU
University of Science and Technology Beijing, China

IEEM19-P-0079
Optimal Design of Modified Group Runs Scheme with Estimated Process Parameters Based on Expected Average Number of Observations to Signal
Zhi Lin CHONG1, Xin Yi LOO1, Michael Boon Chong KHOO2, Khai Wah KHAW2, Xinying CHEW2
1Universiti Teknologi Abdul Rahman, Malaysia 2Universiti Sains Malaysia, Malaysia

IEEM19-P-0083
On Agile Metrics for Operations Management: Measuring and Aligning Agility with Operational Excellence
Andre M. CARVALHO1, Paulo SAMPAIO1, Eric REBENTISCH2
1University of Minho, Portugal 2Massachusetts Institute of Technology, United States

IEEM19-P-0033
The Assessment of Internal Service Quality Perception of System Administrators – Case of Services Provided by Data Centre Hosting to Local Bank in South Africa
Sambil Charles MUKWAKUNGU, Thabang Innocent MOTAPANE, Charles MBOHWA
University of Johannesburg, South Africa

IEEM19-P-0061
The Profile of Forthcoming Quality Leaders: An Exploratory Factor Analysis
J.P. DOMINGUES, Fabio Daniel CORREIA, Biknar UZZURUM, Paulo SAMPAIO
University of Minho, Portugal

IEEM19-P-0534
A Decision Tool for Quality System Improvement
Lucas PICCI, Abdallah BEN MOSBAH, Samuel BASSETTO
Ecole Polytechnique de Montreal, Canada

Abstracts: see page 56

IEEM19-P-0073
Application Research of On-line Quality Control Method to Metallurgical Products
Gang XU, Min LI, Jinwu XU
University of Science and Technology Beijing, China

IEEM19-P-0079
Optimal Design of Modified Group Runs Scheme with Estimated Process Parameters Based on Expected Average Number of Observations to Signal
Zhi Lin CHONG1, Xin Yi LOO1, Michael Boon Chong KHOO2, Khai Wah KHAW2, Xinying CHEW2
1Universiti Teknologi Abdul Rahman, Malaysia 2Universiti Sains Malaysia, Malaysia

IEEM19-P-0534
A Decision Tool for Quality System Improvement
Lucas PICCI, Abdallah BEN MOSBAH, Samuel BASSETTO
Ecole Polytechnique de Montreal, Canada

IEEM19-P-0159
Phase I Analysis of Hidden Operating Status for Wind Turbine
Yuchen SHI, Nan CHEN
National University of Singapore, Singapore

IEEM19-P-0411
Indicators of Quality Assurance in Higher Learning Institutions: A Review
Bupe MWANZA1, Tamala KAMBIKAMBI2, Charles MBOHWA3
1University of Zambwa, Zambia 2Covenant University Zambwa, Zambia 3University of Johannesburg, South Africa

IEEM19-P-0124
Modelling Halal Internal Traceability in Open Source ERP System for Chicken Meat Processing Company
Iwan VANANY1, Diesta Iva MAFTUHAF, Adi SOEPRIJANTO1, Sukoso SUKOSO2, Muhammad ZULHAIFZH2
1Institut Teknologi Sepuluh Nopember, Indonesia 2Universitas Brawijaya, Indonesia

IEEM19-P-0466
Geometric Error Modeling and Monitoring of the 3D Surface by Gaussian Correlation Model
Chen ZHAO1, Jun L1, Shichang D, Yafei CHEW2
1University of Science and Technology Beijing, China 2University of Shanghai Jiao Tong University, China

IEEM19-P-0554
A Distribution Free Control Chart for Monitoring High Dimensional Processes
Lianjie SHU1, Jinyu FAN1
1University of Macau, Macau 2Guangdong University of Finance and Economics, China

IEEM19-P-0234
Continuous Quality Improvement: The Relationship Between Order Dispatches, Ergonomics & the Design Layout
Nita SUKDEO1, Andre VERMEULEN1, Victor Mofohi MOFOKENCO1
1University of Johannesburg, South Africa 2University Of Johannesburg, South Africa 3University Of Johannesburg, South Africa
Reliability and Maintenance Engineering 1
16/12/2019 11:00 - 12:30
Room: Parisian #7102
Chairs: Sambıl Charles
MUKWAKUNGU University of Johannesburg
David VALIS University of Defence in Brno Faculty of Military

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IEEM19-P-1174
Optimal Cleaning Scheduling for Photovoltaic Systems in the Field Based on Electricity Generation and Dust Deposition Forecasting
Zhonghao WANG, Zheng-Guo XU, Min XIE
City University of Hong Kong, Hong Kong SAR
Zhejiang University, China

IEEM19-P-0441
A Study on Improvement of As-Built Deliverables Transfer Process for Nuclear Power Plant Operations & Maintenance
Kwang-Jae KIM, Chang-Woo PARK, Dae-Geun HONG
Seoul National University, South Korea
Pohang University of Science and Technology, South Korea

IEEM19-P-1131
Optimal Preventive Maintenance for Parallel System with Two Failure Modes
Hui XIAO, Gang KOU, Rui PENG
Southwestern University of Finance and Economics, China
University of Science and Technology Beijing, China

IEEM19-P-0025
The Effectiveness of Rolling Stock Maintenance on Quality Assurance at the Largest South African Rail Company
Sambıl Charles MUKWAKUNGU, Zandile SIBEKO, Charles MBOHWA
University of Johannesburg, South Africa

IEEM19-P-0018
Reliability Assessment of Mining System Based on Time Mining Data
David VALIS, Jakub GAJEWSKI, Kamilla HASLOVA, Marie FORBELSKA, Jozef JONAK
University of Defence, Czech Republic
Lublin University of Technology, Poland
Mendel University in Brno, Czech Republic

IEEM19-P-0017
Perspective Exploratory Methods for Multidimensional Data Analysis
David VALIS, Libor ZAK, Zdenek VINTR
University of Defence, Czech Republic
University of Technology, Czech Republic

Reliability and Maintenance Engineering 2
17/12/2019 08:30 - 10:30
Room: Parisian #7102
Chairs: Yoshinobu TAMURA Tokyo City University
Om Prakash YADAV North Dakota State University

Abstracts: see page 64

IEEM19-P-0054
Prognostic Study of CNC Machine Component Using a Systematic Method
Yates DENG, Shichang DU, Chen ZHAO
Shanghai Jiao Tong University, China

IEEM19-P-0244
Assessment of Reliability and Remaining Fatigue Life of Topside Piping Using Dynamic Bayesian Network
Arvind KEPRATE, R.M. Chandima RATNAYAKE
DNF Gl, Norway
University of Stavanger, Norway

IEEM19-P-0191
Predicting the Remaining Useful Life of Ball Bearing Under Dynamic Loading Using Supervised Learning
Savinay SINGH, Tamil AGARWAL, GIrish KUMAR, Om Prakash YADAV
Delhi Technological University, India
North Dakota State University, United States

IEEM19-P-0235
Working-Condition Importance Measures for Multi-Component Systems
Zhijiang CHEN, Xiaoyan ZHU
University of Chinese Academy of Sciences, China

IEEM19-P-0009
A Review of Metrics, Algorithms and Methodologies for Network Reliability
Vaibhav GAUR, Om Prakash YADAV, Gunjan SONI, Ajay Pal Singh RATHORE
Malaviya National Institute of Technology, India
North Dakota State University, United States

IEEM19-P-0182
A Method of Parameter Estimation in Flexible Jump Diffusion Process Models for Open Source Maintenance Effort Management
Yoshinobu TAMURA, Hironobu SONE, Sugisaki KODAY, Shigeru YAMADA
Tokyo City University, Japan
Tottori University, Japan

Reliability and Maintenance Engineering 3
17/12/2019 16:30 - 18:00
Room: Parisian #7102
Chairs: Zhiqiang CAI Northwestern Polytechnical University
Zhiqiang TIAN University of Alberta

Abstracts: see page 86

IEEM19-P-0468
A Case Study on the Replacement Policy for a Pan System of Sugar Industry
Huy TRUONG-BA, Michael E. CHOLETTE, Lin MA, Geoff KENT
Queensland University of Technology, Australia

IEEM19-P-0277
Bayesian Estimation Method for Storage Reliability Based on Drift Brownian Motion
Xuexong YANG, Shunang ZHANG, Honglin WANG
Beihang University, China

IEEM19-P-0436
Application of TPM Tools in an Automotive Battery Assembly Line
Amelia CASTILLO-REVELO, Ulset MANUÍCO-SALAS, Fernando MARADEGUIA-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0017
Consequence Classification Based Spare Parts Evaluation and Control in the Petroleum Industry
R.M. Chandima RATNAYAKE
University of Stavanger, Norway

IEEM19-P-0265
A Numerical Method for Wind Farm Condition-Based Maintenance Policy Assessment
Zhiqiang TIAN, Fangfang DING, Han ZHANG
University of Alberta, Canada

IEEM19-P-0142
Maintenance Optimization of Consecutive-k-out-of-n System with Multi-objective Birnbaum Importance-based Particle Swarm Optimization
Zhiqiang CAI, Chenyang ZHU, Wei WANG, Pan ZHANG
Northwestern Polytechnical University, China
IEEM19-P-0029
An Optimizing Strategy Based on Resource Competing Coupling Model in Interbank Risk Contagion
Kun CHEN1, Ning HUANG2, Chunlan WANG2
1Beihang University, China
2The 14th Research Institute of China Electronic Technology Corporation, China

IEEM19-P-0007
Credit Risk Contagion Model Based on Financial Industry Clusters
Zhiwen YU1, Ning HUANG2, Yanan BAI2
1Beihang University, China
2China Aerospace Science and Industry Corporation Limited, China

IEEM19-P-0016
Airports as Critical Infrastructure: The Role of Transportation-by-Air System for Regional Development and Crisis Management
Christine GROßE
Mid Sweden University, Sweden

IEEM19-P-0127
Predicting Profit Performance of International Construction Projects
Fengfeng ZHU1, Yufeng SUN1, Guangyan ZHAO1
Beihang University, China

IEEM19-P-0035
Using Survival Signature to Analyze Availability of Repairable System
Zhihong XU1, Yufeng SUN1, Guangyan ZHAO1
Beihang University, China

IEEM19-P-0428
A Critical Review on Hazardous Chemical Emissions and Particle from Fused Decomposition Modelling (FDM) Machine
Sha Lun MAK1, Fanny TANG1, Chi Ho LP1, Winnie CHIU2, H. K. LAU3
1The Open University of Hong Kong, Hong Kong SAR
2Hong Kong Institute of Vocational Education (Tuen Mun), Hong Kong SAR

IEEM19-P-0433
Using Survival Signature to Analyze Availability of Repairable System
Shu Lun MAK1, Fanny TANG1, Chi Ho LP1, Winnie CHIU2, H. K. LAU3
1The Open University of Hong Kong, Hong Kong SAR
2Hong Kong Institute of Vocational Education (Tuen Mun), Hong Kong SAR

IEEM19-P-0477
Development of a Risk-Based Maintenance (RBM) Strategy for Sewage Pumping Station Network
Md. Farhan MASUD1, Gopinath CHATTOPADHYAY1, Indra GUNAWAN1
1Federation University Australia, Australia

IEEM19-P-0322
Comparing Programme Theory and Intermediaries’ Views: Assessment of OSH Programmes in Italy
Guido J.L. MICHELI1, Enrico CAGNO2, Nicola RIGGIO3
1Politecnico di Milano, Italy

IEEM19-P-0168
The Meaning of Car Use / Driving in Japanese Young Generation
Hideki SHTMIZU1, TANAKA2
1Kyoto University of Advanced Sciences, Japan

IEEM19-P-0197
Sharing Personal Failure Story in Organization: Sharing with Individual or Organization?
Sanetake NAGAYOSHI1, Jun NAKAMURA2
1Shizuoka University, Japan
2Chuo University, Japan

IEEM19-P-0361
Philipp HUMBECK1, Elena VOČK1, Thomas BAUERK5HANS1
1Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany

IEEM19-P-0465
Designing Through Value Co-creation: A Study of Actors, Practices and Possibilities
Mohd Absan Kabir RIZVI1, Man Hang YIP2, Eng CHEW1, Philippa CARNIE2MOLLA1
1University of Technology Sydney, Australia
2University of Cambridge, United Kingdom

IEEM19-P-0036
Data-Driven “Market Basket”- Pricing and Personalized Health Information Services Using Salesforce’s Model-Driven Systems Service Design
Chienn-Sing LEE1, Adrian TIONG2, Nicholas See-Leong TANG1, Kah-Hou YAP2
1Sunway University, Malaysia
2Salesforce, Singapore

IEEM19-P-0315
Queue Server Efficacy in the Retail Industry: A Behavioral Study
Charuka FREMATHILAKA, Niles PERERA1, Ranil SUGATHADASA2
1Niles PERERA University of Moratuwa
2Sunway University, Malaysia
Service Innovation and Management 2
17/12/2019 11:00 - 12:30
Room: Parisian #7301
Chairs: Stanislav CHANKOV Jacobs
University of Bremen
Armesh TELUKDARIE
University of Johannesburg
Abstracts: see page 73

Supply Chain Management 1
16/12/2019 11:00 - 12:30
Room: Parisian 47001
Chairs: Linda ZHANG IESEG School of Management
Fremaratne SAMARANAYAKE Western Sydney University
Abstracts: see page 41

Supply Chain Management 2
16/12/2019 16:00 - 17:30
Room: Parisian 47001
Chairs: Aries SUSANTY Diponegoro University Indonesia
Jun-Der LEU National Central University
Abstracts: see page 54

IEEM19-P-0152
Research on Strategic Leading Mechanism of Latecomer Firms
Haibing LIU1, Lei YANG2, Qirong XU2
1Lanzhou Jiaotong University, China
2Zhejiang University, China

IEEM19-P-0110
Modelling Digital Innovation Value Chain in SMEs: Evidence from China
Fen LIU1, Yuming ZHU2, Catherine DE LA ROBERT2
1University of Paris 1 Pantheon-Sorbonne, France/ Northwestern Polytechnical University, China
2Northwestern Polytechnical University, China

IEEM19-P-0253
Water 4.0: An Integrated Business Model from an Industry 4.0 Approach
Michal ALABI, Armesh TELUKDARIE, Nicky JANSE VAN RENSBERG
University of Johannesburg, South Africa

IEEM19-P-0043
Supply Management by Remanufacturing Company of Mining Equipment
Marilú ROMAN-RIOS, Mitshel SERRATI-RAMOS, Fernando MARADIEGUA-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0003
Optimizing Joint Production Planning, Pricing and Retailer Selection with Emission Control based on Stackelberg Game and Nested Genetic Algorithm
Linda L. ZHANG1, Gang DU2, Jun WU2, Yuejie MA3
1IESEG School of Management, France
2Tianjin University, China

IEEM19-P-0077
A Conceptual Design of Infrastructures and Facilities in Distribution Center for Frozen and Chilled Fishery Products
Shawin BOONMEE1, Chompoonsoot KASEMSET, Picha PICHAYAPAN1, Pimsiri THOVICHIT1, Boonsub PANICHAKARN2
1Chiang Mai University, Thailand
2Narosan University, Thailand

IEEM19-P-0050
Used Product Acquisition Control by Financial Incentives in Remanufacturing
Tatsuya INABA
Kanagawa Institute of Technology, Japan

IEEM19-P-0106
Pricing Decisions with Product Return and Consumer Fit Uncertainty
Aditya NUGROHO1, Chung-Chi HSIEH2
1National Cheng Kung University Taiwan, Taiwan
2Kanagawa Institute of Technology, Japan

IEEM19-P-0369
Service Supply Chain Management Process Capabilities: A Theoretical Framework and Empirical Study
Pattama LENUWAT, Sakun BOON-ITT
University of Trisakti, Indonesia

IEEM19-P-0046
Investigating the Effect of Partnerships on the Impact of Supply Chain Risks Upon Supply Chain Responsiveness
Bingcong ZENG1, Benjamin PC YEN1
1Hong Kong Government, China
2The University of Hong Kong, China

IEEM19-P-0113
Path Location Problem for the Container Terminal with Yard Arrangement Efficiency
Etsuko NISHIMURA1, W. GUO2
1National Institute of Technology Bandung, Indonesia
2Kobe University, Japan

IEEM19-P-0274
An Adaptation of the Record-to-Record Travel Algorithm for the Cumulative Capacitated Vehicle Routing Problem
Fadillah RAMADHAN, Airi IMRAN
National Institute of Technology Bandung, Indonesia

IEEM19-P-0143
Locating Humanitarian Relief Effort Facility Using P-Center Method
Ferdinand LAMANON2, Jun-Der LEU2
1Diponegoro University, Indonesia
2The University of Hong Kong, China

IEEM19-P-0094
Mapping the Drivers in Implementing Halal Logistic
Aries SUSANTY1, Ariska CATERINA1, Marco TIEMAN1, Raden DIDIET RACHMAT2
1Diponegoro University, Indonesia
2Malaysia

IEEM19-P-0275
Chilled Fishery Products Distribution Center for Frozen and Chilled Fishery Products
Chawis BOOONWATT2, Chompoonoot KASEMSET, Picha PICHAYAPAN1, Pimsiri THOVICHIT1, Boonsub PANICHAKARN2
1Chiang Mai University, Thailand
2Narosan University, Thailand

IEEM19-P-0040
Managing Chain Responsiveness
Shawin BOONMEE1, Chompoonsoot KASEMSET, Picha PICHAYAPAN1, Pimsiri THOVICHIT1, Boonsub PANICHAKARN2
1Chiang Mai University, Thailand
2Narosan University, Thailand

IEEM19-P-0002
Bingcong ZENG1, Benjamin PC YEN1
1Hong Kong Government, China
2The University of Hong Kong, China

IEEM19-P-0113
Path Location Problem for the Container Terminal with Yard Arrangement Efficiency
Etsuko NISHIMURA1, W. GUO2
1National Institute of Technology Bandung, Indonesia
2Kobe University, Japan

IEEM19-P-0274
An Adaptation of the Record-to-Record Travel Algorithm for the Cumulative Capacitated Vehicle Routing Problem
Fadillah RAMADHAN, Airi IMRAN
National Institute of Technology Bandung, Indonesia

IEEM19-P-0143
Locating Humanitarian Relief Effort Facility Using P-Center Method
Ferdinand LAMANON2, Jun-Der LEU2
1Diponegoro University, Indonesia
2The University of Hong Kong, China

IEEM19-P-0094
Mapping the Drivers in Implementing Halal Logistic
Aries SUSANTY1, Ariska CATERINA1, Marco TIEMAN1, Raden DIDIET RACHMAT2
1Diponegoro University, Indonesia
2Malaysia

IEEM19-P-0275
Chilled Fishery Products Distribution Center for Frozen and Chilled Fishery Products
Chawis BOOONWATT2, Chompoonoot KASEMSET, Picha PICHAYAPAN1, Pimsiri THOVICHIT1, Boonsub PANICHAKARN2
1Chiang Mai University, Thailand
2Narosan University, Thailand

IEEM19-P-0040
Managing Chain Responsiveness
Shawin BOONMEE1, Chompoonsoot KASEMSET, Picha PICHAYAPAN1, Pimsiri THOVICHIT1, Boonsub PANICHAKARN2
1Chiang Mai University, Thailand
2Narosan University, Thailand
Supply Chain Management 3

17/12/2019 08:30 - 10:30
Room: Parisian #7001

Chairs: Linda ZHANG ISESEG School of Management
Michel AZZANONDO
Toulouse University / IMT-Mines Albi

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IEEM19-P-0264
Robust Inventory Routing Problem with Replenishment Lead Time
Weibo ZHENG, Hong ZHOU
Beihang University, China

IEEM19-P-0266
The Impact of Extended Warranty on Base Warranty: A Game Approach
Houping TIAN1, Qingping YANG1, Changjian LIU2
1Nanjing University of Science & Technology, China
2Nanjing University of Posts and Telecommunications, China

IEEM19-P-0240
Strategic Sourcing Under Optimism Bias and Information Asymmetry
Tarun JAIN1, Jishnu HAZRA1
1Indian Institute of Management Udaipur, India
2Indian Institute of Management Bangalore, India

IEEM19-P-0276
Optimal Pricing Strategy of Environmental Patent Transaction Under Asymmetric Information
Houping TIAN1, Anna DAF1, Changjian LIU2
1Nanjing University of Science & Technology, China
2Nanjing University of Posts and Telecommunications, China

IEEM19-P-0296
Emerging Information Technologies Usage: Opportunities and Challenges for Supply Chain Vulnerability
Xiaoting GUO1, Zhaojun YANG1, Chrissie Diane TAN1
1Xidian University, China
2Northwestern Polytechnical University, China

IEEM19-P-0304
Decision Making Simulator for Supply Allocation Under Uncertainty
Vanessa BEDDOE, Sayli SHIRADKAR, Jayendra VENKATESWARAN
Indian Institute of Technology Bombay, India

IEEM19-P-0335
An Integrated Two-Stage Optimization Method for Job-Shop Bottleneck Planning and Scheduling
Na CAO, Seung Ki MOON
Nanyang Technological University, Singapore

IEEM19-P-0340
Supply Chain Contract with Combined Revenue Sharing and Markdown Policy
Rasnaq SRIVASTAVA1, Prites RAY
Indian Institute of Management Ranchi, India

IEEM19-P-0493
Hybrid Covering Location Problem: Set Covering and Modular Maximal Covering Location Problem
Roghayyeh ALIZADEH, Tatsushi NISHI
Osaka University, Japan

IEEM19-P-0504
Learning from the Nature: Enabling the Transition Towards Circular Economy Through Biomimicry
Markus BOCKHOLT1, Jesper KRISTENSEN1, Brian VEJRUM WEHRENS1, Steve EVANS1
1Aalborg University, Denmark
2University of Cambridge, United Kingdom

IEEM19-P-0199
Information Sharing with Multiple Customer Segmentations
Tai PHAM1, Truong Ton Hien DUC2, Jirachai BUDDHAKULSOMSIRI3
1Thammasat University, Thailand
2RMIT University, Australia
3Thammasat University, Thailand

IEEM19-P-0095
Prioritization and indicator for Measuring Sustainable Performance in the Food Supply Chain: Case of Beef Supply Chain
Aries SUSANTY1, Nia BUDI PUSPITASARI, Ratna PURWANINGSIH, Haikal HAZAZI
Diponegoro University, Indonesia

Supply Chain Management 4

17/12/2019 11:00 - 12:30
Room: Parisian #7003

Chairs: Aries SUSANTY

Abstracts: see page 69

IEEM19-P-0415
Implementation of Lean Warehousing to Reduce the Level of Returns in a Distribution Company
Kevin BONILLA-RAMIREZ, Pedro MARCOS-PALACIOS, Juan QUIROZ-FLORES, Edgar RAMOS-PALOMINO, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0419
Supply Model for Dependent Demand in the Peruvian Textile Industry: A Case Study
Andrea GÜEVARA-YARASCA, Gian FALLA-MARCELO, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0427
An Evolutionary Game Model in Closed-Loop Supply Chain
Zhang LI1, Tatsushi NISHI1
Osaka University, Japan

IEEM19-P-0174
“Buffer Inventory + Information Sharing” Strategy for Retailers in Two-Level Fresh Supply Chain
Lin LI1, Zhaojun YANG1, Chrissie Diane TAN1
1Xidian University, China
2Northwestern Polytechnical University, China

IEEM19-P-0405
Supplier Selection and Ranking Towards Sustainable Procurement with Multiple Decision Makers
Premaratne SAMARANAYAKE1, Sev NAGALINGAM1, Tritos LAOSIRIHONGTHONG1
1RMIT University, Australia
2University of South Australia, Australia
3Thammasat University, Thailand

Supply Chain Management 5

17/12/2019 13:30 - 15:30
Room: Parisian #7001

Chairs: Premaratne SAMARANAYAKE Western Sydney University
Ali SIADAT, Arts et Metiers ParisTech

Abstracts: see page 76

IEEM19-P-0401
An Evolutionary Game Model in Closed-Loop Supply Chain
Zhang LI1, Tatsushi NISHI1
Osaka University, Japan

IEEM19-P-0174
“Buffer Inventory + Information Sharing” Strategy for Retailers in Two-Level Fresh Supply Chain
Lin LI1, Zhaojun YANG1, Chrissie Diane TAN1
1Xidian University, China
2Northwestern Polytechnical University, China

IEEM19-P-0405
Supplier Selection and Ranking Towards Sustainable Procurement with Multiple Decision Makers
Premaratne SAMARANAYAKE1, Sev NAGALINGAM1, Tritos LAOSIRIHONGTHONG1
1RMIT University, Australia
2University of South Australia, Australia
3Thammasat University, Thailand
IEEM19-P-0100
Framework for Alliance Capabilities: A Study in Malaysian University-Industry R&D Alliances
Armita ASMawi, Nabila KAMARUZAMAN, Kok-Wai CHEW, Noor Shahaliza OTHMAN
Multimedia University, Malaysia

IEEM19-P-0140
A Meta-Synthesis of Research on Absorptive Capacity Concept Among Companies
Nurul INDARTI, Andy Susilo LUKITO-BUDI, Kusdiaranto SETIAWAN
Universitas Gadjah Mada, Indonesia

IEEM19-P-0165
Competitive Advantage Analysis of Small Medium Industries in Indonesia: An Approach of Management Technology and Strategic Management
Augustina Ash RUMANTY, Iwan Irzawan WIRATMADJA, Fadel MUHAMMAD, Afrin Fauzya RIZANA, Luciana ANDRAWINA
Bandung Institute of Technology, Indonesia

IEEM19-P-0170
Reuse Engineering Assets
Kong SAR CHEUNG, Andy C. L. YEUNG
The Hong Kong Polytechnic University, Hong Kong

IEEM19-P-0175
A Case Study of Intellectual Property Rights Management with Capability Maturity Model
Shaoming FU, Chieh-Min CHOU
Feng Chia University, Taiwan

IEEM19-P-0180
Organizational Learning: Overseas Expansions and Environmental Performance in China
Abise P. L. JONG, Andy C. L. YEUNG
The Hong Kong Polytechnic University, Hong Kong

IEEM19-P-0185
A Generic Knowledge-based Model for Commercial Offerings: Towards a Unified Model to Configure Products, Services and PSS During Calls for Tenders
Delphine GUIJON1, Rania AYACH1, Elise VAREILLES2, Michel ALDANONDO3, Eric VILLENEUVE1, Christophe MERLO1, Andreas Felipo BARCO SANTA1, Konstantinos KRYTOPOULOS1
1University of Bordeaux, ESTIA Institute of Technology, France
2Université de Toulouse / IMT Mines Albi/ ENI Tarbes, France, Metropolitain
3Université de Toulouse/ IMT Mines Albi, France, Metropolitain

IEEM19-P-0195
Developing Flexible Modules - A Pragmatic Way to Organize and Reuse Engineering Assets
Dag RAUDBERGET, K. HÖRNMARK1, B. YOUNGADAM1
1Jönköping University, Sweden
2Fagerhults Belysning, Sweden

IEEM19-P-0200
A Study of Intellectual Property Rights Management with Capability Maturity Model
Shaoming FU, Chieh-Min CHOU
Feng Chia University, Taiwan

IEEM19-P-0205
Knowledge Management System for Maintenance Activity: Case Study at the Maintenance Department of XYZ Corporation
Dila Alifita ISWOROWATI, Fadel MUHAMMAD, Amelia KURNIAWATI, Mochamad Teguh KURNIAWAN
Telkom University, Indonesia

IEEM19-P-0210
Organization of Learning: Overseas Expansions and Environmental Performance in China
Abise P. L. JONG, Andy C. L. YEUNG
The Hong Kong Polytechnic University, Hong Kong

IEEM19-P-0215
Digitalization of Higher Education Institutions
Armosh TELUKDARIEF, Megashnee MUNSAMY
1University of Johannesburg, South Africa
2Mangosuthu University of Technology, South Africa

IEEM19-P-0220
External or Internal Cooperation? Patenting Activities and Cooperative Structures in the Chinese ICT Sector
Siya LU, Suli ZHENG, Qian XU
China Jilin University, China

IEEM19-P-0225
Towards Industry 4.07 Digital Maturity of the Manufacturing Industry in a Swedish Region
Leif SUNDBERG, Katarina GIDLUND, Leif OLSSON
Mid Sweden University, Sweden

IEEM19-P-0230
Use of Pull Product Development for Enhancing Lean Startups
Ville ISOHERRANEN, R.M. Chandima RATNAYAKE1
1University of Oulu, Finland
2University of Stavanger, Norway

IEEM19-P-0235
Analyzing Stakeholder’s Response to Indian Government’s EV Policy
Vivek L. BHAMBHI, Mukundh CHAUDHARI, Vishwas DOHALE, Priya AMBILKAR
National Institute of Industrial Engineering, India
EIEEM19-P-0200 Evaluating Leadership Fuzzy Comprehensive of College Students Based on Triangular Fuzzy Number
Shujuan ZHANG, Xing ZHOU, Pei AN, Ruxue JIN
Northeastern Polytechnical University, China

EIEEM19-P-0203 Research on Classification of Logistics Equipment Based on Rough Set
Ronggui LEE*, Ping ZHU, Yuming ZHU, Yinmei LEE*
1Shaanto Tobacco Company, Chile
2Northeastern Polytechnical University, China

EIEEM19-P-0207 A Bluetooth Location-based Indoor Positioning System for Asset Tracking in Warehouse
Chen-Ka Man LEE, C.M. IP, Taesoon PARK, S.Y. CHUNG*
1The Hong Kong Polytechnic University, Hong Kong SAR
2Sejong University, South Korea

EIEEM19-P-0236 Application of SIRI for Industry 4.0 Maturity Assessment and Analysis
Weidong LIN, M.Y.H. LOW, Y.T. CHONG, C.L. TEO
Singapore Institute of Technology, Singapore

EIEEM19-P-0237 Concept and Implementation of a Cyber-Physical Digital Twin for a SMT Line
Weidong LIN, Malcolm LOW
Singapore Institute of Technology, Singapore

EIEEM19-P-0242 Knowledge Discovery Through the Machine Learning of Farming Parameters and Yield Performance
Y.T. CHONG, Poh Kok LOO, Zhongjiang DING
Singapore Institute of Technology, Singapore

EIEEM19-P-0245 A Simulation-based Dynamic Spatial Scheduling Method of Block Assembly in Shipbuilding
Jiwang DU, J. J. WANG, Xiaomin FAN
Shanghai Jiao Tong University, China

EIEEM19-P-0248 Cyber Physical Production Systems: A Review of Design and Implementation Approaches
Xuan WU*, Virginie COEPP, Ali SIADAT*
1Arts et Métiers ParisTech, France
2INSA Strasbourg, France

EIEEM19-P-0257 A Study of Creative Concept Design Capability and Inquire Capability Scale Development
Feng-Ming SUP, Jen-Chia CHANG, Hsi-Chi HSIAO*
1Hua Hwa University of Technology, Taiwan
2National Taipei University of Technology, Taiwan
3Cheng Shiu University, Taiwan

EIEEM19-P-0302 Applying FANP to Criteria Evaluation of Sports Field Project Planning
C. N. LAI, J. L. HUNG, Cheng-Che CHEN
Far East University, Taiwan

EIEEM19-P-0327 Optimal Policy for Modeling of Economic Production Quantity Involving Major Repair and Preventive Maintenance
Gwo-Liang LIAO*, Li-Chun LIAO, Wei-Hao TANG, Ren-Hao GU*
1National Taiwan University, Taiwan
2Chung Yuan University of Technology, Taiwan

EIEEM19-P-0353 A Pilot Study on Affect Appeal of Water-Saving Equipment Design Employing Canonical Correlation Analysis with ABC Model by the Attitudes of the Public Toward Using Water-Saving Equipment
Kuei-Chen CHU*, Chien-Lung CHEN, Shin-Far LIN*, Yung-Hsun WU, Lan-Ting SHIH
1National Cheng Kung University, Taiwan
2Fortune Institute of Technology, Taiwan

EIEEM19-P-0358 Maintenance Costs in the Process Industry: A Literature Review
Lucas CORREA LEMES, Lars HVAM
Technical University of Denmark, Denmark

EIEEM19-P-0395 Collaborative Construction Industry Integrated Management Service System Framework Based on Big Data
Xin YUAN, Yi-Wen CHEN, Hong-Bo FAN, Wei-Hui HE, Xin-Guo MING*
1Shanghai Jiao Tong University, China
2National University of Singapore, Singapore

EIEEM19-P-0404 An Object-Based and Attribute-Oriented Method for Deciding the Effect in Product Development Lifecycle
Wen-Lung TSAL, Wan-Chu HUANG, Chia-Tung LEE
Oriental Institute of Technology, Taiwan

EIEEM19-P-0409 User Classification in Electronic Devices Using Machine Learning Methods
Xingfa LIU, Wan WANG, Wai Kin Victor CHAN, Chiung Ying KUAN, Jumyoung LEE
Tsinghua University, China

EIEEM19-P-0430 Observational Learning in the Product Configuration Process: The Effect of Information Presentation Format
Yue WANG, Daniel Y. MO
The Hang Seng University of Hong Kong, Hong Kong SAR

EIEEM19-P-0439 An Exact Formulation for Multi-workshop Facility Layout Problem with Clearance Bounds
Chao GUAN, Zeqiang ZHANG, Shu LIU*
1Singapore Centre for 3D Printing, Singapore
2Singapore Technological University, Singapore
3Southeastern Freight University, China
4Logistics Engineering of China Mechanical Engineering Society, China
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EIEEM19-P-0455 A Fault Location Method Considering Distribution Network Partition Based on Deep Learning
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EIEEM19-P-0475 Which is the Priority for the Public While Adopting Energy-Saving Facilities? An Analysis of Association Between Acceptance and Attitudes Toward Using Energy-Saving Facilities
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EIEEM19-P-0505 An Efficient 2D Genetic Algorithm for Optimal Shift Planning Considering Daily-Wise Shift Formats: A Case of Airport Ground Staff Scheduling
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EIEEM19-P-0550 A Review of Asset Administration Shell
Kang WEI, Jianzhi SUN, Ruijun LIU
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EIEEM19-P-0557 Optimization and Simulation on Tanker Vessels Scheduling for Efficient Terminal Operations
Desing ZHAI, Xinan LI, Hai-Yan XU, Xiao Feng YIN, Vasundhara JAVARAMAN, Wanhong ZHANG, Rick Siow Mong GOH
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EIEEM19-P-1006 Investigation Into Characterising Tensile Properties of FDM Ultim™ 9085 Parts
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IEEM19-P-1024
Developing User Evaluation Technology Based on New Product Concepts
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IEEM19-P-1032
Relationship Between Technological Innovation and Market Value in the Drug Industry
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National Taiwan University, Taiwan

IEEM19-P-1038
Partial Coalitions in Collaborative Game Theory for Supply Chains with Two Manufacturers and One Common Retailer
Mao HASEGAWA, Tatsushi NISHI
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IEEM19-P-1040
Key Player and Core Team: A Collaboration Perspective
Chung-Hui KUAN
National Taiwan University of Science and Technology, Taiwan

IEEM19-P-1059
An Efficient Scheme for Monitoring Network Interactive Data
Junjie WANG
City University of Hong Kong, China

IEEM19-P-1060
Proposal of Adapted Day Reconstruction Method for Contextual Inquiry on Consolidated Financial Service
Kyang-Jun LEE, Yongmin KIM, Joong Junjie WANG
National Taiwan University of Science and Technology, Taiwan

IEEM19-P-1061
A Hybrid Correspondence Analysis to Explore Competitor Product Portfolio Strategy in the Dental Medical Device Industry
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IEEM19-P-1062
Collaboration in Taiwanese Patenting Activities: A Case Study on R&D of Nanotechnology
Szu-Chia LO
National Taiwan University, Taiwan

IEEM19-P-1064
Interorganizational Fraud Management - A Measurement Tool Development
William HO
The University of Melbourne, Australia

IEEM19-P-1068
Development and Planning of Innovation Service Model S for Data Added Value in Big Data Industry Chain
Tsung-Yi CHEN
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IEEM19-P-1083
Reliability and Validity of Arduino EMG System
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2Pusan National University, South Korea

IEEM19-P-1090
Condition-based Incorporation of Material Handling Time in Redesign of Production System for Scheduling
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2Singapore Institute of Manufacturing Technology, Singapore

IEEM19-P-1103
Solving Linear Programming by Dantzig-Wolfe Decomposition with Multiple Subproblems
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IEEM19-P-1114
A Systematic Innovation Approach
Yeh-Chun JUAN, Chun-Yu FAN
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IEEM19-P-1120
Effects of Trained Flexibility on Back Muscle Flexion-Relaxation Response
Yi-Lang CHEN, Wei-Cheng LIN, Pei-Yu KANG
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IEEM19-P-1122
Artificial Intelligence Assisted Online Tuition Platform
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IEEM19-P-1126
The Impact of Stock Analysts on Corporate R&D Investment: A Study of Taiwanese Publicly Listed Firms
Cheng-Yu LEE, Quang Anh LE
Southern Taiwan University of Science and Technology, Taiwan

IEEM19-P-1132
Process Modeling and Hybrid Multi-Objective Optimization of Aerosol Jet 3D Printing
Hanming ZHANG, Seung Ki MOON
Nanyang Technological University, Singapore

IEEM19-P-1133
Enhance Chemical Mass Balance Receptor Model by Genetic Algorithm
Min-Der LIN, Machine HISIE, Pei-Yu LAI
National Chung Hsing University, Taiwan

IEEM19-P-1150
Price Forecast by Simple Merit Order Model for JEPX Spot Market Price
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2KIT Japan Oil & Energy Corporation, Japan

IEEM19-P-1152
Consistent Vehicle Routing Problem with Time Windows and Synchronized Visits
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IEEM19-P-1155
The Role of Attitudes in Contractual Parties’ Intentions to Form Project Partnering
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IEEM19-P-1157
How Do Non-Family CEOs Affect Firm Innovativeness? A Different Perspective on the Non-family CEOs Risk-Taking Orientation in Family Business
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2National Taiwan University, Taiwan
3Southern Taiwan University of Science and Technology, Taiwan

IEEM19-P-1162
A GA-Based Learning for Defect Prediction in Plastic Injection Molding
Guyuchan SIM, Seyoung KIM, Kwang Byel RYU
Pusan National University, South Korea

IEEM19-P-1163
The Study of the Relationship Among Perception of Workplace Illegally Infringed, Positive Psychological Capital and Turnover Intention
Shu-Ping YI, Yu-Hao HUANG
Ming Chi University of Technology, Taiwan

IEEM19-P-1164
An Intelligent Lock-Out Tag-Out System for Monitoring and Control of the Locked Device
Woon-Jin IO, Sebyun HWANG, Inho KEE, Inhak LEE, Soobong LEE
YONSEI University, South Korea

IEEM19-P-1167
Computational Theoretical Analysis for the 11th Foresight Survey
Nobuyuki SHIRAKAWA, Hitoshi KOSHIBA
National Institute of Science and Technology Policy, Japan

IEEM19-P-1173
Security and Data Privacy in Consumer Internet of Things
Mfachsenib NGWENYA, Mpho NGOEPE
University of South Africa, South Africa
participate in joint pollutant abatement depends on if there are defection. Whether those with low initial resource endowments will between enterprises can effectively reduce the occurrence of cooperation. Whereas broadening the gap of resource endowments cooperation and weakens punitive tax rate's role in promoting endowments, the other with low initial resource endowments. Evolutionary dynamics in two distinct scenarios namely fair contribution and altruistic preference are analyzed. The paper proves that enterprises with high initial endowments have greater incentives to cooperate, and are more likely to be altruistic agents. Moreover, effects of increment of risk rate on cooperation are two sided. A large group size of enterprises hinders the prevalence of cooperation and weakens punitive tax rate's role in promoting cooperation. Whereas broadening the gap of resource endowments between enterprises can effectively reduce the occurrence of detection. Whether those with low initial resource endowments will participate in joint pollutant abatement depends on if there are cooperators in enterprises with high initial endowments.

IEEM19-P-0458
Evolutionary Game Analysis of Pollutant Abatement with Collective-Risk
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This paper examines strategies of asymmetric enterprises in joint pollutant abatement with collective-risk. Asymmetric enterprises are divided into two types: one type with high initial resource endowments, the other with low initial resource endowments. Evolutionary dynamics in two distinct scenarios namely fair contribution and altruistic preference are analyzed. The paper proves that enterprises with high initial endowments have greater incentives to cooperate, and are more likely to be altruistic agents. Moreover, effects of increment of risk rate on cooperation are two sided. A large group size of enterprises hinders the prevalence of cooperation and weakens punitive tax rate's role in promoting cooperation. Whereas broadening the gap of resource endowments between enterprises can effectively reduce the occurrence of detection. Whether those with low initial resource endowments will participate in joint pollutant abatement depends on if there are cooperators in enterprises with high initial endowments.

IEEM19-P-0154
A Mathematical Model for Internal Task Scheduling in Cross Docking
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This study proposes a novel problem for solving task scheduling in cross docking. In particular, we formulate a mathematical model for the task scheduling between inbound and outbound dock doors in order to minimize total operational time based on limited resource. The goal is to determine the start time and finish time of each operation on the assigned working team and transfer equipment with respect to maximum resource utilization. The use of mathematical model is paving the way to Artificial Intelligence (AI) for smart decision in cross docking since AI is a key factor in industries 4.0. Moreover, facility cost is analyzed based on trade-off features between cost and makespan so that a decision can be made based on a decision maker’s preference.

IEEM19-P-0241
Concept for Deriving System Architectures from Reference Architectures
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The reuse of existing architectural solutions is a key enabler for the optimization of engineering of industrial production systems with respect to cost, time, and quality. In order to achieve systematic reuse of architectural solutions within the design process of specific systems, the standard “VDI 3695” determines the use of reference architectures as one possible option. Often, within the development of industrial production systems, individual aspects and specific requirements need to be regarded, which may not be fully represented by a reference architecture. In order to create specific system architectures based on reference architectures an approach is needed that considers a mix of existing and newly defined architecture content, which must be integrated in the process of designing system architectures. Therefore, within this paper, an approach for the creation of system architectures based on a reference architecture is presented, with the goal of supporting the engineering of such production systems.

IEEM19-P-0320
Open Innovation for Course Development Process Using Simulation-based Programming
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2National Institute of Technology Bandung, Indonesia
Open innovation is a collaborative approach to integrate knowledge into innovative process. The purpose of this research is to develop the simulation model for open innovation in the course development process. A university in Indonesia is used as a research object. Every year, all lecturer assistants from different laboratory discuss each other with a various opinion related to all important criteria to make a new solution. Simulation-based programming is used to simulate the behavior of people in the course development process. The first step is to develop the simulation model for calculating the interaction model. An individual interaction model step is used to determine the core processes in the model. The last step is testing the model in the course development process. The result shows that after 37 interaction, all the opinion become a new solution hence the model can be used as a tool for creating the open innovation process. The result shows that all participants have the same opinion with the new solution.
IEME-P-0030 Framework for Alliance Capabilities: A Study in Malaysian University-Industry R&D Alliances

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Industry 4.0 radically disrupts manufacturing technologies, and also fundamentally impacts societal well-being. In Malaysia, R&D and innovation play a strategic role to ensure a smooth migration into Industry 4.0. However, the current levels of R&D and innovation are still inadequate. Hence, various national policies have called for greater university-industry R&D alliances. To increase these R&D alliances, further research on ‘alliance capability’ is needed. Alliance capabilities can be analyzed at the macro-level or micro-level. Currently, there is limited knowledge on how R&D university-industry alliances operate at the micro-level. Therefore, this study aims to construct a framework on how micro-level alliance capabilities influence R&D alliance success.

IEME-P-0450 A Meta-Synthesis of Research on Absorptive Capacity Concept Among Companies

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Universitas Gadjah Mada, Indonesia
This meta-synthesis study reviewed 128 papers related to the use of absorptive capacity (ACAP) concept among various companies from 2004 to 2018. Several variables used to study the ACAP do have more variations than others, such as performance, knowledge, capability, and entrepreneurial orientation. Little attention has been studied in the aspect of innovation and intellectual capital. The ACAP variables used for large companies tended to be more systematic and emphasized on long-run effect compared to SMEs. The majority studies of the ACAP concepts focused more on dependent, independent, and moderating variables. Investigating deeper on organizational size, integrating various theories (internal and external) and examining mediating factors are future directions for absorptive capacity studies. These calls would contribute to provide comprehensive understanding on the ACAP studies particularly in the context specificity of company size (i.e. small- and medium-sized enterprises versus large companies).

IEME-P-0308 Green Production Implementation Through Perspective of Knowledge Sharing and Open Innovation: Case Study at Indonesian Handmade Batik Industries

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3Mid Sweden University, Sweden
Small Medium Industries (SMIs) are the industry model that originates from the regions’ ability to explore their potential. SMIs fostered in the district have more advantages because they can share information, knowledge, and facilities communally. The green production application in SMIs demands an innovation process that environmentally friendly. Limitations possessed by the organization are capital, inadequate technology, lack of knowledge and skills in managing the internal organization, understanding of competition and market desires, and the ability to manage networks with an external organization. The concept of open innovation provides an opportunity for many organizations, including SMIs, to enhance their innovative capability through the usage of knowledge from the external organizations that have similar characteristics. Knowledge sharing is a source of open innovation in an organization. Knowledge sharing is considered a social activity to build inclusion of individuals to obtain new knowledge as a basis to strengthen the capability of innovation.

IEME-P-0055 Competitive Advantage Analysis of Small Medium Industries in Indonesia: An Approach of Management Technology and Strategic Management

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This research discusses the achievement of competitive advantage through the perspective of management technology and strategic management. The object of the research is the Small Medium Industry (SMI) of leather and puppet in Yogyakarta. Based on the result of data processing through the technometric concept of technology management, it was found that TCC value of 0.0073 which classified the technology used by the SMI of Maju Karya as traditional technology. Although relatively low, the current technology condition of the SMI of Maju Karya has reached ideal condition. It shows the SMI has utilized its capabilities optimally. The further step is to test the hypotheses for the variables constructed in the research model using SmartPLS software. The result of data processing concluded that hypotheses of H11 and H21 are accepted. It means both the technology component and strategic management have a positive influence on competitive advantage. The last phase is to analyze the strategic position of the business portfolio by using the BCG Growth-share matrix. The result of data processing categorized the SMI of Maju Karya as Cash Cows.

IEME-P-0552 Digitalization: Rise of the (Mega) Machines

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Drawing upon the work of Lewis Mumford, this paper discusses the use of digital technology in terms of polytechnics and monotechnics. The research is conducted by performing a study of prior literature on the history of digital computers in Sweden together with an analysis of Swedish government documents on digitalization. The findings reveal how digital technology was developed for military and scientific needs and then implemented in the public sector, supported by a bureaucratic structure in the 1960s. After a period of pessimism and decentralization in the 1970s and 1980s, digital technology was subject to increased expectations through renewed leadership and additional networked capabilities in the 1990s. After a setback following the dot-com crash, the terminology shifted again: through digital agendas in 2010–2011, digitalization became a dominant term for the use of digital technology in government documents. This paper concludes by presenting five contrast pairs, which can be utilized to analyze what views on technology that become dominant in policies, and practice.

IEME-P-0056 A Generic Knowledge-based Model for Commercial Offers: Towards a Unified Model to Configure Products, Services and PSS During Calls for Tenders

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2Université de Toulouse / IMT Mines Albi/ ENI Turbes, France, Metropolitan
3Université de Toulouse / IMT Mines Albi, France, Metropolitan
4Universidad Santiago de Cali, Colombia
5National Technical University of Athens, Greece
Today, consumption patterns are changing: firstly, customers (private and industrial ones) want more and more products and services that can be personalized to their needs, and secondly, they are more and more willing to pay for usage of a product rather than ownership. Companies have therefore to adapt their catalog of solutions by putting on the market customizable and suitable solutions going from products to services, including all their possible combinations. The aim of this article is to propose a generic knowledge-based model, dedicated to commercial offers configuration, which can cope with all the diversity of solutions a company can deliver. Up to our knowledge, even if some works on product, service and product-service system exist, none is generic enough to support such commercial offer configuration while bidding. In this paper, after a brief state-of-the-art, the need of a generic model is set up. Then, a unified model is proposed and illustrated on use-cases coming from industrial situations.
remanufacturers to run their business efficiently. The practical insights presented in this study would help analyzing the captured data becomes feasible. Assuming the use of progress in the IoT technologies, monitoring the products and in the market and the timing when they are replaced. But with the fact that remanufacturer does not know the status of the products lower the efficiency of the production. This uncertainty is caused by raw materials in remanufacturing, too much or too little acquisition may not fully understand their characteristics before purchasing. The firm’s profit will be increased. On the other hand, when consumers find product fit or when more consumers understand with the new products, in the second period. We find that when more firm’s decisions and pricing, and retailer selection while considering emission control. In view of the interactive decision-making processes, we adopt the Stackelberg game theory and develop a 0-1 mixed nonlinear bi-level programming model to maximize the profits of a manufacturer and his retailers. Involving two submodels representing the decision-making processes of the manufacturer and retailers, respectively, the Stackelberg game model is very complex and impossible to be solved analytically. Therefore, we further develop a nested genetic algorithm (NGA) to solve the game model. Numerical examples demonstrate (i) the applicability of the Stackelberg game model in making joint decisions and (ii) the robustness of the NGA. Sensitivity analysis sheds light on several important managerial implications.
This study identifies and categorizes barriers that startup companies often face, and offers effective solutions to overcome them, specialized in the medical device industry in Taiwan. The high rate of failure witnessed in startup companies has raised widespread concern for not only entrepreneurs, investors, governments but also the whole economy. We construct this study to provide pathways and strategies for new medical device businesses, to minimize the challenges that they would face, and seize chances in this opportunistic industry. Ultimately, twenty barriers were collected from literature and expert interviews then were sorted into five groups: Expertise Barriers, Operation Barriers, Resource Barriers, Regulation Barriers, and Market Access Barriers. Subsequently, we used two methods: ANP and VIKOR respectively, to analyze solutions for each of these groups. The findings show that experts whose suggestions are considered the most reliable for startups seeking solid suggestions toward the removal of barriers to successful market access are scholars. They view problems from many angles, both company managers and researchers, who are involved in the startup development one way or another. Hence, the scholars are believed to have the clearest vision on the overall scenario and properly prevent startups from yielding to the barriers.

IEEM19-P-0026
Analyzing the Impact of Vehicle Speed on Distribution Cost for Cold Chain Logistic
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The cold chain logistics industry has a promising prospect, while high costs impede its development. In order to reduce cost pressure on cold chain logistics, this paper investigates the impact of vehicle speed on distribution cost for cold chain logistics. Firstly, a mathematical model with which minimize the total cost is constructed. The sub-costs consist of fixed costs, fuel costs, refrigeration costs and damage costs. Then, an actual case data is used to conduct the experiments. Through experiments, it is demonstrated that optimizing vehicle speed can greatly reduce total cost of the cold chain logistics. We also find that there is a reasonable speed range where the total cost changes slightly. Furthermore, this paper also discussed the impacts of spoilage rate and unit refrigeration cost on optimal speed and the reasonable speed range. The results show that as spoilage rate and unit refrigeration cost increase, both the optimal speed and the reasonable speed range will firstly increase and then stabilize. Finally, some managerial implications based on our findings were also presented targeting enterprises and the government.

IEEM19-P-0098
A Novel Normalization Method for Using in Multiple Criteria Decision Analysis
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A typical multi-criteria decision analysis (MCDA) problem aims to rank a set of alternatives according to a set of criteria. The problem deals with selection of criteria, determination of criteria weights, normalization of criteria scores and aggregation of normalized criteria scores. The focus of this paper is on the normalization method. Most MCDA methods (e.g., AHP and TOPSIS) use a linear normalization method. Its main drawback is that the “magnitudes” of the normalized criteria scores of different criteria are different in terms of average. The difference in magnitude actually changes the relative importances of criteria so that the final rankings of alternatives may not appropriately reflect the preference of decision makers. To address this issue, a novel normalization method is proposed. The proposed normalization method uses a Gaussian value function to transform the criteria scores to interval (0, 1). The parameters of the value function are determined so that the average and variance of the normalized criteria scores are equal to pre-specified constants. A real-world dataset is used to illustrate the advantages of the proposed normalization method.

IEEM19-P-0076
An Improved Bi-Objective Stochastic Model with SAA-based Solution Method for Reverse Logistics Design of Hazardous Materials
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Nowadays, the unprecedented advancement in technology and rapid development of economy have not only brought opportunities for improving people's living standards but also resulted in a tremendous increase on waste generation. The treatment of hazardous materials from both industrial sectors and households has become one of the most significant challenges in waste management. Because of the negative impact on the environment and the safety issues posed to the nearby residents, the design and management system is, however, a complicated decision-making problem. Hence, an improved bi-objective stochastic model is proposed to design the multi-stage reverse logistics system for hazardous materials under uncertainties from different input information. Moreover, a sample average approximation (SAA) based solution method is also proposed so as to find out the Pareto optimal solutions to this model under a stochastic environment. The results of the numerical experiments illustrate the tradeoff between economic efficiency and system risk in reverse logistics design of hazardous materials. In addition, the impact from uncertainties related to the input information is also revealed.
minor modifications. We demonstrate the effectiveness and efficiency of the proposed approach by comparing it to a state-of-the-art algorithm on a test set that comprises 18 instances of the capacitated clustered vehicle routing problem. The proposed approach performed particularly well on large-sized instances with more than 100 clusters. It even found new best-known solutions for the four largest instances in the test set.

IEEM19-P-0115
A Revised KDD Procedure for the Modeling of Continuous Production in Powder Processing
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In this paper, a revised Knowledge Discovery in Databases (KDD) procedure is proposed, which is designed especially for data mining in powder processing and other types of continuous production. The revised KDD procedure includes data preprocessing, feature engineering, machine learning and model evaluation. The proposed methods are implemented and evaluated using a dataset from a fluidized bed opposed jet mill. The results show that the machine learning model can accurately predict the product quality in this scenario and capture the internal relations between processing parameters and product quality.

IEEM19-P-0160
Latin American Oil Export Destination Choice: A Machine Learning Approach
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We implement machine learning techniques to predict the destination for Latin American crude oil exports. Utilizing a unique dataset of shipment data, derived from the Automatic Identification System (AIS) for ship tracking, we investigate the micro- and macro-level determinants of the destination choice. We use decision tree, Random Forests and boosted trees techniques in training a model to predict the export destinations which can help to identify seller/buyer groups with the largest instances in the test set.

IEEM19-P-0044
Collaborative Technological Process Planning with 5G Mobile Networks and Digital Tools: Manufacturing Environments’ Perspective
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Technological process planning (TPP) requires an adaptation to the newest industrial trends, such as virtual reality (VR), mobile communication networks (e.g. Fifth Generation (5G) networks), Internet of Things (IoT), etc., to satisfy the frequently changing product demands in different manufacturing environments. TPP also uses the best practices, knowledge of experts and various digital tools (DTs), which have been implemented as software or hardware digital solutions, helping to achieve the anticipated production aims in the digital era. The DTs have been developed in parallel to the latest industrial trends. This paper presents the general notion of a collaborative technological process planning approach (CTPPA), taking into account the capabilities of the latest developments in mobile communication techniques such as 5G mobile networks. It also discusses the levels of communication within a manufacturing environment and several scenarios of the CTPPA, by considering TPP performance. Finally, it presents how the new 5G technology and new DTs can enhance TPP in the near future. It also demonstrates how faster data transfer can change the functionalities of existing DTs and redefine TPP methodologies.

IEEM19-P-0090
Efficient Compression and Preprocessing for Facilitating Large Scale Spatiotemporal Data Mining – A Case Study based on Automatic Identification System Data
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The large scale deployment of sensor, Global Positioning System (GPS) and other mobile devices generates large volumes of spatiotemporal data, which facilitates the understandings of objects’ movement trajectories and activities. However, it is very challenging to store, transfer and load such a large volume of data into system memory for processing and analysis. In this study, we look into a study case that processes the large scale of Automatic Identification System (AIS) data in the maritime sector, and propose a computational framework to efficiently compress, transfer and acquire necessary information for further data analysis. The framework is composed of two parts: The first is a lossless compression algorithm that compresses the AIS data into binary form for efficient storage, speedy loading and easy transfer across networks and systems within the organization; the second is an aggregation algorithm which derives movement and activity information of vessels grouped by grid and/or time window from the compressed binary files, therefore improves data accessibility and reduces storage demand. The proposed framework has been applied to extract vessel movement information within Singapore port with high compression rate and fast access speed, and it can be extensively applied for other data processing applications.

IEEM19-P-1174
Optimal Cleaning Scheduling for Photovoltaic Systems in the Field Based on Electricity Generation and Dust Deposition Forecasting
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This study focuses on cleaning scheduling for photovoltaic (PV) systems in the field. A method to design cleaning schedules for PV strings is proposed to maximize the profit of PV systems over an extended period. Previous studies usually consider experimental systems and focus solely on the cleaning frequency. Our method designs specific cleaning schedules for real PV systems based on the forecasting of environmental conditions, PV power generation and dust deposition. We formulate cleaning decision problem as an infinite scheduling problem. An optimization model for an infinite planning horizon is developed and a periodic scheduling method based on forecasting is proposed to transform the infinite process to an optimizable problem. The cleaning schedules are updated over time, as the forecasting accuracy for future times increases over time. The performance of our proposed method under different conditions is evaluated in a case study, and it is compared with two classical scheduling methods.

IEEM19-P-0441
A Study on Improvement of As-Built Deliverables Transfer Process for Nuclear Power Plant Operations & Maintenance
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\(^2\)Korea Hydro & Nuclear Power Co., Ltd., Korea

This study is to improve the as-built deliverables transfer process for nuclear power plants, which are handed over to the O&M phase. South Korea is one of the first countries that managed the configuration of its nuclear power plants. However, an issue has been raised with the possibility
of data loss, resulting from the lack of data interconnectivity in the information system for configuration management. In order to address this issue, it is necessary to trace the configuration information between varied as-built deliverables. In this study, we reviewed the traceability to improve the safety and reliability for the O&M of nuclear power plants. In particular, we propose a new process that improves the traceability between as-built drawings, the most important part of as-built deliverables, through a practical example.

IEEM19-P-1131
Optimal Preventive Maintenance for Parallel System with Two Failure Modes
Hui XIAO, Gang KOU, Rui PENG
University of Science and Technology Beijing, China
This research considers a parallel system that consists of heterogeneous components subject to two types of failures: a one-stage catastrophic failure and a two-stage delay-time failure. Inspections are conducted periodically to identify the states of each component. Three maintenance policies are studied in this research. In Policy 1, components are replaced if an inspection finds all of them are either defective or failed. In Policy 2, components are replaced if all of them are either defective or failed, and the number of failed components reaches a certain value $y$. In Policy 3, components are replaced even if they are identified as defective or failed at an inspection. To find the optimal inspection interval, we analyze the renewal process of the system to minimize the long-term expected cost per unit time. Due to the complexity of Policy 3, a simulation framework is proposed to evaluate the long-term expected cost per unit time. Numerical experiments are carried out to illustrate and verify the applications of the proposed models and methods.

IEEM19-P-0023
The Effectiveness of Rolling Stock Maintenance on Quality Assurance at the Largest South African Rail Company
Sambil Charles MUKWAKUNGU, Zandile SIBEKO, Charles MBHWA
University of Johannesburg, South Africa
This paper presents the results of the evaluation of the effectiveness that rolling stock maintenance (RSM) has on quality assurance (QA) at the largest rail, port and pipeline company in South Africa, as a case study conducted at its Koedoespoort depots and factories. Using a quantitative approach descriptive in nature, the researchers aimed to gain an insight into the research problem and to investigate the effectiveness. RSM has on QA at freight rail company. Data was collected from a sample of 30 employees randomly selected at the engineering division. The evidence collected shows that the engineering division does not have a criterion to monitor the effectiveness of the current maintenance plan, the division does not have a maintenance system that is well understood by the artisans as well as technicians. The recommendations emphasized on a continuous training program on quality planning and implementation for the whole engineering division to ensure that the proposed maintenance strategy delivers as expected right the first time.

IEEM19-P-0118
Reliability Assessment of Mining System Based on Time Mining Data
David VALIS1, Jakub GAJEWSKI, Kamila HASILOVA, Marie FORBELSKA, Jozef JONAK
1University of Defence, Czech Republic
University of Technology, Czech Republic
The degradation of mechanical systems is a typical phenomenon accompanying most systems. When considering, dependability, safety and cost-effectiveness, the degradation may result in serious consequences. Direct advancement degradation in all technical systems is not easy to observe. In order to do so, related information is used, e.g., the study of diagnostic and operation measures-signals. This article presents a study of the deterioration of a mining head with multi-tool knives. There is a dataset containing the records of the drilling head behaviour in standard operation. The records contain typical operational characteristics such as moment and power for both sharp and blunt knives. Degradation modelling of the studied mining head knives is performed with stochastic continuous diffusion processes. They are Pearson type, Gauss-Markov type and Levy type processes. The achieved results are expected to be used for the observation of i) the first passage time of degradation critical value, ii) the prediction of residual useful life, and iii) the rationalization of in field operation and maintenance.

IEEM19-P-0117
Perspective Exploratory Methods for Multidimensional Data Analysis
David VALIS1, Libor ZAK2, Zdenek VINTR1
1University of Defence, Czech Republic
2University of Technology, Czech Republic
This research considers a parallel system that consists of heterogeneous components subject to two types of failures: a one-stage catastrophic failure and a two-stage delay-time failure. Inspections are conducted periodically to identify the states of each component. Three maintenance policies are studied in this research. In Policy 1, components are replaced if an inspection finds all of them are either defective or failed. In Policy 2, components are replaced if all of them are either defective or failed, and the number of failed components reaches a certain value $y$. In Policy 3, components are replaced even if they are identified as defective or failed at an inspection. To find the optimal inspection interval, we analyze the renewal process of the system to minimize the long-term expected cost per unit time. Due to the complexity of Policy 3, a simulation framework is proposed to evaluate the long-term expected cost per unit time. Numerical experiments are carried out to illustrate and verify the applications of the proposed models and methods.

IEEM19-P-0247
Hybrid Welding Jigs with Additive Manufactured Functional Elements
Günther SCHULZ, Georg BERGWEILER, Falco FIEDLER, Kolja LICHTENTHAELER, Sebastian LEIMBRINK
RWTH Aachen University, Germany
This paper deals with the development and design of hybrid welding jigs with additive manufactured (AM) functional elements for pre-series automotive body shops. The designing of the hybrid welding jigs is based on a modular toolkit consisting of standard elements, additive manufactured elements and conventionally manufactured elements, such as 2D cut steel beams and machined location pins. In order to select the most suitable AM material, the AM materials with the highest cost-specific stiffness are analysed. The selected materials are then evaluated by a three-point bending flexural test for validation of the welding jig requirements. Finally, an example hybrid welding jig is designed and tested.

IEEM19-P-0082
Activity-based Cost Model for Material Extrusion Processes Along the Additive Manufacturing Process Chain
Achim KAMPKER, Peter AIYAZ, Gerret LUKAS, Steffen HOHENSTEIN, Viktoria KRÖMER
RWTH Aachen University, Germany
The utilization of additive manufacturing (AM) has entailed numerous benefits such as shortened time-to-market, high product innovation and individualization. The application of AM has gained in significance within the automotive industry as it is transferring from a prototype technology to series applications. Besides technological barriers, an approach to estimate cost to set up a business case of an application is crucial. Material extrusion (ME) as an additive process category is theoretically capable of meeting high requirements in industry. Despite various processes belonging to ME, Simultaneous Layer Modeling (FLM) is the only one entrenched. The establishment of pellet-based processes could overcome restrictions for ME. Although there are various cost estimations for AM, a transparent methodology to carry out a profitability analysis
between ME processes is missing. In this study, a cost model for ME is developed to estimate occurring cost and cost drivers. Existing cost models are compared regarding their suitability for ME. The final cost model for ME is activity-based and measuring occurring unit cost during the process steps pre-, in- and post-processing. The duration of cost-generating activities is considered.

IEEM19-P-0086  
A Single Machine Scheduling Problem with Discrete Machine Conditions  
Wenhe YANG, Lu CHEN  
Shanghai Jiao Tong University, China  
In a real workshop, machine condition is an essential constraint to achieve an overall scheduling optimization. This paper studies a single machine with discrete machine conditions constraint and maintenance consideration. The scheduling sequence decides the actual processing time of jobs by the processing position in scheduling sequence. A tradeoff exists between the rejection of jobs in longer processing time and acceptance of maintenance leading to the delay of future jobs. A finite-horizon Markov decision process models the problem to minimize the makespan. An optimal scheduling decision sequence is developed to deal with the dynamic evolution. Computational experiments are conducted to evaluate the proposed approach.

IEEM19-P-0133  
MA²RA – Manual Assembly Augmented Reality Assistant  
Maximilian KÖNIG, Martin STADLMAIER, Tobias RUSCH, R. SOCHER, Lukas MERKEL, Stefan BRAUNREUTHER, Johannes SCHILP  
Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV, Germany  
Cyber-physical systems and automation play a major role in Industry 4.0. However, due to its flexibility and high responsiveness to short-term changes in the assembly of complex and varied products, manual work cannot be neglected. Cognitive assistance systems relieve the mental stress of a worker and thus help prevent accidents during the assembly process. Systems utilizing augmented reality (AR) technologies are suitable for manual operations. In order to motivate the development needs of industrial augmented reality (IAR) applications, a prototype is described below. This paper focuses on the conceptual development and the implementation of a prototype assistance system. By using AR glasses and a data glove, an inexperienced worker is guided through a demonstrative assembly process where each assembly step is documented by the system. Finally, a user test is performed to evaluate the prototype.

IEEM19-P-1098  
A Digital Twin of Manufacturing System for Energy Efficient Operation  
Junde Feng WANG, Yaqin HUANG, Yufan ZHANG, Shiqi LI  
Huazhong University of Science and Technology, China  
Energy efficient operation of manufacturing systems is important for sustainable development in industry. The different unexpected disturbances make the production control more and more complex for energy efficiency management with timely response. Digital twin is a mirror of physical system in virtual space. A digital twin model of manufacturing systems is proposed for production decision in order to achieve energy efficient operation by coupling the physical system and the virtual system. The main elements and construction procedure of the digital twin are presented. The automatic simulation model generation of manufacturing system is described based on the configuration of physical system. The production data can be inputted into simulation model in real time manner. For the transient decision of machine state, the Max-plus algebra model of the physical system is built to make on-line control of the energy saving machines. For the energy efficiency evaluation of production plans and energy-intensive machines, the off-line simulations based on discrete-event simulation models are adopted. Case studies are presented to illustrate the potential application of energy efficient manufacturing system in Industry 4.0 environment.

IEEM19-P-0218  
Challenges in Implementing Industry 4 Laboratories and Learning Factories in Academia  
Ronnie MURIAN1, Duncan CAMPBELL1, Ziyaen JIN2, Markus STUPTNER1; Javan CHAIH3  
1University of South Australia, Australia  
2University of South Australian Defence Science and Technology Organisation, Australia  
Specialised laboratories and learning factories can play a significant role in developing and advancing the Industry 4 concept and production systems. However, there are many challenges that need to be addressed before creating qualified laboratories that have true Industry 4 characteristics. Some of those challenges originate from the varied definitions of Industry 4, from what different institutions and research groups consider critical/trivial to implement in a laboratory, from Universities’ policies and regulations, and even taxation rules. Many challenges derive from the complexity of the Industry 4 eco-system and its continuous evolution. The objective of this paper is to provide a systematic analysis of the challenges in implementing viable Industry 4 laboratories in academia. These challenges need to be defined explicitly before they can be addressed, and relevant laboratories developed to maximise the success of what can be significant investment.

IEEM19-P-0067  
Virtual Team Performance Factors: A Systematic Literature Review  
Derek CLARK, Anhlie MARNEWICK, Carl MARNEWICK  
University of Johannesburg, South Africa  
What constitutes a successful virtual team or not is of great importance considering their widespread use in business. Despite this, the failure rate of virtual teams remains relatively high compared to non-virtual teams. This study conducted a literature review that analysed 135 articles from peer-reviewed English journals. The results were coded into groups of factors and the impact of these groups on performance and their status in literature were determined. It was found that beneficial interpersonal characteristics such as empathy or behavioural flexibility were the most commonly identified positive factors in virtual team performance, followed by trust, and the appropriateness of functionality and richness of communication technology used by the team. The most significant failure factors in virtual teams were found to be the effects of geographic and temporal dispersion, the effects of cultural diversity, and negative leadership qualities such as bias.

IEEM19-P-0448  
Function Allocation Design of Subway Automatic Train Supervision System’s Alarm Unit  
Jianxin WANG, Weinong FANG, Beiyuan GUO, Ke Niu  
1Beijing Jiaotong University, China  
2Zhengzhou Railway Vocational & Technical College, China  
The degree of automation in rail transit is increasing rapidly. The main responsibility of people in the subway system is transformed into monitoring. A well-designed alarm unit is a guarantee for improving the performance of personnel. By analyzing the sociotechnical complexity of the Automatic Train Supervision (ATS) system besides its alarm unit, the work domain analysis model is constructed. In the process of system model construction, the function allocation between human and automation system was considered. And the human-computer interaction interface of ATS alarm unit was redesigned. Further, the initial verification was carried out by subject matter experts in Skill-Rule-Knowledge framework. Results from this study preliminarily confirmed the reference role of cognitive work analysis in human-automation function allocation design.
Eye Gaze Accuracy in the Projection-based Stereoscopic Display as a Function of Number of Fixation, Eye Movement Time, and Parallax

Yogi Tri PRASETYO, Retno WIDYANINGRUM, Chiuhsiang Joe LIN

Mapua University, Philippines
Sepuluh Nopember Institute of Technology, Indonesia
National Taiwan University of Science and Technology, Taiwan

Eye gaze accuracy is one of the most commonly used parameter to evaluate the eye tracker performance. The current study applied stepwise multiple regression to predict the significant predictors for eye gaze accuracy (AC). 7 male and 3 female were recruited to perform multi-directional tapping task in the projection-based stereoscopic display under 3 different levels of parallax and 6 different levels of index of difficulty (ID). Tobii X2 eye tracker was used to measure the selected four eye movement parameters which consist number of fixation (NF), fixation duration (FD), time to first fixation (TFF), and eye movement time (EMT). The results indicated that NF was found to be the best predictor for AC followed by EMT and parallax. The R2 value of 0.247 indicating that the 24.7% of the variability of the data was explained by the model. Practitioner Summary: The result of multiple regression can be a valuable theoretical foundation for evaluating an eye tracker. The results could be very beneficial for human factors engineers and virtual reality developers especially for predicting eye gaze accuracy.

Organize and Reuse Engineering Assets

Shaoming FU, Chieh-Min CHOU

Technical University of Denmark, Denmark
Jonkoping University, Sweden
Room
Date
Session
Technology and Knowledge Management 2
16/12/2019
13:30 - 15:30
Technology and Knowledge Management 2

A common cause for delays in product development is a premature introduction of new technologies. This can be the case also when organizations have failed to use the existing knowledge of technologies and other engineering assets. One way to increase the reuse of existing engineering assets is to ensure that these assets are relevant, retrievable and renewed. This can be achieved by applying Flexible Modularization as a structured way to organize and reuse engineering assets. This paper presents the introduction of Flexible Modularization at two international product developing and manufacturing companies. It presents three different examples of Flexible Modules and a guideline for developing Flexible Modules in an industrial context.

Postural Analysis Among Machinists Experiencing Work-related Musculoskeletal Disorders in the Philippines

Arianne NECIO, Nicole Emanuelle BATAC, Trizhia May ODIAS, Jan Luigi RICAFORT, Rafael SALAZAR, Yoshiki KURATA

Technological Institute of the Philippines Quezon City, Philippines

Work-related musculoskeletal disorders (WMSDs) in the Philippines has become an ordeal in the manufacturing industry. WMSDs are injuries in both muscle and skeletal systems of the body caused by repetitive tasks, prolonged and strenuous range of actions done by most people. Workers experiencing various WMSDs are associated with increased absenteeism, less productivity, and physical and psychological stress. The study aims to identify and analyze statistically significant variables contributing to work-related musculoskeletal disorders, particularly postural related considerations in the lower back, experienced by machinists in a steel manufacturing company. Through correlation and multiple regression analysis, results showed that Height (p-value = 0.001), Weight (p-value = 0.001), Noise (p-value = 0.010), Temperature (p-value = 0.022), Load Weight (p-value = 0.014), BMI (p-value = 0.047), Sleep Quality (p-value = 0.044) and Workload (p-value = 0.007) contributes to the WMSDs experienced by the machinists. Recommendations such as medical examinations, worker’s education in the use of PPEs, suitable ventilations, adequate working space, and worker’s physical fitness is expected to minimize the risk of WMSDs among workers.

Developing Flexible Modules - A Pragmatic Way to Organize and Reuse Engineering Assets

IEEM19-P-0129

Dag RAUDBERGEP, R. HÖRNMARK, B. YOUNADAM

1Kungpokping University, Sweden
2Fagerhults Belysning, Sweden
3Hauganum Group, Sweden

A Case Study of Intellectual Property Rights Management with Capability Maturity Model

IEEM19-P-0138

Shaoming FU, Chiheh-Min CHOU

Feng Chia University, Taiwan

Capability Maturity Model, CMM, was proposed to assess the software development organizations. In a company, the nature of an Intellectual Property Rights Management (IPRM) Department is like the organization of software development. It is possible to use CMM for assessing the performance of the IPRM Department. The IPRM Department in Company A is responsible for handling US patent applications filing. The department is a professional organization and the performance is relatively difficult to assess. In our case study, the Capability Maturity Model was introduced into the department to assess the performance. The schedule and cost of the US patent applications is controlled and measurable.
The rapid development of technology has driven the technology application in various sectors, including the application of Knowledge Management System (KMS). At the Maintenance Department of the XYZ Corporation, an aircraft manufacturing company in Indonesia, there is a potential of tacit knowledge and experience of maintenance activity cannot be retained by the company when the employees enter retirement. Besides, the company did not have the system to manage tacit knowledge of the maintenance activity to enhance the performance of its employees. The purpose of this research is to design the KMS of the planning & control module to complement the KMS of maintenance activity that previously designed for the XYZ Corporation. The development of the KMS based on the waterfall method. The design of KMS features developed by using the KM Cycle. The KMS for maintenance activity integrates the enhanced features of the maintenance module and Knowledge Management module.

**Session**
Engineering Education and Training 1

**Date**
16/12/2019

**Time**
13:30 - 15:30

**Room**
Parisian 77001

**Chairs**
Leif OLSSON Mid Sweden University, Romayn GALINGAN Technological Institute of the Philippines

**IEEM19-P-0223**

**Knowledge Management System for Maintenance Activity: Case Study at the Maintenance Department of XYZ Corporation**
Dila Aliifita ISWOROWATI, Fadel MUHAMMAD, Amelia KURNIAWATI, Mochamad Teugu KURNIAWAN
Tillan University, Indonesia

**IEEM19-P-1100**

**Organizational Learning: Overseas Expansions and Environmental Performance in China**
Abe P. L. JONG, Andy C. L. YEUNG
The Hong Kong Polytechnic University, Hong Kong SAR

In recent years an unprecedented number of Chinese manufacturing firms have expanded overseas to developed countries. For example, Chinese FDI in the US leaps tripled from $15 billion (in US dollars) in 2015 to $46 billion in 2016. In Europe, Chinese manufacturers focus on the major economies with advanced technology, including Germany, UK and France. Research shows that firms are often attracted to invest in high-cost, developed countries because of their advanced technology assets. However, do overseas expansions also force Chinese firms to be more environmentally responsible? In this research, we attempt to empirically explore if overseas expansions improve firms’ environmental performance through organizational learning and the possible factors that affect this process.

**Session**
Quality Management

**Date**
16/12/2019

**Time**
13:30 - 15:30

**Room**
Parizian 77001

**Chairs**
Leif OLSSON Mid Sweden University, Romayn GALINGAN Technological Institute of the Philippines

**IEEM19-P-0040**

**The Use of Customized YouTube Videos and Internet to Enhance the Academic Performance of Non-Engineering Students Registered in the Faculty of Engineering at a South African University**
Sambil Charles MUKWAKUNGU, Eric Mikoli BAKAMA, Charles MOBOHWA
University of Johannesburg, South Africa

This study suggests a new learning method using online videos and the Internet as a substitute to the traditional teaching method in order to enhance the academic performance of non-engineering students registered in the Faculty of Engineering and the Built Environment at a South African university. Customized video materials covering topics offered in the course Operations Management Techniques, which equips students with decision science related skills as well as operations research knowledge as part of their curriculum in the programs offered in this department were posted on YouTube. 200 questionnaires were sent out and returned. The analysis of results reveals that the current teaching method is quite poor and respondents’ desire to adopt the suggested learning method which removes the boundaries established by the fact that learning would have taken place in one centralized location. With the use of customized YouTube videos, students can access their learning material on the go which renders the course mobile and opens the possibility of online platforms development to accommodate larger number of students while monitoring their academic performance inside and outside the class.

**IEEM19-P-0301**

**Factor Analysis of Cost of Quality to Determine the Adoption of Economics of Quality as a Measure of Quality Management Performance in South African Companies**
Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
University of Johannesburg, South Africa

The current disruptive business environment forces companies to constantly search for improved ways of meeting customer requirements. South African companies are not excluded from daily business challenges. This research assesses the adoption of cost of quality practice as the measure of quality management performance. The study uses the snowball sampling approach to identify the target sample members. It collected information from 45 companies around the Johannesburg area. The convergent validity and discriminant validity were used as the measure of study construct validity. The study identifies preventive cost and appraisal cost as two costs of quality categories which receive high attention from South African companies. The failure cost was identified to be in third place. The opportunity cost was identified as the ignored cost of quality (CoQ) category. Hence, it was recommended that the companies start to pay attention to their opportunity cost and it was also recommended that further research should focus on identifying the challenges experienced by companies in the implementation of cost of quality.

**IEEM19-P-0379**

**A Research on the Application of Cooperative Education in the Capstone Project Course of Technical Universities and Colleges in Taiwan**
Jen-Chia CHANG, Hsiao-Fang SHIH
National Taipei University of Technology, Taiwan

The teaching objectives of technical and vocational education mainly include cultivating students’ professional knowledge, technical skills, professional ethics, innovative thinking and adapting to social changes to meet the needs of the future workplace. The purpose of the capstone project course is to enable students to apply what they majored in professional subjects and internship, and to enable students to learn independently and develop problem-solving skills through capstone project courses. This paper analyzes the current situation of literature and educational research and proposes a special program T (topic) D (discussion) I (implementation) P (presentation) E (evaluation) teaching model (hereinafter referred to as the TDPE model) combined with industrial resources. This paper provided a special teaching model that combines industrial resources and experience. The school cooperates with industrial companies and maximizes benefits for both sides.

**IEEM19-P-0537**

**Do Emotions Determine Rumors and Impact the Financial Market? The Case of Demonetization in India**
Madhuri PRABHALA, Indranil BOSE
Indian Institute of Management Calcutta, India

Studies have identified that rumors circulate in social media and rumors influence different areas of decision-making. Given that rumors are essentially psychological phenomena, there are not enough studies that explore how textual content-based emotions determine social media rumors. Further, while behavioral finance identifies rumors as influencing financial markets, the relationship between social media rumors and financial markets is not well studied. This paper attempts to provide a direction for understanding these two questions. In the context of demonetization in India it finds that while text-based emotion extraction helps identify rumors circulating on social media, these emotions do not impact the movement of the financial market.

**IEEM19-P-0889**

**Are We Ready for the Agenda 2030 for Sustainable Development?**
Per ÅHAG, Lisa HED, Per Hakan LUlundö, Leif OLSSON
1Umeå University, Sweden
2Mid Sweden University, Sweden

Are we as educators of future engineers ready for the United Nations Agenda 2030 for sustainable development? We make a comparative study of the Master’s programme in Industrial Engineering and Management at two Swedish Universities. Our conclusion is that we as educators and programme managers are not yet in the right process for Agenda 2030 and the necessary transition into a
### Designing Passive Indoor Distributed Antenna System with Practical Constraints Using Binary Encoding

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<td>Chairs</td>
<td>Zhao-Xu YANG Xi’an Jiaotong University, Mahmood ALI Institute of Business Management</td>
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In this paper, a general binary tree representation based on Genetic Algorithm (GA) for designing IB-DAS has been devised. The experimental results illustrate that this representation enhances the computational performance and yields optimal or near optimal design have been reported in the literature. However, some of them encounter the scalability issue, while others require a dedicated representation of the problem with highly customized operations. In this paper, a general binary tree representation is employed to measure the familiarity of each two local densities is employed to measure the familiarity of each two antennas. The simulation results demonstrate low computation cost and favorable tracking performance.

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### Tracking Control of a Skid Steered Mobile Robot with Adaptive Robust Second Order Sliding-Mode Controller

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<th>Future Distribution Generation in an Intelligent Smart Energy Network</th>
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<td>Chairs</td>
<td>Michel ALDANOngo Toulouse University / IMT-Mines Albi, Yan-Ling CAI Zhengzhou University</td>
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Path tracking is a key technology for mobile robot navigation. This paper proposes an adaptive robust second order sliding mode controller to accomplish the tracking mission. First, kinematics and dynamics analysis of a skid-steered mobile robot is introduced. Then, a second order sliding-mode dynamic controller is designed for the tracking purpose. In order to improve the robustness and cope with the system uncertainties and disturbances, adaptive rules are utilized in this controller. The convergence of the control system is proved by the Lyapunov stability theory. At last, the effectiveness of the designed method are illustrated in the simulation result.

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### Energy-Efficient Load Balancing for Cloud Data Center Using Virtual Machine Consolidation

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<td>Chairs</td>
<td>Xinli Gao, Zhongshan University, South Korea</td>
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The power consumed by data centers accounted for 1.8% of total power consumption in 2004, but there is a problem with server is not used effectively such that the average occupancy rate is only about 15% to 20%. Because SLA violations can lead to enormous damage, it adopted an operational strategy that prioritizes stability. To solve this problem, we propose a Virtual Machine Consolidation research using virtual machine migration. This study aims to reducing the idle rate of data center servers and load balancing ensures that servers operate as reliably by solving problems.

### Data-Driven Adaptive Processes – A Potential Enabler for Flexible and Versatile Automotive Body Shops

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<td>Chairs</td>
<td>Günther SCHUH, Georg BERGWEILER, Falko FIEDLER, Yannick BOELSEN</td>
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Automated robotic processes are difficult to stabilize, which requires a high ramp up effort and complex variant-specific geometry jigs especially in automotive body shops. This effort increases by higher variance and shorter product life cycles, a current trend in the automotive industry. To avoid this, the approach of this paper aims to use self-learning data analytics models to adapt process controls according to features of individual joining partners. Therefore, as a first step, this paper shows an overall concept for intelligent integrated adjustment planning in body shops as well as a dive-in into adaptive welding processes.

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### Corporate Responses to Internet flaming: Evidence from Japan

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<td>Chairs</td>
<td>Keiya MORI, Fumiko TAKEDA, The University of Tokyo, Japan</td>
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This study examines how target companies react to the Internet flaming and how the reactions affect their stock prices, based on the 154 flaming events targeting Japanese listed companies from 2009 to 2018. Among 154 flaming events, target companies ignored the flaming and did not take any actions in 80 cases while actions were taken in 74 events. These actions include 49 official apologies, 18 objections, and 7 deletions of comments without appropriate

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**NARMAX systems employing the evolving fuzzy approximation.** In the proposed fuzzy controller, dynamic approximation capability is performed by the combined action of structure configuration and parameter adjustment using multiple strategies of recruiting, pruning and updating the data clouds, and self-tuning the consequent parameters. The normalization distance between two local densities is employed to measure the familiarity of each two data clouds, which is the criteria to trigger the pruning of redundant data cloud to further avoid the overlap or conflict. The simulation results demonstrate low computation cost and favorable tracking performance.
IEEM19-P-0194

What Will Influence Customer’s Engagement the Strategies and Goals of Tweet
Dongying YANG, Shuzo FUJIMURA
Tokyo Institute of Technology, Japan

This paper aims to find the correlation between customer’s engagements with the tweet. This paper use Adidas official Twitter accounts as the sample, develop a model to evaluate each tweet with six strategies (celebrity, entertainment, storytelling, product information, mega-event, link) and three goals (brand build, product sale, marketing campaign). In addition, by using CBE theory, this paper wants to release the correlation between each customer’s engagements. This paper finds storytelling, product information, and product sale will have a positive influence on customer engagement; others have negative or irrelevant impact. Meanwhile, customer’s engagement does not correlate; however, the higher rate of quote, the more positive quote will get. Marketing managers can use these findings to decide online marketing strategy.

IEEM19-P-0206

Social Media Marketing Activities and Customers’ Purchase Intention: The Mediating Effect of Brand Image
Haixin ZHANG, Yali ZHANG, Anastasia RYZHKOVA, Chrissie Diane TAN, Feng LI
Northeastern University, China

Social media marketing activities (SMMA) has been the mainstream form of marketing in recent years. This research proposes a model wherein SMMA affects purchase intention mediated by brand image, perceived value and trust. The results of the structural equation model analysis of 395 responses show that SMMA has a positive indirect effect on purchase intention through the mediation of brand image, perceived value and trust. Meanwhile, brand image not only has a direct influence on purchase intention, but also has an indirect influence on it through perceived value and trust.

IEEM19-P-0214

Digital HRM Model for Process Optimization by Adoption of Industry 4.0 Technologies
Megadewi MUNSAMY, Armesh TEELUCKDAR1
1Mangosuthu University of Technology, South Africa

The 4th Industrial Revolution, the digitalisation of industry, is transforming the operation of industries; automated, autonomous and decentralised. This transformation is changing the roles and responsibilities of personnel, requiring transformation of Human Resource Management (HRM) functionalities. A digital model of all HRM activities is created by simulation of HRM business process models. Business process models graphically detail the steps for execution of all HRM activities from recruitment and development of employees to conflict resolution. To align to the need of digitalisation, the digital HRM model is developed into a HRM optimisation model that analyses the impacts of application of Industry 4.0 technologies. The model identifies the applicable Industry 4.0 technologies for each of the HRM business activities and evaluates the personnel time requirements, energy demand and carbon dioxide emissions of each technology or technology mix towards identification of the optimum business activity execution methodology. The results of the model provides essential information for selection of the business activity for reengineering towards digitalisation and the appropriate Industry 4.0 technology for application for optimum business results.

IEEM19-P-0063

Towards a Metric Between Engineering to Order and Assemble/Make to Order Products in Configuration Situations
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Most companies that supply customized or configured product use product configuration systems (PCS). Especially in B2B for technical systems, it happens frequently that the supplier and his PCS cannot find a solution that fulfills all customer requirements because some of them are out of the company standard. In that case, if the supplier wants to make an offer, it is necessary to perform some engineering activities in order to propose a solution which fulfills the out of standard requirements. The key questions that come to the supplier in these situations are: Do we accept this out of standard demand? How far is it from our standard? What are the risks? The goal of this paper is to propose new metrics that can help to answer these questions.

IEEM19-P-0452

Green Entrepreneurship Model Utilising the System Dynamics Approach: A Review
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Green entrepreneurship as a concept is still in its infancy stages around the globe. In order to assess the Green entrepreneurship ecosystem, the researchers adopted a systems dynamic approach to determine key variables that will enable the development of the system. A theoretical review was conducted through a literature review of which n=44 sources met the criteria that the researchers set for ecosystem or variables. Through review of data, the researchers discovered that ecosystem of green entrepreneurship needs to be viewed from meso, macro and micro level with key variables such as green entrepreneurial motives, start-up factors, green support mechanisms, performance and monitoring tools as well as barriers to environmental entrepreneurship. A virtual abstract simulation of system dynamics approach from the systematic review is also formulated in the current paper. Brief summary of findings are classified and explained. Recommendations for future research are also made towards the end of the research paper.
IEEM19-P-0097
Credit Risk Contagion Model Based on Financial Industry Clusters
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Financial industry clusters have been a new trend in modern economic development, and also provide potential channels for risk contagion among the financial system. The current credit risk contagion models mainly study the impact of the interconnectedness of the whole network on risk contagion, but lack consideration of the local risk exposures' characteristics under the impact of financial industry clusters. In view of this, we propose a credit risk contagion model based on financial industry clusters and analyze a scale-free financial network according to institution balance sheet. We detect financial industry clusters by identifying systemically important financial institutions. And by calculating the default probability of the institution in clusters, we propose a “cluster contagion index” to assess the impact of local risk exposures on contagion. We verify the rationality of the model by comparing the default extent after the risk contagion under different network scales and different initial shocking scopes. The results of our model also highlight the impact that heterogeneous connectivity in clusters to magnify shocks, which will be significant for financial market regulators.

IEEM19-P-0116
Airports as Critical Infrastructure: The Role of the Transportation-by-Air System for Regional Development and Crisis Management
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Regional airports constitute an important precondition for supply chains of goods and public services and particularly those of time-critical transports by air. However, common approaches for estimating the effects of airports on the regional economy have overlooked this essential role. This paper analyzes the interconnected role of a regional airport as a hub of critical infrastructure by applying a holistic system perspective to a Swedish case. Departing from a conceptual model, which was developed with soft systems methodology, the analysis provides novel insight into vital societal functions that are interconnected with aviation. Insights from interviews with stakeholders enrich the system model and thus provide suggestions for further developments of economic models that include the value of critical infrastructure for societal resilience.

IEEM19-P-0127
Predicting Profit Performance of International Construction Projects
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This study developed a practical case-based reasoning (CBR) model to predict the profit performance of international construction project (ICP) due to the nature of the prediction as a project-based, unstructured, and small sample issue. The proposed model helps contractors to make reasonable bid decision or risk treatment in the early stage of ICPs by retrieving similar cases. Grey relational analysis is applied to respectively measure the weight and variable similarity so that case similarity can be scored. Finally, the proposed model is tested on the basis of 30 actual overseas rail projects. The results indicate that the proposed CBR model performs at a higher level of accuracy than other classical CBR models. A structured process to choose appropriate methods for CBR model development by considering the prediction accuracy performance of methods available is also included.

IEEM19-P-0169
Application of Bayesian Network for Food Safety Risk in Cattle Slaughtering Industry
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The risk in food safety has become a significant research issue that has often been studied in food safety research. However, few studies pay attention to investigate the relationships between risks event based on the processes using the bayesian network method. This study aims to apply the bayesian network method to measure and analyze the risk in food safety with a case study in the cattle slaughtering industry. Five (5) stages are used to apply the Bayesian network method including identification of risk event in case study, determination of probability of risk event, development of Bayesian network structure, calculation for condition probability table (CPT), and analysis of food safety in case study. Research data collection was conducted through observations, discussion and interviews with supervisors in case study. 50 cow’s observations are used to investigate food safety risk in cattle slaughtering industry. Eight (8) risk events for food safety were founded and the results of Bayesian network based on processes is the slaughter process is the highest food safety risk in cow slaughtering industry.

IEEM19-P-0477
Development of a Risk-Based Maintenance (RBM) Strategy for Sewerage Pumping Station Network
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Industries have been facing ever-increasing challenges to do more with less under ongoing budget constraints. They are pushing the boundary by challenging OEM recommended maintenance intervals and relaxing or tightening based on where it is needed. This is also evident in water sector where industries are trying to do targeted maintenance based on balancing costs, performances and risks. The unexpected failures, the downtime associated with such failures, the environmental overflows and, the increasing maintenance costs are major challenges all wastewater reticulation and distribution networks. Industries have been working hard to increase the availability of equipment and reduce the life-cycle cost without compromising safety and environmental targets. Risk-based maintenance (RBM) strategy is useful for allocation of maintenance resources where first allocation occurs to the highest risk item and progressively allocated till it reached budget limits. This paper is based on findings from a study covering 186 sewerage pumping stations of Townsville Water in North of Queensland in Australia. This study covered identifying the critical subsystems and mitigating the risks of failure of those subsystems. Implementation of risk based maintenance strategy was useful in further enhancing reliability and reduction of maintenance costs.

IEEM19-P-0157
Practical Framework for Advanced Quality-based Process Control in Interlinked Manufacturing Processes
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As the economic manufacturing of high-quality products becomes an increasingly crucial competitive factor, corresponding quality assurance measures are gaining a growing interest. Even though research interest and industrial demand are both high, there is a large gap between methodological approaches and practical applicability that needs to be closed. In this paper we therefore present a practical framework for advanced quality-based process control (AQPC) in interlinked manufacturing processes. Machine learning algorithms are used to predict the expected product quality based on recorded process parameters. That information then serves as an input for the derivation of optimal control decisions. Therefore, we formulate a mathematical optimization model including different options such as order reassignment and process parameter adaption to determine an optimal set of control decisions. We then break down the optimization into a gradual procedure that allows an application-specific integration into manufacturing.

IEEM19-P-0176
A Reusable Scheduling Problem Decomposition Framework for Smart Factories
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In most scheduling problems, such as plant and supply chain problems, the linkages between resources, and operations are often
IEEM19-P-0220
Development and Application of MES Based on Cloud Platform for Steel Structure Enterprises
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In recent years, manufacturing execution system (MES) has been widely used in the manufacturing industry. MES plays an important role in supporting enterprise workshop management. However, generalized MES cannot be applied well in steel structure enterprises due to the particularity and complexity of steel structure enterprises. This paper takes into account the production characteristics and needs of steel structure enterprises and an MES structure based on cyber-physical system (CPS) is proposed. This architecture includes the physical layer, the network layer and the application layer. The cloud platform-based MES system was applied to a steel structure enterprise in Changchun, China, and the functions of each module were introduced in detail. The MES can effectively improve the informatization level of the enterprise, creating a transparent, informative and intelligent production environment for steel structure enterprises. The developed MES can improve resource utilization, reduce enterprise costs, improve product quality, and lay the foundation for steel structure enterprises to find intelligent factories.

IEEM19-P-0198
Digital Twins for Industry 4.0 and Beyond
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Digital twins (DT) and cyber-physical systems (CPS) are two independently developed yet comparable supporting concepts for smart manufacturing, or “Industry 4.0” in a more popular term. Both of their working principle are based on a close interaction between a physical object and its digital counterpart. Such similarity arouses our curiosity on the association between them. The purpose of this study is to highlight the associations between DT and CPS. With the help of co-word analysis, we find that the two terms seldom co-appear in the literature. Nevertheless, they link to a similar set of enabling-technology terms although with different weighting on these terms, implying that they are established on a similar set of technologies. We suggest that topics within a field being developed independent of each other in the early stage is a common phenomenon. The two currently separate literature streams are likely to merge into one in the foreseeable future. We also discuss the future prospect of DT. Other than manufacturing, DT has great potential in applications such as health care and e-commerce.

IEEM19-P-0168
The Meaning of Car Use / Driving in Japanese Young Generation
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In Japan, the number of young people who turn away from driving, car manufacturers have to cope with this situation and they need to know the preferences of Japanese young people to car use / driving. On the other hand, the progress of automatic car drive systems is astonishing and car manufacturers will turn to sell automatic driving cars to customers, instead of young generations nowadays, in near future. So, we also need to investigate Japanese young people’s preferences to automatic driving car. Additionally, we should investigate the relationship between the preference to car use / driving and that to automatic driving car in Japanese young generations. For these questions, we conducted the survey distributed for over 1,000 young people in Japan. Based on Steg’s Scale (2005), we find that Japanese young females tend to regard car as an instrument to move, however, males tend to feel car is a symbolic tool and it brings fun to them. Also, we find that if young people have evaluation of the instrumental function of car use then they prefer the automatic driving cars.

IEEM19-P-0197
Sharing Personal Failure Story in Organization: Sharing with Individual or Organization?
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Learning from failure in organization is important. There are, however, few organizations which are good at it. There are difficulties to disclose your failure experience to your colleagues in organization because of stigma, guilty feelings, shame and other disadvantages. Nevertheless, there was a company, which was good at learning from failure. Authors employed the company to examine whether failure-story sharing with a particular coworker induced failure-story-sharing among anonymous members in organization and/or other particular coworker. Authors found that failure-story-sharing with a particular coworker induced directly failure-story-sharing with particular other coworker, and induced one with anonymous members in organization, partially mediated by work-value-sharing in organization. And Authors also found that the work-value-sharing in organization did not matter with their own behavior of failure-story sharing with a particular coworker.

IEEM19-P-0361
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The customer-provider collaboration that was diminished during the industrial revolution is being revived to achieve higher customer satisfaction and a competitive edge. Manufacturers are now interested in co-creating value with their customers to design a customized and sustainable solution. Value co-creation is being implemented by various businesses to solve customer problems.
using a combination of products and services to form product-service systems (PSS). Although PSS is promising, its design method is underserved. This paper proposes a product-service system design method by combining the concepts of actor-network theory and service-dominant logic. A case study was conducted on a newly built factory to test the proposed method in identifying the actors, practices and possibilities in the design process.

IEEM19-P-0036
Data-Driven “Market Basket”-Pricing and Personalized Health Information Services Using Salesforce’s Model-Driven Systems Service Design
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Risk management and customer loyalty are increasingly critical. Being able to reduce risks through data-driven packaging and pricing and sustaining customer loyalty are therefore important. This study presents a case study on data-driven packaging (simulating market-basket analysis) and pricing to enable patients, and caregivers to obtain personalized health information services and for hospitals, knowledge sharing on marketing opportunities (who and what to target), which services should be paired with which, corresponding pricing and to predict based on past trends, resource allocation. Our personalized health information system, E-healthzone, builds on Salesforce’s model-driven systems service design. It is currently a management information system but we hope to include intelligence eventually. Technology acceptance by sample users indicate positive acceptance. E-healthzone is perceived as useful especially if hospital fees are expensive, and quality and reasonably-priced services are preferred. Most users intend to use the system when it is released. Expert evaluations view the pricing and booking system and gaining insights through the analytics and dashboards as E-healthzone’s greatest strengths.

IEEM19-P-0315
Queue Server Efficacy in the Retail Industry: A Behavioral Study
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Inspired by behavioral operations and supply chain management this research explores the queuing behavior in retail operations. Customers frequently experience waiting for service in a queue at retail stores. Customer waiting time has a psychological and economic costs. Traditional mathematical models of queuing systems do not consider these psychological costs. Retail stores face the challenge of optimizing queue performance with thin profit margins and high labor costs. This leads to dissatisfied customers who may switch to competitive service offerings with efficient queue management systems. This research focuses on managing the queue server, to increase the efficacy in retail counter queues. A leading Sri Lankan supermarket chain acts as the focal company for this research. A behavioral study was conducted and servers who operate the cash register are the subjects. We observe servers’ behavior using a carefully planned field study, where we identify issues and factors that should be addressed in order to increase server efficiency. We find several factors that affect queue servers’ efficacy such as speed and the quality of the machines and equipment at queue server points, unawareness of incentives for efficient service, delays due to the erroneous entry of products, the workload of the queue server and queue server’s job satisfaction.

IEEM19-P-0064
A Benders Decomposition Approach for Appointment Scheduling of Unpunctual Patients in a Multi-Server Setting
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Appointment patients usually arrive unpunctually, which significantly affects the daily operations of healthcare facilities. To mitigate the negative impact of unpunctuality, this paper attempts to optimize the appointment schedule by considering unpunctual arrivals and no-shows in a multi-server setting. A two-stage stochastic programming model is formulated with the objective of minimizing patient waiting cost and overtime cost. The appointment schedule is determined by a modified Benders decomposition with sample average approximation. The effectiveness of this algorithm is validated through the comparison with lower bounds. Extensive experiments show that the optimal appointment schedule exhibits a zigzag pattern rather than a dome pattern. The impacts of various factors are also explored by numerical experiments.

IEEM19-P-0121
Welfare Technology Policy and Practice – A Conceptual Analysis
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This exploratory study identifies two existing conceptions of welfare technology identified from policy and practice. By using policy documents and previous research together with a survey of primary care managers and students, this paper identifies one wider and one narrower conception. The wider tends to include the whole society, making it difficult to specify end-user requirements, while the narrower focuses on the more vulnerable people in society, which can exclude possible users.

IEEM19-P-0122
A Conceptual Model to Evaluate Technology Implementations: A Home Care Case Study
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Digitalisation in the form of new technologies and solutions is a rapid movement affecting the whole world. Home or assistive care has had a long period of trouble trying keep up, even though it is a promising area of application. As home care tries to catch up, rushing to implement technologies or IT systems can result in misfit solutions that do not satisfy their purpose. The values of healthcare mean that measuring success of technology implementation is different than in production sectors. The main focus is patient satisfaction and should, therefore, also be included in any evaluation. The present study proposes a conceptual model that aims to facilitate considering both quantitative and qualitative data, including patient and caregiver values, when measuring efficiency in healthcare management. The model combines multi-criteria decision analysis (MCDA) and data envelopment analysis (DEA) to make it possible to handle both crisp and fuzzy values. The model is tested and evaluated using a home care case study, which shows promising results.

IEEM19-P-0134
A Two-stage Stochastic Programming Model for Outpatient Appointment Scheduling
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Healthcare providers are facing increasing pressure to improve efficiency for healthcare delivery. Efficient appointment scheduling can improve retention and quality of healthcare services. This paper
studies outpatient appointment scheduling as a two-stage stochastic optimization problem with a multi-server model. The first stage optimizes doctor planning according to capacity constraints and patient requests, based on which the second stage optimizes patient planning by taking into account uncertain service durations. Numerical experiments have been conducted and shown that the proposed two-stage stochastic programming model can reduce hospital operating costs while improving patient satisfaction.

IEEM19-P-0227 How to Make a Medical Error Disclosure to Patients? Xizhu CAI, Mingming DENG1,2

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This paper aims to investigate Chinese public's expectations of medical error disclosure, and to develop guidelines for hospitals. A national questionnaire survey was conducted in 2019, collecting 1,008 valid responses. Respondents were asked their views of the severity of error they would like to be disclosed and what, when, where and who they preferred in an error disclosure. Results showed that Chinese public would like to be disclosed any error reached them even no harm. For both moderate and severe outcome errors, they preferred to be disclosed face-to-face, all the information as detail as possible, immediately after the error was recognized and in a prepared meeting room. Regarding attendance of patient side, disclosure was expected to be made to the patient and family. For hospital side, the healthcare provider who committed the error, his/her leader, patient safety manager and high-positioned person of the hospital were anticipated to be present. About the person to make the disclosure, respondents preferred the healthcare provider who committed the error in a moderate outcome case while the leader or high-positioned person in a severe case.

IEEM19-P-0250 Inventory Replenishment Policy for Medicines with Non-Stationary Stochastic Demand: The Case of a Newly Opened Hospital in Thailand

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Inventory and replenishment planning of medicines play a vital role in hospital management. A large replenishment quantity can lower the percentage of medicine shortage, which might be critical for a patient’s life, but somehow needed to be traded off with high inventory cost from excessive stock. Especially for a vital medicine with non-stationary stochastic demand e.g., antivenom serum or adrenaline, demand for these medicines found to be intermittent, yet there is no perfect solution for this type of medicine. In this paper, the authors present a replenishment policy for a newly opened hospital in Thailand. The proposed inventory replenishment policy allows the pharmacist a better decide on its replenishment policy.

IEEM19-P-0239 Defining Effort Indicators to Retrospectively Assess Engineering Change Information

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Engineering change management becomes increasingly important in modern product development. Since the amount of changes, the complexity as well as the cost of engineering changes increases due to the complexity of technical systems, an efficient handling of changes is crucial. Hence, a systematic approach to investigate the engineering change management regarding the effort distribution within the technical system allows to increase transparency for optimizing the change handling. This paper therefore introduces effort indicators to investigate a technical system regarding its promenence to change effort. Hence, it defines indicators which enable an assessment of engineering change effort. Furthermore, it describes an approach to calculate the indicators based on past engineering change data by using network analysis.

IEEM19-P-0249 Set-based Design in Agile Development: Developing a Banana Sorting Module – A Practical Approach

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Flexible development processes and robust designs are crucial for today’s highly dynamic project environments. Agile methods such as Scrum have gained popularity over the years as an effective approach to address these challenges. Although known for providing flexibility, these methods often lack robustness in designs. Pursuing multiple design concepts can be more advantageous when faced with unforeseen changes and uncertainty. Set-based design (SBD) involves the development of alternative designs in a dynamic setting that, as a result, are both robust and flexible. In this paper, we provide a practical approach to combine SBD with the Scrum methodology by using sprint backlogs. It has been proved that the application of SBD, even in small agile projects, can have advantages. We present our results in a product-oriented way to increase the applicability of our approach.
A Method of Fault Identification Considering High Fix Priority in Open Source Project
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Priority in Open Source Project

Open source software is adopted as embedded systems, server usage and so on because of quick delivery, cost reduction and standardization of systems. Many open source software are developed under the peculiar development style known as bazaar method, in which faults are found and fixed by developers around the world, and the result will be reflected in the next release. However, several massive open source projects have a problem that faults fixing takes a lot of time because faults corrector cannot handle many faults reports briefly. In this paper, we make an index to detect faults that require high fix priority and long fault fixing time when faults are reported in specific version of open source project. In addition, we try to improve the detection accuracy of the proposed index by learning not only the specific version but also the fault report data of the past version by using random forest considering the characteristic similarities of faults fix among different versions. As a result, the detection accuracy has highly improved compared with using only specific version data.

An Earned Duration Management Model Integrating Quality Management and Resource Performance Monitoring
Jaye Lois SAN JUAN, Ronaldo POLANCOS
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Project management minimizes the risk that a project deviates from plans. Monitoring and controlling schedule and cost, two of the most critical functions of project management, has been given the most focus in tools such as Earned Duration Management (EDM). Nonetheless, quality and resource management, equally important elements of project management, has not been properly exploited. This paper proposes an extension to the EDM model by incorporating resource performance measurement considering resource capabilities, and how these may be utilized to conduct either quality assurance (QA) or quality control (QC) through rework at any project level to ensure that the project is on track with the published result.

Main Paths of Research in Software Development Management
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Software development involves complicated processes; thus, it requires appropriate methodologies to accomplish a software project. The emphasis of the software development methods shifts in time, along with changes in the underlying technological context. The purpose of this study is to trace the evolution of software development management and examine how the method transformation reflects the changes in the technological context. We apply main path analysis (MPA), an approach that allows visualization of the main knowledge flow by mapping citation networks into few significant citation chains, to trace the major development of the research. 4,700 articles beginning from 1970 in software development management or methodologies were collected from the Web of Science database. MPA reveals three early literature streams including risk management, metrics and measures, and economics in software development. The three streams merge into one around 2005 when the agile approach become the major trend in software development. The approach calls attention to incremental processes, fast adaption cycles, and efficient communication, which largely reduce risks in building modern World Wide Web software applications.

An Adaptation of the Record-to-Record Travel Algorithm for the Cumulative Capacitated Vehicle Routing Problem
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The cumulative capacitated vehicle routing problem (CCVRP) is a CVRP that aims to minimize the cumulative of vehicle arrival times at every customer. This problem is suitable for the customer-centric or service-centric problem to increase the service level at customers. In the routing problem, there are many metaheuristic methods applied to solve the problem. Previous studies show that the record to record travel algorithm (RRT) has been proven to have excellent performance. In this paper, an RRT based algorithm is developed to address CCVRP. Several local searches (uphill and downhill moves), two general structures, and parameter values are adopted in the proposed algorithm. The dataset from previous studies is used to test the algorithm. The result obtained shows that the total cost and CPU time are competitive when compared with the published result.

Locating Humanitarian Relief Effort Facility Using P-Center Method
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The impact of climate change and global warming is more obvious. Extreme weather is more apparent. Thailand encounters with tropical storm or typhoon every year since Thailand is located between two oceans, India Ocean and Pacific Ocean. Southern part of Thailand is area prone to flash flood, flood, and landslide. The relief effort is needed to prepare in advance including Pre and Post-disaster because the medical supplies should be in hand of the victim as soon as possible. The focus of this paper is to investigate...
mathematical model to locate the right location of humanitarian relief effort facility so as to minimize the maximum traveling distance or time to victims. P-center model is used as a preliminary model to find the suitable locations. Districts in Nakhon Thammarat and Phatthalung provinces are investigated for the right location of relief effort facilities.

IEEM19-P-0369
Service Supply Chain Management Process Capabilities: A Theoretical Framework and Empirical Study
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Service Supply Chain Management (SSCM) process capabilities consist of seven dimensions that are interconnected. This paper investigates structural modelling (ISM) method to present a multilevel hierarchical model of identified drivers and a digraph, which illustrates their driving power and dependence. The result of data processing with ISM method indicated that two drivers are having strong driving power namely ‘knowledge sharing in the supply chain’ and ‘easier for business enterprise to distribute the product to the other Muslim countries because of halal guarantee’. Those two drivers will further support other drivers for implementing Halal Logistic in Food and Beverages Industries.

IEEM19-P-0104
Mapping the Drivers in Implementing Halal Logistic
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The purpose of this study is to identify, rank and classify the important drivers for implementing Halal Logistic in Indonesian Food and Beverages Industries. This study adopts interpretive structural modelling (ISM) method to present a multilevel hierarchical model of identified drivers and a digraph, which illustrates their driving power and dependence. The result of data processing with ISM method indicated that two drivers are having strong driving power namely ‘knowledge sharing in the supply chain’ and ‘easier for business enterprise to distribute the product to the other Muslim countries because of halal guarantee’. Those two drivers will further support other drivers for implementing Halal Logistic in Food and Beverages Industries.

IEEM19-P-0144
Lean Six Sigma Based Performance Improvement in Public Passport Services: A Case Study From Office Work
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Passport services involve processes that are significantly dominated by office work. The passport-ordering process (POP) is a standardized process that is dependent on a set of input information from the applicant. Incomplete information diminishes the performance of internal tasks that have to be performed by the passport-issuing authority. It negatively affects the internal process performance, as incomplete information increases non-value-added activities (NVA) in the process. This manuscript focuses on the utilization of Lean Six Sigma (LSS) tools to analyze the current state of the POP. A case study has been carried out at the Norwegian Southwestern Police District, relative to enhancing office work performance with the support of LSS tools. First, process mapping has been employed to identify waste and its causes. Then, Pareto analysis has been conducted to prioritize the most critical causes. Finally, fishbone diagrams have been used to provide a holistic understanding of possible root-causes that result in poor performance.

IEEM19-P-1030
Matching Drivers and Passengers in Online Car-Hailing: A Method Based on Fuzzy Axiomatic Design
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The development of online car-hailing has enabled the drivers and passengers to find satisfied matching results. An optimal match between drivers and passengers can improve users satisfaction and travel safety in online car-hailing platforms. While selecting personalized matching drivers and passengers pairs is of significance for car-hailing service, an area that has been generally neglected in previous studies. This paper reports on a method for personalized matching car-hailing platforms drivers and passengers in which the expectation levels of attributes given by drivers and passengers are considered. First, the matching relationship between the drivers and passengers is defined. Then, from the principle of axiomatic design (AD), a method based on fuzzy axiomatic design (FAD) is developed to identify the personalized matching degree between the drivers and passengers in car-hailing platforms. Further, a multi-objective optimization model is constructed to maximize the overall matching degree of the pairs and to choose the optimal matching pairs. In order to solve the model effectively, we develop a heuristic algorithm. Finally, we do simulation analysis on numerical examples to verify the feasibility of the model and algorithm.

Keywords - Matching, Fuzzy axiomatic design, Sharing economy, Online car-hailing.
matter of evaluation using an extension of the newsvendor model vs. using an adapted base-stock inventory control model. The challenge is to make the comparison equitable by choosing parameters for the models, evaluating end-of-horizon effects, and considering holding costs during the selling season. We use settings and data from the Danish case company to illustrate the best choices under different circumstances.

IEEM19-P-0345
Parking Spots Selection for Shared Bicycle on Campus
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The "shared bicycle" has found a balance when facing the case “driving too close, taxis too expensive and walking too far”, which helps to solve the last mile problem of people on daily life. The shared bicycle industry is developing rapidly, as the use of shared bicycles is more flexible and convenient than public bicycles. On the university campus, bicycles are a means of transportation for almost every student. Shared bicycle brings great convenience to the life of students and staff in universities, but it is followed by parking confusion and serious problems affecting campus order. Taking a certain campus of a well-known university as an example, this paper establishes a multi-objective planning model, and uses the conversion method with LINGO software to find the location plan of the shared bicycle parking point of the campus, which helps improve the campus sequence as well as the satisfaction of the shared bicycle users.

IEEM19-P-0083
On Agile Metrics for Operations Management: Measuring and Aligning Agility with Operational Excellence
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High-quality performance in Operations Management has been measured through different Excellence frameworks, with special emphasis on Operational Excellence models. By allowing to track performance indicators, identify improvement opportunities, and tackle operational limitations, such frameworks have proven their validity throughout the years. However, and despite their history of success, these frameworks remain based on almost the same principles and criteria that were defined when they were first being established, more than three decades ago. As change becomes central to the life of organizations, the ability to reconfigure operations becomes vital for success. However, the current takes on Operational Excellence do not consider the ability to change in their assessments. In a marketplace in transformation, this is perceived as a limitation to the process and highlights the main results of bringing Organizational Agility together with Operational Excellence in the measurement and pursuit of superior operational performance.

IEEM19-P-0079
Optimal Design of Modified Group Runs Scheme with Estimated Process Parameters Based on Expected Average Number of Observations to Signal
Zhi Lin CHONG, Xin Yi LOO, Michael Boon Chong KHOO, Khalid Wah KHAW, Xinying CHEW
1Universiti Tenaga Abdul Rahman, Malaysia
2Universiti Sains Malaysia, Malaysia

The modified group runs (MGR) scheme has a superior performance to the Shewhart and synthetic control schemes, particularly in identifying small and moderate mean shifts in a process. Recently, the MGR scheme was studied using the average number of observations to signal (ANOS) criterion, under the scenario where the process parameters are unknown (Case-U). However, a setback of this study is that the exact shift size must be specified prior to the implementation of this scheme as this is required by the ANOS criterion. In most of the scenarios, practitioners do not have a good knowledge of the exact shift size. To tackle this issue, we propose the use of the expected average number of observations to signal (EANOS) criterion in evaluating the performance of the Case-U-MGR scheme. We also proposed the optimal design of the MGR scheme with Case-U based on minimizing out-of-control (OOC) EANOS. Finally, we present an example of application and demonstrate that the proposed procedure eases the implementation of the MGR scheme with Case-U as it minimizes the risk of misspecifying the shift size.
IEEM19-P-0061
The Profile of Forthcoming Quality Leaders: An Exploratory Factor Analysis
J.P.T. DOMINGUES, Fabio Daniel CORREIA, Ilknur UZDURUM, Paulo SAMPAIO
University of Minho, Portugal
Currently, due to the globalization phenomenon and technological evolution, we are facing a new challenging set of paradigms encompassing social, industrial, financial and cultural issues. Hence, it is a difficult task to anticipate the new demands of the market concerning the most appreciated skills in the forthcoming workforce. This paper intends to report the sets of skills that comprise the desirable profile of the quality professional in the 21st century. To meet this purpose, a worldwide online survey was held online throughout the first quarter of 2018, assessing (adopting a 5-point Likert scale) the importance of 27 skills identified in relevant literature. A total of 319 valid answers, originated from 61 different countries, were collected and summarized through descriptive statistics. The results suggest that seven sets of skills (appreciated skills to forthcoming quality professionals) comprise the profile of the quality professional in the 21st century. Thus, professionals aiming the quality leader role may now tailor their skills based on the information provided in this paper. In addition, companies can use these results to specify the dimensions that their human resources should develop.

IEEM19-P-0534
A Decision Tool for Quality System Improvement
Lucas PICCI, Abdallah BEN MOSBAH, Samuel BASSETTO
École Polytechnique de Montréal, Canada
Any quality process has some weaknesses, and let non-conformities run through production process. Sometimes it reaches the final customer. Organizations give their operational managers the mission to improve the quality system in order to minimize the risk of delivering non-conform products to customers. In this work, a decision tool is developed and presented to determine how to improve an existing quality control process. Firstly, a probabilistic modeling of the propagation of non-conformities is proposed and used to evaluate the Average Outgoing Quality (AOQ). Then, an iterative method is presented, based on the AOQ estimation, aimed to determine the most profitable improvements to perform. The proposed method help managers to reach their global quality target by guiding the improvement process. The proposed tool determines which particular control operation should be improved for maximizing the impact on the Average Outgoing Quality.

IEEM19-P-0230
Productization and Product Structure as the Backbone for Product Data and Fact-based Analysis of Company Products
Janne HARKONEN, Erno MUSTONEN, Hannu HANNILA
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Data are a strategic asset for companies, but are not fully capitalized to serve the business. Company data assets that reside in the enterprise applications, the corporate business IT, have the potential to provide additional value aside serving the typical functional role of these applications. One possible application is the fact-based profitability analysis. Understanding company level or business line profitability is not enough for sustainable long-term business success, but product level analysis is needed. Currently product level analysis is often either seen not possible or entails laborious manual work. This study analyses the roles of productization and product structure as preconditions for fact-based analysis of company products. The study is realized as a combination of a literature review and analysis of eight companies. Those responsible for products and financial results may benefit of the understanding of the significance of productization and product structure for fact-based analysis and reporting on company products. The findings support data-driven approach and fact-based analysis.
When evaluating a practical operation, we calculate a recovery period of investment cost for photovoltaic systems. This problem can be solved with typical solvers directly. The problem can be formulated as a stochastic nonlinear programming problem involving non-linear recourse, which cannot be handled by the L-shaped method, demonstrating the effectiveness of the proposed L-shaped method for solving instances involving up to one million customers and over 100 direct marketing activities to marketing campaigns. In this paper, we study a real-world customer assignment problem of a leading telecommunications provider in Switzerland. The planning problem contains many business and customer-specific constraints that have not yet been covered in the literature. We propose a binary linear programming formulation that solves instances involving up to one million customers and over 100 direct marketing activities to optimality in short running time. The novel formulation delivers substantially better solutions in terms of expected profit than the current practice at the company.

In this paper, we considered the application of mathematical optimization models to energy problems. Using the latest information technology, we try to utilize renewable energy whose output is unstable. Such efforts are collectively called smart communities. Stochastic programming deals with optimization under uncertain conditions. Since the output of solar power generation in a smart community is uncertain, application of stochastic programming is required. Considering practical operational constraints, this model becomes a stochastic programming model involving non-linear recourse, which cannot be solved with typical solvers directly. The problem can be reformulated as a large-scale mixed integer programming problem by piecewise linear approximation to obtain an optimal solution. In our algorithm, we add points for piecewise linear approximation iteratively and increase accuracy of the approximation. In numerical experiments, the effectiveness of the stochastic programming model is shown by comparing it with the deterministic model. Moreover, we calculate a recovery period of investment cost for photovoltaic generation and a storage battery and show usefulness of our model when evaluating a practical operation.

In response to the Philippines education system's development plan in strengthening the research culture of the different higher education institutions, this study was conducted to assess the research efficiency of 18 research universities in the country. Standard Data Envelopment Analysis (DEA) models, have been used in previous researches to measure the relative efficiency of research performance of universities with quantity-oriented indicators inputs and outputs. This study proposed the use of a network DEA (NDEA) model considering quality indicators in assessing the efficiency of the research performance of universities. NDEA allows the measurement of efficiency per stage of a process. The main finding is that the standard DEA tends to exaggerate the research efficiency compared to that of NDEA. The use of quantity-oriented publication indicator also revealed that the use of quantity-oriented indicators alone exaggerates the performance of the universities as it is mainly based on the number of researches produced, not considering the impact or quality of each research. Some of the top-performing universities ranked lower with the use of quantity-oriented indicators.

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The execution of a project is nowadays often distributed among multiple sites. While some resource units are available at a certain site only, other resource units can be moved across the sites. The problem considered here consists of scheduling a single projects’ activities which are interrelated by given precedence relationships of the completion-start type, require various renewable resource types during execution, and can be executed at the different sites of the project, such that the project makespan is minimized; transportation times must be taken into account if a resource unit is moved between two sites, or if two activities interfered by a precedence relationship are executed at different sites. We present a continuous-time formulation of this problem as a mixed-binary linear program. In an experiment based on a set of 480 instances, we compared the performance of this novel formulation with a discrete-time formulation, which is the only formulation known from the literature; it turned out that when using the novel continuous-time formulation, considerably more instances can be solved to feasibility and to optimality, respectively.

**A Comparison Between SEIADR versus SEIR Discrete Epidemic Models**

Iratxe NINO, Marta FERNANDEZ, Manuel DE LA SEN, Santiago ALONSO-QUEZADA, R. NISTAL, Aitor J. GARRIDO, Asier IBEAS

University of the Basque Country / Euskal Herriko Unibertsitatea, Spain

Autonomous University of Barcelona, Spain

This paper proposes, studies and discusses in some detail discrete epidemic models of SEIADR (susceptible-exposed-asymptomatic infectious- asymptomatic infectious-recovered, or immune- dead-infectious-recovered) and SEIR (susceptible-exposed-symptomatic infectious-recovered) continuous in time models. The first one incorporates the asymptomatic infectious and the lying infectious bodies as infectious extra populations on the standard populations of SEIR type models. Several controls are proposed in the general case as, for instance, vaccination treatment and the removal of the lying infectious corpses. The control rules can optionally include feedback information.

**Mission Reliability Allocation Based on Interval-Hesitant Fuzzy Linguistic Term Sets**

Wen CHEN, Guangyan ZHAO, Xiaoxiao LI, Yufeng SUN

Beihang University, China

Reliability allocation, especially mission reliability allocation, is very important to system reliability design. Equal allocation method and scoring allocation method are the most commonly used methods in practical engineering. The former can only used for series system and simple system. The latter is more useful. However, it is difficult to give the accurate scores for experts because of the incompleteness and uncertainty of information, which has a great effect on the result. Therefore, a new system mission reliability allocation method based on the interval hesitant fuzzy linguistic term set was proposed. First, the interval hesitation fuzzy scoring data of expert was processed. Considering the consistency weights and empirical weights of expert opinions, respectively, the comprehensive expert weight was obtained. Then, mission reliability allocation methods based on the expert score above for different reliability logic relations including series system, parallel system, k/n system, and standby system, were given respectively. Finally, comparing the calculation results of the proposed method with the traditional method, an example was analyzed to verify the feasibility and effectiveness of the method.
mathematical model is constructed to model the total waiting
time of all patients, thereby solving the bed allocation problem.
Finally, the model is validated on MATLAB using ophthalmology
departmental data.  An example, this study shows that Monte Carlo
simulation is an efficient method for determining and controlling the
scale of hospital beds when considering complexities, such as
different arrival rates of patients and length of hospital stay
distributions. This work provides hospital managers with an
effective approach for hospital bed planning.

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IEEM19-P-0156
Analyzing Stakeholder’s Response to Indian Government’s EV Policy Through a Text Mining Approach
R. MUKUNDAN, Chandrashekar CHAUDHARI, Vishwas DOHALE, Priya AMBEKAR
National Institute of Industrial Engineering, India
The critical step for developing countries is policy formation/reforms.
Process of policy formation is focused on enhancing the quality of
its citizen’s life or society and transforming the economy of the
country. There will always be a positive/negative impact on the
industries/companies within the policy implementation domain.
Such conditions lead firms realizing the business advancement in
planned policy initiates to shape or support it by helping the
government. Contrary, firms sensing adverse effect on them due to
proposed new policy, tries to resist or delay the deployment of policy.
This article presents a case of an Indian Government’s proposed ‘Electric
Vehicle (EV) Policy’ and the reactions received to it from
various stakeholders viz. firms under policy domain, consumers and
different associations. The feedback from different stakeholders is
examined in this study to determine how the transition took place in
proposed new policy using Text Mining approach. The analysis
consists of reactions of stakeholders to the new policy in terms of
Shape, support, oppose and delay, and Government’s change in its
stand due to the industry’s reaction.

IEEM19-P-0215
Digitization of Higher Education Institutions
Amresh TELUKDARIE1, Megashnee MUNSAMY2
1University of Johannesburg, South Africa
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The fourth industrial revolution, the digitization of industry, is
driving business landscape and associated skills development,
including tertiary education. Universities and institutions of higher
learning have evolved into technological hubs, developing and
delivering skills for the future. The operations and systems together
with workflows of delivery at a tertiary institution should be
modified to deliver services and a product that is 4IR savvy; more
importantly, the systems and processes must be 4IR enabled so as to
deliver a seamless, efficient, smart digital experience. This paper
reviews tertiary institutional operations and provides an architecture
to deliver digitization at institutional level. This research adopts a
functional and architectural view of the system and systems of
systems. A Digital Education Evaluation Model (DEEM) is proposed
for evaluation of traditional and digitized practices, for identification
of digitized technologies for adoption. The DEEM is demonstrated
by comparatively analyzing traditional and virtual classrooms.

IEEM19-P-0453
External or Internal Cooperation? Patenting Activities and
Cooperative Strategies of the Chinese ICT Sector
Siija LU, Suli ZHENF, Qian XU
China Jiliang University, China
Despite abundant studies on patent cooperation, few have carefully
studied the nature and modes. Taking advantage of the patents
granted by the State Intellectual Property Office of the People’s
Republic of China from 2007 to 2017, this paper revealed the overall
situation of patent cooperation, shedding light on the patent
cooperation patterns of listed companies. It shows that the size of
patent cooperation network in the ICT industry demonstrates a
significantly increasing trend, among which, leaders in the industry
have formed their own clusters, with the networks having the small-
world characteristics. Moreover, four structures of patent
cooperation are summarized in the paper: (1) Minimum
cooperation(2) External oriented cooperation(3) Internal oriented
cooperation(4) Compound cooperation.

IEEM19-P-0271
The Interplay Between Knowledge Creation Strategies: The Case of European Information-and-Communications-
Technology Firms
Valeria KIBSK
TallTech, Estonia
This paper explores the interplay between two dimensions of
organizational learning - internal knowledge creation and external
knowledge sourcing. Based on a sample of European information-
and-communications-technology firms, this research demonstrates
that there are differences in behavior as well as co-movement
between the dimensions. The companies engaged in external
learning tend to possess more internal knowledge stock as well as
that higher internal knowledge stock triggers more active external
learning strategies through business combinations, especially
divestments.

IEEM19-P-0183
Towards Industry 4.0? Digital Maturity of the Manufacturing Industry in a Swedish Region
Leif SUNDBERG, Katarina GIDLUND, Leif OLSSON
Mid Sweden University, Sweden
The purpose of this paper is to assess the digital maturity of the
manufacturing industry in a Swedish region. Data is collected using
a survey conducted among the manufacturing industry in the region.
Variables are based on prior research on digital maturity and
Industry 4.0, and analyzed using descriptive and inferential
statistical analysis. An initial finding was that several of the small
organizations within the manufacturing industry does not have a
basic digital presence in the form of a website, email or social media
accounts, which calls for alternative approaches when assessing and
developing digital maturity among these actors. The results from the
survey reveal that perceived potential of digitalization and
organizational enablers are ranked higher than actual operationalizations in the form of technology implementations and
projects. Moreover, the digital maturity varies on variables such as
organization size, location of customer base, and level of
technological output. Organizations with a high degree of female
employees perceive a higher digital maturity concerning some
variables, which is an interesting subject for further studies. The
overall conclusion is that a large part of the industrial sector in the
region has not implemented anything that resemble the concept of
Industry 4.0 in the literature.

IEEM19-P-0031
Use of Pull Product Development for Enhancing Lean Startups
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1University of Oulu, Finland
2University of Stavanger, Norway
To succeed in product development starting from new product concepts
is a challenging task. The lean startup methodology (LSM)
enables on agile testing and learning cycle to validate hypotheses at
the product idea/concept generation level when traditional stage-
gate product development process is too resource consuming and is
lacking speed to market. Lean startups are significantly challenged by
subsequent financial and related other resource restrictions and
subsequently it leads to minimal viable products (MVPs). An MVP
provides minimal sufficient product features to satisfy early
consumers in which provide feedback and revenue for future
products. To pull products from the market, it is necessary to
satisfy early consumers and set up a product development
process. This paper aims to use pull product development
methodology to enhance lean startups.
Benefit the manufacturer. However, counter-intuitively, it reduces the base warranty, as well as the profits of the manufacturers and the retailers. This paper focuses on two scenarios: the manufacturer offers only the base warranty, or an extended service plan (base warranty plus an optional extended warranty), and the retailers. Furthermore, it is interesting that base warranty faces the retailer’s profits. A critical reason is that compared with base warranty, the extended service plan provides less profit margin for the retailer. Therefore, it is necessary to examine the specific relationship between information technology and supply chain vulnerability. This paper adopts the literature review method to explore the drivers of vulnerability from three aspects: demand control, supplier selection, and cooperation, and supply chain process control. Five emerging information technologies with wide application scopes and interactions were selected to examine the multiple relationships between information technology and vulnerability by analyzing their capabilities and strengths, as well as their disadvantages.

IEEM19-P-0264
Robust Inventory Routing Problem with Replenishment
Lead Time
Weibo ZHENG, Hong ZHOU
Beihang University, China

The inventory routing problem (IRP) is studying how to deliver products to several customers from the supplier, which is a combination of inventory management and vehicle routing problems. This paper studied an IRP with considering the time consumption in transportation, which is the replenishment lead time. In this problem, the delivery sequence impacts the transport cost and the replenishment lead time of customers. Three decisions should be made: 1) which customer should be replenished; 2) how much goods should be delivered; 3) the delivery sequence. In this paper, we proposed a single period model, which can very easily be extended to a rolling horizon policy for solving the infinity horizon IRP. We discussed the closed-form solution of robust inventory policy and proposed a Genetic Algorithm to solve this problem. Finally, a numerical example is provided to indicate the feasibility of the algorithm.

IEEM19-P-0266
The Impact of Extended Warranty on Base Warranty: A Game Approach
Houping TIAN1, Qingqing YAN1, Changxian LIU2
1Nanjing University of Science & Technology, China
2Nanjing University of Posts and Telecommunications, China

Extended warranty is a type of optional service beyond the base warranty. It encourages the demands of risk-averse customers. However, it remains unclear to us how the extended warranty affects the base warranty, as well as the profits of the manufacturers and the retailers. This paper focuses on two scenarios: the manufacturer offers only the base warranty, or an extended service plan (base warranty plus an optional extended warranty), and explores the impacts of extended warranty on base warranty. Analyses show that the extended service plan could definitely benefit the manufacturer. However, counter-intuitively, it reduces the retailer’s profits. A critical reason is that compared with base warranty, the extended service plan provides less profit margin for the retailer. Furthermore, it is interesting that base warranty faces downward pressure in the presence of an extended warranty.

IEEM19-P-0240
Strategic Sourcing Under Optimism Bias and Information Asymmetry
Tarun JAIN1, Jishnu HAZRA2
1Indian Institute of Management Udaipur, India
2Indian Institute of Management Bangalore, India

Optimism Bias tends to impact human decision making in various supply chain setting. We analyze how optimism bias would change the procurement strategy of the buyer. We demonstrate how behavioral bias of the buyer can impact the procurement strategy. Our main finding is that the optimism bias leads to booking larger capacity from a wider vendor base.

IEEM19-P-0270
Optimal Pricing Strategy of Environmental Patent Transaction Under Asymmetric Information
Houping TIAN1, Anna DAIF, Changxian LIU2
1Nanjing University of Science & Technology, China
2Nanjing University of Posts and Telecommunications, China

With the customers’ increasing awareness of environment protection, the manufacturers are motivated to purchase green patent from the patent owner to develop green products to respond this trend. However, it remains some challenging issues to be further studied, e.g., how to purchase the patent in case that the manufacturer does not know its actual function (it may be a higher or a relative lower environmental patent)? What is the optimal configuration of the payments (i.e., the combination of the fixed fee and the unit fee)? The paper focuses on this issue and proposes two contracts to explore the patent transaction: the pooling contract and the screening contract. The analyses show two interesting findings: firstly, compared with the pooling contract, the screening contract can catch the true status of the patent. Secondly, compared with the performance of the pooling contract, the manufacturer can enjoy more profits by implementing the screening contract.

IEEM19-P-0296
Emerging Information Technologies Usage: Opportunities and Challenges for Supply Chain Vulnerability
Xiaoting GUO1, Zhaojun YANG2, Christie Diane TAN3
1Xidian University, China
2Northeastern Polytechnical University, China
3Nanyang Technological University, Singapore

Due to the frequent occurrence of destructive events, organizations are more vulnerable to obstruction. As this has become a prominent problem, reducing the vulnerability of the supply chain is imperative. In such an environment, the rapid development of information technology has made emerging technologies a powerful weapon to solve supply chain problems. According to existing research, information technology can improve an enterprise’s ability to cope with supply chain risks. Therefore, it is necessary to examine the specific relationship between information technology and supply chain vulnerability. This paper adopts the literature review method to explore the drivers of vulnerability from three aspects: demand control, supplier selection, and cooperation, and supply chain process control. Five emerging information technologies with wide application scopes and interactions were selected to examine the multiple relationships between information technology and vulnerability by analyzing their capabilities and strengths, as well as their disadvantages.

IEEM19-P-0304
Decision Making Simulator for Supply Allocation Under Uncertainty
Vanessa BEDDOE, Sayli SHIRADKAR, Jayendran VENKATESWARAN
Indian Institute of Technology Bombay, India

This work presents a simulation-based testbed for evaluation of supply distribution strategies in a single product multi-period two-stage social welfare supply chain with a divergent network configuration of supply points and demand points. Further, the supply and demand per period are assumed to be uncertain, which necessitates the use of simulation. The testbed is demonstrated through a test scenario, which in turn is based on an existing supply network. In the demonstration, specific identified strategies were used to allocate the available supply among the demand points. Each of these strategies was individually used and simulated over a year and performance measures indicate how one strategy cannot be used for a prolonged period. Future work would consist of an automation element in the testbed for decision making in supply allocation.
In this empirical study, we experimented with investigating decision biases in the newsvendor setting and presenting a structured comparison of the order decisions made by managers and students. We also proposed a Decision Support System as a debiasing strategy to prevent the order decision bias. To provide a piece of evidence about the effectiveness of the proposed DSS, we experimented with comparing the ordering behavior, before and after DSS implementation. This study found that both managers and students showed demand chasing bias, but the magnitude of the bias differed significantly. This study also showed that an informational DSS generally improved inventory decision-making performance in terms of adjustment behavior and long-term profitability.

IEEM19-P-0196
Service Network Design for Collaborative Last Mile Delivery Considering Parcel Attributes
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2Korea University, South Korea
3Most companies have been building a mobile technology based management system and trying to survive in a rapidly changing market environment. Recently, it is recognized that the emergence of a smart platform is leading the transformation of the distribution market, and performance and quality in last mile delivery service greatly influences its success. Various types of items are shipped such as regular, big-sized/weighted, cold, etc., which makes delivery service more difficult because the shipped items are still mixed and some items require special facilities. This study proposes a collaboration model for service network design in last mile delivery of several types of parcels. A systematic methodology is also applied to form a coalition in courier services with fair allocation of their profits to each participating company. A numerical example problem is performed to verify the appropriateness of the proposed collaboration model.

IEEM19-P-0352
Analysis of Retailer’s Order Decision with the Allowance of ACC Payment Based on Supply Chain Financing
Senyu XU, Huajun TANG
Macau University of Science and Technology, China
Supply chain financing is an efficient and effective channel for small and medium-sized enterprises to obtain the short-term capital and keep the sustainability of the supply chain. This study focuses on the optimal ordering strategy of the retailer with limited capital and random demand of customers, and combines the ACC payment model with supply contracts. The numerical analysis supported the feasibility of the model. Finally this work provides some possible issues for future research.

IEEM19-P-0331
A Methodology of Network Modeling of Risk Prioritization on Transportation of Hazardous Products
Jenjira SUKMANEE, Ramil KESVARAKUL, R. KESVARAKUL,
Nattawut JANTHONG
King Mongkut’s University of Technology North Bangkok, Thailand
The Analytic Network Process (ANP) has been widely researched to choose the best alternative. However, it seems that no one shows interest in using such analytical process in developing the network design on ANP analysis for more accurate results. This paper presents the application of the Design Structure Matrix (DSM) and ANP techniques to develop a methodology that can make a precise network. The preliminary analysis of ANP proves that if the default network is correct, the result will be right as well. The application in this case study is on the transportation of hazardous products. The network designed can be analyzed with ANP to find suitable alternatives for creating a risk management plan, e.g. risk prioritization on transportation system development.

IEEM19-P-0159
Phase I Analysis of Hidden Operating Status for Wind Turbine
Yuchun SHI, Nan CHEN
National University of Singapore, Singapore
Data-driven methods based on Supervisory Control and Data Acquisition (SCADA) becomes a recent trend for wind turbine condition monitoring. These methods have the advantages of being cost-effective, comprehensive and universally suitable. However, SCADA data are known to be of low quality due to low sampling frequency and the complexity of turbines’ working dynamic. In this work, we focus on the phase I analysis of SCADA data to better understand turbines’ working status. As one of the most important characterization, the power curve is used as a benchmark to represent normal performance. A powerful distribution free control chart has been applied after explicitly taking into account the known factors that can affect turbines’ performance in the power curve model. Informativeness out-of-control segments have been revealed in real field case studies. This phase I analysis can help improve wind turbine’s monitoring, reliability, and maintenance for a smarter wind energy system.
IEEM19-P-0411
Indicators of Quality Assurance in Higher Learning Institutions: A Review
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Changes in the provision of education and the drive to meet the sustainable development goals in education has contributed to the establishment of higher learning institutions. To support these developments, the emphasis on quality assurance (QA) in these higher learning institutions has triggered QA assessments and monitoring. The purpose of this study was to review the indicators of QA in higher learning institutions. Based on the concepts on which QA is examined in higher learning institutions, a methodology was adopted. A number of key indicators at the input, process and outcome concept of QA examination have been revealed. These indicators are relevant to implement in existing and new QA systems of higher learning institutions. To policy makers, government and regulators, the study provides insights on the development of QA assessment and monitoring tools. The identified indicators of QA and the proposed QA framework can be reengineered in QA systems of higher learning institutions of different contexts.

IEEM19-P-0124
Modelling Halal Internal Traceability in Open Source ERP System for Chicken Meat Processing Company
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The objective of this paper is to develop an internal halal traceability system in open source ERP system that is used to ensure the “halalness” of raw materials. The chicken meat processing company is a case study of this research to testing and validating the customized software on the open-source ERP system. In the first phase (modelling), four stages have been conducted to map the internal business process, to model the relationship actors using the use case diagram, determine the lot number code, and to determine the halal information tracing data model using the class diagram. In the second phase, two stages of research are conducted to testing the applicability of customized software and to validating with opinions for functions and design of customized software from case study’s workers. Two process transactions in customized software to ensure the halalness of raw materials such as purchasing and manufacturing order transaction. Their opinions indicated that the functions and design of customized software have been fulfilled.

IEEM19-P-0466
Geometric Error Modeling and Monitoring of the 3D Surface by Gaussian Correlation Model
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Geometric error represents the deviation of the actual surface shape of a machined part from its ideal shape, which directly affects the quality of the 3D surface. Modeling and monitoring geometric error can reveal quality information of the 3D surface for evaluating the stability of the production process. Advanced measurement technology allows for a large number of measurement points to express geometric errors in close detail, but results of the problem of spatial correlations. In this study, the Gaussian correlation model is employed to represent the spatial correlations and to model the geometric errors of the 3D surface. A new statistic is established to monitor the surface errors in phase II. The proposed model is applicable to any 3D surface. We use the model to monitor a 3D surface manufacturing process and compare its performance with other existing methods through simulation.

IEEM19-P-0554
A Distribution Free Control Chart for Monitoring High Dimensional Processes
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The high dimensionality presents a new challenge to the traditional tools in multivariate statistical process control, due to the “curse of dimensionality”. Various tests for mean vectors in high dimensional situations have been discussed recently; however, they have been rarely adapted to process monitoring. This paper develops a distribution free control chart based on interpoint distances for monitoring mean vectors in high-dimensional settings. The proposed approach is very general as it represents a class of distribution free control charts based on distances. Numerical results show that the proposed control chart is efficient in detecting mean shifts in both symmetric and heavy tailed distributions.

IEEM19-P-0234
Continuous Quality Improvement: The Relationship Between Order Dispatches, Ergonomics & the Design Layout
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1University of Johannesburg, South Africa 2University Of Johannesburg, South Africa

The South African manufacturing and logistics industry is one main economic growth driver in the country. The sector contributes to the employment of most semi-skilled and unskilled workers. This research paper addressed the inaccurate order dispatches to customers that is influenced by the design layout, ergonomics involved, and the quality standard facilitating the process. The study applied an interpretive approach through a combination of qualitative and quantitative research methods, carried out as a single with dual warehouse case studies. The study made recommendations from the research findings. The South African manufacturing and logistics industry needs to address the quality continuous improvement challenges to reduce inaccurate order dispatches to customers and increase productivity.

IEEM19-P-0054
Prognostic Study of CNC Machine Component Using a Systematic Method
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The prognostic study of CNC machine component plays a key role in increasing the reliability and safety of manufacturing systems. A systematic prognostic method based on multi-sensor information for CNC machine component is proposed in this paper, where the data characteristics and system properties are all considered. The proposed method includes data pre-processing based on a noise-assisted multivariate empirical mode decomposition method, a two-stage feature selection strategy and remaining useful life prediction based on the trajectory similarity method. An experimental case study is given to evaluate the proposed method. The results show that the systematic prognostic method could be applied in the industrial field.

IEEM19-P-0244
Assessment of Reliability and Remaining Fatigue Life of Topside Piping Using Dynamic Bayesian Network
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Hydrocarbon release due to Vibration Induced Fatigue (VIF) costs millions of dollars each year in inspection, maintenance and replacement activities, as well as lost production for oil and gas operators. Therefore, it is vital to assess the reliability of topside piping against VIF. In this context, the authors have utilized the fundamentals of probability, reliability and statistical methods, using...
Dynamic Bayesian Networks (DBNs) to estimate the reliability of process piping. Firstly, different sources of uncertainty, such as physical variability, statistical uncertainty, etc., in the crack growth process (Paris law is used to model the crack growth) are identified and quantified, with suitable distributions and parameters obtained from literature. Thereafter, a DBN is developed to obtain the distribution of the Remaining Fatigue Life (RFL). The results (in terms of crack size) are validated against experimental data. Thereafter, statistical methods are used to obtain the reliability/POF curve from the RFL distribution derived previously, which can be used to set up an inspection schedule, as illustrated in the case study. The advantage of using DBNs for reliability analyses lies in the ease of updating the prior information to obtain the posterior distributions.

IEEM19-P-0191
Predicting the Remaining Useful Life of Ball Bearing Under Dynamic Loading Using Supervised Learning
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Rolling element bearing is one of the most critical components of rotating machinery. Its failure can be catastrophic and often results in both human and material losses. This paper presents a machine learning approach to predict the model the crack growth process and remaining useful life of a bearing element using classification and regression techniques respectively. An algorithm is developed to recognize the underlying mapping function directly from the data using machine learning principles. Pearson correlation methodology is used to track the important features associated with the evolution of wear and understand its progression. Further, backward elimination technique with ordinary least squares regression results was used to track features for predicting the remaining useful life. The proposed approach is illustrated on a bearing failure data set from the national aeronautics and space agency. This study will be useful in forecasting the fault status of the bearing before it causes any major loss.

IEEM19-P-0245
Working-Condition Importance Measures for Multi-Component Systems
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In industry, the working conditions of systems are complicated. It may contain some adverse/favorable factors that can damage/improve components’ reliabilities compared to that in the designed working condition. The same product/system may also work in different sites whose conditions exist significant differences to each other. Then the reliability of the system is not only determined by system structure, components’ designed reliabilities, etc. It can be also influenced by its working condition. In previous researches in importance measures, the environmental influence on system reliability has been paid little attention. In this paper, two working-condition importance measures for multi-component systems are introduced.

IEEM19-P-0093
A Review of Metrics, Algorithms and Methodologies for Network Reliability
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Networks have become an indispensable part of the modern society. The numerous engineering realms, mainly computers and communication, transportation, electric transmission, and oil and gas distribution are based on interconnectedness of complex networks. However, the basic theories of such networks are similar to each other. This article provides a holistic view of the complex network analysis. The metrics of network connectivity are explained in this paper. The practicalities of each metric for network analysis as well as their limitations are presented in a condensed manner. The algorithms and methodologies that have evolved over time along with their scope, advantages, and limitations are presented in this paper. This article may prove to be beneficial for practitioners and researchers associated with network reliability evaluation.

IEEM19-P-0182
A Method of Parameter Estimation in Flexible Jump Diffusion Process Models for Open Source Maintenance Effort Management
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We focus on several irregular behavior under jump in the operation performance of open source software (OSS). This paper proposes a flexible jump diffusion process model (JDPM) to model the crack growth processes for maintenance effort in the OSS usage associated with version upgrade. Especially, we discuss a method of parameter estimation based on the flexible JDPM considering the unexpected irregular behavior in major version upgrade transition for the project of OSS. Also, it will be useful for the managers of OSS to measure the status of maintenance effort with OSS major version upgrade in terms of the quality management. Moreover, The actual data is analyzed to present the numerical illustrations based on the proposed parameter estimates considering the characteristics with major version upgrade under OSS operation.

IEEM19-P-0188
A Review on Flexible Forming of Sheet Metal Parts
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2Braunschweig University of Technology, Germany
The automotive industry is facing intensified challenges due to shortened product life cycles, increasing individualization, an uncertain demand, and pressure to innovate caused by e-mobility. Currently, there is no suitable technology for the economic production of large quantities in low quantities. Due to tooling lead time costs, deep drawing is only economical in high quantities. To ensure profitability along common annual quantities, the literature shows various approaches, e.g. sheet metal forming by AM tools. Therefore, the aim of this paper is to summarize current approaches presented in the literature and evaluate those using criteria, e.g. lead time and costs, sustainability, and product flexibility.

IEEM19-P-0339
A Two-Phase Relax-and-Fix Heuristic for Multi-Level Lot-Sizing and Facility Location Problems
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This paper examines a new problem, which integrates the multi-level lot-sizing problem and the well-known facility location problem. A mixed integer programming model with the objective to minimize the system-wide costs, including facility operating cost, setup cost, production cost, transportation costs, inventory-holding cost and backlog cost, is established. For small-scale instances, the commercial solvers can be employed to solve the problem to optimality. For large-scale instances, we propose a two-phase relax-and-fix heuristic to conquer the NP-hardness. Experimental results show that the designed two-phase relax and fix algorithm performs well, especially in large cases.

IEEM19-P-0392
New Product Development (NPD) Process in the Context of Industry 4.0
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Industry 4.0 consists of smart, connected and autonomous manufacturing systems is fast becoming a reality. In view of this, industries are making radical changes in their manufacturing systems to adapt to new and evolving climate of manufacturing. Secondly, the Industry 4.0 implementation is bridging the different jump between product design and design of product service systems (PSS). One can see a strong and inevitable coupling among product design,
process design and production system design. All these aspects call for revisiting new product development (NPD) processes and to modify the same in the context of new manufacturing settings. This paper identifies key changes needed in NPD process and proposes a new structure to derive value accrued by embracing Industry 4.0 technologies. The research has been carried out in the context of machine tool industry and proposed changes have been ratified by industry experts.

IEEM19-P-0407
A Study on Operator Allocation Method Considering the Productivity and the Training Effect in Labor-Intensive Manufacturing System
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Since productivity depends on the operator's skill in the labor-intensive c manufacturing system, effective skill training is a type of important issue. We proposed the operator allocation method using the skill index as a new index of human factor in our previous study. However, the training and productivity are in trade-off relation in general. In this study, we propose the operator allocation method of the labor-intensive manufacturing system by the case of cell manufacturing system which considers operator training and productivity at the same time by using the sum of skill index and the makespan in multi-objective function. For using the different unit of indexes, the standardization point in this method was adopted. The pilot test was executed and standardized an index to deal with a different index at the same time. And Simulated Annealing was using to find a solution.

IEEM19-P-0538
Reverse Logistics Barriers: A Case of Plastic Manufacturing Industries in Zambia
Bupe MWANZA, Charles MBOTWA
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The problem with constraints is formulated and solved based on genetic algorithm, which uses self-adaptive refusal and penalty function strategy to improve the performance. The case study of the real system is carried out and the results show that the data driven simulation-based optimization is efficient to the problem.

IEEM19-P-0123
Mobile Robots Charging Assignment Problem with Time Windows in Robotic Mobile Fulfilment System
Kin Lok KEUNG, Carman Ka Man LEE, Ping II
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A customer-driven E-commerce economy leads to a higher expectation on delivery of products. The lead time in the supply chain becomes shorter and shorter and a higher efficiency on picking and packing activities for the warehouse is required. Compared with the traditional warehouse, robotic mobile fulfillment system can increase the efficiency of picking products to fulfill the orders with the characteristics of high volume and high variety consumption pattern. A mobile robot with a mobile storage rack follows the positioning identifier and picking. In the context of E-commerce implementation, data-driven optimization is one of the objectives for the robotic mobile fulfillment system. Data are collected from different sources such as sensor, tracking data and demand traffic. The objective of this paper is to simulate the charging activities for mobile robot under different designed instances. The results of the model show the charging time of different battery capacity of RC time and charged percentage.

IEEM19-P-0494
The Effects of Memes on Memetic Algorithms for Solving Quadratic Assignment Problem
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The objective of this paper is to present the effect of local search algorithm referred to as meme on Memetic Algorithms (MAs). We also compare four different local search metaheuristics: Hill Climbing Algorithm (HC), Tabu Search (TS), Simulated Annealing (SA) and Iterated Local Search (ILS) for solving QAP and analyze their performance in terms of solution quality. The results show that ILS is the best metaheuristic followed by SA, TS, and HC, respectively. While the MA using ILS as a meme is the best among all four MAs, the MA using SA as a meme is not the second-best metaheuristic, but the worst among all.

IEEM19-P-1154
Simulated Annealing for the Share-a-Ride Problem with Adjustable Compartment
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Singapore Management University, Singapore
The Share-a-Ride Problem with Adjustable Compartment (SARPAC) is the extension of the Share-a-ride problem (SARP) where both passenger and parcel requests are handled by a single taxi network. In this problem, a taxi is allowed to adjust its compartment size within its lower and upper bounds while maintaining the same total capacity. Taxies are able to fully utilize their space to maximize profit. The objective function of SARPAC is to maximize total profit obtained from serving passenger and parcel requests simultaneously. We formulate a mathematical model and propose a Simulated Annealing (SA) algorithm to solve the problem. Furthermore, we study the effect of delaying the slack time mechanism on our algorithm's computational time and solution quality by activating a mutation mechanism at a later stage of the temperature reduction. The performance of our algorithm is benchmarked against CPLEX. The proposed algorithm obtains optimal solutions for some instances with reasonable computational time.
A Hybrid Differential Evolution with Cuckoo Search for Solving Resource Constrained Project Scheduling Problems
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The Resource Constrained Project Scheduling Problem (RCPSP) has been considered as a scheduling problem which has a wide range of applications in construction industries, manufacturing, production planning and project management domains. To solve such RCPSPs, in this paper we propose a hybrid algorithm that utilizes the strengths of both differential evolution (DE) and cuckoo search (CS) algorithms in one framework called hybrid differential evolution with cuckoo search (DECS) algorithm. In it, a selection mechanism based on the solutions’ quality and populations’ diversity is used to select the most appropriate algorithm during the evolutionary process. A linear population reduction mechanism is utilized to update the DE population size. A number of data sets of single-mode RCPSPs from the project scheduling library (PSPLIB) have been considered and solved by the proposed hybrid DECS algorithm. Computational results and comparisons with some recent state-of-the-art algorithms show that DECS is able to produce very high quality results.

IAIM19-P-0442
A Mathematical Programming Model for the Green Mixed Fleet Vehicle Routing Problem with Realistic Energy Consumption and Partial Recharges
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1National Taiwan University of Science and Technology, Taiwan
2Singapore Management University, Singapore

A green mixed fleet vehicle routing with realistic energy consumption and partial recharges problem (GMFVRP-REC-PR) is addressed in this paper. This problem involves a fixed number of electric vehicles and internal combustion vehicles to serve a set of customers. The realistic energy consumption which depends on several variables is utilized to calculate the electricity consumption of an electric vehicle and fuel consumption of an internal combustion vehicle. Partial recharging policy is included into the problem to represent the real life scenario. The objective of this problem is to minimize the total travelled distance and the total emission produced by internal combustion vehicles. This is a new variant of problem which is developed from a mixed fleet of electric and internal combustion vehicles, full recharging policy, and operational cost minimization. A mixed integer programming model is then developed to address this problem and commercial software is utilized to solve the model.

IAIM19-P-0316
Factors that Influence Sharing Behaviors in Sharing Economy Based on the Theory of Social Capital and Social Exchange: Example of Taiwan-Based USPACE
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National Kaohsiung University of Science and Technology, Taiwan

Sharing economy has been a phenomenon in many countries for years owing to a number of factors such as the economic recession which contributes to a pervasive thinking of renting over buying. This paper examines the sharing behavior in sharing economy based on social capital theory and social exchange theory, and looks at the example of USPACE, a start-up company providing shared parking services in metropolis, Taiwan. The research covers the urban areas in Taipei and Kaohsiung and collects data of USPACE users. A total of 160 copies of questionnaire have been distributed and 151 valid copies returned, a valid response rate of 94.4%. The Partial Least Squares (PLS) has been used for empirical analysis. The findings show that trust and identification will significantly affect the intention to share, so will extrinsic rewards and the enjoyment in helping others, while norms and reciprocity do not have significant impacts on the sharing intention. The results not only extend the application of social capital and social exchange theory, but also provide directions for future studies from sharing economy’s perspective of various industries.

IAIM19-P-047
Analysis of the Relationship Between Motivation for “Work for Non-core Business” and Organizational Commitment of Young Employees
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2Seisaku Business Co., Ltd., Japan

Against the background of a mobile labor market and the emergence of new perspectives on careers, employees now engage in work for non-core businesses, which is NOT related their core business in the middle/long time horizon, qualitative analyst, open-minded/disorganized, organized, emotional stability, naive, punctual, and responsible. Young employees are especially motivated to engage in such work for their future careers. However, the structure of their motivation and its relationship to organizational commitment is still unclear. In this study, we conducted a questionnaire survey and statistical analysis to determine the latent factors behind their motivation and to clarify the relationship between these factors and organizational commitment. The results point to three factors: social contribution, own work creation, and sub-employer exploration. However, only social contribution has a positive correlation with organizational commitment. According to this finding, the organization should focus on the social contribution aspect of employees’ motivation and need not to consider other factors to enhance organizational commitment.
IEEM19-P-0035
In Search of an Optimizer Matrix for Affordance Design
Chien-Sing LEE
Sunway University, Malaysia
Affordance in product, packaging and service design has attracted much attention. Aiming at increasing perceived usefulness and usability, foci has increasingly extended to user experience and interaction. Neuroscience research and can also benefit from affordance research, i.e., by designing external task demands to trigger/train functional networks and possibly, to compensate dysfunctional networks. Visual processing influences diverse cognitive processes. Hence, aspects investigated are types of contexts and properties which contribute to visual salience (colour, shape). The aim is to investigate which among these factors can serve as LeCun’s common filter to improve search strategies and identification of the region of interest across sample well-defined and ill-defined contexts.

Function (goal), structure (associative schema) and behaviour (actionable possibilities) stand out as the meta-heuristics, above and-Service, Not on Process restraining factors are suggested and useful insights are provided by performance evaluation system. Measures to deal with the top four and transferor’s attitude towards TT and commercialization. The top two enabling factors to be absorptive capacity of the transferee; and ten literature-derived restraining factors to technology transfer. Respondents rated each of the ten literature-derived enabling factors drawn from entrepreneurs and six Gauteng universities.

The sample consisted of researchers and technology managers as to recommend how the restraining factors could be addressed. Publicly-funded universities (transferor) to SMEs (transferee), as transfer and commercialization of technology from South African commercialization of their technologies to resource-constrained conditions, less labor demanding, and more efficient. Despite of long and data centric, innovative, better quality, more convenient working advantages for companies to make the whole value chain customer focus and colour. A hierarchical optimizer matrix linking affordance design with schematics is then proposed.

IEEM19-P-0487
Transfer and Commercialization of Technologies from Universities to Small Companies in South Africa
Sinothi MAPHUMULO, Hannelie NEL
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World-wide many universities have a significant role in the socio-economic development of their countries and regions. One avenue for universities to achieve this role is through the transfer and commercialization of their technologies to resource-constrained small, medium enterprises (SMEs). A survey-based study was conducted to establish the factors that enable and restrain the transfer and commercialization of technology from South African publicly-funded universities (transferor) to SMEs (transferee), as well as to recommend how the restraining factors could be addressed.

The sample consisted of researchers and technology managers drawn from entrepreneurs and six Gauteng universities. Respondents rated each of the ten literature-derived enabling factors and ten literature-derived restraining factors to technology transfer and commercialization from universities to SMEs. Results show the top two enabling factors to be absorptive capacity of the transferee; and transferor’s attitude towards TT and commercialization. The top two restraining factors are university bureaucracy and the university performance evaluation system. Measures to deal with the top four restraining factors are suggested and useful insights are provided by the research findings.

Session
Technology and Knowledge Management 4
Date
17/12/2019
Time
11:00 - 12:30
Room
Bordeaux 27.3
Chairs
Mukondeleli KANAKANA - KATUMBA
University of South Africa,
Nobayuki SHIRAKAWA National Institute of Science and Technology Policy

IEEM19-P-0423
Digitalization: Size Doesn’t Matter, Put Focus on Product- and Service, Not on Process
Mait RUNGI
Estonian Entrepreneurship University of Applied Sciences, Estonia
Digitalization is opening new era in business as it provides clear advantages for companies to make the whole value chain customer and data centric, innovative, better quality, more convenient working conditions, less labor demanding, and more efficient. Despite of long list of potential benefits it is not known how good companies are to implement them and how it affects the performance. Quantitative data from 132 Estonian companies is used to reveal the impact. Estonia is European Union country known for high innovativeness and companies’ emphasis on process improvements. Results indicate that process digitalization is not as important as product/service digitalization. Managerial decisions have more effect than staff activities. Impact on performance is surprisingly marginal. There is no size related variance.

IEEM19-P-0445
Long Working Hours as a Buffer to Adjust Labor Costs
Takahumi MIYAZAKI, Noritomo OUCHI
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The Japanese government is increasingly promoting “work-style reform” and many Japanese companies are working on redressing long working hours. Several studies have suggested that long working hours play the role of a buffer to adjust labor costs when an economic negative shock occurs. However, the conditions under which long working hours are utilized as a buffer, are unclear. This study attempts to clarify what kind of industries utilize long working hours as a buffer. We calculate the contribution rate of non-scheduled hours worked to the rate of change of total labor costs and conduct correlation analysis between this rate and each index indicating industry characteristics. The results reveal that labor-intensive and growth industries utilized non-scheduled hours worked as a buffer. This suggests that there is a risk of losing such a buffer by redressing working hours, especially in these industries.

IEEM19-P-0446
Investigating Problems of Research and Development of Artificial Intelligence Technology in Japan
Chihito YAMADA, Ryo TAKEMURA, Tatsuki FUKUSHIMA, Noritomo OUCHI
Aoyama Gakuin University, Japan
Japan is behind the United States in industrialization of Artificial Intelligence (AI). Thus, we must clarify the problems with AI research and development (R&D) in Japan. In the field of technology management, many studies have examined R&D activities using scientific papers or patent data, which represent the output of basic research and applied research, respectively. We attempt to reveal problem with the R&D of AI technology in Japan by analyzing data pertaining to patents and scientific papers, focusing on the linkage between basic and applied research. We demonstrate that Japan is weak in terms of patent clusters with no related to paper clusters. In addition, regarding patent clusters that are related to one or more paper clusters, we demonstrate that Japan has both strengths and weaknesses in these fields. Our findings could provide suggestions for R&D strategy and policy related to AI.

IEEM19-P-0177
Can Domain Theory Combined with the Resource-Based View Demonstrate the Missing Link in IT Value Creation?
Michael BAYER, Franziska SCHORR, Lars HVAM
Technical University of Denmark, Denmark
The purpose of this paper is to apply the rationale of Domain Theory (DT) with the taxonomy of the Resource-Based View (RBV) to explain how information technology (IT) creates value. Based on literature, a conceptual model was developed, which is tested in a case study. Findings demonstrate that both theories combined are a novel way to describe the IT value creation. Particularly, breaking down the IT value construct into three domains, each described by functions and properties, demonstrates the IT value creation. Describing the IT value creation by functions and properties enables practitioners to both highlight the impact of IT and derive meaningful measurements to prove the value of IT. This research contributes to literature by applying the rationale of DT to describe the IT value creation.

IEEM19-P-0544
Barriers to Improved Energy Efficiency in the Indonesian Steel Industry: Empirical Evidence
Aprtani SOEPARDI1, Mochammad CHAERON1, Gunawan WIATMOKO2
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2Badan Pengkajian & Penerapan Teknologi (BPPT), Indonesia
This research is an explorative study, purposed at amplifying the knowledge of the industrial energy saving in the Indonesian steel company, by analyzing the obstacles to energy saving improvement. A questionnaire collects data from steel company practitioners in Indonesia. The results denote that the top five of the twenty obstacles considered falls into two categories, namely the quality-type of raw material-fuel used and the group of the policy. These barriers include that the energy prices, quality of raw material, the absence of economic incentive mechanisms, inadequate for incentive amount, and distortion in energy efficiency policy.
Postal Development: Literature Review into Adoption Models
Kagiso MOKGOHLOA¹, Mukondeleni KANAKANA-KATUMBA¹, Wilson MALADZIH², John Alfred TRIMBLE³
¹University of South Africa, South Africa
²Tunasawa University of Technology, South Africa
³Aalborg University, Denmark

The changing postal landscape and rise of digitalization powered by the multiple technology revolutions of the 21st century has prompted Postal Operators across the world to expand their services well beyond the original (traditional) service of merely delivering letters which started more than 100 years ago. However, according to the Postal Development Report of 2018, compiled by the Universal Postal Union (UPU), the majority of Postal Operators are under performing on the Integrated Index for Postal Development (IPID) that measures four dimensions of postal development: relevance, resilience, reach and reliability. The purpose of the study was to review literature on the IPID, Industry 4.0, Technology Adoption and Technology Diffusion as key determinants that could lead to postal excellence. The literature points to postal development as a function of postal excellence. Literature further points to adoption and diffusion variables as key determinants for adoption and diffusion of disruptive technologies.

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An Integrated Two-Stage Optimization Method for Job-Shop Bottleneck Planning and Scheduling
Na GAQI, Seung Ki MOON
Nanyang Technological University, Singapore

In many literatures, planning and scheduling problems have been considered separately. Furthermore, resource constraints for scheduling are not only relevant for equipment, but are also strongly affected by second resources and set up conversions. This paper derives how constraint programming enables problem-dependent specialization and increases planning and scheduling efficiency. Constraint programming based scheduling involves multi-resources capacity limit, demand fulfillment, precedence, initialization, down activities and sequence-dependent set up. Then, we improve this model to address more complex problems by introducing a two-stage optimization method to decrease the computational burden. Finally, computational results are demonstrated to show the efficiency of the proposed method for a real-time large-scale planning and scheduling problem.

Supply Chain Contract with Combined Revenue Sharing and Markdown Policy
Ranuq SRIVASTAVA, Pritee RAY
Indian Institute of Management Ranchi, India

This paper considers a risk-neutral, two-stage, supply chain with one manufacturer and one retailer. The retailer’s demand depends on initial stock levels and product price at the store. Retailer’s order quantity is limited by manufacturer’s capacity. This paper proposes a centralized setting and three decentralized settings with revenue sharing contract, markdown policy and a combined contract. Numerical analysis shows that the retailer’s expected profit is higher in markdown policy with respect to revenue sharing and vice versa for the manufacturer. For retailers who prefer revenue sharing mechanism due to lower initial expense, the combined contract improves the total expected profit. Sensitivity analysis shows that stock dependency and demand uncertainty are inversely proportional to the supply-chain performance, while increase in price sensitivity and capacity of the plant, improve the overall supply-chain performance.
IEEM19-P-0095
Prioritization an Indicator for Measuring Sustainable Performance in the Food Supply Chain: Case of Beef Supply Chain
Arios SUSANTY, Nia BUDI PUSPITASARI, Ratna PURWANINGSIH, Haikal HAZAZI
Diponegoro University, Indonesia
The first objective of this paper is to select the indicators that apply to each dimension to measure the sustainability performance in the beef supply chain. The second objective is to make a prioritization among the selected indicators. The study was carried out using the analytical hierarchy process (AHP) technique as the basis for pairwise comparisons of three criteria (economic, environmental, and social) and eleven indicators. The eleven indicators are recognized from a literature survey and also from the field survey. The results showed that, out of the eleven indicators, the top three indicators are diversity and structure industry (ECO2), energy consumption (ENV2), and the number of employee per enterprise or the number of active workers per unit business in the cattle farm and slaughterhouse sector (SOC1). The result does not surprise since small-scale cattle systems are dominating the beef supply chain in Indonesia.

IEEM19-P-1106
A Decision Analysis of Conspicuous and Non-Conspicuous Consumption Behavior
Jianghan GU
Northwestern Polytechnical University, China
Conspicuous consumption behavior exists widely in today’s society. People take material consumption as the standard to measure social status and wealth level. Conspicuous consumption behavior often results in irrational decision-making when decision maker consumes goods or services. However, some conspicuous consumption is now transferring to a so-called “non-conspicuous consumption”, which is considered as an intangible asset investment that transcends material values and tends to “art appreciation”. In our study, grounded in decision theory, we evaluated the development stages of conspicuous and non-conspicuous consumption in China and U.S., an analysis of regional responses for both was conducted, and a comprehensive research on “advantages and disadvantages” for both is in progress. This study not only reveals the secrets of both behaviors, but also provides insights for future behavioral economics study. In our opinion, either conspicuous consumption or non-conspicuous consumption is an inevitable derivative of social development. Neither of conspicuous and non-conspicuous consumption behaviors should be judged by right or wrong, but only decision maker’s advantages.

IEEM19-P-1137
Planning an Urban Postal Service Network by Using a Location-Based Hybrid Optimization-Simulation Method: A Real-World Case Study
Xu SUN, Hao YU, Wei Deng SÖLVANG
University of Tromsø – The Arctic University of Norway, Norway
The planning of an urban postal service network is a complex decision-making problem that involves the determination of the locations of post offices and the allocation of customers to respective post offices. This paper investigates a location-based hybrid optimization-simulation approach for the optimal planning of an urban postal service network in Narvik, Norway. First, a p-median location problem is formulated and is applied to determine the optimal network configuration. The computational result showed, in the optimal network-planning, the total customer travel distance can be reduced by approximately 16% compared with the existing plan. In order to validate and visualize the result in a more realistic and dynamic environment, a set of scenario analysis between the current configuration and the optimal configuration is conducted with a professional simulation software AnyLogic. Through incorporating a GIS-based network system and running a set of simulation with different sample sizes, means of transportation and test periods, a more accurate and realistic comparison is obtained, which shows a 25%-29% performance improvement (travel distance and carbon emission) can be achieved by implementing the optimal configuration of the postal service network in Narvik.

IEEM19-P-1078
Applying BPN to Build the Prediction Model for Site Selection
Hun-Fin YU, Hisao-Ping YEH, Tien-Hsiang CHANG, Cheng-Chang TSAI
National Kaohsiung University of Science and Technology, Taiwan
This study used back-propagation neural network (BPN) – to build a systematical and reliable site selection prediction model for chain convenience store (CVS). To achieve parameter optimization of executing BPN, the Taguchi method (TM) was also adopted to identify the best parameters of BPN. Therefore, the actual operational data of a chain CVS is used to validate the site selection prediction model build in this paper. Finally, the results indicated that the accuracy rate increased from 55% to 65% and the root-mean-square-error (RMSE) was reduced 40.1% (from 10188 to 6045). This also displays that the prediction accuracy rate and the decision quality of the built prediction model is higher than the decision method of existing experienced managers.

IEEM19-P-0140
A Composite Indicator for Supply Chain Performance Measurement: A Case Study in a Manufacturing Company
Rui OLIVEIRE1, Catarina CUBO1, Rui ESTRADA2, Ana FERNANDES2, Paulo AFONSO2, Maria do Sameiro CARVALHO1, Paulo SAMPAIO2, João ROQUE2, Marcio REBELO1
1University of Minho, Portugal
2Bosch Car Multimedia, Portugal
This paper proposes a methodology to develop and implement a Composite Indicator (CI) to measure the performance of Supply Chain processes. It reflects the aggregation of individual measures, related to the same process, with a weighted average, in order to assess the global performance in terms of both efficiency and effectiveness. Through a case study in a manufacturing company, the concept validation was performed by implementing the methodology in the Return process of the Supply Chain. The results showed that the combination between a Composite Indicator and a Business Intelligence tool provides a better understanding of the overall performance of a given process, facilitating also the identification of root causes. This paper aims to contribute to the supply chain performance management research field, proposing a methodology to implement a Composite Indicator, which is a topic insufficiently explored in the existing literature.

IEEM19-P-1172
An Integrated Decision Support System for Sustainable Supplier Selection, Evaluation, and Benchmarking Using a FIS and MOLP Approach
DuA WERAIKAT1, Sharfuddin Ahmed KHAN1
1Supreme Court of Jordan, Jordan
2Department of Business Administration, University of Minho, Portugal
Organizations that wish to stay competitive in today’s challenging era have to adopt innovative techniques. Our research proposes a new methodology for an effective procedure to decide on sustainable suppliers. The traditional method of ranking suppliers and evaluating their performance is not enough to handle the ever-rising consumer demands. Moreover, the research conducted on frameworks that integrate these concepts is limited. On the other hand, ecological pressures from stakeholders have emphasized the importance of the sustainability of supply chain performance through supplier selection. A systematic and sustainable evaluation system is, therefore, a necessity to efficiently classify suppliers and evaluate and benchmark their performance for continuous improvement. In order to achieve this goal, a hybrid decision support system (DSS), based on fuzzy inference systems (FIS) and multi-objective linear programming models (MOLP), is provided. It is a generic DSS that can be implemented in any industry regardless of the nature of the business.
The purpose of this study is to explore the characteristics of syndrome differentiation of Qian Yi's book from the perspective of modern behavioral decision science. This book is called Xiao-er-zheng-zhi-jue and provides a theoretical and prescription basis for later learning of Chinese medicine and pediatrics. The choice of the research version is based on the bibliographic analysis. First, we selected the school version, then chose the school contrast version, and then used the modern medical doctor Zhang Shanlei's Jian zheng (correct words) to help with the interpretation of semantic meaning and the comprehension of text content. Finally, the method of behavioral diagnosis concepts was applied on the texts.

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IEEM19-P-1169

The Initial Study of Behavioral Diagnosis on Qian Yi's Xiao-Er-Yao-Zheng-Zhi-Jue

Mei-Chen LO, Si-Tao YANG, Tung-Ti CHANG, Lu-Hai WANG
National United University & China Medicine University, Taiwan
China Medicine University, Taiwan

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IEEM19-P-0527

Case Study: A Semi-Supervised Methodology for Anomaly Detection and Diagnosis

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Ecole Polytechnique de Montreal, Canada

In this paper, a semi-supervised methodology for anomaly detection and diagnosis is proposed. The approach combines techniques of non-parametric statistics, quality control, and deep learning to provide a tool that allows an adequate and online detection of faults in a production system and a diagnosis of the factors associated with the failure. We propose a semi-supervised neural network for detection and a particular control chart called Open Up for the diagnosis. This neural network is composed of the adjustment of an autoencoder followed by a Long Short-Term Memory model (LSTM). Open Up is used in the last stage to identify the variables associated with the anomaly. This proposal achieves a high correct classification rate using real data of a monitoring system in paper manufacturing and simulated data from the Tennessee Eastman Process.

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IEEM19-P-1121

Fault Prediction of Fan Based on Failure Window Period

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Southeast University, China
Beijing Goldwind Science & Creation Windpower Equipment Co., Ltd., China

Fault diagnosis has always been one of the core issues of wind power operation and maintenance. How to accurately predict faults based on SCADA monitoring data has become a hot issue. Many researchers use machine learning algorithms and deep learning algorithms to obtain the "status data" of the wind turbine monitoring by SCADA as a training sample for the above methods. In the application, the state data of "t" time (the time when the fault occurs) is often selected as the fault sample data, and the "latency period" data of the fault is ignored. This paper mainly studies the sampling method of the fault sample, and proposes the concept of “failure window period” and applies it. The second derivative of the state data fitting curve finds the value of the window period [t–k, t] when the "t” time is faulty. After applying this method for fault sampling, the same fault prediction is tested in the same state data set. The method shows that the accuracy of the CGBD and LR algorithms is about 10% higher than that of the previous sampling.

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IEEM19-P-0321

Investigating a Breast Cancer Gene Expression Data Using a Novel Clustering Approach

Leila NAENI, Amir SALEHIPOUR
Toshiba Tec Corporation, Japan
Toshiba Corporation, Japan
Tokai University, Japan

Historically, breast cancer has been perceived as a disease with varying histological and clinical features. Breast cancer tumor classification is important in disease prognosis and prediction because different breast tumors respond differently to different treatments and have different survival rates. Gene expression profiling studies have increasingly been motivated in the past decades to develop a good classification of breast cancer in molecular subtypes, which can improve the standard clinical assessments by providing extra prognostic information. In this research, one of the most comprehensive breast cancer gene expression datasets is analyzed by applying a novel clustering approach to predict the breast cancer subtypes. The novel unsupervised clustering approach initially model the gene expression data as a network and employ a community detection method to identify network clusters. This method utilizes an efficient problem specific metaheuristic algorithm to optimize the modularity value and identify clusters of breast cancer samples with similar characteristics that presents different subtypes of breast cancer. To assess the significant of the newly defined breast cancer subtypes, we compared our findings with three breast cancer subtyping methods.

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IEEM19-P-0443

Application of Feature Selection Method to Error Factor Extraction of Multifunction Peripheral

Myungsook KO, Tatsuya INAG, ManasukI TAKADA, Toru YANO
Toshiba Corp., Japan

Multifunction peripheral (MFP) manufacturers provide customers with remote maintenance services, such as supplies provision and automatic firmware updates, to lower customer burdens and to avoid device downtime. Such remote services are required for maintenance so that Japanese machine manufacturers can deliver products to foreign markets, because service bases in overseas locales must cover broader geographical areas than those in Japan. When MFP devices experience a fault, they generally alert users of an error. Although some faults can be solved remotely, there are faults that require an engineer to perform on-site actions. To repair them on-site efficiently, online investigation and pre-assessment of fault factors will be effective. In this paper, we apply the Group Lasso regularization method for logistic regression to select features determined as error factors. We evaluate the engine on two kinds of error examples: those frequently causing alerts in MFP models in the past, and those causing alerts due to part wear. This engine is expected to help engineers determine causal factors of errors.

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IEEM19-P-0102

A Hierarchical Feature Fusion-based Method for Defect Recognition with a Small Sample

Yiping GAO, Liang GAO, Xinyu LI
Huazhong University of Science and Technology, China

As one of the breakthroughs in modern manufacturing, deep learning (DL) performs large-scale network architectures and achieves some outstanding performances in vision-based defect recognition. However, most of these large-scale networks require a large sample for training, and a small sample might cause the networks over-fitting and collapse. Since the defect often occurs with a low probability, it is costly to collect large-scale samples. To overcome this problem, a hierarchical feature fusion-based method is introduced for defect recognition with a small sample. The proposed method divides a pretrained VGG16 network into different blocks, and learns the hierarchical features from the low- and high-level blocks. The results are better than the other methods. This result manifests the proposed method suits problem, and the defect recognition could be deployed earlier with the proposed method.
**IEEM19-P-0308**

**Predicting Commercial Real Estate Rent: An Empirical Study**

Usha ANANTHAKUMAR\(^1\), Rishita SINHA\(^1\)

\(^1\)Indian Institute of Technology Bombay, India

The paper aims to assess the dynamics that affects the retail rental outcomes in a metro city considering the case of Mumbai, the commercial capital of India. The study uses a data set of shopping outlets in both shopping malls and stand-alone stores in this metro city. Regression and CART models are constructed to estimate the importance of the determinants and predict the rental values of the shopping outlets. The findings of the paper clearly indicate the significance of some of the determinants used in the study in predicting rental values. The results of the study would help builders, developers and investors to gain critical and empirical insights into the variables of the retail rent in any emerging real estate market.

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**IEEM19-P-0386**

**Effective Implementation of Last Planner System® in Construction Projects: A Case Study**

Ragnhild GJERDE, R.M. Chandima RATNAAYAKE, Samindri SAMARRAKON

University of Stavanger, Norway

The construction industry has been relatively less productive compared to the manufacturing industry. A significant number of construction projects have been delayed and/or exceeded their budget. Planning has been a significant challenge in the construction industry, due to the highly customized nature of designs, construction processes, and suppliers. Planning, monitoring, and continuous control of the progress of a construction project is vital to improve the project’s performance. Although Lean construction approaches (LCAs) and Last Planner System® (LPS) have been proven to deliver target project performance in certain construction projects, to date, most engineering contractors have struggled to implement them in practice. This manuscript presents the results of an illustrative case study, carried out in collaboration with a construction firm, to investigate the potential use of LCAs in practice. Microsoft Excel and Synchro software have been used to deploy the LPS. The findings demonstrate how planning capabilities have been improved with the support of the plan percent completion (PPC) calculation, performed in Microsoft Excel, together with the animation capabilities of Synchro software.

**IEEM19-P-0481**

**Full Factorial Design of Experiment Approach to Quantify the Effect of Forming Parameters on Wrinkling Effect of Deep Drawn Cylindrical Cups**

Lakshitha MERAGALGE, Pramila GAMAGE, Manjula NANAYAKKARA

University of Peradeniya, Sri Lanka

With the advancement of the manufacturing industry and the increase in competition, the need of quality has become an ever-growing challenge in metal forming industry. Deep drawing is a typical sheet metal forming process which is widely used to manufacture thin walled automotive panels, aircraft body panels and utensils. Blank holding force, drawing ratio, lubrication and die profile are few key process parameters that effect on the quality of the final product. Since the complicated interaction of these forming parameters, deep drawn parts are susceptible to various defects such as ironing, earing and thinning. Wrinkles are a common defect in sheet formed products. This study focuses on improving the quality of deep drawing products by minimizing the formation of wrinkles. The effect of Blank Holding Force (A), Blank Sheet Thickness (B) and Punch Force Applying Rate (C) were considered. Full Factorial Design of Experiments (DOE) conducted by simultaneously changing each parameter. Wrinkles were measured using surface roughness machine. Results shows that there is a significant interaction between Blank Sheet Thickness and Blank Holding Force at 5% significance level. Results were validated by conducting several confirmation runs with optimum parameter settings.

**IEEM19-P-0348**

**Hierarchical Classification and Regression with Feature Selection**

Shih-Wen CHI, Chi-Wei YEH

National Central University, Taiwan

Hierarchical estimation approaches, usually a combination of multiple estimation models, have been proposed for solving some specific domain problems. However, in the literature, there is no generic hierarchical approach for estimation and no hybrid-based solution that combines classification and estimation techniques hierarchically. Hence the HCR was proposed in our recent work. The HCR approach significantly outperformed three well-received single flat prediction models. Having seen the potential of the proposed HCR as a generic hierarchical regression scheme, we propose to further improve the HCR by introducing feature selection (FS) techniques to the HCR. In order to thoroughly investigate the effect of FS on the HCR, we examine different numbers of attributes remained after feature selection with respect to datasets of various sizes. The results showed that the HCR with linear regression performed significantly better than the other HCRs while feature selection helped lower the RMSE slightly with only 50% of the original features.

**IEEM19-P-0303**

**Research and Design on Key Technologies of Spatial-Temporal Cloud Platform Construction**

Bin ZHANG, Rui YU, Donghosa PEI, Baichuan HUANG, Yao SONG, Ling PENG, Yuhuai ZENG

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1Wuhan University, China

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Up till the present moment, the construction of cloud platform at home and abroad still needs to be improved. To a certain extent, it restricts the development of spatial-temporal application. We integrate internet of things, sensing technology, cloud computing technology, data mining technology, dual-frequency precision positioning technology, big data analysis technology and broadband network technology. Compiling with simple programming mode, data storage and management, virtualization technology and other key technologies. Through software and hardware for experimental configuration, deployment of cloud nodes, the establishment mode of mathematical models. Designed a unified spatial-temporal information cloud platform with universality, completeness and easy realization. In order to realize the architecture design and development of the cloud platform. This study give a cloud platform structure design to provide support for national planning. It provides new clues for the theoretical development and application of the spatial-temporal cloud platform construction of the strategic new districts such as the Great Bay Area, China Xiong’an New District and Wuhan Yangtze River New Town.
manufacturer company in Peru. The main problem faced by the company is the high index of work in progress (WIP) generated by the bottleneck of the productive flow. This is caused mainly by the absence of a flow system that allows control of the production. This problem amounts to a monthly cost of approximately $53,272. In this study, a pilot is implemented in the production line to evaluate the results obtained and, in parallel, a simulation system is designed to evaluate the long-term results. From the results obtained, it can be concluded that the application of the proposed tools will reduce the WIP of each component produced, avoiding overproduction and optimizing costs.

IEEM19-P-0437
Reduction of Nonconformities in Galvanized Process Using Model Based on Lean Manufacturing Tools
Brigite FARFAN-MEZA, Carmen VEGA-VILLASANTE, Fernando MARADEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aaplicadas, Peru

From our analysis of the situation within a manufacturing company in the metal-mechanical sector in Lima, Peru, we found problems due to the noncompliant products index. They originated mostly during the galvanizing process, for which analysis of the current situation was initially conducted. To reduce the nonconforming products, we designed and implemented a proposal using lean manufacturing tools. Then we validated the attainment of positive results compared to the initial situation. For example, we achieved a 6% reduction of nonconforming products, a 10% decrease in claims, a 6% reduction of reprocessing, and a 0.8% lower percentage of elimination.

IEEM19-P-0449
Analysis of User Groups for Assistance Systems in Production 4.0
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2Chang Mai University, Thailand
3Fraunhofer Italia Research s.c.a.r.l., Italy

The fourth industrial revolution aims to digitize the production chain. The goal is to optimize production processes while minimizing error rates and contemporaneously increasing the productivity. Not only the production lines are considered, but also the employee himself, for whom the working environment should be designed to be more comfortable, ergonomic and adapted to the individual needs. To get closer to this goal, assistance systems can be used, which accompany the worker through appropriate support individual needs. To get closer to this goal, assistance systems can be designed to be more comfortable, ergonomic and adapted to the production system.

IEEM19-P-0476
Determining the Process Choice Criteria for Selecting a Production System in a Manufacturing Firm Using a Delphi Technique
Vishwas DOHALE, Milind AKARTE, Priyanka VERMA
National Institute of Industrial Engineering, India

Manufacturing strategy formulation is one of the key aspects of business to gain the competitive advantage by aligning manufacturing function with the business goals. The crucial step in manufacturing strategy formulation is a process choice due to the involvement of huge investment. Process choice concerns the determination of a production system for a given manufacturing firm. Traditionally, there exist four kinds of production systems viz. Job-Shop, Batch-Shop, Mass/Assembly line, and Continuous flow. Being a long-term decision, the process choice selection should be made appropriately. Variety of criteria considered while selecting a production system. The current study tries to identify the criteria considered while selecting the most compatible production system for a manufacturing firm. An extensive literature review methodology is used to determine and collect the process choice criteria (PCC). A total of 39 PCC are identified. Further, a Delphi technique is used to validate those criteria using experts’ advice. Through Delphi, out of 39, 28 criteria are retained based on the consistency validity ratio (CVR) score. The identified PCC can aid researchers and practitioners to understand and evaluate the production system.
Value Creation Through Product-Service Systems in Business Ecosystems – Identification of Key Challenges for Managing Companies
Philipp HUMBECK1, Franziska GOB1, Thomas BAUERNHANSL2
1TRUMPF Werkzeugmaschinen GmbH + Co. KG, Germany
2Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany

The spread of information and communication technologies (ICT) triggers the emergence of innovative business models in mechanical engineering. These are often based on integrated offerings, combining services and products to one product-service system (PSS), which satisfies customer needs to a higher extent. Manufacturers integrate complementary competences and technologies from diverse actors into their own offering to sustain success at the market and enhance their innovativeness by interacting in business ecosystems. Although academic literature investigated value creation through developing and operating PSS and value creation in business ecosystems individually, a conjoint approach has yet been poorly examined. Aim of this paper is to identify arising challenges and derive requirements for management in creating value through PSS in business ecosystems. To unify these two concepts, first, a literature review has been performed. Second, 28 partly structured expert interviews have been conducted and analyzed according to a qualitative content analysis to identify key fields of action. Third, prerequisites for successful executive management were elaborated by performing a cause-analysis. The results contribute to superiorly understand challenges and upcoming requirements that management faces to sustain innovativeness.

Modelling Digital Innovation Value Chain in SMEs: Evidence from China
Fen LYY1, Yuming ZHU1, Catherine DE LA ROBERT1
1University of Paris 1 Panthéon-Sorbonne, France/ Northwestern Polytechnical University, China

The diffusion of new digital technology into various industries can create new opportunities for digital innovation. Several studies have been investigating the digital innovation for large firms, but focus on how the adoption of digital technology influences the performance of SMEs using the framework of different value chain and network theory, this study empirically examines the path of adoption of digital technology to SMEs’ commercial performance through data collection from 208 digital SMEs in China. Our results first indicated that adoption of digital technology has a positive influence on digital source including business network and personal network, then we also found out that digital source significantly affects three types of digital innovations, namely digital products, digital services and business model. Lastly, we discovered that digital products and business model both positively affect SMEs’ commercial performance measured by market share and profit level, whereas digital service turned out to have an insignificant influence on SMEs’ commercial performance. This study contributes by modelling digital innovation value chain in SMEs and validating it. It helps researchers greatly to enrich their understanding toward how the value generates during the digital innovation value chain in SMEs of China.

Water 4.0: An Integrated Business Model from an Industry 4.0 Approach
Michaël ALABI, Aneesh TELUKDARIE, Nicky JANSE VAN Rensburg
University of Johannesburg, South Africa

Water is one of the most valuable natural resource used for everyday living. The era of Fourth Industrial Revolution (4IR) also referred to as Industry 4.0 has brought about different “Smart thinking” such as smart city, smart mobility, smart manufacturing and smart factory. In the water industry, the Germany Water Partnership is championing the Water 4.0 initiative since 2016. The essence of Water 4.0 initiative is to harness the digital revolution or decentralization of the water industry. This paper takes a close look at the business side of Water 4.0 from an 4IR perspective and aimed to develop an “Integrated Business Model” for Water 4.0 revolution. This paper is expected to answer this research question “can water industry be regarded as an integrated business?”. This paper started with a comprehensive literature reviews around the title of the research and integrated business model in relation to water industry. The literature reviews were analyzed and examined, and relevant factors considered suitable for integrated business model which are carefully selected for Water 4.0 paradigm.

Assortment Optimization is one of the main problems for retailers, and it has been widely studied. In particular, we focus on vending machines (especially beverage vending machines), which have many issues to be considered different from other retailers. In this study, we formulate assortment optimization problems for the case such as vending machines and propose an approach to solve this problem, based on POMDP (partially observable Markov decision process). The approach includes incomplete state observations, stochastic consumer behavior and policy decisions that maximize future expected rewards. In vending machines, workers (called agents) repeatedly change the assortment of products to get better sales. The
IEEM19-P-0156

Engineering Effort Estimation for Product Development Projects

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1FNSS Sarusuna Sistemleri A.Ş., Turkey
1Middle East Technical University, Turkey

Cost estimation is an essential process for gaining competitive advantage in the bidding phase of every project. Besides, cost estimates are also vital for effective project control. For product development projects engineering hours is the main cost item and hence estimating engineering hours for potential product development projects is an important task. In this paper a case study, which is carried out at one of the leading manufacturers and suppliers of tracked and wheeled armored vehicles and weapon systems for the Turkish and Allied Armed Forces, is presented. In the company, currently there is no structured method for this purpose. The aim of this study is to create a method for estimating design engineering hours for potential projects based on available past data. Regression tree and k-Nearest Neighbor (k-NN) algorithm using Attribute Weighted Value Difference Metric methods are used for this purpose and the results are reported and discussed.

IEEM19-P-0479

Optimal Short-Term Forecasting Using GA-based Holt-Winters Method

Mardic NAVARRO, Bryan NAVARRO
Technological Institute of the Philippines, Philippines

One of the key issues nowadays in using Holt-Winters Method of forecasting is the appropriate selection of smoothing coefficients. To identify values of smoothing coefficients, an optimization approach is explored that minimizes a forecasting error like Mean Squared Errors (MSE) or Mean Absolute Deviation (MAD). This paper develops a methodology that optimizes forecasting error by determining the optimal smoothing coefficients of the Holt-Winters Method using Genetic Algorithm (GA). This paper focuses on the Mean Square Error (MSE) as an objective value of the optimization problem. The efficiency of the proposed approach was verified using actual test cases based on rice stock commodity in the Philippines. Different variants of the Holt-Winters Method were examined and the result shows that additive seasonal effect was more appropriate for the rice stock data. The proposed approach was compared to other models and the results are promising.

Session       Project Management 2
Date          17/12/2019
Time          13:30 - 15:30
Room          Bordeaux #7.3
Chairs        R.M. Chandima RATHNAYAKE University of Stavanger
              Seung Ki MOON Nanyang Technological University

IEEM19-P-0205

Integration of Environmental Public Welfare Projects and Internet Platforms: Survey of Environmental Public Welfare Organizations

Feng LI, Yali ZHANG, Christie Diane TAN, Haixian ZHANG, Zhaodong MA
Northeastern Polytechnical University, China

With the rapid development of the Internet, the public welfare industry has also shown a high degree of digital innovation. This study focuses on the integration of environmental public welfare projects and Internet platforms. The grounded theory approach was applied through in-depth interviews conducted with 10 managers from environmental public welfare organizations in China, all of which have cooperated with the Internet public welfare platforms. Through data collection, open coding, axial coding and selective coding, the status quo and existing problems of the integration of environmental public welfare projects and Internet platforms were obtained, and suggestions and guidelines for such integration were provided. This study contributes a new research method and theoretical foundation for the development of environmental public welfare projects in China within the Internet context.

Session       Welfare Organizations
Date          17/12/2019
Time          13:30 - 15:30
Room          Bordeaux #7.3
Chairs        R.M. Chandima RATHNAYAKE University of Stavanger
              Seung Ki MOON Nanyang Technological University

IEEM19-P-1171

Development of Air Cargo Loading Optimization Model for Airline Operations

Eugene WONG, Kev LING
The Hang Seng University of Hong Kong, Hong Kong SAR

A mathematical model is developed to assist air cargo load planning operations for an airline, with consideration of weight and balance, aircraft structure, cargo destinations, dangerous goods segregation, and aircraft safety. The developed air cargo loading model aims to maximize the utilization and yield of the aircraft through simulations with the use of LINGO in solving the non-linear optimization problem with over 9,300 constraints. Simulation cases have been carried out with derived optimal load plan reflecting the recommended cargo allocation and position of unit load devices (ULDs) to be stowed in aircraft. This decision support model assists cargo load planner in determining the optimal cargo load plan with the selection of the ULDs to be loaded in the respective positions in the aircraft. The model not only simulates optimal load plans instead of feasible plans but also reduces the processing time in generating the plan. The model considers safety segregation on the positioning of dangerous goods in the main deck of an aircraft. The study could be extended in applying the over-size cargo in the cargo load plan simulation.

IEEM19-P-1143

Modeling and Reliability Analysis for Three Solar Array Configurations in Space Debris Environment

Zhanjui WANG, Xiaobing MA
Beihang University, China

The unceasing exploration of cosmic space has accumulated massive space debris, which greatly threatens the operation safety of orbiting space vehicles. A noticeable threat of space debris is its high velocity impact on solar array, which causes catastrophic failure of solar modules and ultimately the reduction of array power capacity. This paper aims to minimize such velocity impact via the optimization of array configuration, with focus on reducing mismatch losses and voltage variations. To this end, the relationship between module capacity and debris size is quantified, and the performance of three configurations, Series-Parallel, Total-Cross-Tied, and Bridge-Link under various debris impact cases are compared on a photovoltaic array. The experimental results using Simulink state the superior performance of Total-Cross-Tied configuration in impact reduction and reliability improvement.

IEEM19-P-1170

Optimising Maritime Vessel Slot Allocation Planning with Genetic Algorithm: The Case for a Trans-Pacific Trade Service

Eugene WONG, Kev LING
The Hang Seng University of Hong Kong, Hong Kong SAR

A novel multi-echelon collaborative slot allocation planning model for multiple trade lane and service loops is developed to improve utilisation and revenue for global ship liners. A three-stage optimisation is designed with the adoption of genetic algorithm in facilitating the slot allocation within traffic loading regions and slot exchange among ship alliance members. A case study in optimising the vessel allocation of selected Trans-Pacific Trade service loops in a ship liner is carried out. The simulated findings are evaluated against the results of current plan in the company. Scenarios on multiple tradelane and service loops with cargo shifting are modelled and simulated. Sensitivity analysis is carried out in reviewing the projection accuracy/cost affect the utilisation/revenue of the allocation plan. The model assists trade traffic planners in maximising slot usage and yield as well as ensuring that cargo dimensions and weight fall within the cargo payload capacity and verified gross mass requirements. Future develop would be focused on the analysis of the robustness of the model.

IEEM19-P-0156

Engineering Effort Estimation for Product Development Projects

Zeynep OZTURK YURT1, Cem IYIGUN2, P. BAKAL1
1FNSS Sarusuna Sistemleri A.Ş., Turkey
1Middle East Technical University, Turkey

Cost estimation is an essential process for gaining competitive advantage in the bidding phase of every project. Besides, cost estimates are also vital for effective project control. For product development projects engineering hours is the main cost item and hence estimating engineering hours for potential product development projects is an important task. In this paper a case study, which is carried out at one of the leading manufacturers and suppliers of tracked and wheeled armored vehicles and weapon systems for the Turkish and Allied Armed Forces, is presented. In the company, currently there is no structured method for this purpose. The aim of this study is to create a method for estimating design engineering hours for potential projects based on available past data. Regression tree and k-Nearest Neighbor (k-NN) algorithm using Attribute Weighted Value Difference Metric methods are used for this purpose and the results are reported and discussed.
An Investigation of Estimation Techniques for Information Technology Projects

Janes PRATER1, Konstantinos CHATTOPOULOS2, Tony MA

1University of South Australia, Australia
2National Technical University of Athens, Greece

One of the key activities for a project manager at the commencement of a new project is to develop an accurate realistic schedule. The development of an accurate schedule sets the project up for success and understanding what estimation techniques work, and more importantly the ones that don’t work is key to setting the project up for success. This research reviews eight estimation techniques and provides a statistical insight into which of these techniques is perceived to work by project management practitioners.

The Roles of Functional Managers and Project Managers in a Matrix Organization

Nishan KISHORE1, Jan Ham PRETORIUS2, Gopinath CHATTOPADHYAY

1University of Stavanger, Norway
2Federation University Australia, Australia

In the era of technological change, the success of capital expenditure projects is significantly influenced by good project management, including project management structure. This paper presents how the roles of functional and project managers can positively influence project performance in a matrix structure. The focus on organizational structure is important since the fourth industrial revolution (Industry 4.0) depends more on high-performance computing and the co-existence of technology with human resources.

A case study was conducted in a technology company in South Africa which had restructured their software department from a top-down reporting structure to a matrix structure (dual management system). This research identified gaps in the current roles of the managers and in the matrix structure itself. The focus of the research was to identify the factors that were negatively influenced by the matrix structure such as the quality of the projects produced, the level of risk involved and return on investment from the projects delivered. It was found that functional teams were hemorrhaging 9.56% of employees through resignations and projects were only achieving 54.17% of their objectives.

On the Need for Effective Lean Daily Management in Engineering Design Projects: Development of a Framework

Daria BISKUPSKA, R.M. Chandima RATNAYAKE

University of Stavanger, Norway

Engineering contractors (ECs) need to focus on minimizing performance waste, in order to maintain their competitiveness, as the global petroleum industry experiences lack of investments in new projects. (Industry 4.0) depends more on high-performance computing and the co-existence of technology with human resources. The main purpose of managing a supply chain is to ensure the life cycle of a product or service, from receipt of raw materials to final distribution. A key factor in achieving the goals of the organization lies in the timing of its processes, since variations in demand can lead to late deliveries, cancellation of orders, and increased reliance on inventory. Therefore, this paper proposes a model that determines the optimal amount to be produced, taking into account the various stages of the supply chain, many of which have not been considered in original models. This model involves reducing inventory overruns and the opportunity cost of using the Excel spreadsheet.
IEEM19-P-0427
An Evolutionary Game Model in Closed-Loop Supply Chain
Ziang LIU, Tatsushi NISHI
Osaka University, Japan
An evolutionary game model is investigated to study the stability conditions for four different reverse channel structures in the closed-loop supply chain. The proper channel structures are analyzed for the given conditions. We consider one centrally coordinated model and three decentralized models that consist of manufacturer collection, retailer collection, and third-party collection model. The profit function is maximized for the centralized model and Stackelberg equilibriums are obtained for the other three decentralized models. Using the optimal profit functions, an evolutionary game model is proposed. On the basis of the stable conditions, we propose a profit sharing allocation method that can make the centralized supply chain model stable from a long-term view. Also, several numerical experiments are conducted. The results show that the coordinated channel structure is preferable over other structures with a proper profit sharing allocation method.

IEEM19-P-0074
"Buffer Inventory + Information Sharing" Strategy for Retailers in Two-Level Fresh Supply Chain
Lin LI1, Zhaojun YANG2, Chriseis Diane TAN2
1Xidian University, China
2Northwestern Polytechnical University, China
In the supply chain of fresh agricultural products in China, there are huge commodity losses during the transportation and storage of agricultural products due to limitations in cold chain logistics technology, which affects the performance of the fresh supply chain. This paper aims to improve the accuracy in forecasting market demand and reduce inventory by studying the impact of information sharing strategies on inventory and revenue at all levels of the supply chain, by establishing a system dynamics model that analyzes the capability of information sharing to reduce the expected inventory of suppliers and retailers, and by examining the impact of information sharing on demand forecasting accuracy and inventory stability. Results show that the strategy of information sharing combined with setting the buffer inventory can better improve the performance of the fresh produce supply chain.

IEEM19-P-0405
Supplier Selection and Ranking Towards Sustainable Procurement with Multiple Decision Makers
Premaratne SAMARANAYAKE1, Sev NAGALINGAM2, Tritos LAOCHIRI.HONGTHONG2
1Premaratne University of Macau, Macau
2University of South Australia, Australia
3Thammasat University, Thailand
The paper proposes a holistic selection and ranking approach for supplier evaluation and purchasing order allocation among suppliers who meet acceptable triple bottom line (TBL) performance. Supplier ranks are developed using judgements from multiple decision-makers. Purchasing order allocation among the ranked suppliers is determined using a linear programming (LP) model, which minimizes the total purchasing cost subject to multiple TBL based constraints. This research enables decision-makers to incorporate sustainability conditions in the supplier evaluation as the basis for best practice with an industry-friendly approach, which relies on input from key functional units for a holistic organization wide decision. The proposed approach is expected to motivate decision-makers to consider sustainable perspectives in supplier evaluation and order allocation processes in a global supply chain. This paper illustrates the applicability of the approach using a cement-manufacturing scenario in an emerging economy.

IEEM19-P-0558
The Joint Optimization of Spare Parts and Maintenance Personal Under Lateral Transshipment
Bowen CUI, Qiang FENG, YiREN,BoSÜN,ChengQIAN,Dezheng YANG
Beihang University, China
This paper proposes an optimization approach to plan the maintenance personnel and spare parts in a multiple echelon stocking system. In this system, for each failure requested by group p ∈ Pj, if the jth local warehouse has available inventory, maintenance personnel with a spare part will be supplied by it, otherwise, the resources request will be routed to other warehouses. The optimal stock policy (S) which can minimal total cost is the optimized target, including holding cost, ordering cost, maintenance cost and transshipment cost. A heuristic approach is used to obtain S. Using the heuristic methods, a complex system consisted of one plant, two central warehouses and three local warehouses is considered, the system served for three groups with two machines, and five modules is consisted in each equipment. The simulation results show the model’s effectiveness.

IEEM19-P-0561
Sensor Completion Based 3d Reconstruction of Binocular Stereo Vision
Ze-Hua LIU1, Hai-Jun RONG2, Zhao-Xu YANG2, Zhi-Xin YANG2
1University of Macau, Macau
2Nanyang Technological University, Singapore
Binocular stereo vision is a common way for 3D reconstruction of objects, which is core technology in the fields of computer-aided geometric design, machine vision and so on. However, the conventional binocular stereo vision algorithms are very sensitive to the ambient lighting, restricting their further promotion. The method of tensor completion, applied to the process of preprocessing the captured binocular image, provides a way to solve this problem. In this paper, a binocular stereo vision algorithm that uses low-rank tensor completion to perform 3D reconstruction is presented. In the pictures, the positions where the ambient illumination are strong are regarded as information that cannot be observed, and the others are regarded as observable information. The unobservable information will be completed using the observable information based on tensor completion. The results show that the 3D reconstruction results obtained using tensor completion are better than those without tensor completion.
Challenges in Implementing Transportation Tracking System in Saudi Arabia

IEEM19-P-0422

Mahmood ALI1, Maver TARBUISL1, Asim MAJEED2
1Institute of Business Management, Pakistan
2Supply Chain Specialist, Saudi Arabia

The advancement in information technology is transforming the business environment. The logistics industry is a major beneficiary since it has enabled them to better coordinate and integrate their operations while ensuring real-time tracking. However, the implementation of new technology introduces a unique set of challenges. This paper presents a case study with the main objective to understand the challenges an organisation face in implementing a freight tracking system. Adopting qualitative methods, in-depth interviews are conducted with the implementation team, users and major stakeholders. The in-depth analysis suggests that minimising user resistance and change management strategy forms the basis of successful implementation. In addition, establishing new rules and procedure, learning and development environment, accountability and communication are the pillars for the smooth transition to the new system.

Smart City Energy Trend Transformation in the Fourth Industrial Revolution Digital Disruption

IEEM19-P-0318

Anthony MATHER1, Jane Catherine NGILA1, Cecilia Kinuthia NJENGA2, Mohamed BELAID1, Nickey JANSE VAN RENSBURG2
1University of Johannesburg, South Africa
2United Nation Environment Programme, South Africa

The future of digital transformation of industrial platform and electricity lies on the electrification, decentralization and digitalization. Technologies are becoming commercially available to systems and services that can enable efficient and sustainable management of energy production and use. In short, smart cities can be defined as a city that uses ICTs solutions such as smart sensors, cognitive learning, and context awareness to make life more comfortable, more efficient and more sustainable. A smart city is a sustainable and efficient urban center providing its inhabitants with a high quality of life through optimal management resources. This study examines how intelligent technologies and services can integrate local energy production and use to provide a more sustainable and efficient system. Due to rapid urbanization, energy management in smart cities is an essential challenge to tackle. Due to the complexity of the energy systems and their vital role, energy management is one of the most demanding issues within urban centers. Therefore, this problem needs to be devoted to considerable attention and effort. Optimized operations using predictive analytics, data mining and modeling are the main tools commonly used to evaluate the technological and policy impacts of smart solutions, as well as to plan the best ways to move from current to smarter cities.

The reviews show energy-related work on smart city planning and operating models by classifying their scope into main areas of intervention: energy generation, infrastructure, energy storage, mobile internet, cloud technology, internet of things (IoT), autonomous and near autonomous vehicles, facilities, and intelligent transport system.

IEEM19-P-0304

Performance Gap Between Valid and Invalid Patents in Six Technology Fields

IEEM19-P-0334

Huao Ru DONG1, Dan-Zen CHEN1, Mu-Hsien HUANG2
1Fu Jen Catholic University, Taiwan
2National Taiwan University, Taiwan

In past studies, it has often been assumed that valid patents are related to the quality of patents. However, whether the quality of valid patents is higher than that of invalid patents is yet to be verified. This study uses three indicators, namely the citations per patent, science linkage, and communication, and explores whether a performance gap exists between valid and invalid patents. First, valid and invalid patents from the whole United States Patent and Trademark Office data are analyzed. Then, we further examine whether a performance gap exists between valid and invalid patents in six technical fields. The results indicate that a performance gap exists between valid and invalid patents. The detailed reasons for this gap should be studied in the future.

IEEM19-P-0469

Graph-based Semi-Supervised Classification for Online Customer Reviews Using Consensus Clustering

IEEM19-P-0357

Kenjiro TORIZUKA1; Hiromi SAITOH1; Syoset SHIIZU2
1Aoyama Gakuin University, Japan
2Chiba Institute of Technology, Japan

The purpose of this research is to present a graph-based semi-supervised learning (GBSSL) method with high classification accuracy for handling a large number of customer reviews. Following recent developments in information and communication technology, it has become essential for companies to employ efficient methods for analyzing customer reviews for improving their products and services. In analyzing these reviews, it is necessary that they are classified based on the review content. However, there are only a few labelled customer reviews that can be used for the purpose of classification. Semi-supervised learning is effective in such case. In this research, we introduce GBSSL and show how it improves classification accuracy with the use of unsupervised clustering. The proposed learning method defines the result of consensus clustering based on the similarity between nodes. This research classifies customer reviews for a beauty salon using the proposed method and compares its accuracy with that of other machine learning methods to demonstrate the former’s effectiveness.

IEEM19-P-0356

Knowledge Graphs for an Automated Information Provision in the Factory Planning

IEEM19-P-0546

Uwe DOMBROWSKI, Alexander REISWICH, Christoph IMDAHL

Technische Universität Braunschweig, Germany

Graph-based semi-supervised classification is one of the powerful methods for analyzing customer reviews for improving their products and services. In analyzing these reviews, it is necessary that they are classified based on the review content. However, there are only a few labelled customer reviews that can be used for the purpose of classification. Semi-supervised learning is effective in such case. In this research, we introduce GBSSL and show how it improves classification accuracy with the use of unsupervised clustering. The proposed learning method defines the result of consensus clustering based on the similarity between nodes. This research classifies customer reviews for a beauty salon using the proposed method and compares its accuracy with that of other machine learning methods to demonstrate the former’s effectiveness.

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A Critical Review on Hazardous Chemical Emissions and Particle from Fused Deposition Modelling (FDM) Machine
Shu Lun MAK¹, Fanny TANG, Chi Ho LE¹, Winnie CHIU¹, H.K. LAU²
¹The Open University of Hong Kong, Hong Kong SAR
²Hong Kong Institute of Vocational Education (Tuen Mun), Hong Kong SAR

Due to patent expiry of 3D Printing technology, the cost of 3D printer becomes affordable to the domestic, primary and secondary schools. The Fused Deposition Modelling (FDM) is one of the most popular 3D printing technologies and different polymeric materials are available in the market. The Acrylonitrile Butadiene Styrene (ABS) and Polyactic Acid (PLA) are the most commonly used materials due to lower cost. The FDM consists of printing head with heater and nozzle. The plastic filament was melted due to high temperature. During the melting process, chemicals are evaporated through the nozzle. The exact amount and compositions of hazardous chemical emissions are not yet defined. Although the industrial standard, ANSI/UL 940A, was published on January 31, 2019, it only covers the technical requirements on both tracking the current status of a product feature through chips, processors and embedded systems, offer new possibilities on both tracking the current status of a product feature and deduce optimization potentials on the existing product. Smart products, which permanently provide product usage data through chips, processors and embedded systems, offer new possibilities on both tracking the current status of a product feature and deduce optimization potentials. This paper introduces a framework to increase product performance by investigating specific product features. Optimization measures shall be identified and deduced by the systematic analysis of product usage data.

IEEM19-P-0432
A Critical Review on Hazardous Chemical Emissions and Particle from Fused Deposition Modelling (FDM) Machine
Shu Lun MAK¹, Fanny TANG, Chi Ho LE¹, Winnie CHIU¹, H.K. LAU²
¹The Open University of Hong Kong, Hong Kong SAR
²Hong Kong Institute of Vocational Education (Tuen Mun), Hong Kong SAR

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The purpose of this research is to investigate the policy instruments and mechanisms that promote the dissemination of three Italian national programmes, and to study the contribution of intermediaries in enabling these mechanisms within the specific context of Italian micro- and small-sized enterprises. Results show that some mechanisms are irrelevant in the dissemination of programmes because they are not supported by the activities of intermediaries; other mechanisms instead are better aligned with the role of intermediaries in the Italian context, so that they are much more effective. The study provides useful information both to improve the dissemination of existing programmes and to clarify to researchers and practitioners how the knowledge gained can be used in the design of new Italian (but not limited to) intervention programmes.

Session
Production Planning and Control

Date
17/12/2019

Time
13:30 - 15:30

Room
Parisian #7201

Chairs
Zhe ZHANG Nanjing University of Science and Technology,
Jinyu FAN Guangdong University of Finance & Economics

IEEM19-P-0444
On Two New Dynamic-programming Procedures as Efficient as the Wagner-Whitin Regeneration-point Type in Dynamic Lot Sizing
Eiji MIZUTANI, Brighte TRISTA
National Taiwan University of Science and Technology, Taiwan

For a dynamic lot sizing problem involving time varying deterministic demand of a single item, Wagner and Whitin (1958) have developed an efficient regeneration-point dynamic programming (DP) approach under a special cost assumption. The purpose of this paper is twofold: First, Bellman’s standard DP type can be made as efficient as the regeneration point DP when the special property is appropriately exploited, although the resulting DP requires one more state variable. This is because the regeneration point DP computes a sum of multiple stage costs by summation, while the standard DP computes it by DP recurrence relations. Second, we relate those two DP methods to yet another DP that solves an associated minimum cost flow network problem. We then show that those three DP procedures are equally efficient by describing their insightful relations and features.
with limited processing capability and the promised delivery time are considered in this paper. At the same time, lot-splitting is also concerned, and an integrated decision-making model for order acceptance and scheduling with the goal of maximizing net profit is established. An improved genetic algorithm is designed for the proposed model. In the end, a numerical example is applied to illustrate the validity and feasibility of the proposed model and algorithm.

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**IEEM19-P-0057**
**Network Model Approach for Fuel Transportation Business**
Manop DONMUN, Komkrit PITIRUEK
Khon Kaen University, Thailand

This paper represents mathematical models for improving oil transportation problem with multi-products and multi-compartment. Recently, oil is shipped from refinery plants to gas stations throughout Thailand's northeastern part by multi-compartment trucks. However, there is no systematic approach to allocate oil to all customers. Manual and heuristic methods are widely used to manage the shipping with somewhat higher cost. Wages, overtime costs, fixed and variable transportation costs, and overhead costs were also considered. The proposed model provided better result when compared to the existing Worker Experience Heuristic (WEH), which exhibited approximately 11% improvement and short processing times.

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**IEEM19-P-0328**
**Optimization Model on Peak-Valley Time Electricity Consumption**
Yun HUANG, Rachael K.F. ID; Fan GAO
Macao University of Science and Technology, China

Based on the satisfaction degree of residential electricity demand and the result of peak-valley time division, this paper designs a peak-valley power dispatching optimization model. Firstly, in order to analyze the daily electricity consumption of residents under the current ladder price environment in Macau SAR, the paper team visited the residents of a community in Wanzai, Macau, and obtained the data needed for the paper. Secondly, based on the existing ladder price situation in Macau SAR, the paper simulated the peak-valley instant electricity price model by integrating the factors of residents' satisfaction, and built a model through MATLAB software. Calculating and analyzing the electricity consumption of the community; The simulation results show that setting the peak and valley time reasonably on the basis of the ladder price can effectively smooth the residential load curve while fully guaranteeing the functions of the original ladder price. Therefore, this paper aims to formulate a generalized reliability optimization design model for the multi-state k-out-of-n system based on a suggested reliability-redundancy allocation problem (RRAP). The proposed model is solved to obtain the optimal component reliability and redundancy, which is relatively blurry in the aspect of giving designers an explicit orientation to improve the system reliability. Therefore, this paper proposes a new mixed-integer nonlinear programming problem, the artificial bee colony (ABC) algorithm is improved through improving the search formulas. Several examples verify the effectiveness and efficiency of the improved algorithm. Further, an illustrative example about the reliability optimization design of the solar module is also given to demonstrate the availability of the proposed model.

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**IEEM19-P-0354**
**Enhancing the Dimensional Accuracy of Components Fabricated Using Rapid Prototyping Technique by Optimizing Machine Parameters of a 3D Printer**
Duminda BANDARA HERATH, Shiron THALAGALA, Pramila GAMAGE
University of Peradeniya, Sri Lanka

This research was focused on enhancing the dimensional accuracy of 3D printed products while studying the effect of 3D printer parameters on the geometry of 3D printed components by conducting a Fractional Factorial DoE. The efficiency of 3D printers is increasing when the layer thicknesses are increasing. MakerBot® have three layer thicknesses (0.1 mm, 0.2 mm and 0.3 mm) and printing efficiency is high when the layer thickness is high (0.3 mm), but the quality, i.e. the dimensional accuracy of the printed product is very low compared with the products printed with small layer thickness. This study comprises five MakerBot® 3D printer parameters (extruder temperature, speed while extruding, fan power, number of shells and infill pattern) in order to identify their optimum settings to improve the dimensional accuracy of 3D printed product with high layer thickness (0.3 mm). The analysis results show that it is difficult to identify common optimum factor settings to enhance the dimensional accuracy of every component of 3D printed product, but it was possible to identify the common factor settings for similar geometries as spherical shapes, cubic shapes, etc.

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**IEEM19-P-1093**
**Reliability Optimization Design for Multi-State K-out-of-n Systems Using Optimal Strength and Redundancy Strategies**
Jianchun ZHANG, Yu ZHAO, Xiaobing MA
Beihang University, China

The system reliability optimization design is an indispensable part in the reliability engineering. The traditional reliability-redundancy allocation problem (RRAP) is widely studied and used to optimize the system reliability. However, researchers mainly focused on the optimal redundancy and subsystem reliability strategies, which is relatively blurry in the aspect of giving designers an explicit orientation to improve the system reliability. Therefore, this paper proposes a new mixed-integer nonlinear programming problem, the artificial bee colony (ABC) algorithm is improved through improving the search formulas. Several examples verify the effectiveness and efficiency of the improved algorithm. Further, an illustrative example about the reliability optimization design of the solar module is also given to demonstrate the availability of the proposed model.

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**IEEM19-P-0309**
**A New Mathematical Model for the Traveling Repairman Problem**
Leila NAENI, L. Moslemi NAENI, Amir SALEHIPOUR
University of Technology Sydney, Australia

We propose a new mixed-integer program for the traveling repairman problem (TRP). The model benefits from the position-based variables. We aim to utilize only available solvers for optimizing the model. We test the proposed model by solving 70 randomly generated instances, ranging from 10 to 50 vertices, from the literature by CPLEX, and comparing its solutions with those of available models from the literature. We show that our model delivers the largest number of best solutions and that in a shorter time.
shortages comparing with those of CR and TSB methods. Adjusting the smoothing constants every 4 weeks provided lower smoothing constants were unchanged until 12 weeks. Meanwhile, results from CR and TSB methods provided lower MSEs when the types of vital medicines, obtained from the community hospital in performance indicators of these methods. The simulation used 2 Mean square error (MSE) and number of shortage periods were used amount of on-hand inventory would be equal to forecasting values.

The work proposed a combination of Exponential and Poisson Teunter, Syntetos, and Babai’s (TSB) methods. Furthermore, this performance of forecasting methods for inventory planning. This paper provides various sensitivity analyses for the effects of the parameters needed for the assessments of each method. The results show that the Micromort value increases how it is sensitive to each parameter needed for the assessments of Micromort value (a way to value a risky decision deal in dollars) and vector machines. Experiments show that the proposed model has a highest accuracy in predicting the severity of autism. Our method can help patients predict their condition and assist doctors in accurate diagnosis.

Forecasting Lumpy Demand for Planning Inventory: The Case of Community Hospitals in Thailand Phataraporn KALAYA, Preecha TEUNTS, Thananya WASUSRI King Mongkut’s University of Technology Thonburi, Thailand The pattern of lumpy demand affects the healthcare industry such as small community hospitals which encounter sporadic demands of slow-moving medicines. The objective of this work aimed to study performance of forecasting methods for inventory planning. This work compared two forecasting methods: Croston’s (CR) and the Teunter, Syntetos, and Babai’s (TSB) methods. Furthermore, this work proposed a combination of Exponential and Poisson distribution and the use of average inter-demand interval combining with average demand to forecast lumpy demand. It assumed that amount of on-hand inventory would be equal to forecasting values. Mean square error (MSE) and number of shortage period were used as performance indicators of these methods. The simulation used 2 types of vital medicines, obtained from the community hospital in Mae Hong Son province from January 2015 to December 2017. The results from CR and TSB methods provided lower MSEs when the smoothing constants were unchanged until 12 weeks. Meanwhile, adjusting the smoothing constants every 4 weeks provided lower shortages. Meanwhile, the other two proposed methods led to lower shortages comparing with those of CR and TSB methods.

Investigation and Prioritization of Performance Indicators for Inventory Management in the University Hospital Pornwatin SIRISAWAT, Narath HASACHOO, Thanwa KAEWVEAT Mae Fah Luang University, Thailand The objective of this study focus on the investigation and prioritization of the inventory performance indicators in the university hospital. The results of this study: (i) the group of main criteria quality (Q) is the most important indicator for inventory management in the university hospital. For sub-criteria, patient safety e.g. delays, errors (Q4) is the most important indicators in the group of quality of replenishment time (T1) is the most important indicator in the group of the time, inventory cost (F1) is the most important indicators in the group of financial. Inventory turnover (P1) is the most important indicators in the group of productivity. Therefore, the presented results of this study will help the people who do work in the healthcare industry or related industry for using to be the guideline for improving the performance of inventory management.

A Sensitivity Analysis for The Derived Micromort Value of Life and Death Decisions Using Two Methods for Constructing Utility Functions Ahmed A. ALZANQI, Ali E. AIBAS University of Southern California, United States This paper provides various sensitivity analyses for the effects of the elicitation parameters of two methods for the utility function assessments needed to deal with risky decisions involving health state and consumption. The two methods include: a) Using a utility function over a deterministic value function, and b) Using a utility copula function over utility functions for each attribute. The two methods are explored and compared in terms of the derived Micromort value (a way to value a risky decision deal in dollars) and how it is sensitive to each parameter needed for the assessments of each method. The results show that the Micromort value increases with the consumption level and decreases with age. As the decision-maker increases the tradeoff between health and wealth, the Micromort value tends to increase. In addition, becoming highly risk averse over value, the decision-maker also has a higher Micromort value.

IEEM19-P-0251
An Approach for Severity Prediction of Autism Using Machine Learning Min CHE, Liya WANG, Lin HUANG, Zhibin JIANG Shanghai Jiao Tong University, China Effective early diagnosis of autism can have a significant impact on its intervention and treatment. In this paper, an approach is proposed for comprehensively considering genetic factors and environmental factors to predict the severity of autism. According to the Childhood Autism Rating Scale (CARS), a sample set was collected from the autism clinic and a predictive model based on a stacked sparse auto encoder combined with a softmax classifier was constructed. We compared the proposed model with decision trees and support vector machines. Experiments show that the proposed model has a highest accuracy in predicting the severity of autism. Our method can help patients predict their condition and assist doctors in accurate diagnosis.

Solving Deficit Funding Issues in Indonesian Health Insurance Systems Diva KURNIAININGTYAS, Budi SANTOSA, Nurhadi SISWANTO Institut Teknologi Sepuluh Nopember, Indonesia Indonesian National Health Insurance System (INHIS) is a government program that aims to provide health insurance to citizens by guaranteeing their health services. However, INHIS finances continued to experience a deficit since 2014. The purpose of this study was to find a solution so that the stock of funds remained stable. This is done by changing the patient’s referral mechanism in INHIS. This is one solution so that the total health care costs do not increase. In this case the dynamic system simulation model is needed to find the relationship pattern between variables so that it can estimate the condition of INHIS funds. The decision variables in this study are the total health care costs and the stock of funds. From the simulation process, the results show that the proposed model can reduce the total health care costs by 44% and be able to maintain a stable supply of funds up to 40% of the sudden increase.

Managing Information Systems Requirements Volatility in Development Projects: Mapping Research and Surveying Practices Faraz KHAN, Youues BUNSLIMANE, Zijiang YANG York University, Canada This paper focuses on information systems (hereafter IS) requirements volatility during development projects. First, it provides a comprehensive research-based map that integrates measurements, antecedents, consequences and solutions for IS requirements volatility. Second, it offers insights into industry practices related to the key IS requirements volatility components identified in that map. Findings from a survey of 44 professionals leading IS development projects show that IS requirements volatility continues to be an issue most likely caused by requirements misspecification problems. Findings also present a ranking of the relative importance of possible solutions used to minimize that volatility. Implications for research and practice are discussed.

Recognition of Barriers in Brownfield Redevelopment PPP Project Meng YANG, Yuming ZHU, Hongli LIN, Naveed AHMAD Northwestern Polytechnical University, China The brownfield redevelopment projects (BRPs) have attracted much attention due to the increasing shortage of land resources. Public-Private-Partnership (PPP) model is an effective way for local governments to carry out infrastructure projects. However, when PPP is applied to the brownfield redevelopment, the project is still delayed or interrupted due to many factors. This paper uses literature research AHP and Force-DiMAT approach method to construct
a set of barriers related to brownfield redevelopment PPP project, and identifies four main barriers: inefficiency of government approval, variability of government decision-making, insufficient management ability of enterprise PPP project, lack of professionals and institutions. This paper lays a theoretical foundation and provides practical guidance for brownfield redevelopment PPP application in order to promote China brownfield redevelopment PPP project process.

The Development of a Roadmap for Project Management Framework and Process
Mozghan PAKDAMAN, Vahid DOKHTZAYNAL, Alireza ABBASI, Ripon CHAKRABORTTY
University of New South Wales at the Australian Defence Force Academy, Australia

In recent years, competitive environments require organisations to have a plan looking at the future. Project-based organisations are no exception to this rule and need an effective project management (PM) plan. They need a bespoke frameworks and processes to guarantee successful projects. Nowadays, some organisations have a wrong perspective on using PM frameworks. They just use PM framework, which are available in market, without any tailoring and plan. They need to have a plan not only to customize PM frameworks and processes but also to make an integration between different parts of an organization. An effective Project Management Roadmap (PMR) can enable organizations to overcome this issue. It creates a forward-looking map to improve PM processes to get more value from investments in portfolios of projects. This paper proposes a useful model to help organizations develop their PMR. This model considers internal and external environmental factors, PM frameworks and processes, potential portfolios of projects, and organization infrastructures as main layers to develop a bespoke PMR for organizations. It shows how to customize an organization and shows its future PMR as well.

Effective Antidotes to Address Adverse Situations During Multi-Stakeholder Engagement: The Case of International ICT Projects
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Seungjun AHN
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2National Technical University of Athens, Greece

Adversarial multi-stakeholder engagement in international ICT projects can bring up adverse or negative situations that can be detrimental to project performance, project outcomes and project actors well-being. Prior studies do indicate the antidotes as remedial strategies or proven practices to address adversarial multi-stakeholder engagement but lack empirical research on investigating the effectiveness of the antidotes in addressing the difficulties in stakeholder engagement. This knowledge gap is addressed using a questionnaire survey involving 144 global ICT professionals. 20 antidotes were ranked using the Relative Importance Index (RII). The top highly effective antidotes are trust building, transformational leadership, single point of contact, stakeholder analysis and interaction planning. The research findings contribute to project stakeholder management practice in providing the general awareness and enablement of the project management community in proactively or reactively deploying the antidotes to avoid or alleviate difficulties during multi-stakeholder engagement.

Digital Twin-based Cyber Physical System for Sustainable Project Scheduling
Ripon K. CHAKRABORTTY, Mohammad Humyoun Fuad RAHMAN, Haudong MO, Michael J. RYAN
University of New South Wales Canberra at the Australian Defence Force Academy, Australia

In the presence of increasingly dynamic environments, frequent uncertainties, high customer specifications, strict project deadlines, and stricter requirements on sustainability, modern project managers are challenged in their ability to schedule and control projects. Thus, in the context of sustainable project scheduling problem, two important elements are to be considered as decision variables: the input elements of a scheduling (e.g. resources: workforce, machine, money) that enable the realization of a schedule for a project and the output element that are consequences of the realization of the project (e.g. completion time, energy, noise, pollution, waste etc.). In this context, integration of innovative approaches and concepts under the framework of fourth generation industrial revolution is must to build up a sustainable project scheduling model (SPSM). Considering this burning issue, this paper introduces digital twin (DT) technology and cyber physical system (CPS) principles to develop effective and efficient sustainable project scheduling systems and proposes a framework to show how they are interconnected through physical and cyber layers. The proposed framework is also applied to a real-life energy system as a case study for identification of the degradation of a physical layer.

Teaching Fundamental Concepts of Industrial Engineering and Management by Using Examples from the Video Game Industry
Leif SUNDBERG
Mid Sweden University, Sweden

This paper presents experiences from using examples from the video game industry to teach fundamental concepts and theories of Industrial Engineering and Management. The video game console Dreamcast, which was released by SEGA in Japan in 1998, and discontinued in 2001, was used as a case to let engineering students analyze the trajectory of the console. A framework based on First Principles of Instruction was used to analyze the learning situation. The material consists of students’ assignment and evaluations, and the responsible teacher’s reflections. Students generally appreciated the opportunity to apply skills to explain a real-world problem. Pre-knowledge of the context was different between male and female students, which needs to be taken into consideration in future variants of the course. Teacher’s reflections summarized advantages with this as using a market that many students are familiar with, that has a history related to engineering and economics, and differentiated market. Disadvantages included formal limitations in course duration and evaluation, but also lack of peer-reviewed material, and the reputation of video-games as just being “toys”.

Research Output on the Usage of Artificial Intelligence in Indian Higher Education – A Scientometric Study
Kalyan Kumar BHATTACHARJEE
Indian Institute of Technology Delhi, India

Scientometrics is a branch of science which performs reproducible measurements of scientific activity. Scientometric analysis of research papers/articles indexed in Scopus database (www.scopus.com) for last ten years (2009 to 2018) have been done. The study focuses on the research publications for the applications of Artificial Intelligence (AI) in higher education. A scientometric assessment of the trend of the research papers on AI usage in education sector have been presented in the study by way of analyzing; annual growth of research publications of AI (both globally and country wise) and growth trend of the “AI usage in education” publications (both country-wise as well as individual share). The study reveals the growth of AI in research publications both in international and in Indian context, but its applicability in the field of higher education is substantially low. The usage of AI in Indian education sector has tremendous scope for growth and in most likelihood research publications in the said field will expand considerably in years to come. This study will help subject specialists, researchers, policy makers for drafting effective policies, and those who wish to map the scientometric patterns of research publications in the capacity of academic administrator or as an individual.

Indian Higher Education
Research Output on the Usage of Artificial Intelligence in Global and Country Wise Perspectives
Indian Institute of Technology Delhi, India

The study focuses on the research publications for the applications of Artificial Intelligence (AI) in higher education. A scientometric assessment of the trend of the research papers on AI usage in education sector have been presented in the study by way of analyzing; annual growth of research publications of AI (both globally and country wise) and growth trend of the “AI usage in education” publications (both country-wise as well as individual share). The study reveals the growth of AI in research publications both in international and in Indian context, but its applicability in the field of higher education is substantially low. The usage of AI in Indian education sector has tremendous scope for growth and in most likelihood research publications in the said field will expand considerably in years to come. This study will help subject specialists, researchers, policy makers for drafting effective policies, and those who wish to map the scientometric patterns of research publications in the capacity of academic administrator or as an individual.
IEEM19-P-0065
Quality Analysis and Improvement of Rear Axle Assembly Line of G Motor Company
Hungying SHAN, Chuang WANG, Lina LI, Yu YUAN
Tuition University, China
This paper analyzes and improves the product quality of rear axle assembly line of G Motor Company, finds the main factors influencing the quality through data analysis, and puts forward relevant measures. Firstly, this paper introduces the background and significance of the research, the quality management status of the company, and its current quality management method system. Secondly, the corresponding improvement measures are put forward by using the Six Sigma method for the product quality of the rear axle assembly line. Finally, through the analysis and improvement of the quality problems of the rear axle assembly line, the production cost of the workshop is reduced, the unnecessary waste is eliminated, the product quality and the production efficiency are improved.

IEEM19-P-0062
Engineering Meaningful Computing Education: Programming Learning Experience Model
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2Universiti Tunku Abdul Rahman, Malaysia
An e-learning system provides a platform for communication between educators and students. It facilitates the sharing of information and learning content in a form which can be easily accessed by the users. The scope of the research revolves around the idea that an automated assessment in an e-learning platform would be able to help programming learners understand defects in their program and independently learn how to program. This research would investigate the effects on college or university students. This research analyzes the effectiveness of various ways to learn a programming language. It is believed that automated assessment tools would be able to monitor and improve students' programming skills over time and reduce the effort for both instructors and students.

IEEM19-P-0333
Online Learning Approaches for Science, Engineering and Technology in Distance Education
Mukondelezi KANAKANA-KATUMBA, Wilson MALADZHI
University of South Africa, South Africa
Online learning has been adopted in distance education worldwide. The rise of the use of digital technology in teaching and learning has enabled distance education institutions to adopt online learning to reduce costs and improve student success. The purpose of this paper is to investigate appropriate teaching approaches that could be applied in an online learning model to achieve the desired success in student progress without reducing student autonomy. The results of this study indicate that cognitive, social constructivism and connectivity form the basis of relevant teaching approaches in the 21st century with regard to curriculum and material design. The success of the students’ learning is determined by the conducive environment created by the educators using technological means. Teaching approaches, such as community of practice, the integrative approach, apprentice and experiential learning, project- and problem-based approaches, as well as a competency-based approach, seem to dominate the Science, Engineering and Technology (SET) environment in the online teaching space. Students and their lecturers continue to engage after their formal interaction on an online platform.

IEEM19-P-0396
Modelling Student Satisfaction Through I-E-M Method for Improved Learning Experience of Selected Generation Y and Z Engineering Students
Romaylan GALINGAN
Technological Institute of the Philippines, Philippines
Generational cohorts are groups of individuals sharing birth years, history, and characteristics. This study determined that generational cohort and learning preference are associated with each other. Data showed that there is significant difference on the learning style of Generation Y and Generation Z engineering students. But there is no significant difference in the preferences when these respondents are grouped according to gender. Results also showed that generation Y engineering students see Teaching Method and Feedback and Learning Preferences as significant indicators of overall student satisfaction. On the other hand, Generation Z students find Teaching Method, Learning Environment and Feedback and Learning Preferences. From these significant findings the study puts forward the I-E-M method — Integrate, Evolve and Modernize framework that engineering colleges could adapt to optimize engineering student's satisfaction.

IEEM19-P-0322
From Product to Service Business: Productization of Product-Oriented, Use-Oriented, and Result-Oriented Business
Erno MUSTONEN, Janne HARKONEN, Harri HAAPASALO
University of Oulu, Finland
Companies considering a shift from manufacturing and selling physical products to selling services face several questions on service structure and repeatability. The current and potential offerings should be compared in the light of commercial and technical portfolio. The commercial offering visible to the customer needs to be productized and linked to the technical structure for services, including the needed processes and resources. From the financial viewpoint, the cost of delivering the offering should be known to be able to set a profitable price. Productization through a common product structure that acknowledges the commercial and technical views could be used as a tool to clarify the current and potential offerings and transform them into systematic and repeatable form that is comparable. The present study provides an example of using this kind of product structure to model a physical product offered as part of product-oriented, use-oriented, and result-oriented product-service systems. The presented product structure logic enables companies to clarify the offering, describe the processes and resources needed for delivering the offering, and evaluate its profitability.

IEEM19-P-0285
Design of Inventory Pledge Financing Model Based on Internet of Things Technology and Operational Risk Management
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In recent years, supply chain finance business has developed rapidly at home and abroad, but some problems, such as the information asymmetry between bank and enterprises, and a lagging financing mode resulting in increased operation and maintenance risks, simultaneously exist. From the perspective of model optimization, in this paper, we combine with the unique functions of Internet of Things technology and design a new inventory pledge financing model and therefore construct the extreme value theory Peak Over Threshold (POT) model, which can be used to measure the operational risk of the inventory pledge financing model. Empirical analysis shows that the external fraud of the supply chain financial inventory pledge financing model causes the greatest loss. The new inventory pledge financing model based on the Internet of Things technology effectively reduces the operational risk according to the comparison of E5 value between the new model and the traditional model.
The empirical evidence further suggests that although the framework could support the delivery of improved project outcomes, that cause them is thereby often not possible. Existing methods, such as activity-based costing or process costing, aim for a cause-related allocation of costs, particularly indirect and overhead costs, to products. Because required data for the cost model has to be collected manually, existing approaches are extremely time consuming, costly and do not represent the current cost status. The increasing digitization and use of business information systems in companies provide new capabilities to get cost-relevant data faster and increase the timeliness of the cost calculation. In this paper, a method to calculate and allocate the complexity costs to related products is provided. The method makes use of data in different information systems which is analyzed and structured by process data mining. Thus, the effort for the calculation of complexity costs should be decreased and the transparency and timeliness should be increased.

**IEEM19-P-1135**

**Forecasting the Diffusion of New Competitive Technologies Based on Evolutionary Game Theory:**

**Battery Electric Vehicle and Fuel Cell Electric Vehicle**

Yoonjeong LEE, Dook-Joo LEE

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As the speed of technology development increases, technologies that can be substituted for the others appear simultaneously. This paper suggests the model that analyzes the diffusion of each technology economically in terms of the interaction between consumer and producer when there exists competition between new technologies. We construct the agents' payoff regarding value like profit and cost and figure out the dynamic of the equilibrium with modeling the situation based on the evolutionary game theory. We also apply the case of Electric Vehicle(EV) and Fuel Cell Electric Vehicle(FCEV) to this model. We set the payoff with respect to the economic value including vehicle price, production cost, operation cost and the degree of infrastructure construction, which affects the adoption of vehicle in the point of view of the agents, and estimate the impact of the government support with regard to subsidy and infrastructure and change of each vehicle's property like V2G application on EV.

**IEEM19-P-0507**

**Calculation and Allocation of Complexity Costs Using Process Data Mining**

Michael RIESENER, Christian DÖLLE, Alexander MENGES, Günther SCHUH

RWTH Aachen University, Germany

Over the last years, manufacturing companies extended their product portfolio and derived numerous variants of their products. To make strategic decisions regarding the product portfolio, it is essential to know the costs for each product and each product variant. The exact allocation of the indirect costs in a company to the products that cause them is thereby often not possible. Existing methods, such as activity-based costing or process costing, aim for a cause-related allocation of costs, particularly indirect and overhead costs, to products. Because required data for the cost model has to be collected manually, existing approaches are extremely time consuming, costly and do not represent the current cost status. The increasing digitization and use of business information systems in companies provide new capabilities to get cost-relevant data faster and increase the timeliness of the cost calculation. In this paper, a method to calculate and allocate the complexity costs to related products is provided. The method makes use of data in different information systems which is analyzed and structured by process data mining. Thus, the effort for the calculation of complexity costs should be decreased and the transparency and timeliness should be increased.

**IEEM19-P-0295**

**Benefits Management in Infrastructure Projects: Towards a Best Practice Framework**

Supriya MEHTA1, Senevi KIRIDENA2

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Realization of project benefits is considered to be a reflection of project success and is therefore directly linked to organisational performance. However, the failure of projects to achieve their expected outcomes continues to remain a concern, particularly for publicly funded projects. An emerging body of literature suggests that the assessment of a project's capacity to deliver organizational outcomes should be considered within the broader context of 'project benefit realisation' or 'project benefit management'. This paper first develops a conceptual framework capturing the various elements and perspectives of project benefits management applicable to infrastructure projects, and then validates it using empirical data drawn from multiple sources within public sector infrastructure organisations. The findings indicate that pursuance of the proposed framework could support the delivery of improved project outcomes. The empirical evidence further suggests that although the framework holds merit and is well received by project management professionals, its adoption would entail a significant cultural shift in organisations.

**IEEM19-P-0284**

**Factors Affecting Customer Acceptance of Mobile Payment**

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With the popularity of smartphones and the development of wireless networks, payment methods have progressively changed. The mobile payment method is gradually accepted by some consumers as a product of rapid development of technology. However, the real mobile payment era has not yet arrived. This paper studies the factors and causes that hinder the development of mobile payment through some related representative research articles in recent years. The research results show that mobile payment acceptance is driven by the development of a more secure and easy-to-use mobile payment platform.

**IEEM19-P-0451**

**Exploring Followers’ Intention of Donating Online Game Streamers**

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Online game livestreaming is an emerging industry. Followers’ donation is major source of live streamers’ income. The reactions induced by the immediacy and interactivity of online game livestreaming are critical to viewers’ engagement in such livestreams. This study explores viewers’ intention of following and donation toward streamers of online game livestreams, by considering characteristics of the livestreaming context, streamers, as well as viewers’ feelings and perceptions. Results from analyzing data collected by online survey show that the relationship among loyalty, intention to follow, and intention to donate is significant. Value co-creation and flow experience are the main factors promoting viewers’ loyalty. Enjoyment indirectly affects loyalty through the flow experience. The influence of user engagement, media richness, social interaction, and expertise on value co-creation and flow experience is as our expectation. But social interaction and expertise are not as important to viewers. Academic and practical implications are discussed further.

**IEEM19-P-1151**

**Industrie 4.0 in Practice: An Empirical Study in Germany and Taiwan**

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Industrie 4.0 means the application of digital technology to the value-added process as well as the digital transformation of industrial enterprise. Today, some sustainable enterprises are using information and communication technologies for the development of data-driven processes and so as to achieve a future orientated business models. However, this does not seem to be the case in all companies. Especially small and medium sized businesses are overextended. This paper developed a systematic model for the evaluation of Industrie 4.0 evidences in practice. Based on this Industrie 4.0 model, an empirical study was executed, in which the evidences from 330 cases in Germany, and 560 cases in Taiwan were analyzed. In this study, one may find the different maturity level of manufacturing industries in Germany and Taiwan, meanwhile the manufacturing industries in European and Asia have their different spectrum and focus refer to Industrie 4.0. Findings of this paper can support knowledge exchange as well as the digital transformation of manufacturing companies.
Environmental Impact of Last Mile Deliveries and Returns in Fashion E-Commerce: A Cross-Case Analysis of Six Retailers
Regina VELAZQUEZ, Stanislav CHANKOV
Jacobs University Bremen, Germany
The convenience of shopping online has changed the way consumers buy pieces of clothing – getting fast deliveries of multiple items in various colors and sizes and returning the ones they dislike. Unfortunately, this comes with a rise in shipping volumes, in terms of both last mile (LM) and returns, which ultimately carries negative externalities on the environment. Thus, the purpose of this paper is to analyze the environmental impact of fashion e-commerce LM deliveries and returns, identify improvement opportunities and derive initial recommendations for greener practices. Conducting a cross-case analysis on six retailers, we conclude that the environmental impact from LM deliveries and returns deserves a higher priority for it is rapidly growing. While large firms execute numerous green initiatives and involve their logistics service providers, their increasingly high return rates create large negative impacts on the environment. Smaller companies, on the other hand, demonstrate little initiative and interest in investing efforts to improve their environmental impact even though these may result in higher economic returns.

E-Commerce: Stock Market Analysis Blended With Mining and Ann
Yan-Ling CAI1, Kumar KANNAN1, Yan-Hang XIE1, Liang ZHAO1
Zhejiang University, China
Wolver Institute of Technology, India
Ever since the advent of the financial industry, experts have attempted to create systems to track and analyze trends in the stock market. These systems have not suitably predicted future trends, limiting the advice given to consumers. Expert opinions are subject to human error and personal bias, which can potentially lead to financial losses to the consumer. Thus, a system devoid of personal bias, providing an accurate prediction is highly beneficial to the consumer, the broker and the corporations involved in financial markets. Such a system, coupled with the automatic trading system, will optimize transactions leading to overall economic growth. The proposed system performs as a basic I/O system. The input is the historical market data, and the stock to be predicted. The output is the recommendation on whether to buy or sell the stock and supplemental graphs to aid the consumer. The key modules of the system are the capture, analysis, search and visualisation modules. These feed into the prediction module, which uses the concept of mining based Artificial Neural Networks (ANN) to provide a reliable recommendation. Finally, all these modules represented to the consumer with webpage based convenient format via home screen.

A Case Study on the Replacement Policy for a Fan System of Sugar Industry
Huy TRUONG-BA, Michael E. CHOLETTE, Lin MA, Geoff KENT
Queensland University of Technology, Australia
In sugar production, the vacuum pans used for crystallisation constitute one of most important systems and replacement costs are a significant capital expenditure. The maintenance strategy for pans, involving the use of total productive maintenance (TPM) tools as the internal and external factors affecting a company. The proposed methodology can be applied to small and medium-sized manufacturing industries with different production lines. As a result of its application, the number of non-compliant batteries was reduced by 30%, machine efficiency increased by 3.00%, and the mean time between failures was reduced by 19.86%.

A Bayesian Estimation Method for Storage Reliability Based on Drift Brownian Motion
Xueming YANG; Shunning ZHANG; Honglin WANG
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At present, many products have the characteristics of “long-term storage, one-time use”. Therefore, evaluating the storage reliability of products has become a hot topic. However, for products that are stored for a long period of time, it is difficult to determine the distribution of the product life due to lack of using data, so it is considered to analyze the storage reliability from the viewpoint of the amount of performance degradation. The performance degradation process as a continuous random process can be described by the drift Brownian motion. In view of the long storage time, variable stress accelerated experiments are usually used to obtain degradation data. The data under different stresses need to be integrated in order to calculate the final estimation value of parameters, which will inevitably cause errors in the process of the integration. The Bayesian method is an estimation method that considers prior information, thus it can be applied to the integration process of data under different stress conditions. The parameter estimation obtained under the previous stress is used as the prior information of the parameter distribution under the next stress, so as to maximize the use of experimental data to reduce the estimation error. Then, the final value of the acceleration model parameters is fitted to evaluate the storage reliability and life of the product. In the case, the solder joint is taken as the research object, and the storage reliability is evaluated by the degradation of the shear strength. The feasibility of the method is demonstrated by the application of the solder joint case.
assessments. This has resulted in a significant level of ad hoc spare part recommendations, causing significant loss to asset owners. This manuscript firstly demonstrates current SPE&C practices in the petroleum industry. Secondly, it presents frameworks to standardize SPE&C tasks. Finally, it proposes inventory policies, based on consequence and unit cost, which provide an approach to compensate for ad hoc SPE&C tasks, to minimize SP-related losses to the assets’ owners.

IEEM19-P-0265
A Numerical Method for Wind Farm Condition-Based Maintenance Policy Assessment
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University of Alberta, Canada

The cost of wind energy is greatly affected by wind farm reliability and maintenance management. In this paper, we focus on condition-based maintenance (CBM) optimization for wind farms considering multiple turbines, while each turbine involves multiple components. In previous studies, economic dependency among multiple turbines and multiple components in a turbine were considered, and a simulation-based method was developed for wind farm CBM policy cost evaluation [1]. The simulation-based method was flexible in modeling various scenarios and factors, but due to its sampling-based nature, there are variations in CBM cost evaluation, and the resulting CBM cost function surface is not quite smooth. This could lead to a challenge in the optimization process and cause local minima or convergence problems. Thus, an accurate numerical method is desired. In this paper, a numerical method is proposed to assess the overall maintenance cost of the CBM policy. Therefore, the optimal maintenance policy corresponding to the minimum maintenance cost is more accurately determined compared to the simulation method.

IEEM19-P-0142
Maintenance Optimization of Consecutive-k-out-of-n System with Multi-objective Birnbaum Importance-based Particle Swarm Optimization
Zhigang CAI, Chongyang MA, Wei WANG, Pan ZHANG
Northwestern Polytechnical University, China

This paper focuses on the maintenance optimization problem of consecutive-k-out-of-n systems which are maintained through exchanging the position of components and improving the reliability of components. At first, the multi-objective maintenance optimization model is constructed based on comprehensive consideration of the system reliability and maintenance cost. Then, the relationship between component reliability and maintenance cost is discussed and introduced into the Birnbaum importance to establish the idea of multi-objective Birnbaum importance (MOBI). It is clear that the maintenance strategy based on MOBI was more effective than the maintenance strategy based on traditional Birnbaum importance. Thirdly, the MOBI-based particle swarm optimization (MOBI-PSO) method is proposed by taking the advantages of MOBI and particle swarm optimization. Finally, the MOBI-PSO is applied to solve the problem of multi-objective maintenance optimization for consecutive-k-out-of-n systems. The simulation results show that the optimization algorithm based on MOBI could make the system more reliable with lower maintenance cost after maintenance.

IEEM19-P-0141
Proposal of a Reconfigurability Index Using Analytic Network Process
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1University of Coimbra, Portugal
2Jiánu University, China
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This paper proposes a reconfigurability index. Its development is based on five core characteristics, namely modularity, integrability, diagnosis, adaptability, and superiority, and takes into consideration the interdependencies that may exist among them. The analytic network process (ANP) method is used to attribute importance weights to each characteristic. This index can be very useful in practice since it can guide manufacturing companies to a better understanding of the various enablers of reconfigurability, as well as in the decision-making process, to decide which core characteristic requires more attention, in order to further improve the reconfigurability in existing manufacturing systems.

IEEM19-P-0148
Approach for Implementing Industry 4.0 Framework in the Steel Industry
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The advancements of the Steel Industry require a fully integrated manufacturing and business system for real-time decision making. The main challenge in the Steel Industry is the disconnection between the shop floor systems such as Manufacturing Execution System (MES) and business systems such as Enterprise Resource Planning (ERP). The production process of Steel Industries requires visibility of operations, planning and scheduling, lead times, quality management, machine health, maintenance planning, to name but a few aspects. This study investigates current technologies and investments employed by steel companies and how to leverage these existing investments to attain a smart enterprise and subsequently manage current and future steel demands efficiently. Industry 4.0 simplifies the approach to implement complex systems in a structured and logical manner in manufacturing organisations. This paper deliberates the Industry 4.0 framework and the path to implement Industry 4.0 in the steel sector.

IEEM19-P-0078
Optimal Scheduling of the Reentrant Multi-Degree Cyclic Multi-Heist Scheduling Problem
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The current paper deals with the cyclic multi-heat scheduling problem in electroplating lines considering reentrance. Identical parts are produced with processing time windows. Moreover, re-entrance is also considered. These together make it more challenging to obtain better schedules improving the productivity. To achieve this, multi-degree cycles are considered. To our best knowledge, this is the first research in this generally complicated scenario. In order to maximize the productivity of the production line, i.e. minimize the cycle time for a given degree, operations of heists are first analyzed in detail to avoid their collision. Then, operations related the re-entrance are modeled. Based on these work, a mixed integer linear programming model is proposed. An industrial instances is used to test the proposed model. It is solved using the commercial software ILOG CPLEX. Results illustrate the efficiency of the proposed approach.
IEEM19-P-0529
How to Achieve the Supply Chain Performance of Small and Medium-Sized Enterprises?
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Small and medium-sized enterprises (SMEs) have long been the backbone and the focus of development in industrial countries. This study adopted the supply chain process perspective to investigate effects of the supply chain process on the supply chain performance of SME. To it, the supply chain mechanism of SMEs (comprising the production, transportation, and warehousing logistics and the service logistics) and three dimensions of the supply chain performance (capability of operations, flexibilities, and services) were modelled, and then an empirical study was executed in Taiwan. 277 samples were collected, and the SEM (Structural Equation Modelling) method was used to analyze the model. The results showed that the firm’s production, transportation, and warehousing logistics positively influenced the flexibility of the supply chain, whereas service logistics affected the operations and services of the supply chain. Findings of this study can be applied to the strategic supply chain configuration of SME.

IEEM19-P-0524
Solving the Twin Yard Crane Scheduling Problem in Automated Container Terminals
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This study focuses on scheduling twin Automated Stacking Cranes (ASCs) that collaborate to serve storage and retrieval jobs from opposite ends of a block. Since the ASCs cannot cross each other, there is a handshake bay that serves as a temporary storage location so that one crane can leave a job for the other to complete. A proposed mixed integer programming model that aims to minimize the time required to finish all jobs is formulated and solved. Four modes of crane interference that may occur at the handshake bay are taken into consideration. This paper is the first to investigate the effect of different handshake bay locations on the objective value when a task is split into jobs, and results show that the handshake bay location has no effect on the objective value if the task is split into jobs of equal number of size.

IEEM19-P-0131
Pricing the PHEV Considering CVs of the Same Model as PHEV
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When original equipment manufacturers (OEM) introduced conventional vehicles (CVs) into the market and put plug-in hybrid electric vehicles (PHEV) into the market again, it faces another pricing decision. First of all, OEM needs to decide whether CVs should be repriced at the same time as PHEV is priced, or whether the original CVs pricing should be followed. OEM then needs to determine the specific retail price of each vehicle. In addressing this pricing issue, this paper takes into account the differences in consumer preferences for traffic privileges and environmental consciousness, and establishes a two-dimensional characteristics space. The study found that whether enterprises reprice CVs is related to the original retail price of CVs. At the same time, corporate profits are affected by a variety of policy factors. In particular, a moderately high purchase tax can improve corporate profits.

IEEM19-P-1153
A Model for Inventory Management and Replenishment Policy for Automated Teller Machines in India
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We study a problem of managing the inventory of cash and replenishment policies for automated teller machines (ATM) which provides the service for deposit or withdrawal of the cash or both. The problem is envisioned as a multi-item, multi-period capacitated inventory routing problem with pick-up and delivery. A mixed integer programming model is formulated to minimize the total inventory, transportation and handling cost so as to meet the required service level at each node. Owing to the complexity of the problem, we propose decomposition heuristic and metaheuristics to efficiently solve the problem. The efficacy of the proposed approach is tested against the solution from Gurobi solver with the randomly generated problem instances.

IEEM19-P-1026
Fuzzy Customer Response Model in the Last Mile Logistics
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A large portion of logistics cost arises in the last mile which is the last point in the supply chain from the delivery center to the final customers. Since the profits are originally from the final customers, customer response or relationship is an important issue in the supply chain management. Thus, this study suggests a fuzzy customer response model in the delivery plan. Delivery plan may be changed in dynamic environments in urban area. Customers response these changes differently. We propose a model for the customer responses with fuzzy logic. The model provides the strategy to reduce the customer complaints and to increase the service level.

Keywords - Customer response, Fuzzy logic, Last mile logistics, Delivery plan.
IEEM19-P-0045
Multigene Genetic Programming Based Fuzzy Regression for Modelling Customer Satisfaction Based on Online Reviews

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As markets become increasingly competitive, most businesses have adopted modern practices that helps them to enhance the competitiveness of their products. Such practices involve the use of internet though which companies gain insights into the concerns of their customers. For instance, the proliferation of e-commerce websites has enabled consumers to voice their opinions on the products they have purchased. This study proposes a methodology for modelling customer satisfaction (CS) based on online reviews using a new multigene genetic programming based fuzzy regression (MGGP-FR). Polynomial structures of CS models were developed by employing the multigene genetic programming method. The fuzzy coefficients of the polynomial structures were then determined using the fuzzy regression analysis. The proposed method was illustrated using an electronic hair dryer as a case study. The validation test results indicated that MGGP-FR outperformed the genetic learning techniques. This study applied support vector machine (SVM) of machine learning technique compared to regression analysis of traditional technique. The SVM is applied to forecast South Africa’s energy consumption of five subsectors (manufacturing, basic non-ferrous metals, basic iron and steel, non-metallic minerals and basic chemicals), with activity, structure and intensity as inputs whereas energy consumed was the output from 1970 to 2016. In contrast to the traditional technique, results confirmed SVM to be a better modelling system in terms of visual inspection (Figures 2 and 3) and statistical measures of performance in Table 1 (correlation coefficient, RMSE and RBSE).

IEEM19-P-0077
A Review on the Implementation of System Modelling Techniques in Lean Healthcare Applications

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Healthcare systems are under enormous pressure to improve efficiency and quality of care due to increasing cost and demand. To address such challenges, there is an increasing awareness on the utilization of lean tools in healthcare settings aimed at minimizing wastes in operational processes. A potential approach that can be integrated with lean tools is System Modelling Techniques (SMTs), to help identify comprehensive list of wastes in a systematic way. To investigate the relationship between lean tools and SMTs, this paper reviews the literature in the field and provides a conceptual framework for potential link between these two complementary approaches. The results of the proposed framework is quite valuable for healthcare quality and process improvement managers.

IEEM19-P-0080
The Energy-Efficient and Environmentally-Friendly Vetiver-Polyurethane Thermal Insulation Foams

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This experimental research investigates the thermal conductivity and mechanical properties of the rigid thermal insulation foams fabricated from mixtures of vetiver fibers (VF) and the polyurethane (PU) composites. The vetiver fibers were of three mesh sizes (100, 150 and 200 mesh) and the VF concentrations were varied from 0%, 5%, 10%, 15%, 20%, 25% to 30% w/w. The results revealed that the VF influenced the density, thermal conductivity and mechanical properties of the VF-PU foams. Specifically, the foam density was inversely correlated with the VF concentration, while the thermal conductivity and the VF content were positively correlated. The increase in the VF content contributed to the deterioration of the mechanical properties because of the development of large closed cells. The results also showed that the 200-mesh VF was the optimal mesh size due to the lowest thermal conductivity. In fact, all the experimental VF-PU foams meet the ASTM C 208 standard, indicating the prospects of mixing the vetiver fibers with polyurethane to produce the environment-friendly thermal insulation foams.

IEEM19-P-0104
Predicting Industrial Sector’s Energy Consumption: Application of Support Vector Machine

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To follow in Europe’s footsteps in minimizing emission rate, much concentration should be on Africa’s industrial energy consumption. South Africa’s industrial sector is contributing immensely to the country’s economic growth of which energy plays significant role. To reduce its consumption will mean planning accurately. Forecasting techniques have gained grounds when it comes to planning accessibility to energy demand to prevent incessant increase in emission rate. These techniques include traditional and machine learning techniques. This study applied support vector machine (SVM) of machine learning technique compared to regression analysis of traditional technique. The SVM is applied to forecast South Africa’s energy consumption of five subsectors (manufacturing, basic non-ferrous metals, basic iron and steel, non-metallic minerals and basic chemicals), with activity, structure and intensity as inputs whereas energy consumed was the output from 1970 to 2016. In contrast to the traditional technique, results confirmed SVM to be a better modelling system in terms of visual inspection (Figures 2 and 3) and statistical measures of performance in Table 1 (correlation coefficient, RMSE and RBSE).

IEEM19-P-0105
Analysing Impacts Responsible for South Africa’s Energy Consumption: LMDI Application

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Industry participation is pivotal to the economic growth of any nation. However, its energy demand, if not managed can cripple the economy. South Africa recently experienced load shedding resulting in the decreased of manufacturing and mining outputs among others dragging down the economic growth. This study focused on understanding those factors responsible for the energy consumption in the following industrial sub-sectors: basic chemicals, non-metallic minerals, basic iron and steel, basic non-ferrous metals and other manufacturing industries, between 1994 and 2016 through the application of Logarithmic Mean Divisia Index (LMDI), a form of Index Decomposition Analysis (IDA). These factors are the activity, structure and intensity. Among the three factors, activity was the most responsible for the increase in the amount of energy consumed whereas intensity factor contributed to minimizing energy consumption. Structural effect contributed minimally to the consumption of energy. The results implied concentrating more on policies that would affect the activity effect.

IEEM19-P-0120
On Fusing Multiple Instance Selection Results

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Instance selection is an important pre-processing step in data mining. Its aim is to filter out unrepresentative data samples from a given training dataset, which allow the classifier to perform better than the one without instance selection. Since various instance selection algorithms have been proposed in the literature, no study considers applying the information fusion principle to combine multiple instance selection results. This paper uses three well-known instance selection algorithms, which are IB3, DROP3, and GA, and their selection results are combined via the union, intersection, and multi-selection algorithms, which are IB3, DROP3, and GA, and their selection results are combined via the union, intersection, and multi-intersection strategies. Our experimental results based on 50 various domains of datasets show that the union between GA and DROP3 performs the best. However, it does not produce the largest reduction rate. On the other hand, if both classification accuracy and reduction rate are considered, the union between DROP3 and IB3 is the better choice.
combinations. It is also worth noting that single activation function applied to combine the strengths and create a new model or classifier. kinds of classifiers, the method of weighted combinations can be prediction, comprising of weighted arithmetic, geometric, harmonic, contra-harmonic, and cubic combinations. When there are several kinds of classifiers, the method of weighted combinations can be applied to combine the strengths and create a new model or classifier.

That is, weighted combination method(s) would be able to combine the advantage of different activation functions to train the neural network in deep learning. Six open-source projects are used to evaluate the performance of weighted combination methods of activation functions: single, double- and triple-weighted approaches. Our experiments show that double-weighted combinations of activation function outperform single and triple-weighted combinations. It is also worth noting that single activation function outperform triple-weighted combination.

A Semi-Supervised Approach for Steam Turbine Health Prognostics Based on GAN and PF
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Steam turbines are indispensable part of power plants, they will cause serious impact once fail. Health prognostics is an effective technology to keep steam turbine in healthy condition and avoid unnecessary losses. This paper proposed a semi-supervised framework for health prognostics on steam turbines. The framework is based on Generative Adversarial Networks (GAN) and Particle Filter (PF). In this framework, anomaly detection and remaining useful life (RUL) prediction are conducted. During anomaly detection, a health index (HI) is constructed to indicate steam turbine operation conditions and an anomaly threshold is used to detect anomalies. During predicting the RUL, an approach based on PF is employed to predict the RUL. Real case are demonstrated to validate the effectiveness of the proposed framework. Results indicate that the proposed framework has good performance on anomaly detection and RUL prediction.

Use Text Mining to Abstract Affective Words in the Dream Log to Assist Dream Consultation
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This study analyzes affective expression in dream log by text mining, guide participants focusing on the affective words in their dream log to release their emotions. This study provided a new method for exploring the correlation between dream and stress in psychology research area, and improved the application of knowledge management by text mining for dream log. The results show that teacher or counselor can improve their consultation by feeling empathy with the affective words in the dream log those emotions be ignored in previous consultation but picked from dream log by artificial intelligence.

Influences of Parenting Style and The Teacher-Student Relationship on Self-Directed Learning of High School Students: The Mediating Effect of Core Self-Evaluations
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The paper takes the high school students as the research object, discusses the factors influencing the self-directed learning of such a special group, selects 306 high school students from Yunnan Province and Xiamen City, studies the relation between the students’ parenting style, the teacher-student relationship and the students’ self-directed learning by means of questionnaire survey, explores the mediating effect of the core self-evaluations therein, and conducts the data analysis with softwares SPSS22.0 and AMOS22.0. The results of the study confirm the psychological mechanism that the parenting style and the teacher-student relationship do have an influence on the self-directed learning of high school students and that the core self-evaluations plays a partial role in mediation of their relation, which have proposed some suggestions on the high school students’ self-directed learning.

Knowledge Discovery and Data Visualization for Taiwan Stock Market: Using F-Score Analysis
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This study examines the performance of stocks investment portfolio by using accounting information. The sample is selected from Taiwan Economic Journal to test F-SCORE cooperating with Dividend-to-price ratio, Earnings-to-price Ratio and Book-to-Market respectively. The sample period is from May, 2008 to May, 2018. The findings of this study are as follows. First, if we choose Dividend-to-price ratio, Earnings-to-price Ratio or Book-to-Market to distinguish from the value and growth portfolio, the value portfolio is significantly better than the growth one. Second, if we choose F-SCORE to distinguish from high and low score, the high score portfolio is significantly better than the low score one. The result showed that when the investor use Dividend-to-price ratio, Earnings-to-price Ratio or Book-to-Market together with fundamental financial information, they could become more profitable or more effectively improve the performance.

The Application of FANP and BOCR in O2O Service Model for Sports-product Retailers
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The competition of sports-product retailers is getting fierce because of the progress of electronic commerce. It poses a great challenge to make a good decision for sports-product retailers to incorporate O2O service model to their business model. In this study, FANP with BOCR are applied to construct an O2O service model for sports-product retailers. In this O2O service model, experts’ opinions are collected and aggregated in evaluating O2O implementation alternatives. A case study of a sports-product retailer is used in evaluating the most suitable service model for the retailer when plan to introduce O2O service into their business model.

Assessing Stakeholder Preferences in Urban Planning – A Multi-Attribute Utility Approach
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In urban planning, decision makers often need to take a variety of aspects into account, including stakeholder attitudes. The purpose of this paper is to compare how decision makers and the public assess different criteria in an urban planning project. The study was carried out through interviews and a survey about an urban planning project. By compiling data using multi-attribute utility theory, it was possible to reveal similarities and differences between the decision makers and the public. The findings reveal that the perceived value of the project differed greatly between these two perspectives. The public’s opinion was closer to a status quo perspective, while the decision makers were more optimistic about the project. While some of the
differences can partly be explained by uncertainty about the project and the criteria, the results reveal the importance of including the public in an early stage of these initiatives. Furthermore, the multi-attribute utility approach is a useful tool for compiling assessments, but additional data is needed for gaining further understanding of stakeholder preferences. Therefore, a mixed-methods approach to collecting stakeholder preferences is suggested.

IEEM19-P-0192
A Fuzzy-AHP Approach for Strategic Evaluation and Selection of Digital Marketing Tools
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The prevalence and rapid development of the Internet and mobile technology in recent decades has revamped our living styles and daily habits. To ride on the digital trend, more business activities have been engaged in the digital world. Marketing and advertising is one of typical business areas that is transformed digitally. The rise of Key Opinion Leaders (KOLs), social media platforms, and Omni-channel retailing have attracted countless business entities to consider the adoption of digital marketing tools for promoting and advertising their brands and products. However, with the increasing diversity of the types of digital marketing tools, they must be carefully selected based on a multiple number of criteria. In this paper, a fuzzy-AHP method is proposed and developed for assisting industry practitioners in systematically and effectively evaluate and select proper digital marketing tool(s) for adoption. The developed method not only streamlines the internal business process of digital marketing tool selection, but it also increases the practitioner’s effectiveness of achieving the pre-defined strategic marketing objectives.

IEEM19-P-0195
Optimal Control of Blank Holder Force Based on Deep Reinforcement Learning
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In deep drawing, reasonable control of blank holder force is the key to the quality of finished products. Traditional blank holder force control methods often need to model the highly non-linear deep drawing process. Because it is difficult to obtain an accurate system dynamics model, the results of traditional methods deviate from the actual situation. In this paper, a blank holder force control model based on the integration of deep reinforcement learning and finite element analysis is proposed. The blank holder force control policy is optimized by combining the perception ability of deep neural network with the decision-making ability of reinforcement learning, which avoids the fitting of system dynamics. Firstly, an algorithm of blank holder force optimization based on deep reinforcement learning is proposed. The deep neural network is used to deal with the large state space. Secondly, by using a new network structure to construct the policy network, the blank holder force policy is divided into global part and local part, which effectively improves the control effect of policy. Experiments show that the proposed control model can effectively optimize blank holder force control policy and improve product quality compared with the traditional deep reinforcement learning algorithm.

IEEM19-P-0196
Wafer Map Defect Recognition Based on Deep Transfer Learning
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Due to the complexity and dynamics of the semiconductor manufacturing processes, wafer maps will present various defect patterns caused by various process faults. Identification of wafer map defect patterns can help operators in finding out root-causes of abnormal processes, and then ensures that the manufacturing process is restored to the normal state as soon as possible. This paper proposes a wafer map defect recognition (WMDR) model based on integration of deep transfer learning. Our model reduces the training time and improves feature learning performance of DenseNet. In addition, the recognition algorithm based on transfer learning can solve the problem of class imbalance in the WMDR task.

IEEM19-P-0200
Evaluating Leadership Fuzzy Comprehensive of College Students Based on Triangular Fuzzy Number
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With the rapid development of the global economy and the increasingly fierce employment market, modern society has higher requirements for managers’ leadership and comprehensive quality. College students, as the main force of enterprise leaders, plays a decisive role in the future development of enterprises. The leadership evaluation of college students refers to the process of comprehensively using scientific and reasonable evaluation methods, study the actual situation of college students’ leadership, make objective and effective evaluation results, and ultimately promote students to improve their own leadership ability and the quality of comprehensive quality of higher education. This paper mainly focuses on the central proposition of leadership evaluation of college students. The main research work is as follows: (1) construction of leadership evaluation index system for college students. (2) This paper completes the construction of the fuzzy comprehensive evaluation model of college students’ leadership based on triangular fuzzy number analytic hierarchy process, and the case study of the leadership evaluation of college students.

IEEM19-P-0203
Research on Classification of Logistics Equipment Based on Rough Set
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Logistics Equipment (LE) is concerned with decreasing management costs and operational losses for by developing a logistics equipment classification model. In this paper we developed an initiatory index system of LE classification based on literature review and expert interview. Through rough set theory, we conducted a logistics equipment classification model which filtrated the original index system and extracted the LE classification rules. Additionally, a case analysis was used to verify the validity of the classification model. Results indicated that the LE classification model provides support for enterprises to improve the management performances of logistics equipment.

IEEM19-P-0207
A Bluetooth Location-based Indoor Positioning System for Asset Tracking in Warehouse
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In recent year, with the development of mobile device and wireless communication, the concept of Internet of things (IoT) emerges and extensive research and development of IoT application enables the real-time indoor localization for asset tracking through wireless sensor network. Many studies have focused on the positioning technology using Global Positioning System (GPS), Radio Frequency Identification (RFID) and ZigBee, but little attention has been paid on the industrial application of low-cost Bluetooth location-based indoor positioning system in asset localization. In this paper, a Bluetooth location-based indoor positioning system is proposed for warehouse asset tracking purpose to achieve a cost-effective asset management solution.

IEEM19-P-0236
Application of SIRI for Industry 4.0 Maturity Assessment and Analysis
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Smart Industry Readiness Index (SIRI) is one of the Industry 4.0 maturity models that help industrial companies to identify the opportunities moving towards Industry 4.0. SIRI is strongly aligned with other global manufacturing initiatives, and has the potential to be one of the global standards for the future of manufacturing Industry 4.0. However there is little literature found on applications of SIRI due to it is a relatively new model released in 2017. This paper discussed the methodology and processes of applying SIRI to help companies to identify the gaps and opportunities moving towards industry 4.0. For illustration purpose, four pillars, i.e. Operations, Automation, Connectivity and Intelligence, are selected to illustrate
the methodology and processes for assessing the respective dimensions. The designed rubrics with questionnaire to facilitate the processes and methodology are demonstrated with examples.

IEEM19-P-0237
Concept and Implementation of a Cyber-Physical Digital Twin for a SMT Line
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This paper conducted research on the concept design and implementation of a cyber-physical digital twin system for manufacturing. Based on literature reviews and industry requirements for a cyber-physical digital twin system for manufacturing, this paper proposed a concept design architecture of a cyber-physical digital twin system and its implementation methodology. An application of building a cyber-physical digital twin system for a Surface-Mounted-Technology (SMT) line is illustrated based on the proposed concept and framework. The basic requirements of the proposed cyber-physical digital twin system are divided into three layers, i.e. operations layer, visualization layer, and intelligence layer. Operations layer is about systems modeling of the physical processes and establishing connections with the cyberspace. Visualization layer is related to the collection and displaying of the historical and present data in a visual manner. The intelligence layer is the ability to conduct data analytics and decision making to identify patterns and bottlenecks, reduce waste, perform predictive maintenance, etc. A proof of the concept prototype is developed based on the proposed cyber-physical digital twin system for a SMT line.

IEEM19-P-0242
Knowledge Discovery Through the Machine Learning of Farming Parameters and Yield Performance
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To enhance the food security of Singapore, the project reported in this article investigated the use of machine learning techniques for yield enhancement of food production. A concept of a knowledge discovery system is proposed, which are general enough to cover agricultural activities ranging from crop farming to fish farming. This paper presents an example of crop farming using the concept, including the system layout, system prototype and a simulated experiment.

IEEM19-P-0245
A Simulation-based Dynamic Spatial Scheduling Method of Block Assembly in Shipbuilding
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With the application of module-shipbuilding technology, problems of block spatial scheduling occur in lots of shipyards, and this restricts the productivity of shipbuilding. To address the problems, a simulation-based spatial scheduling method is proposed, which considered influence factors and contained new piecewise dynamic spatial scheduling strategy adjustment. Through the system we developed, the visual results of daily block layout and process chart can be easily obtained. The proposed system is tested with real examples that demonstrate the potential for use in a real block assembly workshop.

IEEM19-P-0248
Cyber Physical Production Systems: A Review of Design and Implementation Approaches
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Cyber Physical System (CPS) is a very crucial and promising technology in Industry 4.0 context. The application of CPS in the production and manufacturing environment gave rise to the term Cyber Physical Production Systems (CPPSs). CPPSs hold great potential to make production systems become intelligent, resilient and self-adaptive by utilizing the cyber world to realize the distributed collaboration in the physical world. There is growing interest in CPPSs, yet there is a scarcity of review to document the current status of CPPSs. This review aims to classify the current research activities within CPPSs field with a special focus on design and implementation approaches in view of industrial engineering and to analyze research gaps based on the literature review. Findings of this review can be used as the basis for future research in CPPSs and related topics.
cognition is relatively weak. This result shows that the design of water-saving equipment based on artificial intelligence are saving equipment should give priority to emotional appeals, and the service for the designer, supply chain collaborative management services for various roles in the construction industry, such as project collaborative management, building supply chain management, building process of construction from four aspects of building collaborative service models. It develops modules of services covering the whole service function module of construction industry, innovates various things, among others. Cost reduction and modeling are often studied, but related literature lacks the basic indication of common maintenance costs throughout process manufacturing. This paper departs a literature review on such maintenance costs, defines clusters for easy identification of factors, tries to identify the magnitude of such costs and provides insights on gaps in the literature.

Collaborative Construction Industry Integrated Management Service System Framework Based on Big Data

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The collaborative multi-process and multi-service integrated construction industry management service system framework based on big data proposed in this study, focuses on the big data intelligent decision-making service of construction industry based on integrated management, builds a big data intelligent decision service platform for construction industry based on integrated management, develops multi-process integrated management service function module of construction industry, innovates various service models. It develops modules of services covering the whole process of construction from four aspects of building collaborative design management, building supply chain management, building project collaborative management, and hardship personalization. It also provides innovated, efficient, networked and personalized services for various roles in the construction industry, such as mobile-oriented service for an engineer, design selection decision service for the designer, supply chain collaborative management service for the supplier and others.

An Object-Based and Attribute-Oriented Method for Deciding the Effect in Product Development Lifecycle

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This study explore the emotions, behaviors, and cognition of people when using water-saving equipment by investigating the use of three kinds of faucets. We conduct a questionnaire based on the ABC (affective, behavior, cognition) model of psychology. The results show that the public’s acceptance of water-saving faucets is mainly influenced by emotions factors. The impact of water-saving cognition is relatively weak. This result shows that the implementation of water-saving activities and the design of water-saving equipment should give priority to emotional appeals, and the design of water-saving equipment based on artificial intelligence are more popular.

Maintenance Costs in the Process Industry: A Literature Review

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Maintenance costs in the process industry have changed considerably in the past years due to technological advancements such as increase in automation, Industry 4.0, Big Data, Internet of Things, among others. Cost reduction and modeling are often studied, but related literature lacks the basic indication of common maintenance costs throughout process manufacturing. This paper departs a literature review on such maintenance costs, defines clusters for easy identification of factors, tries to identify the magnitude of such costs and provides insights on gaps in the literature.

An Exact Formulation for Multi-workshop Facility Layout Problem with Clearance Bounds

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An innovative multi-workshop facility layout problem is developed and investigated in this paper, which involves the placement of a series of departments into several workshop floors, meanwhile the clearance bounds among departments are also considered. In addition, the internal and external logistics costs are taken into account, both constitute total material handling cost. In order to solve the problem, a mixed integer linear programming model is formulated with minimizing objective of material handling cost. The model proposed in this paper is also able to present the unequal-area facility layout problem and special multi-floor facility layout problem. Finally, several benchmark instances that match our problems are selected and solved using CPLEX software, and the best layouts of them are obtained.

User Classification in Electronic Devices Using Machine Learning Methods

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User classification is a major concern for electronic device providers, because accurate and efficient classification can cut operating cost of company significantly. To deal with this problem, manufacturers try to classify customer into several categories and recognize the characteristic of users, then adopt different promotion strategies to improve sales revenue. This study aims to build models to divide users into several categories, and identify critical and controllable features which dramatically affects classification results. We test proposed models with real data coming from an electronic device producer. Results shows that random forest model performs best. Our main contributions are: 1) we focus on user classification of electronic devices; although a few studies have discussed similar problem, few of them focus on applications in electronic devices; 2) we consider imbalance sample, and datasets are from real company. This work will be helpful for electronic device producers to improve operation and enhance marketing competitiveness.
IEEM19-P-0455
A Fault Location Method Considering Distribution Network Partition Based on Deep Learning
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In this paper, a fault location method considering distribution network partition based on deep learning is proposed, in which the Tensorflow framework is employed to establish and construct the fault location model of the distribution network. This method first collects the current and voltage data to form fault data vectors through the Feeder Terminal Unit. Combined with the complex network theory, each node degree is calculated to represent the node priority, and the topology of the distribution network is partitioned to form each regional model. Secondly, it builds a feature extracting network and a Deep Neural network to mine the mapping relations between fault data vectors and fault sections and form the final fault location model through training. Case studies show that compared to the back propagation (BP) neural network model and the support vector machine (SVM) model, the deep learning model has faster convergence speed and higher fault location accuracy.

IEEM19-P-0467
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This paper develops an assessment framework of national quality infrastructure efficacy (NQIE) which represents a new quality management paradigm for stakeholders and quality managers. The basis is to decompose the complex concept of NQIE into several portions and then integrate portions together with multi-criteria decision analysis method to assess NQIE. The constructed NQIE assessment framework was applied to a case study in Zhejiang province, China for validation. The results showed that NQIE construction in Zhejiang province had achieved great progress with continuous growth. Meanwhile, the contribution analysis of each common success factor of general NQIE, and therefore taking measures to improve NQIE.

IEEM19-P-0472
Identification of Key Success Factors in Intelligent Manufacturing Enterprises
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The purpose of this paper is to explore the consistency between cognition and behavior of energy-saving toward using energy-saving facilities via establishing a canonical correlation model between acceptance and attitudes toward using energy-saving facilities by conducting a questionnaire based on the ABC (Affective, Behavior, and Cognition) model. The results show that the proposed model has a good model fitness and there is a high canonical correlation coefficient between acceptance and attitudes while people using energy-saving facilities. Besides, affecting factor should be given priority when designing energy-saving facilities. That is while planning an energy-saving system, designing an energy-saving facility, developing a set of energy-saving education courses, and promoting energy-saving activities, considering affective factor will be more popular.

IEEM19-P-0450
An Efficient 2D Genetic Algorithm for Optimal Shift Planning Considering Daily-Wise Shift Formats: A Case of Airport Ground Staff Scheduling
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Owing to the computational efficiency in dealing with combinatorial optimization problems, the genetic algorithms (GAs) have been widely applied to human resource planning and scheduling. Shift planning is of particular importance for personnel scheduling when practical concerns must be taken into account. Daily-wise shift formats are often introduced in practical operations in order to facilitate execution of the planned tasks and accommodate certain managerial convenience. However, the highly repetitive nature of running daily-wise shift formats entails an extreme imbalance of set covering between the tasks and staff availability, which leads to tremendous computational challenges in solving the combinatorial optimization problem that is subject to large redundancy of zero elements. In line with the inherent two-dimensions of shift planning in terms of shift formats and days, this paper proposes a two-dimensional (2D) encoding scheme to implement the GA for efficient shift planning. An application to a real-life airport Ground Staff Scheduling (GSS) problem is presented to illustrate the feasibility and potential of the proposed 2D GA for efficient handling of daily-wise shift formats.
IEEM19-P-1006
Investigation Into Characterising Tensile Properties of FDM Ultem™ 9085 Parts
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In characterising additively manufactured materials, researchers often resort to using conventional standards for characterising plastics, such as D638 and ISO 527. In a previous study, it was found that different coupon geometries lead to very different mechanical properties for coupons printed using Fused Deposition Modelling (FDM) technique. In this investigation, several geometries of the tensile coupons are investigated to determine the possible reasons in deviation between the mechanical properties results. Several coupon geometries from the following standards are utilized for this investigation: ASTM D638 Type 1, ASTM D638 Type 2, ISO 527-2 Type 1A, ASTM D3039, etc. In addition, various methods of manufacturing the coupon, such as printing to net shape, machining specimens from a printed plate are investigated. Using Digital Image Correlation (DIC) methodology, the strain profiles of the coupons are compared to determine the location of high stress in the coupon, in an attempt to address the aforementioned deviations.

IEEM19-P-1024
Developing User Evaluation Technology Based on New Product Concepts
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It is important for Small and Medium-sized Enterprises (SMEs) to objectively grasp their internal capabilities in developing new products. We will present a methodology for analyzing competencies to achieve the desired product development by evaluating the company’s own capabilities in accordance with each activity class in Porter’s Value Chain, especially identifying user needs. This internal competency analysis is divided into presenting evaluation methodology guidelines and evaluation worksheets for SMEs to use in their work. Furthermore, user survey method, instant observation method, and SNS analysis method are suggested to create new customer experience values, which is also considering characteristics of SMEs with limited cost, observation time and observation place. As a result, each company is capable to evaluate whether each role of the value chain can perform its own role in promoting new product developments. Thus, this study can be used to objectively analyze internal capabilities of a current company through the internal competency analysis and evaluation methodology. Moreover, it will be helpful for the company to strengthen its own strategy compared to competitors by identifying distinguished characteristics of the products.

IEEM19-P-1032
Relationship Between Technological Innovation and Market Value in the Drug Industry
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This study investigated the relationship between technical innovation activities and market values in 24 drug companies, the components of NYSE ARCA PHARMACEUTICAL INDEX. We conduct a correlation analysis by using the dataset from USPTO and Datastream during 2009-2018 to obtain HFI and h index as the technological innovation performances and ROI and ROE as the market value performances in each company. The results showed that the accumulative h index growth rate was significantly positively correlated with cumulative ROI of the companies. Moreover, the study divided the companies into four quadrants on the basis of the patent index and discovered that companies in each quadrant differed in their technical characteristics and correlations between patent quality indicators and stock indices. Companies in the first quadrant should maintain their technological uniqueness and patent technological concentration. Companies in the second quadrant had high growth rate of the patent quality but low patent technological concentration; thus, they need to enhance technological diversity and reduce costs to match potential rivals. In the third and the four quadrants, companies have to improve technology continuously rather than expand or change the product market.

IEEM19-P-1038
Partial Coalitions in Collaborative Game Theory for Supply Chains with Two Manufacturers and One Common Retailer
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Most cooperative game theoretical approach assumes perfect competition or grand coalition for players in supply chains. However, partial coalitions may exist in practical situations. We analyze the equilibrium solutions for all possible coalition structures of the pricing problem for a supply chain consisting of two manufacturers and one common retailer. Equilibrium solution indicates that there are coalition externalities. We apply a partition function form (PFF) game to analyze profit allocation with coalitional externalities. We propose solution concepts for PFF games and partial coalition based on optimistic and pessimistic core, and optimistic and pessimistic Shapley values. From numerical example, it is demonstrated that optimistic and pessimistic core exist when the substitutability of products is decreased. The derived managerial insight indicates that high product substitutability leads to form unstable grand coalition because the core does not exist. The results indicate the proposed solution concepts are reasonable to analyze profit allocation of PFF games.

IEEM19-P-1040
Key Player and Core Team: A Collaboration Perspective
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This study proposes to assess a player (e.g., inventor, researcher) involved in collaboration works by how “important” the player is relative to all other players. From a play j’s perspective, a player i’s collaboration rate (CR) with player j is defined as CRij = ej|cij|, where cij = the number of works involving both players i and j. Then, the “importance” of the player i is determined by summing up his/her collaboration rates to all other players as follows: CRi = ∑CRij. In other words, a player is more “important” if he/she is a major collaborative partner to those collaborating with him/her. This study further defines collaboration strength (CS) between players i and j as: CSij = ej|cij|CRij. Then, players i and j have a strong collaboration strength if they are “important” relative to each other, and a core team is defined as those having pairwise CS above a threshold. That is, the members of a core team are mutually important to each other. In this study, the measures are applied to empirical data to see how they differ from conventional metrics and approaches.

IEEM19-P-1059
An Efficient Scheme for Monitoring Network Interactive Data
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With the development of Internet of Things (IoT) technology, increasing number of complex systems witness their components interacting with each other as nodes within a network. Recording the communicating acts of pairs of nodes can generate high-volume network interactive data. However, few charting techniques are available for online surveillance of them although it is useful for detecting anomalies in corresponding systems. This article proposes a novel control chart to monitor communication level of a network based on its interactive data. First, the communicating acts between each pair of nodes, called dyadic interactions, are characterized by a multimonial random variable. Second, we develop a charting statistic for each dyadic interaction based on generalized likelihood ratio test. Third, a nonparametric multivariate control chart is established to monitor all charting statistics simultaneously. Finally, simulation study and a practical example demonstrate the high efficiency of proposed monitoring scheme in detecting shifts of communication level within a network.
IEEM19-P-1060
Proposal of Adapted Day Reconstruction Method for Contextual Inquiry on Consolidated Financial Service

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In financial services, incorporating structure makes users to get various choices to use. Thus, financial service providers have to scrutinize more information when inquire user’s behavior. This study proposed an adapted Day Reconstruction Method (DRM) to gathering user’s financial service usage behavior. In adapted DRM, unit of usage cases, categories of usage steps and surroundings, and results of usage are defined to grasp context and enhance results of analysis. 12 questionnaire items are selected such as ‘Type of service’, ‘Constraints’, ‘Tool’, ‘Complains’, ‘Desired Solution’ and so on. 42 participants ages from 16 to 46 recorded their usage cases for one week. Several questionnaires such as ‘Type of financial service’, ‘Action’, ‘Tool’, and so on, set as categorical question. These categorical answers let results of quantitative analysis to be derived such as usage patterns. Descriptive statistics turned out financial service usage distributions and conditional probability turned out decision patterns and factors of decision. And text analysis base on context of use are derived. Through the adapted DRM, it seems to researchers could collect the context surrounding the choices and their needs.

IEEM19-P-1061
A Hybrid Correspondence Analysis to Explore Competitor Product Portfolio Strategy in the Dental Medical Device Industry

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This purpose of this study is to provide a hybrid correspondence analysis to explore width, length, depth of competitor product portfolio in the dental medical device industry. We used four indicators —number of product categories, the number of products, the activity index (AI) and the Herfindahl-Hirschman Index (HHI), to measure product portfolio of each firm. The research sample is 11,106 USA FDA’s 510(k) premarket product announcements of the year 2018. First, we classified 2592 firms into eight types of product analysis, in order to determine what is the core product of every firm in each group and who are the competitors adopting the similar product type in the Cluster 4 to 7. There are 2401 firms with average 1.9 products in Cluster 8.

IEEM19-P-1062
Collaboration in Taiwanese Patenting Activities: A Case Study on R&D of Nanotechnology

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Collaboration is a strategy applied by organizations to obtain complementary resources for research and development. Besides publishing papers, patenting is used to demonstrate research and innovation results, and co-patenting reflects the extent of collaboration among contributors of an invention. This study took patent bibliometrics approach to examine the patents in nanotechnology granted to Taiwan-based institutions by United State Patent and Trademark Office (USPTO) to identify the types of collaboration involved in development of nanotechnology in Taiwan, such as the level of cross sectors collaboration, knowledge flow in the research. The results show the high level collaboration between Hon Hai Precision Industry Co., Ltd. and Beijing Tsinghua University in the development of nanotechnology. From the inventor bases, this case demonstrates that Hon Hai Precision Industry Co., Ltd. was more like funding agent and Beijing Tsinghua University provided knowledge pool in the collaboration, academic sector outsourced knowledge to the private sector for the production of the inventions.

IEEM19-P-1063
Reliability and Validity of Arduino EMG System

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Research using EMG has been widely used for musculoskeletal studies. There are needle EMG methods for inserting needles into muscles and surface EMG methods for attaching electrodes to skin surface. Surface EMG measurement method is most widely used for various reasons such as ease of use and hygiene problem. Although there are ready-made devices for measuring EMG, recent studies have been conducted to measure EMG using arduino, but the reliability and validity of arduino-based EMG measurement has not been achieved. The purpose of this study is to verify the reliability and validity of arduino EMG measurement equipment by comparing the existing EMG measurement equipment and arduino EMG system which are widely used in EMG measurement research. The maximum grip strength was measured three times for each subject in the standardized sitting posture presented by ASHT using the MFFM(Multi Finger Force Measurement) system. When EMG exerts its grip force, EMG from flexor carpi radialis and extensor digitum of forearm is measured by using ready-made EMG equipment and arduino EMG equipment. The measured EMG is analyzed through the same process. The results of the analysis are analyzed through statistical analysis through SPSS.

IEEM19-P-1064
Interorganizational Fraud Management - A Measurement Tool Development

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Interorganizational fraud is a critical component of supply chain fraud and supply chain relational risk. Despite being largely a hidden phenomenon, interorganizational fraud can have major implications for supply chain performance. To date, this area of risk has been largely unexplored. Using the theory of the Fraud Diamond, a model for measuring the supply chain’s exposure to losses from interorganizational fraud is developed. The measurement model includes the four dimensions of the Fraud Diamond: opportunity, pressure, rationalization, and capability. Supply chain measures for the dimensions of the Fraud Diamond are developed based on previous literature on fraud and supply chain opportunism. Survey data suggests that supply chains experience significant losses from interorganizational fraud. Using a two-step Generalized Method of Moments (GMM) technique for estimation, we find evidence suggesting that supply chain opportunity, supply chain pressure, and supply chain capability are positively related to losses from interorganizational fraud within a supply chain, and that supply chain capability serves as a key moderator of the relationships between supply chain opportunity and supply chain pressure and losses from interorganizational fraud.

IEEM19-P-1066
Development and Planning of Innovation Service Model S for Data Added Value in Big Data Industry Chain

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Enterprises and social media sites have accumulated a substantial amount of data. Also, the assetization of enterprise data has become a trend. Successful attainment of the effectiveness and value of big data (BD) analytics implemented by enterprises depends on its effective integration with external information and heterogeneous data. To support enterprises in creating competitive advantages, BD analytics must incorporate cross enterprise data processing, BD integration and cooperation across enterprises is an inevitable trend. Therefore, enterprises and the related upstream and downstream organizations for BD analytics must form a BD industry chain with shared interests. If an electronic BD service platform that ensures fair and safe transactions can be established, the transactions of data can be more convenient. This study examines the application bottlenecks and obstacles faced by the BD industry chain and investigate the potential development of innovation business models for the BD industry and the feasibility of enterprise data commercialization. Hence, through research and evaluation, this study plans the three innovative service models for BD virtual enterprise service model, BD marketplace service model, and customization BD analytics matching service model.

IEEM19-P-1068
S for Data Added Value in Big Data Industry Chain
With the rise of smart manufacturing, sensorized data can be captured which can be used in the redesign of production systems. By including scheduling in the redesign stage, with the appropriate amount of resources, the complexity of scheduling is reduced so that a better schedule can be found in a shorter amount of time. In addition, automated material handling such as automated intelligent vehicles (AIV) required in the transfer of materials is another key aspect in smart manufacturing, which occurs before the start of each operation. Material handling time incurs production lead time which affects scheduling objectives including makespan and tardiness. As concurrent operations can occur at any point of time, there may be insufficient AIVs to perform material handling. In this paper, an algorithm is presented to calculate the material handling time based on the number of AIVs and concurrent operations and incorporate it in the planned production schedule.

Solving Linear Programming by Dantzig-Wolfe Decomposition with Multiple Subproblems
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Traditionally, the decomposed LP consists of one LP master problem and “one” LP subproblem. The master problem and the subproblem is solved alternatively by exchanging the dual prices of the master problem and the proposals of the subproblem until the LP is solved. It is well known that convergence is slow with a long tail of near-optimal solutions (asymptotic convergence). Hence, the performance of DW-LP highly depends upon the number of decomposition steps. If the decomposition steps can be greatly reduced, the performance of DW-LP can be improved significantly. To reduce the number of decomposition steps, one of the methods is to increase the number of proposals from the subproblem to the master problem. To do so, we propose to add a quadratic approximation function to the LP subproblem in order to develop a set of approximate-LP subproblems (multiple subproblems). Consequently, in each decomposition step, multiple subproblems are solved for providing multiple proposals to the master problem. The number of decomposition steps can be reduced greatly.

A Systematic Innovation Approach
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Innovation is important for enterprise sustainability. The existing innovation methods usually started a user research to catch the user requirements. Then, divergent thinking is used to generate a large number of ideas and convergent thinking is used to refine the ideas to get 1-3 alternatives for user requirements. Finally, the detailed design develops and verifies the specifications to select the best solution from the alternatives. Furthermore, various instruments have been introduced to facilitate the innovation process. However, the innovation teams still need to subjectively decide about what and how the instruments be used and correlated with one another in the innovation process. This study proposes a two-staged systematic innovation approach to explicitly define the uses and correlations of the instruments at each innovation steps. The first stage, user experience research, uses the analytic hierarchy process (AHP) method, interviews, and verbatim transcript analysis, etc., to identify the important service/product characteristics, sweet/pain spots and user demand insights. The second stage, innovation design, introduces the brainstorming, KANO model, service blueprint, etc., to generate ideas, objectively evaluate innovative alternatives, and devise the service blueprint for best innovation solution implementation.

Effects of Trained Flexibility on Back Muscle Flexion-Relaxation Response
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This study recruited 20 male participants (10 high- and low-flexibility, and were defined as controlled and experimental groups, respectively), who were requested to statically flex their trunks at 7 trunk flexion positions (0-90 deg) and their erector spinae (ES) activations and lumbosacral angles (LSA) were collected. After 6 weeks of flexibility training in the low flexibility group, the aforementioned experiment was repeated for comparison. The results showed that there was no difference in flexibility between the controlled group and the experimental group, which were trained in flexibility for a period of 6 weeks. The lower ES activations (average 6.8%MVC after forward flexion of 45 deg) and the smaller LSA (12.4 deg) were observed in the less flexible participants before training, by contrast, the ES activations and LSA were significantly increased after training (9.1%MVC and -5.8deg), and there was no difference in flexion-relaxation response (FRR) patterns between the two groups. The results of this study show that the flexibility training can postpone the time and reduce the degree of FRR occurrence, thus alleviating the lower back load caused by the poorly sloping postures.

The Impact of Stock Analysts on Corporate R&D Investment: A Study of Taiwanese Publicly Listed Firms
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Stock analysts have been viewed as an important external governance mechanism because they play intermediaries roles by providing information of publicly traded companies, suggesting that the periodic reports and earnings forecasts by stock analysts could affect a firm’s corporate behaviors. However, the existing studies related to the effect of earnings forecast on a firm’s innovation behavior is not only insufficient but also inconsistent. This study based on a sample of Taiwanese publicly listed firms found that when a firm’s performance missed (or underperformed) the earnings forecasts, it tends to increase R&D intensity. Besides, the size of coverage was also found to be associated with a firm’s R&D investment. These findings echo the behavioral theory of the firm that firms would initiate search and risk-taking activities when they perform poorly and verify that external corporate governance mechanisms are critical to corporate operations.
Therefore, this study integrates the CMB receptor model with manual screening and judgment. It's not only inefficient but also easy to understand the source and cause of PM pollution, the receptor model becomes one of the most concerned issues for the public. In order to obtain models are driven with a genetic algorithm to optimize the inherent contradictions of the AIP process in 3D design space. The experimental results verify the validity of the proposed hybrid multi-objective optimization approach. Keywords - Aerosol jet printing, multi-objective optimization, response surface methodology.

Enhance Chemical Mass Balance Receptor Model by Genetic Algorithm

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The problem of air pollution caused by particulate matters (PM) has become one of the most concerned issues for the public. In order to understand the source and cause of PM pollution, the receptor model is often used to analyze the pollution sources and their contributions. Chemical mass balance (CMB) model is the most commonly used receptor model, but the current operations still rely on the analyst's manual screening and judgment. It's not only inefficient but also easy to obtain inaccurate results due to not thoroughly screening. Therefore, this study integrates the CMB receptor model with optimization model to improve analyzing abilities of CMB. The objective of this study aims to develop a more robust CMB model which can provide a set of best potential results for the analysts to make final interpretations more efficiently and accurately.

IEEM19-P-1135
The Role of Attitudes in Contractual Parties’ Intentions to Form Project Partnering

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Project partnering is defined as an informal relationship established among contractual parties for a single construction project. It is argued to be insufficiently diffused in the construction industry. One possible explanation is that organizations do not intend to form construction partnering. According to the theory of planned behavior, attitudes are a major antecedent of behavioral intentions. In other words, for promoting the intention to project partnering, contractual parties should develop positive attitudes toward project partnering. The current paper, therefore, aims to discuss the role of attitudes in influencing organizations’ intentions to form project partnering. Through a research that involves a model conducted by the contractual parties should develop positive attitudes toward project partnering. The results of computational studies indicate that the proposed LNS effectively solves ConVRPTWSyn.

IEEM19-P-1157
How Do Non-Family CEOs Affect Firm Innovativeness? A Different Perspective on the Non-family CEOs Risk-Taking Orientation in Family Business

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In high-tech industries, we found that the presence of an NFC is positively but insignificantly related to innovation investment by the focal family firms. More importantly, the results show that family involvement in management and the degree of board independence yield significantly negative and positive moderating effects on the innovation investment outcome of NFCs. We further tests the configurational effect of two moderators on the main relationship, and shows that the negative effect of family involvement in management not only outweighs but deteriorates the positive moderating effect of board independence. Our findings contribute to the family business research and the strategy literature by arguing that the risk-taking orientation of a NFC is not universally held but rather is deliberately arranged for effect.
A GA-Based Learning for Defect Prediction in Plastic Injection Molding
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The process of plastic injection molding involves injecting molten plastic resin into a mold under a high pressure and then cooling down before ejection. At every such shot cycle, the injection molding machine records the values of control parameters including material temperature, injection speed, injection pressure, holding pressure, and so on. In this paper, we propose a genetic algorithm (GA) to learn a model for predicting defective shots through real-time monitoring of these parameter values and detecting their deviations from the normal values. What makes this learning problem difficult is that defects are detected usually late in the production process and thus the exact timings of defective shots are unknown, which implies that we cannot obtain well-labeled data required for applying ordinary learning algorithms. The occurrence of a defect becomes known late when the monitoring module tells that the settings of control parameters are manually altered for a resolution. Our GA learns a predictive model from these loosely labeled data by determining the deviation levels of the parameter values and the number of parameters deviated appropriate for signaling a defect.

Acknowledgement - This research was supported by the MSIT (Ministry of Science and ICT), Korea, under the ICT Consilience Creative program (IITP-2019-2016-0-00318) supervised by the IITP (Institute for Information & communications Technology Planning & Evaluation)

The Study of the Relationship Among Perception of Workplace Illegally Infringed, Positive Psychological Capital and Turnover Intention
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The human resources are the most important assets of an organization. Losing one employee can bring invisible impact to the enterprise, especially the loss of technical staff. Employee retention is becoming great challenge for companies. According to Directorate-General of Budget, Accounting and Statics, Executive Yuan, R.O.C., there are numerous reasons of employee resignation, including health condition, family issue, and corporation regulations. Recently, companionship in workplace draw much attention. Verbal attack from colleagues and supervisors lead to the disharmony and anxiety that initiate the conscious of resignation. To improve occupational safety and dignity of labor, Ministry of Labor had enacted the law to make entrepreneur face up to the unlawful bully in working environment and prevention. The main purpose of this study was to determine perception of workplace illegally infringed and positive psychological capital will affect turnover intention, and understanding the study variables between different demographic variables. First of all, we reviewed the related domestic and international literature to identify as the theoretical basis for the study, secondly, we used a questionnaire to survey the employees of small and medium-sized enterprises. There was a total of 274 valid questionnaires; the effective response rate was 87.53%. The findings of this study show that, first, there is a positive significant correlation of resignation intention between workplace bullying perception, personal bullying perception, and physical bullying perception.; Second, Perception of workplace illegally infringed between self-efficacy, optimism, hope and resilience had a negative correlation; finally, there is partially significant of demographic attribute between resignation intention and workplace bullying perception.

The results of the study will provide corporate managers for further decisions making.

An Intelligent Lock-Out Tag-Out System for Monitoring and Control of the Locked Device
Woojin JO, Sehyun HWANG, Inho KEE, Inhak LEE, Soohong LEE
YONSEI University, South Korea

Although rare, a majority of incidents or accidents in modern engineering plants are caused by some form of human error. Of the operation procedures, during an inspection or maintenance is when an accident is most likely to happen. One of the concepts used to enhance safety during this phase of operation is lock-out tag-out (LOTO). This research suggests a way to enhance the functionality of LOTO systems with the incorporation of Supervisory Control and Data Acquisition (SCADA). A small-scale plant model has been equipped with automated LOTO mechanism and various types of sensors, based on IoT technology. This allows flexible access to the status of a device, quick response to danger, and ease of maintenance.

Computational Theoretical Analysis for the 11th Foresight Survey
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The “Delphi” method fostered the development of multiple survey practices. However, their theoretical validity and prediction accuracy have not been investigated in depth, especially from the perspective of mathematical or computational science. In this paper, we run virtual subject experiments with agent-based simulations to verify the validity of the information obtained from two methods: a Delphi survey for a repeated questionnaire and a real-time Delphi method aimed to present the response status when a systematic information feedback is implemented according to predefined conditions/protocols. In the results, the Delphi method emerges as a way to consolidate opinions and make them converge. On the contrary, the degree of consolidation/convergence ensured by the real-time Delphi method varies greatly across multiple simulations, even within the same respondents’ group. Moreover, this method cannot be validated theoretically with respect to the statistical group response, as the basic Delphi principle is not satisfied.

Security and Data Privacy in Consumer Internet of Things
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The rise of Internet of Things (IoT) comes with real challenges in as far as data privacy, security and trust is concerned. In the consumer IoT space, personal data gets shared with businesses for marketing, monitoring and evaluation of the IoT products, among other things. Consumers download mobile apps and use them without thinking twice about the kind of personal information they are exposing to the owners of the apps and possibly to the rest of the world. In a world where cyber criminals have tremendously increased, people need to be made aware of the benefits, as well as the dangers that come with these advances in technology. With these challenges in mind, there is a need for a holistic framework to protect consumers of IoT as they adopt the IoT technology. A holistic framework is proposed that seeks to address the challenges of consumer IoT from a legal, technical and social point of view. For consumer IoT to succeed, safety is critical and all the stakeholders in the IoT assemblage need to ensure protection of consumers.
Macau is an autonomous region on the south coast of China, across the Pearl River Delta from Hong Kong. A Portuguese territory until 1999, it reflects a mix of cultural influences. Its giant casinos and malls on the Cotai Strip, which joins the islands of Taipa and Coloane, have earned it the nickname, “Las Vegas of Asia.” One of its more striking landmarks is 338m-high Macau Tower, with sweeping city views.

Macau is just 28 square kilometres (a sixth of Washington DC) and has a border of just 3km with China in the mainland part of Old Macau. Macau is one of the smallest in the world, ranked 238 out of a list of 254 territories.

**A-Ma Temple**

A-Ma Temple already existed before the city of Macau came into being. It consists of the Gate Pavilion, the Memorial Arch, the Prayer Hall, the Hall of Benevolence, the Hall of Guanyin, and Zhengjiao Chanlin (a Buddhist pavilion). The variety of pavilions dedicated to the worship of different deities in a single complex make A-Ma Temple an exemplary representation of Chinese culture inspired by Confucianism, Taoism, Buddhism and multiple folk beliefs.

**Grande Praça**

“Whimsical Sculpture”, a curation of botanical artistry and topiary sculptures, is now on display at Grande Praça. The Aquarium where trained divers feed hundreds of colorful fishes is located at the centre of Grande Praça.

**Senado Square**

Senado square has been Macau’s city centre for centuries and is listed into the World Heritage Sites as part of Historic Centre of Macau. Today, the square is still the most popular venue for public events and celebrations. Locals enjoy spending their leisure time at the square because of the peaceful atmosphere.

**Macau Tower Convention & Entertainment Centre**

Macau Tower Convention & Entertainment Centre, also known as Macau Tower, is a tower located in Sé, Macau. The tower measures 338 m in height from ground level to the highest point. Pearl River Delta from its observation deck and revolving restaurant, at the 223-metre level. There is the opportunity to walk around the outside of the tower, for instance “Skywalk X”.

**Ruins of St. Paul**

Arguably Macau’s most famous landmark, the Ruins of St. Paul’s continue to captivate visitors centuries after it was originally constructed. Today, most tourists who visit the remains of a beautiful old church, but there’s more to its story.

**Fisherman’s Wharf**

Macau Fisherman’s Wharf is the largest leisure and entertainment themed complex in Macau Peninsula. The European-themed complex features over 70 stores and restaurants, a convention and exhibition centre, two hotels and a casino.
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IEEM 2020
14-17 DEC 2020, SINGAPORE

Paper Submission by 1 Jun
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