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2019 IEEE International Conference on
Industrial Engineering & Engineering Management

IEEE IEEM2019

15-18 Dec, Macau

Organizers
IEEE Macao Section
IEEE TEMS Singapore Chapter
IEEE TEMS Hong Kong Chapter

Message from the **CHAIRS**

Yonghua SONG
General Chair

Kah Hin CHAI
Organizing Chair

Zhixin YANG
Organizing Chair

Roger JIAO
Program Chair

Min XIE
Program Chair

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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Yonghua SONG
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National University of Singapore
Zhixin YANG
University of Macau

Program Chairs
Roger JIAO
Georgia Institute of Technology
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MEETING MATTERS INTERNATIONAL
密迈国际会务公司
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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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Linda ZHANG IÉSEG
School of Management

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

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Venue Address

The Parisian Macao
Estrada do Istmo,
Lote 3, Cotai Strip,
Macao SAR, P.R. China

Contact Secretariat

Meeting Matters
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Tel: (65) 6472 3108

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 17:00
  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

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; 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.

Sun-15 Dec 2019
Parisian Ballroom North Foyer

15:30 – 17:00
WELCOME RECEPTION
(All Are Welcome!)

Mon-16 Dec 2019
Parisian Ballroom #7103

Jacob Jen-Gwo CHEN
Ph.D., IISE Fellow,
WAPS Fellow Vice Chairman
Hon Hai/Foxconn Technology Group

09:00 – 09:45
KEYNOTE **"THE NEW FOXCON IE WAY"**

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.

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.

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

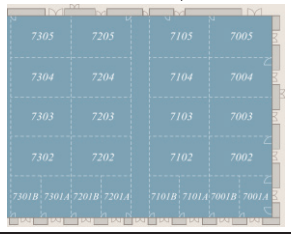
Highlights
This tour covers the Central Campus, Library and the State Key Laboratory of Internet of Things for Smart City

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

CAMPUS TOUR TO **THE UNIVERSITY OF MACAU**
(Ticketed Event) Please enquire at Registration

MON – 16 DEC

Parisian Ballroom, 5th Floor



Parisian #7103

08:30
Official Opening
09:00 – 09:45
Keynote "THE NEW FOXCON IE WAY"
09:45 – 10:30
Keynote "ADVANCES IN AUTONOMOUS DRIVING"

Parisian #7203

10:30 – 11:00 AM Coffee/Tea

11:00 – 12:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Norbert TRAUTMANN	Elise VAREILLES	Linda ZHANG	Hao YU
Nita SUKDEO	Ville ISOHERRANEN	Premaratne SAMARANAYAKE	Yaqiong LV
Systems Modeling & Simulation 1 *P.39*	**Technology & Knowledge Management 1** *P.40*	**Supply Chain Management 1** *P.41*	**Decision Analysis & Methods 1** *P.41*
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Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
R.M. Chandima RATNAYAKE	David VALIS	Romeo MARIAN	**"Meet-the-Editors" Panel Session Chaired by Michael Y. WANG**
Haiyan XU	Sambil Charles MUKWAKUNGU	Dinh Son NGUYEN	
Big Data & Analytics 1 *P.42*	**Reliability & Maintenance Engineering 1** *P.43*	**Manufacturing Systems 1** *P.44*	
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Parisian #7203

12:30 – 13:30 Lunch Buffet

Parisian #7202

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

MON – 16 DEC

13:30 – 15:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Yoshiki KURATA	Elise VAREILLES	Leif OLSSON	Zhao-Xu YANG
Yogi Tri PRASETYO	Nobuyuki SHIRAKAWA	Romalyn GALINGAN	Mahmood ALI
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310	1100	89	562
			317
Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
Michel ALDANONDO	Guido J.L. MICHELI	John LIU	H. Niles PERERA
Yan-Ling CAI	Zhiqiang CAI	Xin LI	Chien-Sing LEE
E-Business & E-Commerce 1 *P.48*	**Safety, Security & Risk Management 1** *P.49*	**Manufacturing Systems 2** *P.50*	**Service Innovation & Management 1** *P.51*
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452	477		315
Parisian #7203			
15:30 – 16:00 PM Coffee/Tea			

16:00 – 17:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Budi SANTOSA	Yoshinobu TAMURA	Aries SUSANTY	Yaqiong LV
Yoshiki KURATA	Markus HARTONO	Jun-Der LEU	Anders THORSTENSON
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	1035		51

16:00 – 17:30 (Cont)

Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
Sambil Charles MUKWAKUNGU	Arnesh TELUKDARIE	Ali SIADAT	Philipp BAUMANN
Domingues J.P.T.	Bin ZHANG	Romeo MARIAN	Te-Min CHANG
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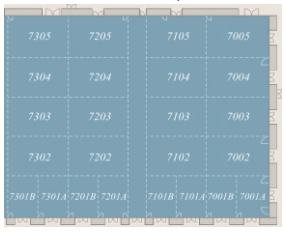
33	230	281	165
61	189	282	15
534	1115	293	382

TUE – 17 DEC

Parisian Ballroom, 5th Floor



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)

08:30 – 10:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Tatsushi NISHI	Ville ISOHERRANEN	Linda ZHANG	Hao YU
Songlin CHEN	Leif OLSSON	Michel ALDANONDO	Mei-Chen LO
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Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
Lianjie SHU	Yoshinobu TAMURA	Junfeng WANG	Ripon CHAKRABORTTY
Nita SUKDEO	Om Prakash YADAV	Keng-Pei LIN	Amir SALEHIPOUR
Quality Control & Management 2 *P.63*	**Reliability & Maintenance Engineering 2** *P. 64*	**Manufacturing Systems 4** *P. 65*	**Operations Research 2** *P.66*
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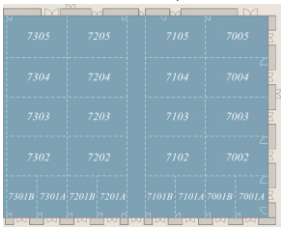
411	244	339	494
124	191	392	1154
466	235	407	442
554	93	538	125
234	182	398	
Parisian #7203			
10:30 – 11:00 AM Coffee/Tea			

TUE – 17 DEC

Parisian Ballroom, 5th Floor



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)

11:00 – 12:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Markus HARTONO	Mukondeleli KANAKANA - KATUMBA	Aries SUSANTY	Mei-Chen LO
Chien-Sing LEE	Nobuyuki SHIRAKAWA	Domingues J.P.T.	Anders THORSTENSON
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487	401	95	1169
Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
Norbert TRAUTMANN	Bin ZHANG	Dinh Son NGUYEN	Stanislav CHANKOV
Usha ANANTHAKUMAR	David VALIS	Junfeng WANG	Arnesh TELUKDARIE
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527	386	416	555
1121	481	437	368
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443	303	476	1101
102		513	253
308		454	

Parisian #7203

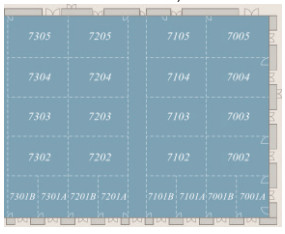
12:30 – 13:30 Lunch Buffet

Parisian #7202

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

TUE – 17 DEC

Parisian Ballroom, 5th Floor



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)

13:30 – 15:30

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Ajinkya TANKSALE	R.M. Chandima RATNAYAKE	Premaratne SAMARANAYAKE	Mahmood ALI
Zhigang TIAN	Seung Ki MOON	Ali SIADAT	Zhao-Xu YANG
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1105	205	415	1161
1148	156	419	558
1170	170	427	561
1171	190	174	422
1143	149	405	318
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Parisian #7101	Parisian #7102	Parisian #7201	Parisian #7301
Philipp BAUMANN	Guido J.L. MICHELI	Zhe ZHANG	Tatsushi NISHI
Usha ANANTHAKUMAR	H. Niles PERERA	Jinyu FAN	Amir SALEHIPOUR
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357	473	444	1112
546	559	457	354
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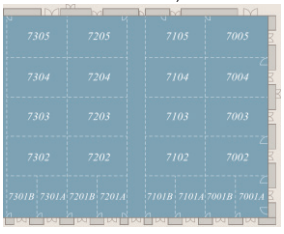
162	322	146	309
Parisian #7103			
15:30 – 16:00 Closing & Best Paper Awards			
Parisian #7203			
16:00 - 16:30 PM Coffee/Tea			

TUE – 17 DEC

Parisian Ballroom, 5th Floor



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)

16:30 – 18:00

Bordeaux #7.2	Bordeaux #7.3	Parisian #7001	Parisian #7002
Budi SANTOSA	Ripon CHAKRABORTTY	Mukondeleli KANAKANA - KATUMBA	Jinyu FAN
Seung Ki MOON	Lianjie SHU	Romalyn GALINGAN	Om Prakash YADAV
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Stanislav CHANKOV	Zhiqiang CAI	Xin LI	Haiyan XU
Yan-Ling CAI	Zhigang TIAN	Jun-Der LEU	Ajinkya TANKSALE
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1151	436	148	524
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	142		1026

TUE – 17 DEC

16:30 – 18:00

Parisian #7202			
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Safety, Security & Risk Management	**Service Innovation & Management**	**Systems Modeling & Simulation**	**Big Data & Analytics**
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Intelligent Systems	**Reliability & Maintenance Engineering**	**Operations Research**	
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Decision Analysis & Methods	**Technology & Knowledge Management**	**Human Factors**	**Manufacturing Systems**
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187	1032	353	236
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302	1062	1060	248
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Parisian #7203			
18:30 – 20:30 Conference Banquet (Ticketed Event)			

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.

Authors Put Up Posters (Parisian Ballroom #7202)	From 12:30 on Mon-16 Dec 2019 Must be Completed by 12:30 on Tue-17 Dec
Poster Presentation (Presenter Attendance Required)	Tue-17 Dec 2019, 16:30 to 18:00
Authors Remove Posters	Latest By 18:30 latest on Tue-17 Dec After this time, posters left on the board will be discarded

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.

Sessions
Abstracts
Author Index

Big Data and Analytics 1

16/12/2019 11:00 - 12:30
Room: Parisian #7101

Chairs: R.M. Chandima RATNAYAKE *University of Stavanger*
Haiyan XU *Institute of High Performance Computing*

Abstracts: see page 41

IEEM19-P-0228
Ocean Mesh Grid: Applications in Shipping Modeling
Vit PROCHAZKA[1], Roar ADLAND[2]
[1]*SNF – Centre for Applied Research at NHH, Norway*
[2]*NHH Norwegian School of Economics, Norway*

IEEM19-P-0347
A Binary Linear Programming-Based K-Means Approach for the Capacitated Centered Clustering Problem
Philipp BAUMANN
University of Bern, Switzerland

IEEM19-P-0115
A Revised KDD Procedure for the Modeling of Continuous Production in Powder Processing
Kilian VERNICKEL, Judith WEBER, Xujia LI, Julia BERG, Gunther REINHART
Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV, Germany

IEEM19-P-0160
Latin American Oil Export Destination Choice: A Machine Learning Approach
Haiying JIA[1], Roar ADLAND[2], Yuchen WANG[3]
[1]*Norwegian School of Economics, Norway*
[2]*NHH Norwegian School of Economics, Norway*
[3]*Massachusetts Institute of Technology, United States*

IEEM19-P-0044
Collaborative Technological Process Planning with 5G Mobile Networks and Digital Tools: Manufacturing Environments' Perspective
Roman WDOWIK[1], R.M. Chandima RATNAYAKE[2]
[1]*Rzeszów University of Technology, Poland*
[2]*University of Stavanger, Norway*

IEEM19-P-0090
Efficient Compression and Preprocessing for Facilitating Large Scale Spatiotemporal Data Mining – A Case Study based on Automatic Identification System Data
Hai-Yan XU, Vasundhara JAYARAMAN, Xiuju FU, Nasri Bin OTHMAN, Wanbing ZHANG, Xiao Feng YIN, Deqing ZHAI, Rick Siow Mong GOH
Institute of High Performance Computing, Singapore

Big Data and Analytics 2

17/12/2019 11:00 - 12:30
Room: Parisian #7101

Chairs: Norbert TRAUTMANN *University of Bern*
Usha ANANTHAKUMAR *Indian Institute of Technology Bombay*

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Case Study: A Semi-Supervised Methodology for Anomaly Detection and Diagnosis
A. MORALES-FORERO, Samuel BASSETTO
Ecole Polytechnique de Montreal, Canada

IEEM19-P-1121
Fault Prediction of Fan Based on Failure Window Period
Bin YAN[1], Qiaozhen NING[2], Xianpeng WANG[2], Dongsheng YU[2]
[1]*Southeast University, China*
[2]*Beijing Goldwind Science & Creation Windpower Equipment Co., Ltd., China*

IEEM19-P-0321
Investigating a Breast Cancer Gene Expression Data Using a Novel Clustering Approach
Leila NAENI, Amir SALEHIPOUR
University of Technology Sydney, Australia

IEEM19-P-0443
Application of Feature Selection Method to Error Factor Extraction of Multifunction Peripheral
Myungsook KO[1], Tatsuya INAGI[2], Masaaki TAKADA[1], Toru YANO[1]
[1]*Toshiba Corporation, Japan*
[2]*Toshiba Tec Corporation, Japan*

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

IEEM19-P-0308
Predicting Commercial Real Estate Rent: An Empirical Study
Usha ANANTHAKUMAR[1], Rishita SINHA[2]
[1]*Indian Institute of Technology Bombay, India*
[2]*University of Mumbai, India*

Big Data and Analytics 3

17/12/2019 13:30 - 15:30
Room: Parisian #7101

Chairs: Philipp BAUMANN *University of Bern*
Usha ANANTHAKUMAR *Indian Institute of Technology Bombay*

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IEEM19-P-0334
Performance Gap Between Valid and Invalid Patents in Six Technology Fields
Huei-Ru DONG[1], Dar-Zen CHEN[2], Mu-Hsuan HUANG[2]
[1]*Fu Jen Catholic University, Taiwan*
[2]*National Taiwan University, Taiwan*

IEEM19-P-0469
Graph-based Semi-Supervised Classification for Online Customer Reviews Using Consensus Clustering
Kenjiro TORIZUKA[1], Humiaki SAITOH[2], Syohei ISHIZU[1]
[1]*Aoyama Gakuin University, Japan*
[2]*Chiba Institute of Technology, Japan*

IEEM19-P-0357
Machine Learning Based Approach to Predict Short-Term Fuel Consumption on Mobile Offshore Drilling Units
Maria Antun HJELLVIK, R.M. Chandima RATNAYAKE
University of Stavanger, Norway

IEEM19-P-0546
Knowledge Graphs for an Automated Information Provision in the Factory Planning
Uwe DOMBROWSKI, Alexander REISWICH, Christoph IMDAHL
Technische Universität Braunschweig, Germany

IEEM19-P-0432
A Clustering-based Sales Forecast Method for Big Promotion Days in O2O On-Demand Retailing
Hongyan DAI[1], Haoyang YU[1], Qin XIAO[1], Weihua ZHOU[2]
[1]*Central University of Finance and Economics, China*
[2]*Zhejiang University, China*

IEEM19-P-0162
Framework for the Continuous Increase of Product Performance by Analyzing Product Usage Data
Michael RIESENER, Christian DÖLLE, Annika BECKER, Günther SCHUH
RWTH Aachen University, Germany

Decision Analysis and Methods 1

16/12/2019 11:00 - 12:30
Room: Parisian #7002

Chairs: Hao YU *UiT The Arctic University of Norway*
Yaqiong LV *Wuhan University of Technology*

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Willy ZALATAR, Eppie CLARK
De La Salle University, Philippines

IEEM19-P-1095
Startup Resource Allocation Strategy: An Application of Decision Making Approaches
Peng-Ting CHEN, Wei Chih LU
National Cheng Kung University, Taiwan

IEEM19-P-0026
Analyzing the Impact of Vehicle Speed on Distribution Cost for Cold Chain Logistic
Lixia LI, Yu YANG, Gaoyuan QIN
Chongqing University, China

IEEM19-P-0098
A Novel Normalization Method for Using in Multiple Criteria Decision Analysis
Renyan JIANG
Changsha University of Science and Technology, China

IEEM19-P-0076
An Improved Bi-Objective Stochastic Model with SAA-based Solution Method for Reverse Logistics Design of Hazardous Materials
Hao YU, Wei Deng SOLVANG, Xu SUN
University of Tromsø – The Arctic University of Norway, Norway

Decision Analysis and Methods 2

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Room: Parisian #7002

Chairs: Yaqiong LV *Wuhan University of Technology*
Anders THORSTENSON *Aarhus University*

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Lean Six Sigma Based Performance Improvement in Public Passport Services: A Case Study from Office Work
Felix P. SANTHIAPILLAI, R.M. Chandima RATNAYAKE, Maria Antun HJELLVIK
University of Stavanger, Norway

IEEM19-P-1030
Matching Drivers and Passengers in Online Car-Hailing : A Method Based on Fuzzy Axiomatic Design
Yining BAO, Xi CHEN
Xidian University, China

IEEM19-P-0171
Integrating Maximum Deviation Method and VIKOR for Evaluating Enterprise Performance in Semiconductor Industry
Cheng-Yen CHEN
National Kaohsiung University of Science and Technology, Taiwan

IEEM19-P-0518
A New Mathematical Model for the Deterministic Crop Rotation Planning Problem
Ibrahim FIKRY, Mohamed GHEITH, Amr ELTAWIL
Egypt-Japan University of Science and Technology, Egypt

IEEM19-P-1102
Supplying in Bulk or by Flow - The Value of Agility in a Case Study of Sports Garment Retailing
Anders THORSTENSON, Christian LARSEN, Hartanto WONG
Aarhus University, Denmark

IEEM19-P-0345
Parking Spots Selection for Shared Bicycle on Campus
Qianwen ZHOU[1], Yaqiong LV[1], Lei TU[2], Carman Ka Man LEE[3]
[1]*Wuhan University of Technology, China*
[2]*Zhejiang Chinese Medical University, China*
[3]*The Hong Kong Polytechnic University, Hong Kong SAR*

IEEM19-P-0051
Valuing the Option to Delay in Engineering Management: A Case Study
Maximilian ZELLNER, Ali E. ABBAS
University of Southern California, United States

Decision Analysis and Methods 3

17/12/2019 08:30 - 10:30
Room: Parisian #7002

Chairs: Hao YU *UiT The Arctic University of Norway*
Mei-Chen LO *National United University & China Medicine University*

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Decision Bias in the Newsvendor Problem: On the Comparison of Managers and Students as Newsvendors with Decision Support System as Debiasing Strategy
Elok PITALOKA[1], Nur Aini MASRUROH[2], Shi-Woei LIN[3]
[1]*National Taiwan University of Science and Technology/ Universitas Gadjah Mada, Indonesia*
[2]*Universitas Gadjah Mada, Indonesia*
[3]*National Taiwan University of Science and Technology, Taiwan*

IEEM19-P-0213
Loan Recommendation in P2P Lending Investment Networks: A Hybrid Graph Convolution Approach
Yibo CHAI, Yahu CONG, Lu BAI, Lixin CUI
Central University of Finance and Economics, China

IEEM19-P-0261
Adapted Design for Variety: Consideration of the Software-Domain
Christoph RENNPFERDT, Dieter KRAUSE
Hamburg University of Technology, Germany

IEEM19-P-0331
A Methodology of Network Modeling of Risk Prioritization in Hazardous Product Transportation
Jenjira SUKMANEE, Ramil KESVARAKUL, R. KESVARAKUL, Nattawut JANTHONG
King Mongkut's University of Technology North Bangkok, Thailand

IEEM19-P-1096
Service Network Design for Collaborative Last Mile Delivery Considering Parcel Attributes
Muzaffar MAKHMUDOV[1], Ratna Permata SARI[1], Seung Yoon KO[2], Chang Seong KO[1]
[1]*Kyungsung University, South Korea*
[2]*Korea University, South Korea*

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

Decision Analysis and Methods 4

17/12/2019 11:00 - 12:30
Room: Parisian #7002

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

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A Decision Analysis of Conspicuous and Non-Conspicuous Consumption Behavior
Jianghan GU
Northwestern Polytechnical University, China

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 SOLVANG
University of Tromsø – The Arctic University of Norway, Norway

IEEM19-P-1078
Applying BPN to Build the Prediction Model for Site Selection
Hsin-Pin FU, Hsiao-Ping YEH, Tien-Hsiang CHANG, Cheng-Chang TSAI
National Kaohsiung University of Science and Technology, Taiwan

IEEM19-P-0140
A Composite Indicator for Supply Chain Performance Measurement: A Case Study in a Manufacturing Company
Rui OLIVEIRA[1], Catarina CUBO[1], Rui ESTRADA[1], Ana FERNANDES[1], Paulo AFONSO[1], Maria do Sameiro CARVALHO[1], Paulo SAMPAIO[1], João ROQUE[2], Marcio REBELO[2]
[1]*University of Minho, Portugal*
[2]*Bosch Car Multimedia, Portugal*

IEEM19-P-1172
An Integrated Decision Support System for Sustainable Supplier Selection, Evaluation, and Benchmarking Using a FIS and MOLP Approach
Dua WERAIKAT[1], Sharfuddin Ahmed KHAN[2]
[1]*Rochester Institute of Technology, United Arab Emirates*
[2]*University of Sharjah, United Arab Emirates*

IEEM19-P-1169
The Initial Study of Behavioral Diagnosis on Qian Yi's Xiao-Er-Yao-Zheng-Zhi-Jue
Mei-Chen LO[1], Su-Tso YANG[2], Tung-Ti CHANG[2], Lu-Hai WANG[2]
[1]*National United University & China Medicine University, Taiwan*
[2]*China Medicine University, Taiwan*

E-Business and E-Commerce 1

16/12/2019 13:30 - 15:30
Room: Parisian #7101

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

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Keiya MORI, Fumiko TAKEDA
The University of Tokyo, Japan

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

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

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Digital HRM Model for Process Optimization by Adoption of Industry 4.0 Technologies
Megashnee MUNSAMY[1], Arnesh TELUKDARIE[2]
[1]*Mangosuthu University of Technology, South Africa*
[2]*University of Johannesburg, South Africa*

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Towards a Metric Between Engineering to Order and Assemble/Make to Order Products in Configuration Situations
Abdourahim SYLLA[1], Rania AYACHI[2], Michel ALDANONDO[3], Elise VAREILLES[3], Yvan BEAUREGARD[4], Paul PITIOT[3]
[1]*Université Grenoble Alpes, France*
[2]*Université de Toulouse / IMT Mines Albi/ ENI Tarbes, France, Metropolitan*
[3]*Université de Toulouse/ IMT Mines Albi, France, Metropolitan*
[4]*École de Technologie Supérieure, Canada*

IEEM19-P-0452
Green Entrepreneurship Model Utilising the System Dynamics Approach: A Review
Dineo DIALE[1], Mukondeleli KANAKANA-KATUMBA[2], Wilson MALADZHI[2]
[1]*Rhodes University, South Africa*
[2]*University of South Africa, South Africa*

E-Business and E-Commerce 2

17/12/2019 16:30 - 18:00
Room: Parisian #7101

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

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Factors Affecting Customer Acceptance of Mobile Payment
Daniel TSE, Tianjia WEN, Ru WU, Ge YIN, Xinlu ZHAI
City University of Hong Kong, Hong Kong SAR

IEEM19-P-0451
Exploring Followers' Intention of Donating Online Game Streamers
Li-Ting HUANG[1], Yu-Shiang WU[1], Jun-Der LEU[2]
[1]*Chang Gung University, Taiwan*
[2]*National Central University, Taiwan*

IEEM19-P-1151
Industrie 4.0 in Practice: An Empirical Study in Germany and Taiwan
Jun-Der LEU[1], Joerg PUCHAN[2], Yi-Wei HUANG[1]
[1]*National Central University, Taiwan*
[2]*Munich University of Applied Sciences, Germany*

IEEM19-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

IEEM19-P-0362
E-Commerce: Stock Market Analysis Blended With Mining and Ann
Yan-Ling CAI[1], Kumar KANNAN[2], Yan-Hang XIE[1], Liang ZHAO[1]
[1]*Zhengzhou University, China*
[2]*Vellore Institute of Technology, India*

Engineering Economy and Cost Analysis

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Room: Parisian #7002

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

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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

IEEM19-P-0285
Design of Inventory Pledge Financing Model Based on Internet of Things Technology and Operational Risk Management
Di WANG[1], Daozhi ZHAO[1], Baosen WANG[2], Jun WU[3]
[1]*Tianjin University, China*
[2]*Beijing Wuzi University, China*
[3]*Bubi (Beijng) Network Technology Co., Ltd, China*

IEEM19-P-1135
Forecasting the Diffusion of New Competitive Technologies Based on Evolutionary Game Theory : Battery Electric Vehicle and Fuel Cell Electric Vehicle
Yeonjeong LEE, Deok-Joo LEE
Seoul National University, South Korea

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

IEEM19-P-0295
Benefits Management in Infrastructure Projects: Towards a Best Practice Framework
Supriya MEHTA[1], Senevi KIRIDENA[2]
[1]*AMP Capital, Australia*
[2]*University of Wollongong, Australia*

Engineering Education and Training 1

16/12/2019 13:30 - 15:30
Room: Parisian #7001

Chairs: Leif OLSSON *Mid Sweden University*
Romalyn GALINGAN *Technological Institute of the Philippines*

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Sambil Charles MUKWAKUNGU, Eric Mikobi BAKAMA, Charles MBOHWA
University of Johannesburg, South Africa

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

IEEM19-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

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

IEEM19-P-0089
Are We Ready for the Agenda 2030 for Sustainable Development?
Per ÅHAG[1], Lisa HED[1], Per Håkan LUNDOW[1], Leif OLSSON[2]
[1]*Umeå University, Sweden*
[2]*Mid Sweden University, Sweden*

Engineering Education and Training 2

17/12/2019 16:30 - 18:00
Room: Parisian #7001

Chairs: Mukondeleli KANAKANA - KATUMBA *University of South Africa*
Romalyn GALINGAN *Technological Institute of the Philippines*

Abstracts: see page 82

IEEM19-P-0186
Teaching Fundamental Concepts of Industrial Engineering and Management by Using Examples from the Video Game Industry
Leif SUNDBERG
Mid Sweden University, Sweden

IEEM19-P-0545
Research Output on the Usage of Artificial Intelligence in Indian Higher Education – A Scientometric Study
Kalyan Kumar BHATTACHARJEE
Indian Institute of Technology Delhi, India

IEEM19-P-0065
Quality Analysis and Improvement of Rear Axle Assembly Line of G Motor Company
Hongying SHAN, Chuang WANG, Lina LI, Yu YUAN
Jilin University, China

IEEM19-P-0062
Engineering Meaningful Computing Education: Programming Learning Experience Model
Sin-Ban HO[1], Swee-Ling CHEAN[2], Ian CHAI[1], Chuie-Hong TAN[1]
[1]*Multimedia University, Malaysia*
[2]*Universiti Tunku Abdul Rahman, Malaysia*

IEEM19-P-0333
Online Learning Approaches for Science, Engineering and Technology in Distance Education
Mukondeleli KANAKANA-KATUMBA, Wilson MALADZHI
University of South Africa, South Africa

IEEM19-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

Healthcare Systems and Management 1

16/12/2019 16:00 - 17:30
Room: Bordeaux #7.2

Chairs: Budi SANTOSA *Institut Teknologi Sepuluh Nopember*
Yoshiki KURATA *Technological Institute of the Philippines Quezon City*

Abstracts: see page 51

IEEM19-P-0064
A Benders Decomposition Approach for Appointment Scheduling of Unpunctual Patients in a Multi-Server Setting
Xingwei PAN[1], Na GENG[1], Xiaolan XIE[2]
[1]*Shanghai Jiao Tong University, China*
[2]*Université 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 HASSELBLAD[1], Leif OLSSON[1], Madelene BLUSI[2]
[1]*Mid Sweden University, Sweden*
[2]*FoU Västernorrland, Sweden*

IEEM19-P-0134
A Two-stage Stochastic Programming Model for Outpatient Appointment Scheduling
Shuang MA[1], Songlin CHEN[2], Xiaotian CAI[3]
[1]*University of Science & Technology Beijing, China*
[2]*Nanyang Technological University, Singapore*
[3]*Chinese Academy of Science and Technology for Development, China*

IEEM19-P-0227
How to Make a Medical Error Disclosure to Patients?
Xiuzhu GU[1], Mingming DENG[2]
[1]*Tokyo Institute of Technology, Japan*
[2]*Shaanxi 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, Pornwasin SIRISAWAT, Thunwa KAEWKET
Mae Fah Luang University, Thailand

Healthcare Systems and Management 2

17/12/2019 16:30 - 18:00
Room: Bordeaux #7.2

Chairs: Budi SANTOSA *Institut Teknologi Sepuluh Nopember*
Seung Ki MOON *Nanyang Technological University*

Abstracts: see page 81

IEEM19-P-0251
Forecasting Lumpy Demand for Planning Inventory: The Case of Community Hospitals in Thailand
Phattaraporn KALAYA, Preecha TERMSUKSAWAD, 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
Pornwasin 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. ABBAS
University of Southern California, United States

IEEM19-P-0114
An Approach for Severity Prediction of Autism Using Machine Learning
Min CHE, Liya WANG, Lin HUANG, Zhibin JIANG
Shanghai Jiao Tong University, China

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

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 Engineering Management. Mapua University*

Abstracts: see page 44

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
Jianxin WANG[1], Weining FANG[1], Beiyuan GUO[1], Ke NIU[2]
[1]*Beijing Jiaotong University, China*
[2]*Zhengzhou Railway Vocational & Technical College, China*

IEEM19-P-0275
What are the Sentiments About the Autonomous Delivery Robots?
Hio Nam IO, 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[1], Retno WIDYANINGRUM[2], Chiuhsiang Joe LIN[3]
[1]*Mapúa University, Philippines*
[2]*Sepuluh Nopember Institute of Technology, Indonesia*
[3]*National 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, Trizhia May ODIAS, Jan Luigi RICAFORT, Rafael SALAZAR, Yoshiki KURATA
Technological Institute of the Philippines Quezon City, Philippines

Human Factors 2

17/12/2019 11:00 - 12:30
Room: Bordeaux #7.2

Chairs: Markus HARTONO
University of Surabaya
Chien-Sing LEE
Sunway University

Abstracts: see page 66

IEEM19-P-0447
Analysis of the Relationship Between Motivation for "Work for Non-core Business" and Organizational Commitment of Young Employees
Kentaro TAKASHIMA[1], Tomoya NISHIGAKI[1], Tomoyuki TAKESHITA[2]
[1]*Japan Advanced Institute of Science and Technology, Japan*
[2]*Seiwa 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, Hannelie NEL
University of Johannesburg, South Africa

Information Processing and Engineering 1

16/12/2019 16:00 - 17:30
Room: Parisian #7102

Chairs: Arnesh TELUKDARIE
University of Johannesburg
Bin ZHANG *City University of Hong Kong*

Abstracts: see page 56

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[1], Iwan VANANY[1], Erwin WIDODO[1], Ig. Jaka MULYANA[2], Kevin CORNELIUS[2]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Widya Mandala Catholic University, Indonesia*

IEEM19-P-0378
Enhanced MORE Algorithm for Fully Homomorphic Encryption Based on Secret Information Moduli Set
Kamaldeen Jimoh MUHAMMED[1], Kazeem Alagbe GBOLAGADE[2]
[1]*University of Ilorin, Nigeria*
[2]*Kwara 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
Testing and Proof of Concept for Automated Leak Detection Using Wireless Sensors: A Pilot Study for Johannesburg Water Company
Pholo 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

Information Processing and Engineering 2

17/12/2019 11:00 - 12:30
Room: Parisian #7102

Chairs: Bin ZHANG *City University of Hong Kong*
David VALIS *University of Defence in Brno Faculty of Military*

Abstracts: see page 71

IEEM19-P-0386
Effective Implementation of Last Planner System® in Construction Projects: A Case Study
Ragnhild GJERDE, R.M. Chandima RATNAYAKE, Samindi SAMARAKOON
University of Stavanger, Norway

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

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[1], Riji YU[2], Dingzhou FEI[1], Baichuan HUANG[1], Yao SONG[3], Ling PENG[4], Yuhuai ZENG[5]
[1]*Wuhan University, China*
[2]*Hubei University, China*
[3]*The Hong Kong Polytechnic University, Hong Kong SAR*
[4]*Huanggang Land and Resources Bureau, China*
[5]*Guangzhou Institute of Geography, China*

Intelligent Systems 1

16/12/2019 13:30 - 15:30
Room: Parisian #7002

Chairs: Zhao-Xu YANG *Xi'an Jiaotong University*
Mahmood ALI *Institute of Business Management*

Abstracts: see page 47

IEEM19-P-0179
Designing Passive Indoor Distributed Antenna System with Practical Constraints Using Binary Encoding
Kin POON, Siddhartha SHAKYA, Khawla SHANQITI, Anis OUALI, Andrei SLEPTCHENKO
Khalifa University, United Arab Emirates

IEEM19-P-1033
Energy-Efficient Load Balancing for Cloud Data Center Using Virtual Machine Consolidation
Hoyoung YUN, Hyungsoo KIM, Kyungsup KIM, Changsoon JEONG
Yonsei University, South Korea

IEEM19-P-0521
Data-Driven Adaptive Processes – A Potential Enabler for Flexible and Versatile Automotive Body Shops
Günther SCHUH, Georg BERGWEILER, Falko FIEDLER, Yannick BOELSEN
RWTH Aachen University, Germany

IEEM19-P-0560
Direct Adaptive Data Cloud Based Fuzzy Control for NARMAX System
Zhao-Xu YANG[1], Hai-Jun RONG[1], Zhi-Xin YANG[2]
[1]*Xi'an Jiaotong University, China*
[2]*University of Macau, Macau*

IEEM19-P-0562
Tracking Control of a Skid Steered Mobile Robot with Adaptive Robust Second Order Sliding-Mode Controller
Ruidong XI, Lulu TANG
University of Macau, China

IEEM19-P-0317
Future Distribution Generation in an Intelligent Smart Energy Network
Anthony MATHERI[1], Mohamed BELAID[1], Nickey JANSE VAN RENSBURG[1], Thabo MAHLATSI[2]
[1]*University of Johannesburg, South Africa*
[2]*City of Johannesburg, South Africa*

Intelligent Systems 2

17/12/2019 13:30 - 15:30
Room: Parisian #7002

Chairs: Mahmood ALI *Institute of Business Management*
Zhao-Xu YANG *Xi'an Jiaotong University*

Abstracts: see page 76

IEEM19-P-1161
Smart and Sustainable Energy Management: Exemplary Examples from Singapore
Jasmine Siu Lee LAM
Nanyang Technological University, Singapore

IEEM19-P-0558
The Joint Optimization of Spare Parts and Maintenance Personel Under Lateral Transshipment
Bowen CUI, Qiang FENG, Yi REN, Bo SUN, Cheng QIAN, Dezhen YANG
Beihang University, China

IEEM19-P-0561
Tensor Completion Based 3d Reconstruction of Binocular Stereo Vision
Ze-Hua LIU[1], Hai-Jun RONG[1], Zhao-Xu YANG[1], Zhi-Xin YANG[2]
[1]*Xi'an Jiaotong University, China*
[2]*University of Macau, Macau*

IEEM19-P-0422
Challenges in Implementing Transportation Tracking System in Saudi Arabia
Mahmood ALI[1], Mayar TARBULSI[2], Asim MAJEED[3]
[1]*Institute of Business Management, Pakistan*
[2]*Supply Chain Specialist, Saudi Arabia*
[3]*Birmingham City University, United Kingdom*

IEEM19-P-0318
Smart City Energy Trend Transformation in the Fourth Industrial Revolution Digital Disruption
Anthony MATHERI[1], Jane Catherine NGILA[1], Cecilia Kinuthia NJENGA[2], Mohamed BELAID[1], Nickey JANSE VAN RENSBURG[1]
[1]*University of Johannesburg, South Africa*
[2]*United Nation Environment Programme, South Africa*

Manufacturing Systems 1

16/12/2019 11:00 - 12:30
Room: Parisian #7201

Chairs: Romeo MARIAN *University of South Australia*
Dinh Son NGUYEN *University of Science and Technology*

Abstracts: see page 43

IEEM19-P-0247
Hybrid Welding Jigs with Additive Manufactured Functional Elements
Günther SCHUH, Georg BERGWEILER, Falko FIEDLER, Kolja LICHTENTHAELER, Sebastian LEIMBRINK
RWTH Aachen University, Germany

IEEM19-P-0082
Activity-based Cost Model for Material Extrusion Processes Along the Additive Manufacturing Process Chain
Achim KAMPKER, Peter AYVAZ, Gerret LUKAS, Steffen HOHENSTEIN, Viktoria KRÖMER
RWTH Aachen University, Germany

IEEM19-P-0086
A Single Machine Scheduling Problem with Discrete Machine Conditions
Wenhui YANG, Lu CHEN
Shanghai Jiao Tong University, China

IEEM19-P-0133
MA²RA – Manual Assembly Augmented Reality Assistant
Maximilian KOENIG, Martin STADLMAIER, Tobias RUSCH, R. SOCHOR, Lukas MERKEL, Stefan BRAUNREUTHER, Johannes SCHILP
Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV, Germany

IEEM19-P-1098
A Digital Twin of Manufacturing System for Energy Efficient Operation
Junfeng WANG, Yaqin HUANG, Yufan ZHANG, Shiqi LI
Huazhong University of Science and Technology, China

IEEM19-P-0218
Challenges in Implementing Industry 4 Laboratories and Learning Factories in Academia
Romeo MARIAN[1], Duncan CAMPBELL[1], Ziyue JIN[1], Markus STUMPTNER[1], Javaan CHAHL[2]
[1]*University of South Australia, Australia*
[2]*University of South Australia/ Defence Science and Technology Organisation, Australia*

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 49

IEEM19-P-0157
Practical Framework for Advanced Quality-based Process Control in Interlinked Manufacturing Processes
Jacqueline SCHMITT[1], Florian HAHN[1], Jochen DEUSE[2]
[1]*TU Dortmund University, Germany*
[2]*University of Technology Sydney, Australia*

IEEM19-P-0176
A Reusable Scheduling Problem Decomposition Framework for Smart Factories
Che Han LIM[1], Seung Ki MOON[1], Evans OKPOTI[2]
[1]*Nanyang Technological University, Singapore*
[2]*Hanyang 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, Xiyu GAO, Dawei GAO
Jilin University, China

IEEM19-P-0198
Digital Twins for Industry 4.0 and Beyond
Yuling HSU[1], Jing-Ming CHIU[2], John S. LIU[2]
[1]*Institute for Information Industry, Taiwan*
[2]*National 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 57

IEEM19-P-0222
Process Management of Customized Product Manufacturing for Steel Structures
Anran ZHAO, Peng LIU, Qixun ZHANG, Kun WANG, Lei WANG, Yiming XUE, Xiyu 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 HUARHUA-MACHUCA, Victor NUÑEZ-PONCE, Ernesto ALTAMIRANO-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0281
Application of Lean Manufacturing Techniques in a Peruvian Plastic Company
Ivonne POVES-CALDERNO, J. RAMIREZ-MENDOZA, Victor NUÑEZ-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-ARCELA, 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 MARIAN[1], Duncan CAMPBELL[1], Ziyue JIN[1], Markus STUMPTNER[1], Javaan CHAHL[2]
[1]*University of South Australia, Australia*
[2]*University 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 64

IEEM19-P-0188
A Review on Flexible Forming of Sheet Metal Parts
Günther 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. PATIL[1], Makarand KULKARNI[2], P.V.M. RAO[1]
[1]*Indian Institute of Technology Delhi, India*
[2]*Indian 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-0538
Reverse Logistics Barriers: A Case of Plastic Manufacturing Industries in Zambia
Bupe MWANZA[1], Charles MBOHWA[2]
[1]*University of Zambia, Zambia*
[2]*University 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 LI, 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*
Junfeng WANG *Huazhong University of Science and Technology*

Abstracts: see page 71

IEEM19-P-0416
Development and Application of Kanban and Milk-Run in Production Process of a Metalworking Company
Alexandra CABALLERO-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
Brigitte FARFAN-MEZA, Carmen VEGA-VILLASANTE, Fernando MARADIEGUE-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 MARK[1], Luca GUALTIERI[1], Erwin RAUCH[1], Rafael ROJAS[1], Dollaya BUAKUM[2], Dominik T. MATT[3]
[1]*Free University of Bozen-Bolzano, Italy*
[2]*Chiang Mai University, Thailand*
[3]*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
Ibaraki 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*

Abstracts: see page 86

IEEM19-P-1142
Transient Analysis of Flexible Production Lines: Bernoulli Reliability Model
Mengyue WANG[1], Hongxuan WANG[1], Jingshan LI[2]
[1]*Tsinghua University, China*
[2]*University of Wisconsin-Madison, United States*

IEEM19-P-0311
Proposal of a Reconfigurability Index Using Analytic Network Process
Isabela MAGANHA[1], Cristovao SILVA[1], Luis FERREIRA[1], Matthias THURER[2], Enzo FRAZZON[3], Marco SILVESTRI[4]
[1]*University of Coimbra, Portugal*
[2]*Jinan University, China*
[3]*Federal University of Santa Catarina, Brazil*
[4]*University of Parma, Italy*

IEEM19-P-0148
Approach for Implementing Industry 4.0 Framework in the Steel Industry
Essendren GOVENDER, Arnesh TELUKDARIE, Michael SISHI
University of Johannesburg, South Africa

IEEM19-P-0078
Optimal Scheduling of the Reentrant Multi-Degree Cyclic Multi-Hoist Scheduling Problem
Xin LI[1], Yanchun PAN[1], Richard Y. K. FUNG[2]
[1]*Shenzhen University, China*
[2]*City University of Hong Kong, 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-Hsing LEE
National Central University, Taiwan

Operations Research 1

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

Chairs: Philipp BAUMANN *University of Bern*
Te-Min CHANG *National Sun Yat-sen University*

Abstracts: see page 58

IEEM19-P-0278
Stochastic Nonlinear Programming Model for Power Plant Operation via Piecewise Linearization
Tomoki FUKUBA[1], Tetsuya SATO[1], Takayuki SHIINA[1], Ken-ichi TOKORO[2]
[1]*Waseda University, Japan*
[2]*Central Research Institute of Electric Power Industry, Japan*

IEEM19-P-0288
L-shaped Method for the Stochastic Vehicle Routing Problem
Shuichi ISOMURA[1], Tetsuya SATO[1], Takayuki SHIINA[1], Jun IMAIZUMI[2]
[1]*Waseda University, Japan*
[2]*Toyo University, Japan*

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

IEEM19-P-0165
Optimizing Customer Assignments to Direct Marketing Activities: A Binary Linear Programming Formulation
Tamara BIGLER, Philipp 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 CHIA
Singapore Management University, Singapore

IEEM19-P-0382
A Continuous-Time Mixed-Binary Linear Programming Formulation for the Multi-Site Resource-Constrained Project Scheduling Problem
Mario GNÄGI, Norbert TRAUTMANN
University of Bern, Switzerland

Operations Research 2

17/12/2019 08:30 - 10:30
Room: Parisian #7301

Chairs: Ripon CHAKRABORTTY *Capability Systems Centre*
Amir SALEHIPOUR University of Technology Sydney,

Abstracts: see page 65

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
Pimprapai 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 PUTU[1], Vincent F. YU[1], Aldy GUNAWAN[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*Singapore Management University, Singapore*

IEEM19-P-0442
A Mathematical Programming Model for the Green Mixed Fleet Vehicle Routing Problem with Realistic Energy Consumption and Partial Recharges
Vincent F. YU[1], Panca JODIAWAN[1], Aldy GUNAWAN[2], Audrey TEDJA WIDJAJA[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*Singapore Management University, Singapore*

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

Operations Research 3

17/12/2019 13:30 - 15:30
Room: Parisian #7301

Chairs: Tatsushi NISHI *Osaka University*
Amir SALEHIPOUR *University of Technology Sydney*

Abstracts: see page 80

IEEM19-P-0057
Network Model Approach for Fuel Transportation Business
Manop DONMUAN, Komkrit PITIRUEK
Khon 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
Shieu-Hong LIN
Biola 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-0309
A New Mathematical Model for the Traveling Repairman Problem
Leila NAENI, L. Moslemi NAENI, Amir SALEHIPOUR
University of Technology Sydney, Australia

Operations Research 4

17/12/2019 16:30 - 18:00
Room: Parisian #7301

Chairs: Haiyan XU *Institute of High Performance Computing*
Ajinkya TANKSALE *Indian Institute of Technology (BHU) Varanasi*

Abstracts: see page 87

IEEM19-P-0043
A Goal Programming Approach for a Fuzzy Single-Source Capacitated Facility Location Problem
A. Shojaei BARJOUEI[1], Abbas BARABADI[1], Reza TAVAKKOLI-MOGHADDAM[2]
[1]*University of Tromsø – The Arctic University of Norway, Norway*
[2]*University 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 HU[1], Zhaojun YANG[1], Jun SUN[2]
[1]*Xidian University, China*
[2]*University 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
Gitae 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 79

IEEM19-P-0041
Non-Preemptive Open Shop Scheduling Considering Machine Availability
Abbas BARABADI[1], A. Shojaei BARJOUEI[1], Reza TAVAKKOLI-MOGHADDAM[2]
[1]*University of Tromsø – The Arctic University of Norway, Norway*
[2]*University of Tehran, Iran*

IEEM19-P-0417
Waste Reduction Using Lean Manufacturing Tools: A Case in the Manufacturing of Bricks
Brenda AREVALO-BARRERA, Fatima PARREÑO-MARCOS, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-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

IEEM19-P-0457
Kanban-CONWIP Hybrid Model for Improving Productivity of an Electrostatic Coating Process
Carlos GUTTI-SALAZAR, Freddy SEGURA-CHAVEZ, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0553
A Sparse Leading-Eigenvalue-Driven Control Chart for Phase I Analysis of High-Dimensional Covariance Matrices
Jinyu FAN[1], Lianjie SHU[2]
[1]*Guangdong University of Finance and Economics, China*
[2]*University of Macau, Macau*

IEEM19-P-0146
Order Acceptance and Scheduling Considering Lot-Spitting in seru Production System
Lili WANG[1], Zhe ZHANG[1], Yong YIN[2]
[1]*Nanjing University of Science and Technology, China*
[2]*Doshisha University, Japan*

Project Management 1

16/12/2019 16:00 - 17:30
Room: Bordeaux #7.3

Chairs: Yoshinobu TAMURA *Tokyo City University*
Markus HARTONO *University of Surabaya*

Abstracts: see page 52

IEEM19-P-0531
A Lazy-Constraints Approach to Resource-Constrained Project Scheduling
Dennis LERCH, Norbert TRAUTMANN
University of Bern, Switzerland

IEEM19-P-0526
Assessing the Complexity of Large-Scale Engineering Projects
Aashrit GAUTAM, Senevi KIRIDENA
University of Wollongong, Australia

IEEM19-P-0239
Defining Effort Indicators to Retrospectively Assess Engineering Change Information
Niklas KATTNER, Sylvia HU, Udo LINDEMANN
Technical University of Munich, Germany

IEEM19-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

IEEM19-P-0130
A Method of Fault Identification Considering High Fix Priority in Open Source Project
Hironobu SONE[1], Yoshinobu TAMURA[1], Shigeru YAMADA[2]
[1]*Tokyo City University, Japan*
[2]*Tottori University, Japan*

IEEM19-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

IEEM19-P-1035
Main Paths of Research in Software Development Management
Jamie LO, John S. LIU, Mei HO
National Taiwan University of Science and Technology, Taiwan

Project Management 2

17/12/2019 13:30 - 15:30
Room: Bordeaux #7.3

Chairs: R.M. Chandima RATNAYAKE *University of Stavanger*
Seung Ki MOON *Nanyang Technological University*

Abstracts: see page 74

IEEM19-P-0205
Integration of Environmental Public Welfare Projects and Internet Platforms: Survey of Environmental Public Welfare Organizations
Feng LI, Yali ZHANG, Chrissie Diane TAN, Haixin ZHANG, Zhanlong MA
Northwestern Polytechnical University, China

IEEM19-P-0156
Engineering Effort Estimation for Product Development Projects
Zeynep OZTURK YURT[1], Cem IYIGUN[2], P. BAKAL[1]
[1]*FNSS Savunma Sistemleri A.Ş., Turkey*
[2]*Middle East Technical University, Turkey*

IEEM19-P-0170
An Investigation of Estimation Techniques for Information Technology Projects
James PRATER[1], Konstantinos KIRYTOPOULOS[2], Tony MA[1]
[1]*University of South Australia, Australia*
[2]*National Technical University of Athens, Greece*

IEEM19-P-0190
The Roles of Functional Managers and Project Managers in a Matrix Organization
Nishaan KISHORE[1], Jan Harm PRETORIUS[1], Gopinath CHATTOPADHYAY[2]
[1]*University of Johannesburg, South Africa*
[2]*Federation University Australia, Australia*

IEEM19-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

IEEM19-P-0231
Product/Process Configuration Evolutionary Optimization: A Multiobjective Clustering in Order to Reduce Inconsistencies During Crossover
Paul PITIOT, Michel ALDANONDO, Elise VAREILLES, Paul GABORIT
Université de Toulouse/ IMT Mines Albi, France, Metropolitan

Project Management 3

17/12/2019 16:30 - 18:00
Room: Bordeaux #7.3

Chairs: Ripon CHAKRABORTTY *Capability Systems Centre*
Lianjie SHU *University of Macau*

Abstracts: see page 81

IEEM19-P-0434
Managing Information Systems Requirements Volatility in Development Projects: Mapping Research and Surveying Practices
Faraz KHAN, Younes BENSLIMANE, 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
Mozhgan PAKDAMAN, Vahid DOKHTZEYNAL, Alireza ABBASI, Ripon CHAKRABORTTY
University of New South Wales at the Australian Defence Force Academy, Australia

IEEM19-P-0155
Effective Antidotes to Address Adverse Situations During Multi-Stakeholder Engagement: The Case of International ICT Projects
Krishnan MYSORE[1], Konstantinos KIRYTOPOULOS[2], Tony MA[1], Seungjun AHN[1]
[1]*University of South Australia, Australia*
[2]*National Technical University of Athens, Greece*

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

Quality Control and Management 1

16/12/2019 16:00 - 17:30
Room: Parisian #7101

Chairs: Sambil Charles MUKWAKUNGU *University of Johannesburg*
Domingues J.P.T. *ALGORITMI Research Centre, School of Engineering, Department of Production and Systems, University of Minho*

Abstracts: see page 55

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 CHONG[1], Xin Yi LOO[1], Michael Boon Chong KHOO[2], Khai Wah KHAW[2], Xinying CHEW[2]
[1]*Universiti Tunku Abdul Rahman, Malaysia*
[2]*Universiti Sains Malaysia, Malaysia*

IEEM19-P-0083
On Agile Metrics for Operations Management: Measuring and Aligning Agility with Operational Excellence
Andre M. CARVALHO[1], Paulo SAMPAIO[1], Eric REBENTISCH[2]
[1]*University of Minho, Portugal*
[2]*Massachusetts 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.T. DOMINGUES, Fabio Daniel CORREIA, Ilknur UZDURUM, 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

Quality Control and Management 2

17/12/2019 08:30 - 10:30
Room: Parisian #7101

Chairs: Lianjie SHU *University of Macau*
Nita SUKDEO *University of Johannesburg*

Abstracts: see page 62

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 MWANZA[1], Tamala KAMBIKAMBI[2], Charles MBOHWA[3]
[1]*University of Zambia, Zambia*
[2]*Cavendish University Zambia, Zambia*
[3]*University of Johannesburg, South Africa*

IEEM19-P-0124
Modelling Halal Internal Traceability in Open Source ERP System for Chicken Meat Processing Company
Iwan VANANY[1], Diesta Iva MAFTUHAH[1], Adi SOEPRIJANTO[1], Sukoso SUKOSO[2], Muhammad ZULHAFIZH[1]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Universitas Brawijaya, Indonesia*

IEEM19-P-0466
Geometric Error Modeling and Monitoring of the 3D Surface by Gaussian Correlation Model
Chen ZHAO[1], Jun LV[2], Shichang DU[1], Yafei DENG[1]
[1]*Shanghai Jiao Tong University, China*
[2]*East China Normal University, China*

IEEM19-P-0554
A Distribution Free Control Chart for Monitoring High Dimensional Processes
Lianjie SHU[1], Jinyu FAN[2]
[1]*University of Macau, Macau*
[2]*Guangdong University of Finance and Economics, China*

IEEM19-P-0234
Continuous Quality Improvement: The Relationship Between Order Dispatches, Ergonomics & the Design Layout
Nita SUKDEO[1], Andre VERMEULEN[2], Victor Mothobi MOFOKENG[1]
[1]*University of Johannesburg, South Africa*
[2]*University Of Johannesburg, South Africa*

Reliability and Maintenance Engineering 1

16/12/2019 11:00 - 12:30
Room: Parisian #7102

Chairs: Sambil Charles MUKWAKUNGU *University of Johannesburg*
David VALIS *University of Defence in Brno Faculty of Military*

Abstracts: see page 42

IEEM19-P-1174
Optimal Cleaning Scheduling for Photovoltaic Systems in the Field Based on Electricity Generation and Dust Deposition Forecasting
Zhonghao WANG[1], Zheng-Guo XU[2], Min XIE[1]
[1]*City University of Hong Kong, Hong Kong SAR*
[2]*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[1], Chang-Woo PARK[1], Dae-Geun HONG[2]
[1]*Seoul National University, South Korea*
[2]*Pohang University of Science and Technology, South Korea*

IEEM19-P-1131
Optimal Preventive Maintenance for Parallel System with Two Failure Modes
Hui XIAO[1], Gang KOU[1], Rui PENG[2]
[1]*Southwestern University of Finance and Economics, China*
[2]*University of Science and Technology Beijing, China*

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 MBOHWA
University of Johannesburg, South Africa

IEEM19-P-0118
Reliability Assessment of Mining System Based on Time Mining Data
David VALIS[1], Jakub GAJEWSKI[2], Kamila HASILOVA[1], Marie FORBELSKA[3], Jozef JONAK[2]
[1]*University of Defence, Czech Republic*
[2]*Lublin University of Technology, Poland*
[3]*Mendel University in Brno, Czech Republic*

IEEM19-P-0117
Perspective Exploratory Methods for Multidimensional Data Analysis
David VALIS[1], Libor ZAK[2], Zdenek VINTR[1]
[1]*University of Defence, Czech Republic*
[2]*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 63

IEEM19-P-0054
Prognostic Study of CNC Machine Component Using a Systematic Method
Yafei 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[1], R.M. Chandima RATNAYAKE[2]
[1]*DNV GL, Norway*
[2]*University of Stavanger, Norway*

IEEM19-P-0191
Predicting the Remaining Useful Life of Ball Bearing Under Dynamic Loading Using Supervised Learning
Savinay SINGH[1], Tanmay AGARWAL[1], Girish KUMAR[1], Om Prakash YADAV[2]
[1]*Delhi Technological University, India*
[2]*North Dakota State University, United States*

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

IEEM19-P-0093
A Review of Metrics, Algorithms and Methodologies for Network Reliability
Vaibhav GAUR[1], Om Prakash YADAV[2], Gunjan SONI[1], Ajay Pal Singh RATHORE[1]
[1]*Malaviya National Institute of Technology, India*
[2]*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[1], Hironobu SONE[1], Sugisaki KODAI[1], Shigeru YAMADA[2]
[1]*Tokyo City University, Japan*
[2]*Tottori University, Japan*

Reliability and Maintenance Engineering 3

17/12/2019 16:30 - 18:00
Room: Parisian #7102

Chairs: Zhiqiang CAI *Northwestern Polytechnical University*
Zhigang TIAN *University of Alberta*

Abstracts: see page 85

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
Xuesong YANG, Shunong ZHANG, Honglin WANG
Beihang University, China

IEEM19-P-0436
Application of TPM Tools in an Automotive Battery Assembly Line
Amelia CASTILLO-REVELO, Liseth MAÑUICO-SALAS, Fernando MARADIEGUE-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
Zhigang 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 MA, Wei WANG, Pan ZHANG
Northwestern Polytechnical University, China

Safety, Security and Risk Management 1

16/12/2019 13:30 - 15:30
Room: Parisian #7102

Chairs: Guido J.L. MICHELI *Politecnico di Milano*
Zhiqiang CAI *Northwestern Polytechnical University*

Abstracts: see page 48

IEEM19-P-0029
An Optimizing Strategy Based on Resource Competing Coupling Model in Interbank Risk Contagion
Kun CHEN[1], Ning HUANG[1], Chunlin WANG[2]
[1]*Beihang University, China*
[2]*The 14th Research Institute of China Electronic Technology Corporation, China*

IEEM19-P-0097
Credit Risk Contagion Model Based on Financial Industry Clusters
Zhiwei YI[1], Ning HUANG[1], Yanan BAI[2]
[1]*Beihang University, China*
[2]*China Aerospace Science and Industry Corporation Limited, China*

IEEM19-P-0116
Airports as Critical Infrastructure: The Role of the 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 ZHU, Hao HU, Feng XU, Ning TANG
Shanghai Jiao Tong University, China

IEEM19-P-0169
Application of Bayesian Network for Food Safety Risk in Cattle Slaugtering Industry
Hana WAHYUNI, Iwan VANANY, Udisubakti CIPTOMULYONO
Institut Teknologi Sepuluh Nopember, Indonesia

IEEM19-P-0477
Development of a Risk-Based Maintenance (RBM) Strategy for Sewerage Pumping Station Network
Md. Farhan MASUD, Gopinath CHATTOPADHYAY, Indra GUNAWAN
Federation University Australia, Australia

Safety, Security and Risk Management 2

17/12/2019 13:30 - 15:30
Room: Parisian #7102

Chairs: Guido J.L. MICHELI *Politecnico di Milano*
H. Niles PERERA *University of Moratuwa*

Abstracts: see page 78

IEEM19-P-0428
A Critical Review on Hazardous Chemical Emissions and Particle from Fused Decomposition Modelling (FDM) Machine
Shu Lun MAK[1], Fanny TANG[1], Chi Ho LI[1], Winnie CHIU[1], H. K. LAU[2]
[1]*The Open University of Hong Kong, Hong Kong SAR*
[2]*Hong Kong Institute of Vocational Education (Tuen Mun), Hong Kong SAR*

IEEM19-P-0433
Using Survival Signature to Analyze Availability of Repairable System
Zhihong XU, Yufeng SUN, Guangyan ZHAO
Beihang University, China

IEEM19-P-0473
Analysis on Risk Factors of Enterprise Dominant Industrial Internet Build-up
Shouyuan WEI, Yuming ZHU, Jing ZHANG, Naveed AHMAD
Northwestern Polytechnical University, China

IEEM19-P-0559
Statistical Analysis on the Effectiveness of Occupational Safety and Health Procedures on a Plastic Manufacturing Company
Jeffrey CACHO, Eldrick FONOLLERA, Rhea MAKINANO
Quezon City University, Philippines

IEEM19-P-0305
Managing Occupational Health and Safety in SMEs: An Evolutionary Web-based Tool
Diego DE MERICH[1], Maria Grazia GNONI[2], Brunella MALORGIO[1], Guido J.L. MICHELI[3], Giusi PIGA[1], Guido SALA[3], Fabiana TORNESE[2]
[1]*INAIL, Italy*
[2]*Università del Salento, Italy*
[3]*Politecnico di Milano, Italy*

IEEM19-P-0322
Comparing Programme Theory and Intermediaries' Views: Assessment of OSH Programmes in Italy
Guido J.L. MICHELI, Enrico CAGNO, Nicola RIGGIO
Politecnico di Milano, Italy

Service Innovation and Management 1

16/12/2019 13:30 - 15:30
Room: Parisian #7301

Chairs: H. Niles PERERA *University of Moratuwa*
Chien-Sing LEE *Sunway University*

Abstracts: see page 50

IEEM19-P-1168
The Meaning of Car Use / Driving in Japanese Young Generation
Hideki SHIMIZU-TANAKA
Kyoto University of Advanced Sciences, Japan

IEEM19-P-0197
Sharing Personal Failure Story in Organization: Sharing with Individual or Organization?
Sanetake NAGAYOSHI[1], Jun NAKAMURA[2]
[1]*Shizuoka University, Japan*
[2]*Chuo University, Japan*

IEEM19-P-0361
Towards the Management of the Development of Product-Service Systems in Business Ecosystems – State-of-the-Art
Philipp HUMBECK[1], Elena VOCK[1], Thomas BAUERNHANSL[2]
[1]*TRUMPF Werkzeugmaschinen GmbH + Co. KG, Germany*
[2]*Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany*

IEEM19-P-0465
Designing Through Value Co-creation: A Study of Actors, Practices and Possibilities
Mohd Ahsan Kabir RIZVI[1], Man Hang YIP[2], Eng CHEW[1], Phillippa CARNEMOLLA[1]
[1]*University of Technology Sydney, Australia*
[2]*University 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
Chien-Sing LEE[1], Adrian TIONG[2], Nicholas Wee-Leong TANG[1], Kah-Hou YAP[1]
[1]*Sunway University, Malaysia*
[2]*Salesforce, Singapore*

IEEM19-P-0315
Queue Server Efficacy in the Retail Industry: A Behavioral Study
Charuka PREMATHILAKA, Niles PERERA, Ranil SUGATHADASA
University of Moratuwa, Sri Lanka

Service Innovation and Management 2

17/12/2019 11:00 - 12:30
Room: Parisian #7301

Chairs: Stanislav CHANKOV *Jacobs University Bremen*
Arnesh TELUKDARIE *University of Johannesburg*

Abstracts: see page 72

IEEM19-P-0555
The Concepts of Modularization in ICT Service Modeling
Franziska SCHORR, Lars HVAM
Technical University of Denmark, Denmark

IEEM19-P-0368
Value Creation Through Product-Service Systems in Business Ecosystems – Identification of Key Challenges for Mechanical Engineering Companies
Philipp HUMBECK[1], Franziska GOß[1], Thomas BAUERNHANSL[2]
[1]*TRUMPF Werkzeugmaschinen GmbH + Co. KG, Germany*
[2]*Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany*

IEEM19-P-0152
Research on Strategic Leading Mechanism of Latecomer Firms
Haibing LIU[1], Lei YANG[1], Qingrui XU[2]
[1]*Lanzhou Jiaotong University, China*
[2]*Zhejiang University, China*

IEEM19-P-1101
Modelling Digital Innovation Value Chain in SMEs: Evidence from China
Fen LYU[1], Yuming ZHU[2], Catherine DE LA ROBERTIE[3]
[1]*University of Paris 1 Pantheon-Sorbonne, France/ Northwestern Polytechnical University, China*
[2]*Northwestern Polytechnical University, China*
[3]*University of Paris 1 Pantheon-Sorbonne, France*

IEEM19-P-0253
Water 4.0: An Integrated Business Model from an Industry 4.0 Approach
Micheal ALABI, Arnesh TELUKDARIE, Nickey JANSE VAN RENSBURG
University of Johannesburg, South Africa

Supply Chain Management 1

16/12/2019 11:00 - 12:30
Room: Parisian #7001

Chairs: Linda ZHANG IESEG *School of Management*
Premaratne SAMARANAYAKE *Western Sydney University*

Abstracts: see page 40

IEEM19-P-0077
A Conceptual Design of Infrastructures and Facilities in Distribution Center for Frozen and Chilled Fishery Products
Chawis BOONMEE[1], Chompoonoot KASEMSET[1], Preda PICHAYAPAN[1], Pimsiri THOVICHIT[1], Boonsub PANICHAKARN[2]
[1]*Chiang Mai University, Thailand*
[2]*Naresuan 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 NUGROHO, Chung-Chi HSIEH
National Cheng Kung University Taiwan, Taiwan

IEEM19-P-0435
Supply Management by Remanufacturing Company of Mining Equipment
Marlith ROMAN-RIOS, Mitshel SERRATTI-RAMOS, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

IEEM19-P-0075
Exploring Green Logistics Management in Thai Small and Medium-Sized Food Exporters
Pittawat UEASANGKOMSATE
Kasetsart University, Thailand

IEEM19-P-0003
Optimizing Joint Production Planning, Pricing and Retailer Selection with Emission Control based on Stackelberg Game and Nested Genetic Algorithm
Linda L. ZHANG[1], Gang DU[2], Jun WU[2], Yujie MA[2]
[1]*IÉSEG School of Management, France*
[2]*Tianjin University, China*

Supply Chain Management 2

16/12/2019 16:00 - 17:30
Room: Parisian #7001

Chairs: Aries SUSANTY *Diponegoro University Indonesia*
Jun-Der LEU *National Central University*

Abstracts: see page 53

IEEM19-P-0046
Investigating the Effect of Partnerships on the Impact of Supply Chain Risks Upon Supply Chain Responsiveness
Bingcong ZENG[1], Benjamin P.C YEN[2]
[1]*Hong Kong Government, China*
[2]*The University of Hong Kong, China*

IEEM19-P-0113
Path Location Problem for the Container Terminal with Yard Arrangement Efficiency
Etsuko NISHIMURA, W. GUO
Kobe University, Japan

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

IEEM19-P-0143
Locating Humanitarian Relief Effort Facility Using P-Center Method
Wichitsawat SUKSAWAT NA AYUDHYA
King Mongkut's Institute of Technology Ladkrabang, Thailand

IEEM19-P-0369
Service Supply Chain Management Process Capabilities: A Theoretical Framework and Empirical Study
Pattama LENUWAT, Sakun BOON-ITT
Thammasat Business School, Thailand

IEEM19-P-0094
Mapping the Drivers in Implementing Halal Logistic
Aries SUSANTY[1], Avika CATERINA[1], Marco TIEMAN[2], Raden DIDIET RACHMAT HIDAYAT[3], Sumunar JATI[4]
[1]*Diponegoro University, Indonesia*
[2]*Logistics Building Blocks, Malaysia*
[3]*University of Trisakti, Indonesia*
[4]*Lembaga Pengkajian Pangan, Obat-obatan, dan Kosmetika Majelis Ulama Indonesia, Indonesia*

Supply Chain Management 3

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

Chairs: Linda ZHANG *IESEG School of Management*
Michel ALDANONDO *Toulouse University / IMT-Mines Albi*

Abstracts: see page 61

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 TIAN[1], Qingqing YAN[1], Changxian LIU[2]
[1]*Nanjing University of Science & Technology, China*
[2]*Nanjing University of Posts and Telecommunications, China*

IEEM19-P-0240
Strategic Sourcing Under Optimism Bias and Information Asymmetry
Tarun JAIN[1], Jishnu HAZRA[2]
[1]*Indian Institute of Management Udaipur, India*
[2]*Indian Institute of Management Bangalore, India*

IEEM19-P-0276
Optimal Pricing Strategy of Environmental Patent Transaction Under Asymmetric Information
Houping TIAN[1], Anna DAI[2], Changxian LIU[3]
[1]*Nanjing University of Science & Technology, China*
[2]*Nanjing University of Science and Technology, China*
[3]*Nanjing University of Posts and Telecommunications, China*

IEEM19-P-0296
Emerging Information Technologies Usage: Opportunities and Challenges for Supply Chain Vulnerability
Xiaoting GUO[1], Zhaojun YANG[1], Chrissie Diane TAN[2]
[1]*Xidian University, China*
[2]*Northwestern Polytechnical University, China*

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

Supply Chain Management 4

17/12/2019 11:00 - 12:30
Room: Parisian #7001

Chairs: Aries SUSANTY *Diponegoro University Indonesia*
Domingues J.P.T. *ALGORITMI Research Centre, School of Engineering, Department of Production and Systems, University of Minho*

Abstracts: see page 68

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

IEEM19-P-0340
Supply Chain Contract with Combined Revenue Sharing and Markdown Policy
Raunaq SRIVASTAVA, Pritee 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 BOCKHOLT[1], Jesper KRISTENSEN[1], Brian VEJRUM WÆHRENS[1], Steve EVANS[2]
[1]*Aalborg University, Denmark*
[2]*University of Cambridge, United Kingdom*

IEEM19-P-0199
Information Sharing with Multiple Customer Segmentations
Tai PHAM[1], Truong Ton Hien DUC[2], Jirachai BUDDHAKULSOMSIRI[1]
[1]*Thammasat University, Thailand*
[2]*RMIT University, Australia*

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

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 75

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 GUEVARA-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
Ziang LIU, Tatsushi NISHI
Osaka University, Japan

IEEM19-P-0174
"Buffer Inventory + Information Sharing" Strategy for Retailers in Two-Level Fresh Supply Chain
Lin LI[1], Zhaojun YANG[1], Chrissie Diane TAN[2]
[1]*Xidian University, China*
[2]*Northwestern Polytechnical University, China*

IEEM19-P-0405
Supplier Selection and Ranking Towards Sustainable Procurement with Multiple Decision Makers
Premaratne SAMARANAYAKE[1], Sev NAGALINGAM[2], Tritos LAOSIRIHONGTHONG[3]
[1]*Western Sydney University, Australia*
[2]*University of South Australia, Australia*
[3]*Thammasat University, Thailand*

Systems Modeling and Simulation 1

16/12/2019 11:00 - 12:30
Room: Bordeaux #7.2

Chairs: Norbert TRAUTMANN *University of Bern*
Nita SUKDEO *University of Johannesburg*

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IEEM19-P-0037
A Green Vehicle Routing Optimization Model with Adaptive Vehicle Speed Under Soft Time Window
Gaoyuan QIN, Fengming TAO, Lixia LI
Chongqing University, China

IEEM19-P-0458
Evolutionary Game Analysis of Pollutant Abatement with Collective-Risk
Ding WANG[1], Wenxuan GUO[2], Xiaonan WANG[1]
[1]*Northwestern Polytechnical University, China*
[2]*Qinghai University, China*

IEEM19-P-0154
A Mathematical Model for Internal Task Scheduling in Cross Docking
Dollaya BUAKUM, Warisa WISITTIPANICH
Chiang Mai University, Thailand

IEEM19-P-0241
Concept for Deriving System Architectures from Reference Architectures
Stephan UNVERDORBEN[1], Birthe BÖHM[1], Arndt LÜDER[2]
[1]*Siemens AG, Germany*
[2]*Otto von Guericke University Magdeburg, Germany*

IEEM19-P-0320
Open Innovation for Course Development Process Using Simulation-based Programming
Amelia KURNIAWATI[1], Fadillah RAMADHAN[2], Rayinda Pramuditya SOESANTO[1], Iwan Inrawan WIRATMADJA[3]
[1]*Telkom University, Indonesia*
[2]*National Institute of Technology Bandung, Indonesia*
[3]*Bandung Institute of Technology, Indonesia*

IEEM19-P-0542
A Framework for Inconsistency Detection Across Heterogeneous Models in Industry 4.0
Minjie ZOU, Huaxia LI, Birgit VOGEL-HEUSER
Technical University of Munich, Germany

IEEM19-P-0172
A System Study on the Quezon City Branch of a Philippine Food Service Company
Pedro Gavino Jr. BANICO, Jan Paolo DELA CRUZ, Jasper Nathan NERY, Dennis CRUZ
De La Salle University, Philippines

Systems Modeling and Simulation 2

17/12/2019 08:30 - 10:30
Room: Bordeaux #7.2

Chairs: Tatsushi NISHI *Osaka University*
Songlin CHEN *Nanyang Technological University*

Abstracts: see page 59

IEEM19-P-0049
A Comparison Between SEIADR versus SEIR Discrete Epidemic Models
Iratxe NINO[1], Marta FERNÁNDEZ[1], Manuel DE LA SEN[1], Santiago ALONSO-QUESADA[1], R. NISTAL[1], Aitor J. GARRIDO[1], Asier IBEAS[2]
[1]*University of the Basque Country / Euskal Herriko Unibertsitatea, Spain*
[2]*Autonomous University of Barcelona, Spain*

IEEM19-P-0270
Mission Reliability Allocation Based on Interval-Hesitant Fuzzy Linguistic Term Sets
Wen CHEN, Guangyan ZHAO, Xiaoxiao LI, Yufeng SUN
Beihang University, China

IEEM19-P-0297
Modeling of Chicken Production for Food Security in Indonesia
Iwan VANANY, Diesta Iva MAFTUHAH, Lalu Muhamad JAELANI, Granita HAJAR, Ni Made Cyntia UTAMI
Institut Teknologi Sepuluh Nopember, Indonesia

IEEM19-P-0336
Principal Component Analysis for High Dimension Stochastic Gaussian Process Model Fitting
Maxime XUEREB, Tian Ming HUO, Szu Hui NG
National University of Singapore, Singapore

IEEM19-P-0413
Model-based Systems Engineering Process for Supporting Variant Selection in the Early Product Development Phase
Huaxia LI, Minjie ZOU, Dominik WEIDMANN, Sadek Amin CHEAIB, Markus MÖRTL, Birgit VOGEL-HEUSER
Technical University of Munich, Germany

IEEM19-P-0060
Hospital Bed Planning in a Single Department Based on Monte Carlo Simulation and Queuing Theory
Ke WU[1], Xiaomin ZHU[1], Runtong ZHANG[1], Shangqing LIU[2]
[1]*Beijing Jiaotong University, China*
[2]*Chinese Academy of Sciences, China*

Systems Modeling and Simulation 3

17/12/2019 13:30 - 15:30
Room: Bordeaux #7.2

Chairs: Ajinkya TANKSALE *Indian Institute of Technology (BHU) Varanasi*
Zhigang TIAN *University of Alberta*

Abstracts: see page 73

IEEM19-P-1105
Study on VR Based Nuclear Power Plant Navigation System in Korea
Byungki LIM
Korea Hydro & Nuclear Power, South Korea

IEEM19-P-1148
A POMDP-based Approach to Assortment Optimization Problem for Vending Machine
Gaku NEMOTO, Kunihiko HIRAISHI
Japan Advanced Institute of Science and Technology, Japan

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

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

IEEM19-P-1143
Modeling and Reliability Analysis for Three Solar Array Configurations in Space Debris Environment
Zhaojiu WANG, Xiaobing MA
Beihang University, China

IEEM19-P-0479
Optimal Short-Term Forecasting Using GA-based Holt-Winters Method
Maricar NAVARRO, Bryan NAVARRO
Technological Institute of the Philippines, Philippines

Technology and Knowledge Management 1

16/12/2019 11:00 - 12:30
Room: Bordeaux #7.3

Chairs: Elise VAREILLES *Ecole Nationale Superieure des Mines Albi*
Ville ISOHERRANEN *University of Oulu*

Abstracts: see page 39

IEEM19-P-0030
Framework for Alliance Capabilities: A Study in Malaysian University-Industry R&D Alliances
Arnifa ASMAWI, Nabilah KAMARUZAMAN, Kok-Wai CHEW, Noor Shahaliza OTHMAN
Multimedia University, Malaysia

IEEM19-P-0450
A Meta-Synthesis of Research on Absorptive Capacity Concept Among Companies
Nurul INDARTI, Andy Susilo LUKITO-BUDI, Kusdhianto SETIAWAN
Universitas Gadjah Mada, Indonesia

IEEM19-P-0038
Green Production Implementation Through Perspective of Knowledge Sharing and Open Innovation: Case Study at Indonesian Handmade Batik Industries
Augustina Asih RUMANTI[1], Iwan Inrawan WIRATMADJA[1], Fadel MUHAMMAD[2], Afrin Fauzya RIZANA[2], Luciana ANDRAWINA[2]
[1]*Bandung Institute of Technology, Indonesia*
[2]*Telkom University, Indonesia*

IEEM19-P-0055
Competitive Advantage Analysis of Small Medium Industries in Indonesia: An Approach of Management Technology and Strategic Management
Augustina Asih RUMANTI[1], Fadel MUHAMMAD[2], Afrin Fauzya RIZANA[2], Iwan Inrawan WIRATMADJA[1], Crisendy ADELIA[3]
[1]*Bandung Institute of Technology, Indonesia*
[2]*Telkom University, Indonesia*
[3]*Atma Jaya Catholic University of Indonesia, Indonesia*

IEEM19-P-0552
Digitalization: Rise of the (Mega) Machines
Leif SUNDBERG
Mid Sweden University, Sweden

IEEM19-P-0056
A Generic Knowledge-based Model for Commercial Offers: Towards a Unified Model to Configure Products, Services and PSS During Calls for Tenders
Delphine GUILLON[1], Rania AYACHI[2], Elise VAREILLES[3], Michel ALDANONDO[3], Eric VILLENEUVE[1], Christophe MERLO[1], Andres Felipe BARCO SANTA[4], Konstantinos KIRYTOPOULOS[5]
[1]*University of Bordeaux, ESTIA Institute of Technology, France*
[2]*Université de Toulouse / IMT Mines Albi/ ENI Tarbes, France, Metropolitan*
[3]*Université de Toulouse/ IMT Mines Albi, France, Metropolitan*
[4]*Universidad Santiago de Cali, Colombia*
[5]*National Technical University of Athens, Greece*

Technology and Knowledge Management 2

16/12/2019 13:30 - 15:30
Room: Bordeaux #7.3

Chairs: Elise VAREILLES *Ecole Nationale Superieure des Mines Albi*
Nobuyuki SHIRAKAWA *National Institute of Science and Technology Policy*

Abstracts: see page 45

IEEM19-P-0129
Developing Flexible Modules - A Pragmatic Way to Organize and Reuse Engineering Assets
Dag RAUDBERGET[1], K. HÖRNMARK[2], B. YOUNADAM[3]
[1]*Jonkoping University, Sweden*
[2]*Fagerhults Belysning, Sweden*
[3]*Husqvarna Group, Sweden*

IEEM19-P-0137
An Operational Tool to Assess Configuration Lifecycle Maturity
Anna MYRODIA[1], Lars HVAM[2]
[1]*Configit A/S and Technical University of Denmark, Denmark*
[2]*Technical University of Denmark, Denmark*

IEEM19-P-0138
A Case Study of Intellectual Property Rights Management with Capability Maturity Model
Shaoming FU, Chieh-Min CHOU
Feng Chia University, Taiwan

IEEM19-P-0223
Knowledge Management System for Maintenance Activity: Case Study at the Maintenance Department of XYZ Corporation
Dila Aliffita ISWOROWATI, Fadel MUHAMMAD, Amelia KURNIAWATI, Mochamad Teguh KURNIAWAN
Telkom 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

Technology and Knowledge Management 3

17/12/2019 08:30 - 10:30
Room: Bordeaux #7.3

Chairs: Ville ISOHERRANEN *University of Oulu*
Leif OLSSON *Mid Sweden University*

Abstracts: see page 60

IEEM19-P-0516
Analyzing Stakeholder's Response to Indian Government's EV Policy Through a Text Mining Approach
R. MUKUNDAN, Chandrashekhar CHAUDHARI, Vishwas DOHALE, Priya AMBILKAR
National Institute of Industrial Engineering, India

IEEM19-P-0215
Digitization of Higher Education Institutions
Arnesh TELUKDARIE[1], Megashnee MUNSAMY[2]
[1]*University of Johannesburg, South Africa*
[2]*Mangosuthu University of Technology, South Africa*

IEEM19-P-0453
External or Internal Cooperation? Patenting Activities and Cooperative Structures in the Chinese ICT Sector
Sijia LU, Suli ZHENG, Qian XU
China Jiliang University, China

IEEM19-P-0271
The Interplay Between Knowledge Creation Strategies: The Case of European Information-and-Communications-Technology Firms
Valeria KIISK
TalTech, Estonia

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

IEEM19-P-0031
Use of Pull Product Development for Enhancing Lean Startups
Ville ISOHERRANEN[1], R.M. Chandima RATNAYAKE[2]
[1]*University of Oulu, Finland*
[2]*University of Stavanger, Norway*

Technology and Knowledge Management 4

17/12/2019 11:00 - 12:30
Room: Bordeaux #7.3

Chairs: Mukondeleli KANAKANA - KATUMBA *University of South Africa*
Nobuyuki SHIRAKAWA *National Institute of Science and Technology Policy*

Abstracts: see page 67

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

IEEM19-P-0445
Long Working Hours as a Buffer to Adjust Labor Costs
Takafumi MIYAZAKI, Noritomo OUCHI
Aoyama Gakuin University, Japan

IEEM19-P-0446
Investigating Problems of Research and Development of Artificial Intelligence Technology in Japan
Chihiro YAMADA, Ryo TAKEMURA, Tatsuki FUKUSHIMA, Noritomo OUCHI
Aoyama Gakuin University, Japan

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

IEEM19-P-0544
Barriers to Improved Energy Efficiency in the Indonesian Steel Industry: Empirical Evidence
Apriani SOEPARDI[1], Mochammad CHAERON[1], Gunawan WIJIATMOKO[2]
[1]*Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia*
[2]*Badan Pengkajian & Penerapan Teknologi (BPPT), Indonesia*

IEEM19-P-0401
Postal Development: Literature Review into Adoption Models
Kgabo MOKGOHLOA[1], Mukondeleli KANAKANA-KATUMBA[1], Wilson MALADZHI[1], John Alfred TRIMBLE[2]
[1]*University of South Africa, South Africa*
[2]*Tshwane University of Technology, South Africa*

Poster

17/12/2019 16:30 - 18:00
Room: Parisian #7202

p.88 IEEM19-P-0045
Multigene Genetic Programming Based Fuzzy Regression for Modelling Customer Satisfaction Based on Online Reviews
Hanan YAKUBU, C.K. KWONG
The Hong Kong Polytechnic University, Hong Kong SAR

p.88 IEEM19-P-0070
A Review on the Implementation of System Modelling Techniques in Lean Healthcare Applications
Maitha ALKAABI[1], Mecit Can Emre SIMSEKLER[1], Raja JAYARAMAN[1], Kudret DEMIRLI[2], Murat TUZCU[3]
[1]*Khalifa University, United Arab Emirates*
[2]*Concordia University, Canada*
[3]*Cleveland Clinic Abu Dhabi, United Arab Emirates*

p.88 IEEM19-P-0080
The Energy-Efficient and Environmentally-Friendly Vetiver-Polyurethane Thermal Insulation Foams
Sirichai TORSAKUL, Natha KUPTASTHIEN
Rajamangala University of Technology, Thailand

p.88 IEEM19-P-0104
Predicting Industrial Sector's Energy Consumption: Application of Support Vector Machine
Oludolapo A. OLANREWAJU
Durban University of Technology, South Africa

p.88 IEEM19-P-0105
Analysing Impacts Responsible for South Africa's Energy Consumption: LMDI Application
Oludolapo A. OLANREWAJU
Durban University of Technology, South Africa

p.88 IEEM19-P-0120
On Fusing Multiple Instance Selection Results
Chih-Fong TSAI[1], Ya-Han HU[2], Ming-Chang WANG[2], Kang LIU[3]
[1]*National Central University, Taiwan*
[2]*National Chung Cheng University, Taiwan*
[3]*National Taiwan University, Taiwan*

p.89 IEEM19-P-0126
A Study of Applying Deep Learning-based Weighted Combinations to Improve Defect Prediction Accuracy and Effectiveness
Chin-Yu HUANG[1], Chin-Yuan HUANG[2], Ming-Chin YANG[2], Wei-Chun SU[3]
[1]*National Tsing Hua University, Taiwan*
[2]*National Taiwan University, Taiwan*
[3]*Realtek Semiconductor Corp., Taiwan*

p.89 IEEM19-P-0132
A Semi-Supervised Approach for Steam Turbine Health Prognostics Based on GAN and PF
Zijun QUE, Yong XIONG, Zheng-Guo XU
Zhejiang University, China

p.89 IEEM19-P-0135
Use Text Mining to Abstract Affective Words in the Dream Log to Assist Dream Consultation
Kuei-Chen CHIU
National Cheng Kung University, Taiwan

p.89 IEEM19-P-0175
Influences of Parenting Style and The Teacher-Student Relationship on Self-Directed Learning of High School Students: The Mediating Effect of Core Self-Evaluations
Ju-Cong TANG, Yu-Ting ZHANG, Yi-Wen CHEN
University of Chinese Academy of Sciences, China

p.89 IEEM19-P-0181
Knowledge Discovery and Data Visualization for Taiwan Stock Market: Using F-Score Analysis
Keng-Chieh YANG[1], Chieh-Yow CHIANGLIN[1], Chia-Hui HUANG[2], I-Hwa CHEN[1]
[1]*National Kaohsiung University of Science and Technology, Taiwan*
[2]*National Taipei College of Business, Taiwan*

p.89 IEEM19-P-0185
The Application of FANP and BOCR in O2O Service Model for Sports-product Retailers
C. C. CHEN, J. L. HUNG, C. M. LAI
Far East University, Taiwan

p.89 IEEM19-P-0187
Assessing Stakeholder Preferences in Urban Planning – A Multi-Attribute Utility Approach
Anna SAMSTAD, Leif SUNDBERG, Aron LARSSON
Mid Sweden University, Sweden

p.90 IEEM19-P-0192
A Fuzzy-AHP Approach for Strategic Evaluation and Selection of Digital Marketing Tools
Ka Ho LEUNG, Daniel Y. MO
The Hang Seng University of Hong Kong, Hong Kong SAR

p.90 IEEM19-P-0195
Optimal Control of Blank Holder Force Based on Deep Reinforcement Learning
Peng GUO, Jianbo YU
Tongji University, China

p.90 IEEM19-P-0196
Wafer Map Defect Recognition Based on Deep Transfer Learning
Zongli SHEN, Jianbo YU
Tongji University, China

Session	Systems Modeling and Simulation 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Bordeaux #7.2
Chairs	Norbert TRAUTMANN *University of Bern*, Nita SUKDEO *University of Johannesburg*

IEEM19-P-0037

A Green Vehicle Routing Optimization Model with Adaptive Vehicle Speed Under Soft Time Window

Gaoyuan QIN, Fengming TAO, Lixia LI
Chongqing University, China

In order to reduce distribution costs and carbon emissions in logistics distribution process, this paper studies the green vehicle routing optimization problem, which considers the impact of speed on distribution costs and carbon emissions. A green vehicle routing optimization model with adaptive vehicle speed under soft time window (GVRP-AS). The model takes the minimum costs as the objective function and is solved by the cycle evolutionary genetic algorithm (CEGA). The research results show that GVRP-AS model can significantly reduce the total costs and carbon emissions, achieving good economic and environmental benefits.

IEEM19-P-0458

Evolutionary Game Analysis of Pollutant Abatement with Collective-Risk

Ding WANG[1], Wenxuan GUO[2], Xiaonan WANG[1]
[1]*Northwestern Polytechnical University, China*
[2]*Qinghai University, China*

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 defection. 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

Dollaya BUAKUM, Warisa WISITTIPANICH
Chiang Mai University, Thailand

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

Stephan UNVERDORBEN[1], Birthe BÖHM[1], Arndt LÜDER[2]
[1]*Siemens AG, Germany*
[2]*Otto von Guericke University Magdeburg, Germany*

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

Amelia KURNIAWATI[1], Fadillah RAMADHAN[2], Rayinda Pramuditya SOESANTO[1], Iwan Inrawan WIRATMADJA[3]
[1]*Telkom University, Indonesia*
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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.

IEEM19-P-0542

A Framework for Inconsistency Detection Across Heterogeneous Models in Industry 4.0

Minjie ZOU, Huaxia LI, Birgit VOGEL-HEUSER
Technical University of Munich, Germany

Manufacturing systems nowadays get more interconnected and flexible. Developing such a system appeals for closer interdisciplinary collaboration. Various models are used by different engineers to shape specific views on the system, but might also introduce contradictions, i.e. inconsistencies, leading to engineering delays or failures. This study proposes a knowledge-based framework to detect and avoid inconsistency across models representing different views of the same system. A prototype of the framework is implemented and evaluated.

IEEM19-P-0172

A System Study on the Quezon City Branch of a Philippine Food Service Company

Pedro Gavino Jr. BANICO, Jan Paolo DELA CRUZ, Jasper Nathan NERY, Dennis CRUZ
De La Salle University, Philippines

The food service industry is a rapidly growing industry where competition lies not only in product quality, but with service quality as well. The study considers a local branch of the Philippine food service chain. The main problem was identified to be slow food service time, which caused losses in sales due to the gap between target and actual satisfaction. The causes of the problem were identified and validated to be insufficient amounts of prepared food components and inattentive food servers. The alternatives offered were a time-based scheduling policy for food components, the use of an improved pizza cutter, buzzers for the dining staff, and limited internet provision for customers. Based on a simulation performed to test the solutions offered, the branch was able to comply with company standards for food service time.

Session	Technology and Knowledge Management 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Bordeaux #7.3
Chairs	Elise VAREILLES *Ecole Nationale Superieure des Mines Albi*, Ville ISOHERRANEN *University of Oulu*

IEEM19-P-0030

Framework for Alliance Capabilities: A Study in Malaysian University-Industry R&D Alliances

Arnifa ASMAWI, Nabilah KAMARUZAMAN, Kok-Wai CHEW, Noor Shahaliza OTHMAN
Multimedia University, Malaysia

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 polices 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.

IEEM19-P-0450

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

Nurul INDARTI, Andy Susilo LUKITO-BUDI, Kusdhianto SETIAWAN
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).

IEEM19-P-0038

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

Augustina Asih RUMANTI[1], Iwan Inrawan WIRATMADJA[1], Fadel MUHAMMAD[2], Afrin Fauzya RIZANA[2], Luciana ANDRAWINA[2]
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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.

IEEM19-P-0055

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

Augustina Asih RUMANTI[1], Fadel MUHAMMAD[2], Afrin Fauzya RIZANA[2], Iwan Inrawan WIRATMADJA[1], Crisendy ADELIA[3]
[1]*Bandung Institute of Technology, Indonesia*
[2]*Telkom University, Indonesia*
[3]*Atma Jaya Catholic University of Indonesia, Indonesia*

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.

IEEM19-P-0552

Digitalization: Rise of the (Mega) Machines

Leif SUNDBERG
Mid Sweden University, Sweden

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.

IEEM19-P-0056

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

Delphine GUILLON[1], Rania AYACHI[2], Elise VAREILLES[3], Michel ALDANONDO[3], Eric VILLENEUVE[1], Christophe MERLO[1], Andres Felipe BARCO SANTA[4], Konstantinos KIRYTOPOULOS[5]
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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.

Session	Supply Chain Management 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Parisian #7001
Chairs	Linda ZHANG *IESEG School of Management*, Premaratne SAMARANAYAKE *Western Sydney University*

IEEM19-P-0077

A Conceptual Design of Infrastructures and Facilities in Distribution Center for Frozen and Chilled Fishery Products

Chawis BOONMEE[1], Chompoonoot KASEMSET[1], Preda PICHAYAPAN[1], Pimsiri THOVICHIT[1], Boonsub PANICHAKARN[2]
[1]*Chiang Mai University, Thailand*
[2]*Naresuan University, Thailand*

This study aims to propose a conceptual design of infrastructures and facilities in the distribution center for frozen and chilled fishery products connecting lower northern provinces to the nearby countries. Firstly, several data were collected and analyzed including primary data and secondary data. Secondly, the activities were listed based on primary data and secondary data. Thirdly, the infrastructures and facilities are proposed that were listed from the activity analysis. Finally, the conceptual design was proposed for designing the infrastructures and facilities in the distribution center for frozen and chilled fishery products. The general function of infrastructures and facilities in the distribution center was firstly proposed. Then, the additional functions that might be integrated were proposed in which the additional functions consisted of retail function, light industrial function, and custom function. This study presented not only possible activities but also infrastructures and facilities in the distribution center for frozen and chilled fishery products to connect lower northern provinces to the nearby countries in which this lead to the development of the economic growth in Thailand and neighboring countries as well.

IEEM19-P-0050

Used Product Acquisition Control by Financial Incentives in Remanufacturing

Tatsuya INABA
Kanagawa Institute of Technology, Japan

Uncertainty of the used product acquisition is one of the cost increasing factors in remanufacturing. Since used products are the raw materials in remanufacturing, too much or too little acquisition lower the efficiency of the production. This uncertainty is caused by the fact that remanufacturer does not know the status of the products in the market and the timing when they are replaced. But with the progress in the IoT technologies, monitoring the products and analyzing the captured data becomes feasible. Assuming the use of the IoT-enabled products, this study proposes a method to control used product acquisition by offering the financial incentives according to the remaining product lifetime. We evaluate feasibility of our proposal using the agent simulation and show preferable incentive patterns to remanufacturer in the different situations. The practical insights presented in this study would help remanufacturers to run their business efficiently.

IEEM19-P-0106

Pricing Decisions with Product Return and Consumer Fit Uncertainty

Aditya NUGROHO, Chung-Chi HSIEH
National Cheng Kung University Taiwan, Taiwan

When firms introduce new products to the market, consumers usually have product fit uncertainty towards these new products and may not fully understand their characteristics before purchasing them. It is thus prevalent that firms offer product returns in order to mitigate consumers' valuation risk. The objective of this study is to develop a two-period model with product return and investigate how consumers' fit uncertainty and product knowledge affect the firm's decisions and profit. The firm sells new products in the first period and refurbishes the returned products and sells them, along with the new products, in the second period. We find that when more consumers find product fit or when more consumers understand product characteristics, the quantity of returned products will be reduced, the selling prices of the products will be lowered, and the firm's profit will be increased. On the other hand, when consumers have higher product valuation in the second period, the quantity of returned products will be reduced, the first-period selling price of the product will be lowered and the firm's profit will be lowered.

IEEM19-P-0435

Supply Management by Remanufacturing Company of Mining Equipment

Marlith ROMAN-RIOS, Mitshel SERRATTI-RAMOS, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

The proposed supply management model is based, firstly, on realizing a Kraljic matrix to obtain a purchasing strategy, and then followed by the homologation of suppliers who are mainly willing to work with an inventory managed by suppliers (VMI) system. The process aims to reduce the delay time in the acquisition of R1600 loader parts so as to meet the customer in 52 days, the frame established by the company under study in reference to the average of 45 days as the sector standard for the same item.

IEEM19-P-0075

Exploring Green Logistics Management in Thai Small and Medium-Sized Food Exporters

Pittawat UEASANGKOMSATE
Kasetsart University, Thailand

This study aims to explore green logistics management (GLM) in Thai small and medium-sized (SME) food exporters. At first, in-depth interviews with representatives/experts in the relevant industry were undertaken to identify the main activities regarding GLM guided by indicators drawn from the relevant literature. Then, a questionnaire was deployed to gather data from representatives of Thai SME food exporters through purposive sampling, which 52 firms completed. Statistical analysis, including Chi-square tests and t-tests, was undertaken for hypothesis testing. The findings indicate that the levels of the production and marketing aspects of engagement in GLM, are the highest and lowest, respectively. The results also reveal that the GLM activity of SME food exporters is independent of ISO14000 implementation. Finally, the evidence confirms that Thai SME food exporters implementing ISO14000 have significantly higher levels of GLM when compared to their non-implementing counterparts in all the tested dimensions.

IEEM19-P-0003

Optimizing Joint Production Planning, Pricing and Retailer Selection with Emission Control based on Stackelberg Game and Nested Genetic Algorithm

Linda L. ZHANG[1], Gang DU[2], Jun WU[2], Yujie MA[2]
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[2]*Tianjin University, China*

We address the joint decision making of production planning, 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.

Session	Decision Analysis and Methods 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Parisian #7002
Chairs	Hao YU *UiT The Arctic University of Norway*, Yaqiong LV *Wuhan University of Technology*

IEEM19-P-0012

Development of a Quadruple Bottom Line-based Composite Sustainability Index to Measure Sustainable Performance

Willy ZALATAR, Eppie CLARK
De La Salle University, Philippines

Manufacturing companies worldwide are faced with the critical issue of sustainable development. The aim of this paper is to develop a quadruple bottom line-based composite sustainability

index which can be used by manufacturing firms in measuring their sustainable performance. The proposed index simultaneously considers a firm's economic performance, social performance, environmental performance, and corporate governance. Field study results indicated that an index having a value from 0 to 1 can indeed be computed based on several sustainability indicators expressed in varying units. The index can be employed for performance evaluation to monitor the sustainable performance of a manufacturing company through the years. It can also be utilized for benchmarking to compare sustainable performance with other firms.

IEEM19-P-1095

Startup Resource Allocation Strategy: An Application of Decision Making Approaches

Peng-Ting CHEN, Wei Chih LU
National Cheng Kung University, Taiwan

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

Lixia LI, Yu YANG, Gaoyuan QIN
Chongqing University, China

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

Renyan JIANG
Changsha University of Science and Technology, China

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

Hao YU, Wei Deng SOLVANG, Xu SUN
University of Tromsø – The Arctic University of Norway, Norway

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 of a hazardous material management system is, however, a complicated decision-making problem. Thence, an improved bi-objective stochastic model is proposed to design a single-product 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 the model under a stochastic environment. The results of the numerical experimentations 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.

Session	Big Data and Analytics 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Parisian #7101
Chairs	R.M. Chandima RATNAYAKE *University of Stavanger*, Haiyan XU *Institute of High Performance Computing*

IEEM19-P-0228

Ocean Mesh Grid: Applications in Shipping Modeling

Vit PROCHAZKA[1], Roar ADLAND[2]
[1]*SNF – Centre for Applied Research at NHH, Norway*
[2]*NHH Norwegian School of Economics, Norway*

Many maritime transportation applications in operations research and analytics require computation of the shortest distance (or time) between two arbitrary positions on the ocean. In this paper, we show how "object meshing" used in engineering applications can be applied to provide a network over the ocean that enables such computation. We present a short description of potential applications in shipping modeling as well as a comparison of computational accuracy with an established port-to-port marine distance table. The numerical results suggest that a shortest-path algorithm applied to our network approximation of the ocean surface performs well for longer distances but relatively poorly for short voyages.

IEEM19-P-0347

A Binary Linear Programming-Based K-Means Approach for the Capacitated Centered Clustering Problem

Philipp BAUMANN
University of Bern, Switzerland

The k-means algorithm is one of the most popular clustering algorithms in the machine learning community. Its simplicity and scalability make it the primary choice for many clustering applications. We introduce here a variant of the k-means algorithm that can account for complex side constraints. The key idea is to use binary linear programming for assigning objects to clusters. Unlike existing extensions of the k-means algorithm that are designed for accommodating specific types of constraints, our approach can be applied to a wide range of constrained clustering problems with

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 centered clustering 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

Kilian VERNICKEL, Judith WEBER, Xujia LI, Julia BERG, Gunther REINHART
Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV, Germany

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 evaluation 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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[2]*NHH Norwegian School of Economics, Norway*
[3]*Massachusetts Institute of Technology, United States*

We implement machine learning techniques to predict the destination for Latin American crude oil exports. Utilizing a unique dataset of micro-level crude oil 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 similar oil trade requirements. The results show that while macro data, such as regional oil price differences and crack spreads, impacts the crude oil flow, micro level information about the oil shipment are key attributes in the destination prediction. Our research has practical implications, particularly with regards to prediction of oil transportation demand, spatial price arbitrage and short-term forecasting of regional crack spreads.

IEEM19-P-0044

Collaborative Technological Process Planning with 5G Mobile Networks and Digital Tools: Manufacturing Environments' Perspective

Roman WDOWIK[1], R.M. Chandima RATNAYAKE[2]
[1]*Rzeszów University of Technology, Poland*
[2]*University of Stavanger, Norway*

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

Hai-Yan XU, Vasundhara JAYARAMAN, Xiuju FU, Nasri Bin OTHMAN, Wanbing ZHANG, Xiao Feng YIN, Deqing ZHAI, Rick Siow Mong GOH
Institute of High Performance Computing, Singapore

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.

Session	Reliability and Maintenance Engineering 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Parisian #7102
Chairs	Sambil Charles MUKWAKUNGU *University of Johannesburg,* David VALIS *University of Defence in Brno Faculty of Military*

IEEM19-P-1174

Optimal Cleaning Scheduling for Photovoltaic Systems in the Field Based on Electricity Generation and Dust Deposition Forecasting

Zhonghao WANG[1], Zheng-Guo XU[2], Min XIE[1]
[1]*City University of Hong Kong, Hong Kong SAR*
[2]*Zhejiang University, China*

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

Kwang-Jae KIM[1], Chang-Woo PARK[1], Dae-Geun HONG[2]
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[2]*Pohang University of Science and Technology, South Korea*

Plant engineering is carried out in planning, engineering, procurement, construction, operation & maintenance (O&M) processes. A large number of deliverables are generated at each stage. These deliverables are submitted as as-built deliverables during the transition from Engineering, Procurement and Construction (EPC) stage to O&M stage. Once the as-built deliverables are verified, they are handed(turned) 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[1], Gang KOU[1], Rui PENG[2]
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[2]*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 certain value y. In Policy 3, components are replaced whenever 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 MBOHWA
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 VALIS[1], Jakub GAJEWSKI[2], Kamila HASILOVA[1], Marie FORBELSKA[3], Jozef JONAK[2]
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[2]*Lublin University of Technology, Poland*
[3]*Mendel University in Brno, 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 advancing 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 operation 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 VALIS[1], Libor ZAK[2], Zdenek VINTR[1]
[1]*University of Defence, Czech Republic*
[2]*University of Technology, Czech Republic*
Technical practice abounds with numerous diverse data records. Sometimes the data is complete, sometimes it is censored or truncated. It is not always easy and straightforward to record the data. And even after, the data processing is by no means simple, especially when the data forms a significant set of a huge size and large informational diversity. Typically, the data containing more observed variables, either dependent or independent, is called multidimensional. Also, if the multidimensional data contains numerous records, it is not easy to determine which dependent or independent variables are important for further study. Our aim and ambition is to introduce a couple of methods which are very suitable and sometimes absolutely necessary for exploratory data analysis. The methods help us to determine i) the level of significance of the data for single recorded variables, ii) the level of mutual dependence among the data, and iii) the choice of the best representatives for further data study. The recommended methods used for the exploratory data analysis are presented with practical examples.

Session	Manufacturing Systems 1
Date	16/12/2019
Time	11:00 - 12:30
Room	Parisian #7201
Chairs	Romeo MARIAN *University of South Australia*, Dinh Son NGUYEN *University of Science and Technology, The University of Danang*

IEEM19-P-0247
Hybrid Welding Jigs with Additive Manufactured Functional Elements
Günther SCHUH, Georg BERGWEILER, Falko 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 AYVAZ, 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, Fused 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
Wenhui 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 scheduling problem 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 maintenance resulting 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 KOENIG, Martin STADLMAIER, Tobias RUSCH, R. SOCHOR, 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 neglect-ed. Cognitive assistance systems relieve the mental stress of a worker and thus help prevent mistakes 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 work-er 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
Junfeng 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
Romeo MARIAN[1], Duncan CAMPBELL[1], Ziyue JIN[1], Markus STUMPTNER[1], Javaan CHAHL[2]
[1]*University of South Australia, Australia*
[2]*University of South Australia/ 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.

Session	Human Factors 1
Date	16/12/2019
Time	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 Engineering Management. Mapua University*

IEEM19-P-0067
Virtual Team Performance Factors: A Systematic Literature Review
Derek CLARK, Annlize 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[1], Weining FANG[1], Beiyuan GUO[1], Ke NIU[2]
[1]*Beijing Jiaotong University, China*
[2]*Zhengzhou 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.

IEEM19-P-0275

What are the Sentiments About the Autonomous Delivery Robots?

Hio Nam IO, Chang Boon LEE
University of Macau, Macau

The technology for autonomous driving is developing rapidly. One application of autonomous driving is the Autonomous Delivery Robots (ADR). The ADR has gained a lot of attention in both the academia and industry. However, most of the extant studies about the ADR focus on the technical side. There is a lack of research on the users' perspective about this new technology. This study applies topic modeling and sentiment analyses to summarize the comments in Weibo about the ADR. The results show that there are both positive and negative sentiments regarding the ADR. The contribution of this study is that the results can help researchers understand the users' concerns about ADR. The negative sentiments can provide guidance to the ADR developers to improve the design of the robots and to allay the users' concerns.

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[1], Retno WIDYANINGRUM[2], Chiuhsiang Joe LIN[3]
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[2]*Sepuluh Nopember Institute of Technology, Indonesia*
[3]*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.

IEEM19-P-0310

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 = 0.000), Temperature (p-value = 0.002), 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.

Session	Technology and Knowledge Management 2
Date	16/12/2019
Time	13:30 - 15:30
Room	Bordeaux #7.3
Chairs	Elise VAREILLES *Ecole Nationale Superieure des Mines Albi*, Nobuyuki SHIRAKAWA *National Institute of Science and Technology Policy*

IEEM19-P-0129

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

Dag RAUDBERGET[1], K. HÖRNMARK[2], B. YOUNADAM[3]
[1]*Jonkoping University, Sweden*
[2]*Fagerhults Belysning, Sweden*
[3]*Husqvarna Group, Sweden*

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.

IEEM19-P-0137

An Operational Tool to Assess Configuration Lifecycle Maturity

Anna MYRODIA[1], Lars HVAM[2]
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[2]*Technical University of Denmark, Denmark*

The use of product configurators is a well-established strategy for companies to support their products' different life cycle phases (engineering, sales, manufacturing, services). The configuration lifecycle management concept is highly relevant for complex configurable products. The business value gained comes in the form of improved lead-times, quality, and costs; benefits perceived both internally by the company and externally by their customers, in the form of increased satisfaction. The size of these benefits is also related to the maturity of the organization with regards to configuration lifecycle management. Therefore, this paper examines an operational approach to assess the level of configuration lifecycle maturity. The focus is on how to guide manufacturing companies to achieve the full potentials from operating configurators across all lifecycle phases of their products. Furthermore, how to assess and improve the utilization of configurators across all product's lifecycle phases within manufacturing companies will be elaborated. The findings of this paper are supplemented with a case study conducted at an engineering company that has been working with configurators for 10 years and it has now high emphasis on digitalization.

IEEM19-P-0138

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

Shaoming FU, Chieh-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.

IEEM19-P-0223

Knowledge Management System for Maintenance Activity: Case Study at the Maintenance Department of XYZ Corporation

Dila Aliffita ISWOROWATI, Fadel MUHAMMAD, Amelia KURNIAWATI, Mochamad Teguh KURNIAWAN
Telkom University, Indonesia

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 the 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.

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	Engineering Education and Training 1
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7001
Chairs	Leif OLSSON *Mid Sweden University*, Romalyn 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 Mikobi BAKAMA, Charles MBOHWA
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-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

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 vocational education and proposes a special program T (topic) D (discussion) I (implementation) P (presentation) E (evaluation) teaching model (hereinafter referred to as the TDIPE 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-0089

Are We Ready for the Agenda 2030 for Sustainable Development?

Per ÅHAG[1], Lisa HED[1], Per Håkan LUNDOW[1], Leif OLSSON[2]
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[2]*Mid 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

sustainable future.

Session	Intelligent Systems 1
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7002
Chairs	Zhao-Xu YANG *Xi'an Jiaotong University*, Mahmood ALI *Institute of Business Management*

IEEM19-P-0179

Designing Passive Indoor Distributed Antenna System with Practical Constraints Using Binary Encoding

Kin POON, Siddhartha SHAKYA, Khawla SHANQITI, Anis OUALI, Andrei SLEPTCHENKO
Khalifa University, United Arab Emirates

With the continuous increase in data traffic in buildings, there is an increasing demand for good cellular network coverage in indoor environments. Passive In-Building Distributed Antenna System (IB-DAS) has been widely used as a dedicated indoor solution for the required coverage. In IB-DAS, spatially separated antennas are connected to a base station through coaxial cables and splitters. Due to the consideration of many factors such as types of splitters and the solution structure of IB-DAS, many different approaches to produce 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 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 lower costs for buildings with higher floors. In addition, it produces neater cabling solutions due to the intrinsic grouping mechanism, which is highly required in practical scenarios.

IEEM19-P-1033

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

Hoyoung YUN, Hyungsoo KIM, Kyungsup KIM, Changsoon JEONG
Yonsei University, South Korea

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.

Keywords - Energy-Efficient, Cloud Data Center, Virtual Machine Consolidation, Migration, Load Balancing.

IEEM19-P-0521

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

Günther SCHUH, Georg BERGWEILER, Falko FIEDLER, Yannick BOELSEN
RWTH Aachen University, Germany

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.

IEEM19-P-0560

Direct Adaptive Data Cloud Based Fuzzy Control for NARMAX System

Zhao-Xu YANG[1], Hai-Jun RONG[1], Zhi-Xin YANG[2]
[1]*Xi'an Jiaotong University, China*
[2]*University of Macau, Macau*

This work presents a novel nonlinear direct adaptive data cloud based fuzzy controller design method for a general class of 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 selftuning 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-0562

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

Ruidong XI, Lulu TANG
University of Macau, China

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.

IEEM19-P-0317

Future Distribution Generation in an Intelligent Smart Energy Network

Anthony MATHERI[1], Mohamed BELAID[1], Nickey JANSE VAN RENSBURG[1], Thabo MAHLATSI[2]
[1]*University of Johannesburg, South Africa*
[2]*City of Johannesburg, South Africa*

The smart city policymakers are incorporating environmental sustainability ICT that contribute to making future cities more sustainable and intelligent future energy networking. Since technological innovation is moving in several directions (smart construction, smart mobility, e-health, e-government, etc.), cities should embrace policy, technology, awareness and retrofitting. Smart city energy disruption solution and evolution of the fourth industrial revolution (4IR) allows organization to be self-sufficient in terms of managing respective supply and demand. The internet of things (IoT) is a key enabler for smart cities where, together with communication and network devices, sensing devices and actuators are major components. The evolution supports smart network towards smarter technology that improve the quality of life. The key role in the ICT support framework is played by local administration and government and they can carry out control and supervision of the organization at various levels. Smart city is a centralized system; therefore, not only should citizens be able to "actively participate in demand side management," but they should also be major providers of feedback, participate in the design approach and be the recipients of personalized services.

Session	E-Business and E-Commerce 1
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7101
Chairs	Michel ALDANONDO *Toulouse University / IMT-Mines Albi*, Yan-Ling CAI *Zhengzhou University*

IEEM19-P-0074

Corporate Responses to Internet Flaming: Evidence from Japan

Keiya MORI, Fumiko TAKEDA
The University of Tokyo, Japan

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

apologies. Using a probit model, we demonstrate that flamed companies are more likely to take actions if their stock prices drop immediately after the flaming, the incident is published in the newspaper, or they have higher PBR or sales growth. We also show whether the effect dies down in the short term depends on responses of the flamed companies. When a company apologizes or deletes comments, its stock price tends to decrease significantly immediately after the outbreak of the flaming, but this decrease does not continue after a few days. In contrast, when the company objects to the flaming, its stock price starts to decline a few days after the flaming outbreak and continues to further decline.

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 evaluative 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, Anastasiia RYZHKOVA , Chrissie Diane TAN, Feng LI
Northwestern Polytechnical 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

Megashnee MUNSAMY[1], Arnesh TELUKDARIE[2]
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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

Abdourahim SYLLA[1], Rania AYACHI[2], Michel ALDANONDO[3], Elise VAREILLES[3], Yvan BEAUREGARD[4], Paul PITIOT[3]
[1]*Université Grenoble Alpes, France*
[2]*Université de Toulouse / IMT Mines Albi/ ENI Tarbes, France, Metropolitan*
[3]*Université de Toulouse/ IMT Mines Albi, France, Metropolitan*
[4]*École de Technologie Supérieure, Canada*

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

Dineo DIALE[1], Mukondeleli KANAKANA-KATUMBA[2], Wilson MALADZHI[2]
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[2]*University of South Africa, South Africa*

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.

Session	Safety, Security and Risk Management 1
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7102
Chairs	Guido J.L. MICHELI *Politecnico di Milano*, Zhiqiang CAI *Northwestern Polytechnical University*

IEEM19-P-0029

An Optimizing Strategy Based on Resource Competing Coupling Model in Interbank Risk Contagion

Kun CHEN[1], Ning HUANG[1], Chunlin WANG[2]
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[2]*The 14th Research Institute of China Electronic Technology Corporation, China*

In interbank networks, creditor banks tend to gain appreciation in asset value by borrowing liquid assets to debtor banks. Meanwhile, funds shortage leads debtor banks competing for the liquid asset, which forms a typical resource competing coupling relationship that affects the whole system. Existing research on interbank risk contagion mainly under the hypothesis that systemic risk in interbank network has accumulated to the threshold, so the behavior of banks in the accumulate process is regarded as static. It ignores the active behavior that derived from resource competing between banks. Therefore, this paper proposes a novel coupling relationship based on resource competing between banks, which takes the liquid assets as constraint, aimed to find proper ways to allocation liquid assets of creditor banks. We further study the influence of resource competing on the risk contagion of interbank network. Then, a network resource optimizing strategy is proposed to control the risk under different initial conditions.

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, still 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

Christine GROßE
Mid Sweden University, Sweden

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

Fengfeng ZHU, Hao HU, Feng XU, Ning TANG
Shanghai Jiao Tong University, China

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 Slaugtering Industry

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Institut Teknologi Sepuluh Nopember, Indonesia

The risk in food safety has become a significant research issue that has often been studied in food safety research. However, a 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 analyse 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

Md. Farhan MASUD, Gopinath CHATTOPADHYAY, Indra GUNAWAN
Federation University Australia, Australia

Industries have been facing ever-increasing challenges to do more with less under ongoing budget constraints. They are pushing the boundary by challenging the 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 down time 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.

Session	Manufacturing Systems 2
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7201
Chairs	John LIU *National Taiwan University of Science and Technology,* Xin LI *Shenzhen University*

IEEM19-P-0157

Practical Framework for Advanced Quality-based Process Control in Interlinked Manufacturing Processes

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[2]*University of Technology Sydney, Australia*

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 methological 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

Che Han LIM[1], Seung Ki MOON[1], Evans OKPOTI[2]
[1]*Nanyang Technological University, Singapore*
[2]*Hanyang University, South Korea*

In most scheduling problems, such as plant and supply chain problems, the linkages between resources, and operations are often

clearly demarcated due to their lateral, sequential nature. In comparison, the combinatorial nature, arising from the inherent network structure of a flexible manufacturing system problem causes the associated jobs, automated guided vehicles and job shops to be intermeshed topologically and temporally. The temporal and spatial network structure impedes direct application of conventional decomposition approaches. In this study, a reusable scheduling problem decomposition framework for Industry 4.0 that facilitates agent embedded optimization is being proposed. Modularity is enabled when each agent and its respective governed resource or resource group is replaceable by one that is similar in functionality, but possibly of a different layout. This schema is attractive to potential schedulers as the plug-and-play nature of resources, via modularity, optimizes user friendliness via minimal customizations.

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, Xiyu GAO, Dawei GAO
Jilin University, China

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 found intelligent factories.

IEEM19-P-0198

Digital Twins for Industry 4.0 and Beyond

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[2]*National Taiwan University of Science and Technology, Taiwan*

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.

Session	Service Innovation and Management 1
Date	16/12/2019
Time	13:30 - 15:30
Room	Parisian #7301
Chairs	H. Niles PERERA *University of Moratuwa*, Chien-Sing LEE *Sunway University*,

IEEM19-P-1168

The Meaning of Car Use / Driving in Japanese Young Generation

Hideki SHIMIZU-TANAKA
Kyoto University of Advanced Sciences, Japan

In Japan, young generations tend to 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 car to customers, including youngsters 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?

Sanetake NAGAYOSHI[1], Jun NAKAMURA[2]
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[2]*Chuo University, Japan*

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 in Japan, 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 with 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 other particular 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 your own behavior of failure-story sharing with a particular coworker.

IEEM19-P-0361

Towards the Management of the Development of Product-Service Systems in Business Ecosystems – State-of-the-Art

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The mechanical engineering industry faces major challenges due to digital transformation. Business model innovation is needed to uncover new sales potential and sustain a competitive advantage. A trend towards servitization is gaining traction – products and services are merging into integrated Product-Service Systems (PSS), providing a higher added value to customers. By cooperating with companies of different sizes and branches that bring novel competencies, resources and market channels, a holistic development over the entire PSS lifecycle is enabled. Business ecosystems emerge if this defined value proposition materializes through the interaction of its actors. The increased organizational and technological interdependencies within this system calls for adequate management. The aim of this paper is to present a state-of-the-art literature research related to the management of the development of a PSS within business ecosystems. Literature from six databases and one search engine was reviewed systematically. The result of the paper is the derivation of 18 fields of action formulating the basis for the design of a management concept.

IEEM19-P-0465

Designing Through Value Co-creation: A Study of Actors, Practices and Possibilities

Mohd Ahsan Kabir RIZVI[1], Man Hang YIP[2], Eng CHEW[1], Phillippa CARNEMOLLA[1]
[1]*University of Technology Sydney, Australia*
[2]*University of Cambridge, United Kingdom*

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 underexplored. 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

Chien-Sing LEE[1], Adrian TIONG[2], Nicholas Wee-Leong TANG[1], Kah-Hou YAP[1]
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[2]*Salesforce, Singapore*

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

Charuka PREMATHILAKA, Niles PERERA, Ranil SUGATHADASA
University of Moratuwa, Sri Lanka

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.

Session	Healthcare Systems and Management 1
Date	16/12/2019
Time	16:00 - 17:30
Room	Bordeaux #7.2
Chairs	Budi SANTOSA *Institut Teknologi Sepuluh Nopember*, Yoshiki KURATA *Technological Institute of the Philippines Quezon City*

IEEM19-P-0064

A Benders Decomposition Approach for Appointment Scheduling of Unpunctual Patients in a Multi-Server Setting

Xingwei PAN[1], Na GENG[1], Xiaolan XIE[2]
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[2]*Université Clermont Auvergne, France*

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

Annika HASSELBLAD
Mid Sweden University, Sweden

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

Annika HASSELBLAD[1], Leif OLSSON[1], Madelene BLUSI[2]
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[2]*FoU Västernorrland, Sweden*

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?

Xiuzhu GU[1], Mingming DENG[2]
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[2]*Shaanxi University of Science and Technology, China*

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

Narat HASACHOO, Pornwasin SIRISAWAT, Thunwa KAEWKET
Mae Fah Luang University, Thailand

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 since it's an unpredictable event, but a shortage of these medicines when needed will result in a serious loss. Adequate recorded data allow the pharmacist a better decide on its replenishment policy. However, this case study is not yet existed since a hospital has just opened for four months. Hence, the objective of this paper is to propose a replenishment policy (Rn,Sn) for this type of medicine including optimal order-up-to level and period with lowest expected total cost using Tarim and Kingsman's MILP. A newly opened hospital in Thailand was selected as a case study. The results were compared with current policy and now being cited as its reference order-up-to level.

Session	Project Management 1
Date	16/12/2019
Time	16:00 - 17:30
Room	Bordeaux #7.3
Chairs	Yoshinobu TAMURA *Tokyo City University*, Markus HARTONO *University of Surabaya*

IEEM19-P-0531

A Lazy-Constraints Approach to Resource-Constrained Project Scheduling

Dennis LERCH, Norbert TRAUTMANN
University of Bern, Switzerland

We study the complex combinatorial optimization problem to schedule the activities of a single project with the objective to complete the project within the shortest possible amount of time such that the limited resource capacities as well as the prescribed precedence relations between pairs of the activities are taken into account. In addition to various specific solution algorithms, the related literature proposes several Mixed-Integer Linear Programming (MILP) models, but these models remain complex to solve even for small-sized instances. We present a novel approach based on a MILP model in which the resource-capacity constraints are formulated for all inclusion-minimal sets of activities which, due to the limited capacities of the resources, cannot be processed simultaneously. We propose to remove these constraints from the model and iteratively add those constraints back which are violated in the solutions obtained. For a set of test instances from the literature, our computational results indicate that with respect to both, the deviation of the project duration obtained from the lower bound devised from the critical-path length and the number of instances solved to optimality, the novel lazy-constraints approach outperforms ten state-of-the-art MILP models.

IEEM19-P-0526

Assessing the Complexity of Large-Scale Engineering Projects

Aashrit GAUTAM, Senevi KIRIDENA
University of Wollongong, Australia

Complexity, an intuitively understood concern for project management practitioners, is often associated with the difficulty of managing projects. The literature suggests that many contemporary projects tend to display the dimensions of complexity such as multi-variance, non-linearity and emergence. Researchers have also proposed multiple frameworks and methodologies to define, identify and measure project complexity. However, the adoption of these frameworks by practitioners is hindered by the lack of a reliable means to classify projects based on their complexity in a practically useful way. This paper aims to address this gap by proposing an approach to identify indicators of project complexity. This approach allows project managers to identify potential causes of complexity in the planning phase of a project with an understanding of the areas of vulnerability. Moreover, they would be able to foresee how complexity manifests during the execution phase of a project and act upon to deal with associated challenges through proactive and reactive measures.

IEEM19-P-0239

Defining Effort Indicators to Retrospectively Assess Engineering Change Information

Niklas KATTNER, Sylvia HU, Udo LINDEMANN
Technical University of Munich, Germany

The 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 proneness 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

Daniel SAAD, Sebastian RÖTZER, Markus ZIMMERMANN
Technical University of Munich, Germany

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.

IEEM19-P-0130
A Method of Fault Identification Considering High Fix Priority in Open Source Project
Hironobu SONE[1], Yoshinobu TAMURA[1], Shigeru YAMADA[2]
[1]*Tokyo City University, Japan*
[2]*Tottori University, Japan*
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.

IEEM19-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
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 projectâ€™s quality meet standards. The modelâ€™s capabilities were demonstrated through a case study. These considerations provide a more realistic update on project performance. Additionally, deciding between QA or QC, although not mutually exclusive, is dependent on factors, such as effectiveness, additional costs, time, other resources required, and the target quality level.

IEEM19-P-1035
Main Paths of Research in Software Development Management
Jamie LO, John S. LIU, Mei HO
National Taiwan University of Science and Technology, Taiwan
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 the 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.
Keywords: software development, project management, agile, main path analysis.

Session	Supply Chain Management 2
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7001
Chairs	Aries SUSANTY *Diponegoro University Indonesia,* Jun-Der LEU *National Central University*

IEEM19-P-0046
Investigating the Effect of Partnerships on the Impact of Supply Chain Risks Upon Supply Chain Responsiveness
Bingcong ZENG[1], Benjamin P.C YEN[2]
[1]*Hong Kong Government, China*
[2]*The University of Hong Kong, China*
In this paper, a model is proposed to explain the mechanism through which partnerships exert influence over Supply Chain Risks (SCRs), then affecting supply chain responsiveness. The analysis result reveals that the development of partnerships in supply chains may help reduce collaboration risks and relationship risks. The major contribution of this study lies in the way we connect partnerships with SCRs at the prospect of supply chain responsiveness. It allows us to demonstrate the benefits of viewing SCRs as a system and partnerships as an impacting factor. The model uncovers the detailed process how partnerships influence SCRs. Among the factors investigated, partnering depth is shown most critical in this process.

IEEM19-P-0113
Path Location Problem for the Container Terminal with Yard Arrangement Efficiency
Etsuko NISHIMURA, W. GUO
Kobe University, Japan
Comparatively new terminal in Japan uses re-claimed land in most cases, in order to secure water depth of the quay. However, the terminals in other countries have various configurations. This study considers the problem to optimize the container block size in the storage area of container terminal with a given shape. Since the path where is located vertical to quay line influence handling efficiency, this study considers it as a problem which finds path location. In order to investigate the effects of the ship arrival pattern and the number of containers handled, it is evaluated by the total service time. From the computational results, in irregular and rectangular shapes, the total service time obtained by the proposed approach can be less than that time at the path arranged in same intervals.

IEEM19-P-0274
An Adaptation of the Record-to-Record Travel Algorithm for the Cumulative Capacitated Vehicle Routing Problem
Fadillah RAMADHAN, Arif IMRAN
National Institute of Technology Bandung, Indonesia
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 and competitive results when solving the VRP. 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.

IEEM19-P-0143
Locating Humanitarian Relief Effort Facility Using P-Center Method
Wichitsawat SUKSAWAT NA AYUDHYA
King Mongkut's Institute of Technology Ladkrabang, Thailand
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 Sri 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

Pattama LENUWAT, Sakun BOON-ITT
Thammasat Business School, Thailand

Service Supply Chain Management (SSCM) process capabilities consist of seven dimensions that are interrelated. This paper investigated the relationship among the seven dimensions. Our findings support the idea that information technology management (ITM) is a key driver in the process. It supports collaboration among various actors such as customers and suppliers. Based on that collaboration, service performance management (SPM) and order process management (OPM) are integrated to achieve capacity resource management (CAP) which is the bypass to demand management (DM).

IEEM19-P-0094

Mapping the Drivers in Implementing Halal Logistic

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[1]*Diponegoro University, Indonesia*
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[4]*Lembaga Pengkajian Pangan, Obat-obatan, dan Kosmetika Majelis Ulama Indonesia, Indonesia*

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 illustrations their driving power and dependence. The result of data processing with ISM method indicated that two drivers are having strong driving power, namely 'increasing of halal market demand' and 'the 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.

Session	Decision Analysis and Methods 2
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7002
Chairs	Yaqiong LV *Wuhan University of Technology*, Anders THORSTENSON *Aarhus University*

IEEM19-P-0144

Lean Six Sigma Based Performance Improvement in Public Passport Services: A Case Study from Office Work

Felix P. SANTHIAPILLAI, R.M. Chandima RATNAYAKE, Maria Antun HJELLVIK
University of Stavanger, Norway

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 focus 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

Yining BAO, Xi CHEN
Xidian University, China

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.

IEEM19-P-0171

Integrating Maximum Deviation Method and VIKOR for Evaluating Enterprise Performance in Semiconductor Industry

Cheng-Yen CHEN
National Kaohsiung University of Science and Technology, Taiwan

For maintaining their life quality in elderly period, citizens should take care of investment activity. Semiconductor industry is the most important economics industry in Taiwan. However, Taiwan semiconductor enterprise faces high risk because PRC-US trade war has been started. This research develops a framework by combining maximum deviation method and VIKOR to analyze, evaluate and understand the performance of Taiwan semiconductor industry. Our method can acquire stable result because the rank of each enterprise does not transform when decision mechanism coefficient changes. Finally, some conclusion, discussion and future research should be explained in last section.

IEEM19-P-0518

A New Mathematical Model for the Deterministic Crop Rotation Planning Problem

Ibrahim FIKRY, Mohamed GHEITH, Amr ELTAWIL
Egypt-Japan University of Science and Technology, Egypt

The objective of the crop rotation planning problem addressed in this paper is to maximize the total net return. An integer linear programming model is formulated which optimizes the crop rotation plans using the branch and bound algorithm. The model considers the maximum allowable frequency for planting each crop during the rotation cycle in each plot. The proposed model incorporates a novel timing preference constraint, along with the agronomic, water availability and seasonal demand restrictions. An analysis has been performed to simultaneously visualize the temporal and spatial variations during the rotation cycle.

IEEM19-P-1102

Supplying in Bulk or by Flow - The Value of Agility in a Case Study of Sports Garment Retailing

Anders THORSTENSON, Christian LARSEN, Hartanto WONG
Aarhus University, Denmark

The traditional approach for retail supply in the fashion industry relies on pre-ordering in large batches before the upcoming selling season. When opportunities for re-ordering are limited, this leads to the typical newsvendor setting, where retailers have to make a bet on future demand based on forecasts with large uncertainties. Conversely, a Danish company, which designs, manufactures, and distributes advanced sports garments, uses a more agile approach to distribution based on flexible manufacturing and frequent deliveries according to a base-stock policy operated by the retailers. In this paper, we consider how to evaluate the choice between the traditional approach and the agile approach. Essentially, this is a

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

Qianwen ZHOU[1], Yaqiong LV[1], Lei TU[2], Carman Ka Man LEE[3]
[1]*Wuhan University of Technology, China*
[2]*Zhejiang Chinese Medical University, China*
[3]*The Hong Kong Polytechnic University, Hong Kong SAR*

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 solution to obtain 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-0051

Valuing the Option to Delay in Engineering Management: A Case Study

Maximilian ZELLNER, Ali E. ABBAS
University of Southern California, United States

An option to delay can increase a project's value by providing the flexibility of choosing various decision alternatives after an uncertainty has been revealed. Therefore, options are valuable in settings with high uncertainty and high upfront investments. This paper presents an engineering management decision and determines the corresponding value of the option to delay using a decision analytic approach. The case study and sensitivity analyses show that the option value attains its maximum at the parameter setting that makes the decision maker without the option to delay indifferent between alternatives, indicating the close relationship between the value of perfect information and option value. The insights provide rules of thumb and provide an upper limit to how much should be spent on attaining an option to delay.

Session	Quality Control and Management 1
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7101
Chairs	Sambil Charles MUKWAKUNGU *University of Johannesburg*, Domingues J.P.T. *ALGORITMI Research Centre, School of Engineering, Department of Production and Systems, University of Minho*

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

A novel methodology of on-line monitoring, diagnosis and optimization for process parameters is proposed to improve the quality of steel products and reduce the mass quality problems caused by the inability to timely adjust the production process parameters. First, the control limit is calculated by the SVDD method with normal samples. Then, the on-line diagnosing method is proposed through the contribution chart of the process parameters. Finally, the normal samples which are adjacent to abnormal samples are selected as target samples and used to construct the optimization rules. The effectiveness of the proposed method is verified using a dataset from a steel production process. The results indicate that the methodology has a good applicability in complex production processes with nonlinear and strong correlation characteristics.

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[1], Xin Yi LOO[1], Michael Boon Chong KHOO[2], Khai Wah KHAW[2], Xinying CHEW[2]
[1]*Universiti Tunku Abdul Rahman, Malaysia*
[2]*Universiti 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-0083

On Agile Metrics for Operations Management: Measuring and Aligning Agility with Operational Excellence

Andre M. CARVALHO[1], Paulo SAMPAIO[1], Eric REBENTISCH[2]
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[2]*Massachusetts Institute of Technology, United States*

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 and draws criticism to Excellence frameworks. In the face of this gap, we develop, deploy and analyze the results obtained by an Organizational Agility assessment framework that is aligned with Excellence in Operations Management. This paper presents this 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-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

This study assesses the perception of service quality provided by data hosting companies to system administrators at one of South Africa's five major banks in Johannesburg in terms of the difference between the expected quality level and the actual service quality received to suggest recommendations aimed at resolving the issues that would be exposed. The SERVQUAL model was adopted in the survey design to classify key service quality dimensions. With a 100% response rate, an analysis of the gap score was conducted on the data collected. The findings showed that such an exercise has never been conducted at the company over the past five years, and it indicated that the overall quality of service is at its lowest as perceived by system administrators which leads to a constantly decreasing level of customer satisfaction. From the evaluation of all the quality dimensions, none of them met customers satisfaction criteria, with all the dimensions presenting negative gap scores. The study recommends that data hosting centers should implement data center service quality (DCSQ) to successfully meet the quality service

expectations of system administrators.

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
Ecole Polytechnique de Montreal, 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.

Session	Information Processing and Engineering 1
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7102
Chairs	Arnesh TELUKDARIE *University of Johannesburg*, Bin ZHANG *City University of Hong Kong*

IEEM19-P-0019
Enterprise Service Bus Solution for an Efficient Development of Geodesic Monitoring Systems
Alina ITU
Transilvania University of Brasov, Romania
Modern constructions are typically monitored with geodesic monitoring systems. One the most important challenges for these systems is represented by the complexity of developing new instance from the ones already set up. The solution introduced herein is based on a service oriented architecture, which in turn relies on an enterprise service bus as its principal component. The monitoring system consists of three principal components: measurement system, data cleaning and integration, and the deformation analysis tool. By employing the herein proposed approach these three components become loosely coupled. Herein, the focus lies on the component performing data cleaning and integration, consisting of three principal chains of services linked either serially or sequentially. The first chain manages the files containing the observations recorded by the tachymeters which perform the object monitoring. The second chain manages the data sent by the humidity and temperature sensors. The third chain performs preliminary analysis functions, and also makes the results public on a website. Error management at bus level is performed by a fourth chain in the ESB: it manages the issues of language level error handling and improves the transparency. Due to the loose coupling characteristics of the system, the components can be developed in parallel. Together with the improved flexibility and the greater reusability, this is a key aspect of a service oriented architecture.

IEEM19-P-0112
Developing Bulk-Liquid Traceability in Indonesian Coconut Oil Company
Ivan GUNAWAN[1], Iwan VANANY[1], Erwin WIDODO[1], Ig. Jaka MULYANA[2], Kevin CORNELIUS[2]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Widya Mandala Catholic University, Indonesia*
Bulk-liquid food industry is identified as the most difficult industry in building a traceability system. A previous study has recommended an information system improvement. Therefore, the information system is proposed and discussed in this paper to improve the traceability system in the bulk-liquid food industry. This paper focused on the development of a bulk-liquid traceability information system architecture and prototype in Indonesian Coconut Oil Company. The system prototype has been verified. It was proven to reduce tracing and tracking time significantly. This system is also equipped with a feature to create a clear lot separation so as to prevent total recall. Finally, a future research direction is proposed.

IEEM19-P-0378
Enhanced MORE Algorithm for Fully Homomorphic Encryption Based on Secret Information Moduli Set
Kamaldeen Jimoh MUHAMMED[1], Kazeem Alagbe GBOLAGADE[2]
[1]*University of Ilorin, Nigeria*
[2]*Kwara State University, Nigeria*
Cloud Computing has offers incredible benefits in terms of data storage and data processing. However, data protection and privacy issues when it comes to data processing on the cloud has triggered several challenges for the existing crypto-systems. In this paper, we propose symmetric based Fully Homomorphic Encryption (FHE) scheme with Matrix Operation for Randomization and Encryption (MORE) that allows arbitrary computation on an encrypted data. The proposed scheme uses Secret Information Moduli Set (SIMS) to preserved data privacy and enhanced the existing MORE scheme. The result shows that the proposed scheme (MORESIMS) tradeoff 2% execution time compared to MORE scheme with high level of security and better storage overhead of n x n based on presented security analysis.

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
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.

IEEM19-P-0189

Testing and Proof of Concept for Automated Leak Detection Using Wireless Sensors: A Pilot Study for Johannesburg Water Company

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

The main objective of automated leak detection is the deployment of wireless sensor network (WSN) system for the continuous monitoring of the urban water supply networks in pursuit to early detection of leaks in order to achieve reduction of real losses within water distribution networks. This research work provides insight on the processes and activities in the run up to the pilot test conducted at Midrand: Johannesburg (Country View) including the findings made on the status of the pipe network. The project is initiated by University of Johannesburg (UJ) and Johannesburg Water (JW) in collaboration with Process Energy & Environmental Technology Station (PEETS) and SME's as part of digitilising water demand management in pursuit to reduction of high levels of Non-Revenue Water. The performance of this innovative automated leak detection monitoring system has been tested and evaluated through a pilot deployment of wireless sensors in a controlled environment under real condition in the City of Johannesburg, Midrand Region. This paper is a continuation of the work done on integration of Small and Medium Enterprises for Industry 4.0 in the South African Water Services Sector specifically looking at business innovative water demand management technologies and entrepreneurship.

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

With the integration of Internet and manufacturing industry, enterprises need to transform to survive and develop, "improving efficiency" and "reducing costs" become the main points. In this paper, an industrial maintenance system based on Microservice Architecture is developed to ensure the digital maintenance of product life cycle. It Improves the digital service capability of industrial enterprises by breaking the information island and resolving low efficiency of data collection in industrial process.

Session	Manufacturing Systems 3
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7201
Chairs	Ali SIADAT *Arts et Metiers ParisTech*, Romeo MARIAN *University of South Australia*

IEEM19-P-0222

Process Management of Customized Product Manufacturing for Steel Structures

Anran ZHAO, Peng LIU, Qixun ZHANG, Kun WANG, Lei WANG, Yiming XUE, Xiyu GAO, Dawei GAO
Jilin University, China

Steel structure manufacturing enterprises mainly according to orders, the process management of steel structure products is characterized by randomness and uncertainty of orders, simultaneous operation of multiple products and large volume of products. In this paper, the simultaneous production of customized steel products with similar process flow is divided into one class and put on one line for production during the technological process setted. As the components of customized products are large, we set up virtual libraries between processes, and the virtual libraries are divided into several sub-virtual libraries to distinguish the components of customized products. In order to determine the processing sequence of parts, the rules of inputting and outgoing storage are set in the virtual library, In order to ensure the efficiency and normal operation of production, while selecting multiple indicators to supervise production, the process is divided into several steps to guide production. And a process management system is developed to manage the production process.

IEEM19-P-0272

Industry Related Requirements for Tools for Planning Energy Efficient Factories

Uwe DOMBROWSKI, Christoph IMDAHL, Alexander REISWICH
Technische Universität Braunschweig, Germany

This paper provides an overview of the importance of energy efficiency in companies. It shows that existing methods and tools for optimizing energy efficiency are not sufficient to overcome barriers in the industry to identify and implement energy efficiency measures. Therefore, nine barriers will be identified that are relevant for future energy efficiency optimization tools and compared with existing approaches. Six requirements have been derived from this comparison which will reduce the effect of the barriers in the future. The implementation and integration of these requirements promises a more comprehensive implementation of energy efficiency measures in industry.

IEEM19-P-0280

Applying Lean Techniques to Reduce Defective Products: A Case Study of an Electrode Manufacturing Company

Andrea HUARHUA-MACHUCA, Victor NUÑEZ-PONCE, Ernesto ALTAMIRANO-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

The main problem facing an electrode manufacturer is the high rate of defective products. Among the factors that have given rise to the defects are downtimes due to line changes and disorganized workstations during production processes. To solve this problem, a proposal was developed using the 5S and Single Minute Exchange of Die (SMED) tools to reduce the number of production defects. To support this analysis, a simulation will be carried out, seeking a considerable reduction of defective products within the production area. Implementing the Lean manufacturing philosophy, the number of defective products was reduced by 11.23%, thereby improving the quality of the production process and yielding economic benefits.

IEEM19-P-0281

Application of Lean Manufacturing Techniques in a Peruvian Plastic Company

Ivonne POVES-CALDERNO, J. RAMIREZ-MENDOZA, Victor NUÑEZ-PONCE, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

This study analyzes the influence of non-fulfillment of orders in a company that produces plastic sheets. The main cause of problems is the long unproductive times during the extrusion process, which decrease the index of the overall equipment effectiveness (OEE). An innovative proposal is presented to address this issue, involving the use of a systematic approach and combining the SMED and preventive maintenance techniques of the lean manufacturing methodology, with the aim of reducing unproductive times to improve the OEE index. To validate the effectiveness of the proposal, the systems were simulated using Arena simulation software and input analyzer, to determine the reduction of unproductive times. Results show that the proposal reduces the unproductive times bh 36.37% and improves the OEE index by 9.02%. This demonstrates the achievement of the objective of the project, which was to maximize the efficiency of the process and reduce the total time of the extrusion process, which will allow the company to fulfill the orders and avoid profit losses.

IEEM19-P-0282

Application of Lean Manufacturing Tools to Reduce Downtime in a Small Metalworking Facility

Flor DE-LA-CRUZ-ARCELA, Jhonatan MARTINEZ-CASTILLO, Ernesto ALTAMIRANO-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

This article analyzes the extensive downtimes found throughout the process of manufacturing metal structures, and how to minimize them in order to increase productivity. The overall process includes welding, beveling, and transfer to the assembly area, the three of which were identified as the most critical, because they have the highest downtimes. This downtime is generated by several factors, among which are a lack of order and cleanliness in the various work stations, and the absence of mechanisms to control production. A proposal was developed to improve the process of manufacturing brick dryer screens using Lean Manufacturing tools such as Kanban and 5'S to reduce downtimes and increase the profitability of the company. The results obtained through a simulation in Arena

Software show an overall reduction of downtime by 62%.

IEEM19-P-0293

Critical Infrastructure for Industry 4 Laboratories and Learning Factories in Academia

Romeo MARIAN[1], Duncan CAMPBELL[1], Ziyue JIN[1], Markus STUMPTNER[1], Javaan CHAHL[2]
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Industry 4 laboratories, Learning Factories and Testlabs are vital facilities for the development and dissemination of the new industrial revolution. However, as they are implemented and reported in the literature at present, they are lacking the specific constituents and their combination and integration that would qualify them as revolutionary – i.e. being clearly distinctive from carefully implemented state of the art technology that has been the norm in the last decades. An essential attribute of Industry 4 systems, as presented in the literature, is the capacity for collection, processing and recording of critical data that describe and characterizes their state and the use of information extracted from the data to monitor, control and optimize the operations. Industry 4 laboratories need to provide real life context for teaching, research, business and industry purposes. This paper discusses the minimal required infrastructure for establishing relevant Industry 4 laboratories.

Session	Operations Research 1
Date	16/12/2019
Time	16:00 - 17:30
Room	Parisian #7301
Chairs	Philipp BAUMANN *University of Bern,* Te-Min CHANG *National Sun Yat-sen University*

IEEM19-P-0278

Stochastic Nonlinear Programming Model for Power Plant Operation via Piecewise Linearization

Tomoki FUKUBA[1], Tetsuya SATO[1], Takayuki SHIINA[1], Ken-ichi TOKORO[2]
[1]*Waseda University, Japan*
[2]*Central Research Institute of Electric Power Industry, Japan*

In this paper, we consider 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 problem 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.

IEEM19-P-0288

L-shaped Method for the Stochastic Vehicle Routing Problem

Shuichi ISOMURA[1], Tetsuya SATO[1], Takayuki SHIINA[1], Jun IMAIZUMI[2]
[1]*Waseda University, Japan*
[2]*Toyo University, Japan*

The number of cargos transported by the logistics industry is increasing every year due to the growth of sales on the internet. It is thus crucial to address issues such as long working hours for employees, fewer personnel, and increasing CO2 emissions for an effective transportation system. However, it is possible to create a productive delivery plan by considering uncertainties in time fluctuations, such as delays in work and delays in transportation due to the traffic congestion. Previous studies have defined mathematical programming models to build delivery plans that satisfy customer demand. However, few studies consider time fluctuations with multiple vehicles. Therefore, this study proposes an effective solution for the stochastic vehicle routing problem (VRP) using the L-shaped method, demonstrating the effectiveness of the proposed model by evaluating the value of stochastic solution (VSS). Specifically, we develop a model for VRP using multiple vehicles, taking into consideration the fluctuations in service and travel time between customers.

IEEM19-P-0204

Quality-Oriented Network DEA Model for the Research Efficiency of Philippine Universities

Wira MADRIA, Angelimarie MIGUEL, Richard LI
De La Salle University, Philippines

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 quality-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.

IEEM19-P-0165

Optimizing Customer Assignments to Direct Marketing Activities: A Binary Linear Programming Formulation

Tamara BIGLER, Philipp BAUMANN, Manuel KAMMERMANN
University of Bern, Switzerland

Direct marketing has become a fundamental advertising method in many industries. In direct marketing, companies target specific customers with personalized product offers. By optimally assigning customers to direct marketing activities, the effectiveness of direct marketing campaigns can be greatly increased. 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.

IEEM19-P-0015

Simulation Model to Evaluate Effectiveness of Queue Management Tool in Supermarket Retail Chain

Michelle Lee Fong CHEONG, Yong Qing CHIA
Singapore Management University, Singapore

As part of its continuous process to improve operational excellence and productivity, a retail company in Asia trialed the usage of a commercial retail tool, known as Queue Buster, to improve queue management processes in its physical stores. We employed Queuing Theory to determine the effectiveness of implementing the Queue Buster. Specifically, we constructed a queuing simulation model based on input parameters derived from queuing data collected at a pilot store. Three main performance metrics - Wait Time, System Time and System Length were measured for two different queue systems, with and without the implementation of Queue Buster. Simulation results demonstrated improvement to all three performance metrics when Queue Buster is implemented. Using the system, we proposed an optimal range of trigger point i.e. the number of customers in the queue where retail chains should start employing Queue Buster to achieve optimal results. Sensitivity Analysis was also performed at various Inter-Arrival Time to test the robustness of the model.

IEEM19-P-0382

A Continuous-Time Mixed-Binary Linear Programming Formulation for the Multi-Site Resource-Constrained Project Scheduling Problem

Mario GNÄGI, Norbert TRAUTMANN
University of Bern, Switzerland

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 interrelated 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.

Session	Systems Modeling and Simulation 2
Date	17/12/2019
Time	08:30 - 10:30
Room	Bordeaux #7.2
Chairs	Tatsushi NISHI *Osaka University,* Songlin CHEN *Nanyang Technological University*

IEEM19-P-0049

A Comparison Between SEIADR versus SEIR Discrete Epidemic Models

Iratxe NINO[1], Marta FERNÁNDEZ[1], Manuel DE LA SEN[1], Santiago ALONSO-QUESADA[1], R. NISTAL[1], Aitor J. GARRIDO[1], Asier IBEAS[2]
[1]*University of the Basque Country / Euskal Herriko Unibertsitatea, Spain*
[2]*Autonomous University of Barcelona, Spain*

This paper proposes, studies and discusses in some detail discrete epidemic models of SEIADR (susceptible-exposed-symptomatic 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 infective 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 infective corpses. The control rules can optionally include feedback information.

IEEM19-P-0270

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.

IEEM19-P-0297

Modeling of Chicken Production for Food Security in Indonesia

Iwan VANANY, Diesta Iva MAFTUHAH, Lalu Muhamad JAELANI, Granita HAJAR, Ni Made Cyntia UTAMI
Institut Teknologi Sepuluh Nopember, Indonesia

Indonesian food security for chicken production as staple protein foods is essential for ensuring the availability to be consumed by toddlers, teenagers, and adults. Ensuring a good price to farmers and a stable of chicken food for the customers also should be achieved. Chicken (meat and eggs) food is most consumed than beef food in Indonesia. Hence, this paper develops a modeling of chicken production for Indonesian protein food security to capture the causality between variables in corn supply, feed mill plant, chicken production, and customer demand system. Modeling of chicken production using Geographic Information System (GIS) approach and developing of system dynamics model are used in this study. The findings of this study suggests that corn productivity, feed mill production, fodder consumption for chicken, and chicken meat and eggs demand and stock as well are critical variables within the model.

IEEM19-P-0336

Principal Component Analysis for High Dimension Stochastic Gaussian Process Model Fitting

Maxime XUEREB, Tian Ming HUO, Szu Hui NG
National University of Singapore, Singapore

Stochastic Gaussian Process models are widely used in stochastic simulation metamodeling to predict the response of noisy simulations. Often, many real-world engineering problems are high-dimensional (more than 10 dimensions), and the Gaussian Process models' prediction for such high-dimensional inputs are computationally expensive due to multiple inversions of the covariance matrix. Therefore, the "curse of dimensionality" on these models prevent them from being used in a high-dimensional setting. To overcome this problem, a methodology for high-dimensional stochastic Gaussian Process models' fitting is proposed in this paper. The input data is first projected onto a reduced set of dimensions found by Principal Component Analysis before being used to fit the model. Numerical experiments prove that the method helps significantly in reducing the computation time.

IEEM19-P-0413

Model-based Systems Engineering Process for Supporting Variant Selection in the Early Product Development Phase

Huaxia LI, Minjie ZOU, Dominik WEIDMANN, Sadek Amin CHEAIB, Markus MÖRTL, Birgit VOGEL-HEUSER
Technical University of Munich, Germany

Combining the benefits of model-based systems engineering (MBSE) and product line engineering (PLE), model-based product line engineering (MB-PLE) is applied for the design and development of complex product line systems with variants. However, due to limitations such as visualization complexity and lack of support for variant selection, MB-PLE is still not widely applied in the manufacturing industry. In this paper, we propose a model-based systems engineering process in the early development phase to promote the application of MB-PLE in the manufacturing industry. Through the integration of PSS planning model, SysML4Mechatronics modeling language and an optimal variant selection approach, the proposed process facilitates the modeling of a product line system and supports variant selection as well as architecture verification. The feasibility of the proposed systems engineering process is demonstrated with a case study.

IEEM19-P-0060

Hospital Bed Planning in a Single Department Based on Monte Carlo Simulation and Queuing Theory

Ke WU[1], Xiaomin ZHU[1], Runtong ZHANG[1], Shangqing LIU[2]
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[2]*Chinese Academy of Sciences, China*

This paper investigates hospital bed planning problem in a single department, proposing a method combining Monte Carlo simulation and queuing theory to determine bed scale and allocation. Firstly, we establish a multi-type patient mixed queuing system and simulate it via Monte Carlo simulation, obtaining major performances of the queue. Then, bed scale is determined based on average waiting time of patients as well as bed utilization constraint. Furthermore, a

mathematical model is constructed to minimize the total waiting time of all patients, thereby solving the bed allocation problem. Finally, the model is validated on MATLAB using ophthalmology department as 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.

Session	Technology and Knowledge Management 3
Date	17/12/2019
Time	08:30 - 10:30
Room	Bordeaux #7.3
Chairs	Ville ISOHERRANEN *University of Oulu*, Leif OLSSON *Mid Sweden University*

IEEM19-P-0516

Analyzing Stakeholder's Response to Indian Government's EV Policy Through a Text Mining Approach

R. MUKUNDAN, Chandrashekhar CHAUDHARI, Vishwas DOHALE, Priya AMBILKAR
National Institute of Industrial Engineering, India

The critical step for developing countries is policy formation/reforms. The 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

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[2]*Mangosuthu University of Technology, South Africa*

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 Structures in the Chinese ICT Sector

Sijia LU, Suli ZHENG, Qian XU
China Jiliang University, China

Despite abundant studies on patent cooperation, few have carefully studied the structure 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 KIISK
TalTech, 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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[2]*University 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 minimum sufficient product features to satisfy early consumers in which provide feed-back and revenue for future product development i.e. product market fit. When there are many previously developed MVPs in the market. It is not clear how to pull them to be the products with minimum viable product features (MVPFs) as the consumer demands rise over the time. This manuscript first briefly discusses current challenges in lean startups and concept of lean/pull product development. Then, it presents a framework to demonstrate pull product development process. Finally, with the support of a case study, it demonstrates how to use multi-criteria analysis methodology to recognize MVPFs. An illustrative analysis and results are presented to demonstrate the use

of the suggested approach for recognizing MVPFs.

Session	Supply Chain Management 3
Date	17/12/2019
Time	08:30 - 10:30
Room	Parisian #7001
Chairs	Linda ZHANG *IESEG School of Management*, Michel ALDANONDO *Toulouse University / IMT-Mines Albi*

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

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[2]*Nanjing 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 that 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

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[2]*Indian 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-0276

Optimal Pricing Strategy of Environmental Patent Transaction Under Asymmetric Information

Houping TIAN[1], Anna DAI[2], Changxian LIU[3]
[1]*Nanjing University of Science & Technology, China*
[2]*Nanjing University of Science and Technology, China*
[3]*Nanjing 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 response 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 GUO[1], Zhaojun YANG[1], Chrissie Diane TAN[2]
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[2]*Northwestern Polytechnical University, China*

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 n supply points and m 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.

Session	Decision Analysis and Methods 3
Date	17/12/2019
Time	08:30 - 10:30
Room	Parisian #7002
Chairs	Hao YU *UiT The Arctic University of Norway*, Mei-Chen LO *National United University & China Medicine University*

IEEM19-P-0210

Decision Bias in the Newsvendor Problem: On the Comparison of Managers and Students as Newsvendors with Decision Support System as Debiasing Strategy

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[2]*Universitas Gadjah Mada, Indonesia*
[3]*National Taiwan University of Science and Technology, Taiwan*

A growing number of studies in the newsvendor problem provided evidence that subjects' ordering behavior deviates from the optimal order quantity. Furthermore, almost all existing studies only engage students as subjects, and it leaves an essential question of whether the insights of those studies can be applied in real business practices.

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-0213

Loan Recommendation in P2P Lending Investment Networks: A Hybrid Graph Convolution Approach

Yibo CHAI, Yahu CONG, Lu BAI, Lixin CUI
Central University of Finance and Economics, China

Low successful rate of loan money has become a significant challenge for P2P Lending platforms. In this paper, we propose a hybrid deep learning algorithm combining strengths of both supervised graph convolution network and unsupervised community discovery, to accurately match the loan requirements and investing lenders on P2P Lending platforms. Our hybrid deep architecture learns predictive node embedding from both local neighborhood information and global structural information through complex investment networks with minimal information loss. We evaluate our method on large-scale dataset collected from a real-world P2P platform. Compared with strong baselines, our proposed method provides optimal loan recommendation performance, generates efficient solutions for "Cold-Start" problem and features fast computing speed.

IEEM19-P-0261

Adapted Design for Variety: Consideration of the Software-Domain

Christoph RENNPFERDT, Dieter KRAUSE
Hamburg University of Technology, Germany

Many companies are expanding their product program in response to current megatrends. In many cases, this leads to an increase in complexity within the company. One way of counteracting this is to develop variety-oriented product structures. However, existing methods do not consider the fact that in many products the functionalities are realized by physical components and/or software. This paper presents an adaptation of the Design for Variety Method (DfV) of the integrated PKT-approach is presented that permits considering the software domain while using the method. The necessary adaptations are presented for each step of the method. It concludes with an outlook on further possible research topics.

IEEM19-P-0331

A Methodology of Network Modeling of Risk Prioritization in Hazardous Product Transportation

Jenjira SUKMANEE, Ramil KESVARAKUL, R. KESVARAKUL, Nattawut JANTHONG
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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-1096

Service Network Design for Collaborative Last Mile Delivery Considering Parcel Attributes

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Most 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.

Session	Quality Control and Management 2
Date	17/12/2019
Time	08:30 - 10:30
Room	Parisian #7101
Chairs	Lianjie SHU *University of Macau*, Nita SUKDEO *University of Johannesburg*

IEEM19-P-0159

Phase I Analysis of Hidden Operating Status for Wind Turbine

Yuchen 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. Informative 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
Bupe MWANZA[1], Tamala KAMBIKAMBI[2], Charles MBOHWA[3]
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[2]*Cavendish University Zambia, Zambia*
[3]*University of Johannesburg, South Africa*
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
Iwan VANANY[1], Diesta Iva MAFTUHAH[1], Adi SOEPRIJANTO[1], Sukoso SUKOSO[2], Muhammad ZULHAFIZH[1]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Universitas Brawijaya, Indonesia*
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
Chen ZHAO[1], Jun LV[2], Shichang DU[1], Yafei DENG[1]
[1]*Shanghai Jiao Tong University, China*
[2]*East China Normal University, China*
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 in 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
Lianjie SHU[1], Jinyu FAN[2]
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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
Nita SUKDEO[1], Andre VERMEULEN[2], Victor Mothobi MOFOKENG[1]
[1]*University of Johannesburg, South Africa*
[2]*University 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 despatches 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 in 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 despatches to customers and increase productivity.

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

IEEM19-P-0054
Prognostic Study of CNC Machine Component Using a Systematic Method
Yafei DENG, Shichang DU, Chen ZHAO
Shanghai Jiao Tong University, China
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
Arvind KEPRATE[1], R.M. Chandima RATNAYAKE[2]
[1]*DNV GL, Norway*
[2]*University of Stavanger, Norway*
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

Savinay SINGH[1], Tanmay AGARWAL[1], Girish KUMAR[1], Om Prakash YADAV[2]
[1]*Delhi Technological University, India*
[2]*North Dakota State University, United States*

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 model to predict the wear process phenomena 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-0235

Working-Condition Importance Measures for Multi-Component Systems

Zhiqiang CHEN, Xiaoyan ZHU
University of Chinese Academy of Sciences, China

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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[2]*North Dakota State University, United States*

Networks have become an indispensible part of the modern society. The numerous engineering realms, mainly computers and communication, transportation, electric transmission, and oil and gas distribution are based on interconnection 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

Yoshinobu TAMURA[1], Hironobu SONE[1], Sugisaki KODAI[1], Shigeru YAMADA[2]
[1]*Tokyo City University, Japan*
[2]*Tottori University, Japan*

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 several jump 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.

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

IEEM19-P-0188

A Review on Flexible Forming of Sheet Metal Parts

Günther SCHUH, Georg BERGWEILER, Falko FIEDLER, Philipp BICKENDORF, Can COLAG
RWTH Aachen University, 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 deep drawn parts in low quantities. Due to tooling lead time and 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. tooling costs, sustainability, and product flexibility.

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

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

B.A. PATIL[1], Makarand KULKARNI[2], P.V.M. RAO[1]
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[2]*Indian Institute of Technology Bombay, India*

Industry 4.0 consisting 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 differences 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

Harumi HARAGUCHI
Ibaraki University, Japan

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[1], Charles MBOHWA[2]
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[2]*University of Johannesburg, South Africa*

To alleviate the depletion of resources, application of reverse logistics (RL) systems in the plastic manufacturing industries is necessary. Numerous challenges exist in the plastic industry that prevent sustainable RL of Plastic Solid Wastes (PSWs). These challenges include; logistics costs, production costs, raw material availability etc. The study assesses RL barriers facing the Zambian plastic manufacturing and/or recycling industries. It identifies sustainable strategies from success stories in developed economies. The barriers preventing sustainable implementation of RL in the Zambian context include; 'lack of household participation in PSWs recycling schemes,' 'lack of recycling technology and infrastructure,' 'ineffective enforcement of extended producer responsibility (EPR),' 'none-existence of legislations and regulations for effective enforcement of PSWs recycling and recovery,' and 'combination of different plastic materials that complicate recycling.' The study recommends the following strategies for implementation; 'having a household PSWs segregation system' and 'establishment of recycling ssystems for industries in the plastics industry.' The strategies provided in this paper are applicable to industries that manufacture and /or recycle other products. To policy makers and the government, the paper provides a foundation for developing policies.

IEEM19-P-0398

Simulation Based Capacity Optimization of a General Assembly Line with Extremely Unbalanced Station Process Time

Wei ZHOU, Shiqi LI, Yaqin HUANG, Junfeng WANG
Huazhong University of Science and Technology, China

A general assembly shop in an aerospace industry has extremely unbalanced workstation time and several re-entry processes. The capacity allocation of buffer-like workstations has been identified as a crucial factor of production improvement. Experience based what-if analyses based on simulation of feasible alternatives are time-consuming and cannot get the optimization solutions. In this study, a data driven simulation-based optimization framework is presented and used to re-design the capacity of buffer-like workstations in the line. The assembly processes with distinct characteristics are introduced and a data driven method is adopted to build the different structures of the simulation model. An optimization problem with constraints is formulated and solved based on genetic algorithm, which uses self-adoptive 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.

Session	Operations Research 2
Date	17/12/2019
Time	08:30 - 10:30
Room	Parisian #7301
Chairs	Ripon CHAKRABORTTY *Capability Systems Centre, UNSW Canberra at ADFA,* Amir SALEHIPOUR *University of Technology Sydney*

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

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 fulfilment system can increase the efficiency of picking products to fulfil 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 for moving. In the context of E-commerce implementation, data-driven optimization is one of the objectives for the robotic mobile fulfilment 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

Pimprapai THAINIAM
King Mongkut's Institute of Technology Ladkrabang, Thailand

The quadratic assignment problem (QAP) is known as one of NP-hard combinatorial optimization problems where a set of facilities must be assigned to a set of locations in order to minimize total cost. In this paper, we 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

Agus Yudisuda Indrakarna PUTU[1], Vincent F. YU[1], Aldy GUNAWAN[2]
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[2]*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 freight transport 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 neighbourhood 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.

IEEM19-P-0442

A Mathematical Programming Model for the Green Mixed Fleet Vehicle Routing Problem with Realistic Energy Consumption and Partial Recharges

Vincent F. YU[1], Panca JODIAWAN[1], Aldy GUNAWAN[2], Audrey TEDJA WIDJAJA[2]
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[2]*Singapore 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.

IEEM19-P-0125

A Hybrid Differential Evolution with Cuckoo Search for Solving Resource Constrained Project Scheduling Problems

Karam M. SALLAM, Ripon K. CHAKRABORTTY, Michael J. RYAN
University of New South Wales Canberra at the Australian Defence Force Academy, Australia

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) algorithm 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.

Session	Human Factors 2
Date	17/12/2019
Time	11:00 - 12:30
Room	Bordeaux #7.2
Chairs	Markus HARTONO *University of Surabaya*, Chien-Sing LEE *Sunway University*

IEEM19-P-0447

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

Kentaro TAKASHIMA[1], Tomoya NISHIGAKI[1], Tomoyuki TAKESHITA[2]
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[2]*Seiwa 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 organization in order to develop their career proactively. 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-0246

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

Poompak KUSAWAT, Nopadol ROMPHO
Thammasat University, Thailand

This exploratory study examines which investing characteristics determine success in an equity market. Based on data from 403 respondents, exploratory factor analysis results in 13 factors: middle/long time horizon, qualitative analyst, open-minded/disciplined, organized, emotional stability, naïve, growth stock, concentrated portfolio, contrarian, value stock, globalized, intrinsic value, and price-independent. Multiple linear regression of individual investors' excess return on these factors show statistically significant relationship. These results deepen our knowledge on what sort of investing characteristics are required to survive in equity markets.

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

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.

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

This study proposes an ergonomics-based approach for those who are living in small housings (known as flats) in Indonesia. With regard to human capability and limitation, this research shows how the basic needs of human beings are captured and analyzed, followed by proposed designs of facilities and standard living in small housings. Ninety samples were involved during the study through in-depth interview and face-to-face questionnaire. The results show that there were some proposed of modification of critical facilities (such as multifunction ironing work station, bed furniture, and clothesline) and validated through usability testing. Overall, it is hoped that the proposed designs will support biopsychosocial needs and sustainability.

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 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 processings. 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 shape 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
University of Johannesburg, South Africa

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 #7.3
Chairs	Mukondeleli KANAKANA - KATUMBA *University of South Africa*, Nobuyuki 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

Takafumi 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

Chihiro 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?

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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

Apriani SOEPARDI[1], Mochammad CHAERON[1], Gunawan WIJIATMOKO[2]
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[2]*Badan 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 denoted 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 regulation, inadequate for incentive amount, and distortion in energy efficiency policy.

IEEM19-P-0401

Postal Development: Literature Review into Adoption Models

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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 (2IPD) that measures four dimensions of postal development: relevance, resilience, reach and reliability. The purpose of the study was to review literature on the 2IPD, 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.

Session	Supply Chain Management 4
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7001
Chairs	Aries SUSANTY *Diponegoro University Indonesia*, Domingues J.P.T. *ALGORITMI Research Centre, School of Engineering, Department of Production and Systems, University of Minho*

IEEM19-P-0335

An Integrated Two-Stage Optimization Method for Job-Shop Bottleneck Planning and Scheduling

Na GAO, 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 programing based scheduling involves multi-resources capacity limit, demand fulfill, precedence, initialization, down activities and sequence-dependent set up. Then, we improve this model to address on 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.

IEEM19-P-0340

Supply Chain Contract with Combined Revenue Sharing and Markdown Policy

Raunaq 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-0493

Hybrid Covering Location Problem: Set Covering and Modular Maximal Covering Location Problem

Roghayyeh ALIZADEH, Tatsushi NISHI
Osaka University, Japan

To benefit from the location advantages provided from two main covering location problems, namely set covering location problem and maximal covering location problem, a new mathematical model is presented in this study. In this model, the main facilities are located gradually through the planning periods, providing full coverage for the incremental demand of nodes. In addition, a limited number of modules are assigned to the located facilities to maximize the covered demand nodes in operational periods. Combining the set covering and maximal covering location problems in one model, to take advantage of the merits of both models is studied. Some test problems are solved to investigate the proposed model. The numerical results confirm the applicability of the model and provide insights for the proposed model.

IEEM19-P-0504

Learning from the Nature: Enabling the Transition Towards Circular Economy Through Biomimicry

Markus BOCKHOLT[1], Jesper KRISTENSEN[1], Brian VEJRUM WÆHRENS[1], Steve EVANS[2]
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[2]*University of Cambridge, United Kingdom*

The natural biosphere operates according to a system of nutrients and metabolisms, in which there is no such thing as waste. Forming an eternal cycle, which iteratively recycles its major nutrients. This objective is what many industrial organizations aim for by closing industrial material and product loops in the Technosphere. In doing so industrial organisations aim to drive sustainability, ensure supply resilience and explore new financial revenue streams. Unlike the biosphere, the technosphere is immature, often failing to prove financial vitality and hence scalability. This paper utilizes biomimicry to cross fertilize natural intelligence, which evolved over millions of years. Biological organism ensures vitality (surplus of calories) by foraging for food, a process, which contains continuous search and digestion processes, optimized to environmental conditions through evolution. This paper explores how biological search and digestion strategies can be exploited in industrial product takeback systems to make informed decisions for maximizing industrial vitality (surplus of financial income).

IEEM19-P-0199

Information Sharing with Multiple Customer Segmentations

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In this paper, the benefit of information sharing is examined in a two-stage supply chain with a make-to-stock manufacturer and two competing retailers facing a three-segment market. Each retailer has its own loyal customers and competes for the other two segments, namely stockpiling and switching. In addition, there exists a market uncertainty which can be forecasted by the two retailers. The retailers consider whether to share the forecasts with the manufacturer, who, in turn, decides whether to fully disclose the received information. In this context, three information sharing scenarios, including no information sharing, and information sharing with either non-disclosure or disclosure, are considered. By using a simulation method, the values of information sharing, the differences of manufacturer's total profits in these scenarios, are determined. In addition, the impacts of various factors on the magnitude of information sharing benefit are explored and the managerial implications of these results are also elaborated.

IEEM19-P-0095

Prioritization an Indicator for Measuring Sustainable Performance in the Food Supply Chain: Case of Beef Supply Chain

Aries 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.

Session	Decision Analysis and Methods 4
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7002
Chairs	Mei-Chen LO *National United University & China Medicine University,* Anders THORSTENSON *Aarhus University*

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-makings 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 SOLVANG
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 shows, 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

Hsin-Pin FU, Hsiao-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 are 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 OLIVEIRA[1], Catarina CUBO[1], Rui ESTRADA[1], Ana FERNANDES[1], Paulo AFONSO[1], Maria do Sameiro CARVALHO[1], Paulo SAMPAIO[1], João ROQUE[2], Marcio REBELO[2]
[1]*University of Minho, Portugal*
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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, a 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 existent literature.

IEEM19-P-1172

An Integrated Decision Support System for Sustainable Supplier Selection, Evaluation, and Benchmarking Using a FIS and MOLP Approach

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[2]*University of Sharjah, United Arab Emirates*

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 the nature of the business.

IEEM19-P-1169

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

Mei-Chen LO[1], Su-Tso YANG[2], Tung-Ti CHANG[2], Lu-Hai WANG[2]
[1]*National United University & China Medicine University, Taiwan*
[2]*China Medicine University, Taiwan*

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-yao-zheng-zhi-jue is an important documentary for studying Qian Yi and his academic thoughts. It is also the first existing pediatric book. It 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.

Session	Big Data and Analytics 2
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7101
Chairs	Norbert TRAUTMANN *University of Bern*, Usha ANANTHAKUMAR *Indian Institute of Technology Bombay*

IEEM19-P-0527

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

A. MORALES-FORERO, Samuel BASSETTO
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.

IEEM19-P-1121

Fault Prediction of Fan Based on Failure Window Period

Bin YAN[1], Qiaozhen NING[2], Xianpeng WANG[2], Dongsheng YU[2]
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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 GBDT and LR algorithms is about 10% higher than that of the previous sampling.

IEEM19-P-0321

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

Leila NAENI, Amir SALEHIPOUR
University of Technology Sydney, Australia

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.

IEEM19-P-0443

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

Myungsook KO[1], Tatsuya INAGI[2], Masaaki TAKADA[1], Toru YANO[1]
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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.

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

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[2]*University of Mumbai, India*

The paper aims to assess the dynamics that affects the retail rental outlets 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.

Session	Information Processing and Engineering 2
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7102
Chairs	Bin ZHANG *City University of Hong Kong*, David VALIS *University of Defence in Brno Faculty of Military*

IEEM19-P-0386

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

Ragnhild GJERDE, R.M. Chandima RATNAYAKE, Samindi SAMARAKOON
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, with a special focus on the use of LPS 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 KE, 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[1], Riji YU[2], Dingzhou FEI[1], Baichuan HUANG[1], Yao SONG[3], Ling PENG[4], Yuhuai ZENG[5]
[1]*Wuhan University, China*
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[3]*The Hong Kong Polytechnic University, Hong Kong SAR*
[4]*Huanggang Land and Resources Bureau, China*
[5]*Guangzhou Institute of Geography, China*

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 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.

Session	Manufacturing Systems 5
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7201
Chairs	Dinh Son NGUYEN *University of Science and Technology, The University of Danang*, Junfeng WANG *Huazhong University of Science and Technology*

IEEM19-P-0416

Development and Application of Kanban and Milk-Run in Production Process of a Metalworking Company

Alexandra CABALLERO-BARRERA, Jhamile VALDIVIA-CASTILLO, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

Demand variability and high competitiveness in the manufacturing sector have influenced companies to adopt different tools to optimize their inventory control. The Kanban tool offers a reduction of minimum inventory levels and increased production flexibility. This study covers the design, application, and validation of a Kanban control system and a milk-run distribution system in a kitchen

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

Brigitte FARFAN-MEZA, Carmen VEGA-VILLASANTE, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, 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 developed. To reduce 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

Benedikt Gregor MARK[1], Luca GUALTIERI[1], Erwin RAUCH[1], Rafael ROJAS[1], Dollaya BUAKUM[2], Dominik T. MATT[3]
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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 during the daily work routine. The following paper discusses various assistance systems both identified in scientific literature and on the market, as well as categorizes diverse user groups in the present production 4.0. As a result, the paper provides a proposal for the matching of assistance systems with the identified user groups.

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 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.

IEEM19-P-0513

A Study on Skip Flow Shop Scheduling Considering with a Cutting Process in Reinforcing Bar Manufacturing

Hiroshi ARAI, Harumi HARAGUCHI
Ibaraki University, Japan

In recent years, technical innovation is also expanded in the field of housing construction. The unit basic reinforcing rod system (BRS) is one of important innovation of "layout of reinforcement bar process" in the making of the housing base. This process was performed by handwork in the past, many housing construction sites are using BRS at now. The BRS is made in factory and production process are complicated. Therefore, the process systematization is behind. A manufacturing premise of BRS is regarded as a flow shop system that the lot sizing condition is different every process. In addition, the first process of BRS is a cutting process. It is also important for making of BRS. In this study, an efficient scheduling method is proposed using the priority of the lot sizing condition and a cutting process.

IEEM19-P-0454

A Method for Generation of Random Lattice Structure for Additive Manufacturing

Dinh Son NGUYEN
The University of Danang, Viet Nam

Additive manufacturing technologies provide us new opportunities to fabricate a product with much more complex geometry and architecture that conventional manufacturing ones such as turning, milling, grinding, casting and molding do not have the ability to implement. Hence, lattice structures are becoming more popular and used extensively in the industrial product design to minimize the usage of materials due to the additive manufacture technologies. Lattice structures are formed by the cellular unit of structure repeated regularly or irregularly in a design area. However, the creation and generation of these structures for additive manufacturing in the current CAD environment have many difficulties. Therefore, the paper will propose a new approach to design the lattice structure, especially the random one. This approach allows helping product designers to design and generate lattice structure randomly based on the Voronoi diagrams.

Session	Service Innovation and Management 2
Date	17/12/2019
Time	11:00 - 12:30
Room	Parisian #7301
Chairs	Stanislav CHANKOV *Jacobs University Bremen*, Arnesh TELUKDARIE *University of Johannesburg*

IEEM19-P-0555

The Concepts of Modularization in ICT Service Modeling

Franziska SCHORR, Lars HVAM
Technical University of Denmark, Denmark

The use of architectures and modularity are key theoretical concepts helping to manage the design of complex products. We propose that those theoretical concepts can also be applied to information and communication technology (ICT) service modeling. Conceptual service models represent how we understand an ICT service's structure, definition, and scope. As service modeling demonstrates resource requirements for ICT service operations, a conceptual model is a prerequisite for knowledge management and competitive advantage, according to the resource-based view of the firm. This explorative case study investigates how the concepts of modularization are represented in conceptual ICT models. We found that ICT service modeling makes use of basic modularity principles such as the modularization of the service components. Without the representation of interfaces, practitioners and researchers may not be able to leverage the suggested benefits of modularity.

IEEM19-P-0368

Value Creation Through Product-Service Systems in Business Ecosystems – Identification of Key Challenges for Mechanical Engineering Companies

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[1]*TRUMPF Werkzeugmaschinen GmbH + Co. KG, Germany*
[2]*Fraunhofer 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.

IEEM19-P-0152

Research on Strategic Leading Mechanism of Latecomer Firms

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The purpose of this paper is to analyze how the strategy of latecomer firms leads innovation and promotes the accumulation and improvement of capability in its development with an analytical framework of "strategy-innovation paradigm-capability" and tries to sum up the internal evolution logic of strategy. Based on this, it makes a longitudinal case study of Haier Group from 1984 to 2018. Through the research, it constructs the L.S.I.C model, which reveals the key role of the strategy in the innovation and capability in the catch-up process of latecomer firms: strategy leads innovation. Innovation is the basis of forming capability. Different innovation paradigm forms different enterprise capability. At the same time, the mechanism of strategic leading innovation is supported by leadership mechanism, learning mechanism and coordination mechanism. The contributions of this paper are as follows: it enriches the theoretical basis of strategic evolution, makes a pioneering analysis of the relationship between strategy, innovation and capability, and probes into the national technology policy.

IEEM19-P-1101

Modelling Digital Innovation Value Chain in SMEs: Evidence from China

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[2]*Northwestern Polytechnical University, China*
[3]*University of Paris 1 Pantheon-Sorbonne, France*

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 is little. For this purpose, using the framework of innovation 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 service 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 enrich their understanding toward how the value generates during the digital innovation value chain in SMEs of China.

IEEM19-P-0253

Water 4.0: An Integrated Business Model from an Industry 4.0 Approach

Micheal ALABI, Arnesh TELUKDARIE, Nickey 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.

Session	Systems Modeling and Simulation 3
Date	17/12/2019
Time	13:30 - 15:30
Room	Bordeaux #7.2
Chairs	Ajinkya TANKSALE *Indian Institute of Technology (BHU) Varanasi*, Zhigang TIAN *University of Alberta*

IEEM19-P-1105

Study on VR Based Nuclear Power Plant Navigation System in Korea

Byungki LIM
Korea Hydro & Nuclear Power, South Korea

Virtual Reality(VR) technology is being applied quiet successfully in military, entertainment, and Gas & Oil power plant. In order to successfully build virtual reality technology, it is most necessary to establish the environment most similar to reality. The current virtual reality technology has a disadvantage that it is disconnected from the real world when the user wears a Head Mounted Device(HMD) for experiencing in a virtual environment and there is a feeling of fatigue due to long wearing. Nuclear power navigation system is to create a virtual environment for a nuclear power plant, taking into account the limitations of the real world and the shortcomings of wearing it for a long time. Nuclear power plant navigation system consist of "walk-through", "optimal path tracking system", and 2D based General Arrangement(GA). It will be possible to search detail information in the VR environment and GA Plant map for nuclear power plant facilities.

IEEM19-P-1148

A POMDP-based Approach to Assortment Optimization Problem for Vending Machine

Gaku NEMOTO, Kunihiko HIRAISHI
Japan Advanced Institute of Science and Technology, Japan

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

goal of assortment optimization is to maximize the expected sales by changing the assortment at each step. By simulation of the model, it is realized that 2-3 points sales (in a percentage ratio of theoretical upper bound) can be increased more than the heuristic method under the same conditions. We also find that the model's results can achieve sales close to the numerical upper limit.

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-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 optimisation 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

Zhaojiu 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-0479

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

Maricar 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 RATNAYAKE *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, Chrissie Diane TAN, Haixin ZHANG, Zhanlong MA
Northwestern 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.

IEEM19-P-0156

Engineering Effort Estimation for Product Development Projects

Zeynep OZTURK YURT[1], Cem IYIGUN[2], P. BAKAL[1]
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[2]*Middle 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-0170

An Investigation of Estimation Techniques for Information Technology Projects

James PRATER[1], Konstantinos KIRYTOPOULOS[2], Tony MA[1]
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[2]*National 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.

IEEM19-P-0190

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

Nishaan KISHORE[1], Jan Harm PRETORIUS[1], Gopinath CHATTOPADHYAY[2]
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[2]*Federation 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 94.17% of their objectives.

IEEM19-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

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, due to low oil and gas prices. This requires ECs to put great emphasis on: improving timeliness of current equipment deliveries; cost-effective and timely implementation of documentation; increased efficiency of engineering tools; and development of new products for future orders. Lean Daily Management (LDM) elements, such as visual control boards, daily accountability, and leader standard work, etc., with identified key performance indicators, support leaders to continuously improve processes and eliminate waste. This manuscript demonstrates the basics of LDM, then presents the findings regarding design project delivery and performance in a case study EC company. It also demonstrates the potential of using LDM to solve the existing challenges pertaining to design projects' delivery in the case study company. Finally, it presents a methodology and guidelines for implementing LDM to minimize backlog of design projects and waste of design projects' delivery process in the case study EC company, to avoid over-budget circumstances.

IEEM19-P-0231

Product/Process Configuration Evolutionary Optimization: A Multiobjective Clustering in Order to Reduce Inconsistencies During Crossover

Paul PITIOT, Michel ALDANONDO, Elise VAREILLES, Paul GABORIT
Université de Toulouse/ IMT Mines Albi, France, Metropolitan

Concurrent configuration of a product and its associated production process is a challenging problem in customer/supplier relations dealing with configurable products. Search for optimized solutions that respect customer's needs and constraints of the problem in a multiobjective context is a particularly difficult task. Constraints Filtering Based Evolutionary Algorithm (CFB-EA) [1] proposes an original way to integrate constraints satisfaction in optimization thanks to a constraints filtering engine. CFB-EA tries to mix solutions randomly selected in order to improve them but leads to many incompatibility occurrences which are time consuming. We propose in this article a dedicated multiobjective clustering algorithm that reduces incompatibilities occurrences and improve the selection of solutions for crossover operator.

Session	Supply Chain Management 5
Date	17/12/2019
Time	13:30 - 15:30
Room	Parisian #7001
Chairs	Premaratne SAMARANAYAKE *Western Sydney University,* Ali SIADAT *Arts et Metiers ParisTech*

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

In this study, the problem of high levels of returns of orders to be dispatched, affecting distribution companies of the mass consumption sector, was analyzed. For this reason, the study was carried out for the company AT, which presents an index of 12.10% returns, equivalent to $ 158,061.69 in lost sales (rejected products), due to the following causes: orders arriving outside the established reception time window (50.71%), incomplete orders (30.57%) and orders arriving in poor condition (18.72 %). Lean Warehousing techniques were used as a practical tool to introduce good and efficient practices in the company. As a standardized framework, the company introduced three stages for the implementation of Lean Warehousing: "create stability," "create flow," and 'make flow," in the warehouse. The implementation was carried out for the three stages by means of a pilot, taking as a baseline the following indicators identified by the VSM tool: picking time (5 hours), percentage of orders left unattended due to lack of stock (28.64%) and the percentage of non-conforming orders due to expiration (25.5%). At the end of the implementation, the picking time was reduced to three hours, the percentage of orders left unattended due to lack of stock to 22%, and the percentage of non-conforming orders due to expiration fell to 20%. In this way, the level of rejections was reduced to 5.5% by improving the gross margin of the company. The result will be used as a baseline and example for future implementations to the rest of the distributors of the sector.

IEEM19-P-0419

Supply Model for Dependent Demand in the Peruvian Textile Industry: A Case Study

Andrea GUEVARA-YARASCA, Gian FALLA-MARCELO, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

The main purpose of managing a supply chain is to ensure the life cycle of a product or service, from reception 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-0174

"Buffer Inventory + Information Sharing" Strategy for Retailers in Two-Level Fresh Supply Chain

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[2]*Northwestern 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 SAMARANAYAKE[1], Sev NAGALINGAM[2], Tritos LAOSIRIHONGTHONG[3]
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[2]*University of South Australia, Australia*
[3]*Thammasat 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.

Session	Intelligent Systems 2
Date	17/12/2019
Time	13:30 - 15:30
Room	Parisian #7002
Chairs	Mahmood ALI *Institute of Business Management*, Zhao-Xu YANG *Xi'an Jiaotong University*

IEEM19-P-1161

Smart and Sustainable Energy Management: Exemplary Examples from Singapore

Jasmine Siu Lee LAM
Nanyang Technological University, Singapore

Industries increasingly find ways to be smarter or more intelligent in processes and operations. Technological advancements enable smarter solutions, which then strengthen a company's competitive advantage. Energy management is an area that offers opportunities for industries to tap on smart technologies to preserve energy resources and become more cost-efficient. This study provides exemplary examples using the case of Singapore's seaport - the largest transhipment hub in the world. Singapore strives to be energy-smart, which is essential as the city state does not have natural energy resources. Port operations are energy-intensive so the port of Singapore utilizes green technologies to reduce energy consumption. Both terminal operators Jurong Port and PSA started the deployment of solar energy as a clean and renewable source for power generation. Smart energy management systems matching energy demand and supply help to improve energy efficiency and sustainability performance, including mitigating exhaust pollutants and greenhouse gas emissions. Therefore, not only the port industry benefits, other stakeholders such as residents can also enjoy a more sustainable environment.

IEEM19-P-0558

The Joint Optimization of Spare Parts and Maintenance Personel Under Lateral Transshipment

Bowen CUI, Qiang FENG, Yi REN, Bo SUN, Cheng QIAN, Dezhen 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 $p \in Pj$, 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

Tensor Completion Based 3d Reconstruction of Binocular Stereo Vision

Ze-Hua LIU[1], Hai-Jun RONG[1], Zhao-Xu YANG[1], Zhi-Xin YANG[2]
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[2]*University of Macau, Macau*

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 progress 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.

IEEM19-P-0422

Challenges in Implementing Transportation Tracking System in Saudi Arabia

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[3]*Birmingham City University, United Kingdom*

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.

IEEM19-P-0318

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

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[1]*University of Johannesburg, South Africa*
[2]*United 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.

Session	Big Data and Analytics 3
Date	17/12/2019
Time	13:30 - 15:30
Room	Parisian #7101
Chairs	Philipp BAUMANN *University of Bern*, Usha ANANTHAKUMAR *Indian Institute of Technology Bombay*

IEEM19-P-0334

Performance Gap Between Valid and Invalid Patents in Six Technology Fields

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[1]*Fu Jen Catholic University, Taiwan*
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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 patent breadth, to explore 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

Kenjiro TORIZUKA[1], Humiaki SAITOH[2], Syohei ISHIZU[1]
[1]*Aoyama Gakuin University, Japan*
[2]*Chiba 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-0357

Machine Learning Based Approach to Predict Short-Term Fuel Consumption on Mobile Offshore Drilling Units

Maria Antun HJELLVIK, R.M. Chandima RATNAYAKE
University of Stavanger, Norway

The application of machine learning models for optimization and improved decision-making has great potential in the drilling industry. This paper demonstrates a model for predicting fuel consumption on a Mobile Offshore Drilling Unit (MODU) with a Multi-layer Perceptron (MLP) artificial neural network. The model is proposed as a tool for setting fuel consumption related performance goals for offshore personnel on a MODU. Operational and environmental data have been used as input variables for the model, with a dataset split into 80% training set and 20% test set. The highest performance is obtained with three hidden layers with 38 nodes each. The Adam solver performs better than the Stochastic Gradient Descent (SGD) solver for weight optimization, and the best α parameter for the L2 regularization term is 0.0001 with the Adam solver. The MLP regression model predicts fuel consumption for the test set with a Root Mean Squared Error (RMSE) of 0.0770. This result indicates that artificial neural networks and the MLP regressor is a suitable algorithm for predictive modelling of fuel consumption on a MODU.

IEEM19-P-0546

Knowledge Graphs for an Automated Information Provision in the Factory Planning

Uwe DOMBROWSKI, Alexander REISWICH, Christoph IMDAHL
Technische Universität Braunschweig, Germany

Today's factory planning is characterized by a multitude of different IT systems. This results in data silos that lead to problems with the provision of information within factory planning. This paper addresses this problem by integrating data from different data silos into a knowledge graph based on the Semantic Web Stack. To improve the information provision a function is developed, which automatically identifies data changes and makes the data available in line with the demands of the planners on the basis of a role-based concept. The developed concept is implemented and validated in the factory planning of a german automobile manufacturer.

IEEM19-P-0432

A Clustering-based Sales Forecast Method for Big Promotion Days in O2O On-Demand Retailing

Hongyan DAI[1], Haoyang YU[1], Qin XIAO[1], Weihua ZHOU[2]
[1]*Central University of Finance and Economics, China*
[2]*Zhejiang University, China*

O2O on-demand service is a fast-growing business model which integrates traditional offline retailing and e-commerce. Big promotion is an effective way to attract new customers and promote sales in O2O service. However, high sales brought by big promotions can incur challenges for the operation management, especially for delivery capacity planning and replenishment scheduling. Using an accurate sales forecast is shown to be an effective way to alleviate such problems, though this technique still has its challenges. In this paper, we propose a clustering-based random forest (RF) method to predict the sale levels in shops for big promotion days. We further apply a dataset from one of the largest O2O grocery platforms in China to validate our method. The results show that the forecast accuracy of our proposed algorithm is 13.43% higher than non-clustering RF method, 22.85% higher than non-clustering ARIMA method.

IEEM19-P-0162

Framework for the Continuous Increase of Product Performance by Analyzing Product Usage Data

Michael RIESENER, Christian DÖLLE, Annika BECKER, Günther SCHUH
RWTH Aachen University, Germany

Today's manufacturing companies in the machinery and plant engineering sector are facing increasingly shorter innovation and technology cycles. As a consequence, admired features of their products are rapidly changing to standard features in the customer's perception. Thus, product optimizations during the product life cycle are gaining in importance. Taking this into consideration, subscription models provide a business framework which aims for a continuous improvement of product performance in return for a periodic payment during the product use phase. In order to define this performance, the challenge is to precisely focus on those product features providing the highest contribution to the specific customer benefit and to detect 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.

Session	Safety, Security and Risk Management 2
Date	17/12/2019
Time	13:30 - 15:30
Room	Parisian #7102
Chairs	Guido J.L. MICHELI *Politecnico di Milano*, H. Niles PERERA *University of Moratuwa*

IEEM19-P-0428

A Critical Review on Hazardous Chemical Emissions and Particle from Fused Decomposition Modelling (FDM) Machine

Shu Lun MAK[1], Fanny TANG[1], Chi Ho LI[1], Winnie CHIU[1], H. K. LAU[2]
[1]*The Open University of Hong Kong, Hong Kong SAR*
[2]*Hong 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 Decomposition 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 Polylactic Acid/Polylactide (PLA) are the most commonly used materials due to lower cost. The FDM consists of printing head with a heater and nozzle. The plastic filament was melt due to high temperature. During the melting process, chemicals are evaporated from the filaments. The exact amount and compositions of hazardous chemical emission is not yet defined. Although the industrial standard, ANSI/CAN/UL 2904, was published on January 31, 2019, it only covers the technical requirements on a single 3D printer. In the paper, we will study the potential compositions of hazardous chemical emission from 3D printer and suggest a list of parameters to be measured in a school laboratories in order to protect students.

IEEM19-P-0433

Using Survival Signature to Analyze Availability of Repairable System

Zhihong XU, Yufeng SUN, Guangyan ZHAO
Beihang University, China

Repairable system is generally dealt by Markov modeling method. But the state space will exponentially explode with increasing number of components. Thus, a newly emerging concept, survival signature, is utilized in this paper to help reduce state space in Markov modeling. On the basis of that, mathematical expressions of availability for repairable system consisting of homogenous components as well as system of heterogeneous components are derived. The final cases demonstrate the application of this method and the method is proved to be efficiency.

IEEM19-P-0473

Analysis on Risk Factors of Enterprise Dominant Industrial Internet Build-up

Shouyuan WEI, Yuming ZHU, Jing ZHANG, Naveed AHMAD
Northwestern Polytechnical University, China

Considering the risks in the process of the building up Industrial Internet led by large enterprises, this paper constructs a risk analysis model based on the Interpretative Structural Modeling(ISM). ISM helps for analyzing the risk factors in the process of enterprise dominant industrial Internet build-up through a systematic approach, including identifying the initial risk factors set through literature review method, screening the final risk factors set by Delphi method and analyzing the risk factors by ISM. Finally, an ISM-based Model for the risk factors of the enterprise dominant Industrial Internet is established and analyzed. This study is expected to provide some implication for large enterprises to avoid risks effectively in the process of industrial Internet build-up.

IEEM19-P-0559

Statistical Analysis on the Effectiveness of Occupational Safety and Health Procedures on a Plastic Manufacturing Company

Jeffrey CACHO, Eldrick FONOLLERA, Rhea MAKINANO
Quezon City University, Philippines

This paper will demonstrate how descriptive statistics, Analysis of Variance (ANOVA), and Hsu post-hoc analysis will be used to assess the effectiveness of safety and health program of a certain Plastic Manufacturing Company. Mean and ranking under descriptive statistics will define where the company efforts should be highly given. Inferential statistics with the use of ANOVA will reveal that factors affecting the effectiveness of safety and health are significantly different and performing Hsu PostHoc Analysis will show that among the given factors, what should be prioritized to improve the safety and health policies and procedure of the company.

IEEM19-P-0305

Managing Occupational Health and Safety in SMEs: An Evolutionary Web-based Tool

Diego DE MERICH[1], Maria Grazia GNONI[2], Brunella MALORGIO[1], Guido J.L. MICHELI[3], Giusi PIGA[1], Guido SALA[3], Fabiana TORNESE[2]
[1]*INAIL, Italy*
[2]*Università del Salento, Italy*
[3]*Politecnico di Milano, Italy*

Even though several guidelines have been proposed by public organizations about how to design an Occupational Health and Safety management system (OHSMS) customized to Small- and Medium-size Enterprises (SMEs), an approach integrating and OHSMS with the risk assessment under a unified and shared logic still misses. This paper presents an evolutionary OHS tool for SMEs that combines the advantages of a simplified procedure to develop a risk analysis and outline a set of risk prevention and protection measures at workplace, such as the one proposed by the Italian legislation, with the advantages of a simplified OHS management model. It is assumed that a software tool could be the preferential way to allow a wide diffusion and an effective application of this model. The online structure also enables distributing OHS-related information directly from institutional databases. This information, provided within the same software tool used for risk assessment and OHS management, can significantly support in particular SMEs with a poor experience.

IEEM19-P-0322

Comparing Programme Theory and Intermediaries' Views: Assessment of OSH Programmes in Italy

Guido J.L. MICHELI, Enrico CAGNO, Nicola RIGGIO
Politecnico di Milano, Italy

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-0041

Non-Preemptive Open Shop Scheduling Considering Machine Availability

Abbas BARABADI[1], A. Shojaei BARJOUEI[1], Reza TAVAKKOLI-MOGHADDAM[2]
[1]*University of Tromsø – The Arctic University of Norway, Norway*
[2]*University of Tehran, Iran*

This paper considers a non-preemptive open shop scheduling problem (OSSP), in which machines are not available to process jobs on known periodic interval times resulted from periodic service repair, rest period, and so on. Asymmetric transportation time between machines is considered, which can be different from one job to another. The objective is to minimize the weighted mean completion time (WMCT). Since the problem is categorized into NP-hard class, two meta-heuristic algorithms including genetic algorithm (GA) and differential evolution (DE) are proposed. Meanwhile, a new initial population is introduced, which significantly improves the performance of the algorithms. Finally, the performance of the algorithms is validated through some large-sized instances and the results are discussed.

IEEM19-P-0417

Waste Reduction Using Lean Manufacturing Tools: A Case in the Manufacturing of Bricks

Brenda AREVALO-BARRERA, Fatima PARREÑO-MARCOS, Juan QUIROZ-FLORES, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

The objective of this study was to identify those aspects of brick production in small- and medium-sized enterprises (SME) that need improvement, and, from this, to propose the implementation of such improvements to increase market competitiveness. The problem identified was the presence of a high rate of waste in the production process, having two main parts: high levels of reprocessing and waiting times. According to the root cause analysis, implementation of an improvement model is proposed using tools from the Lean Manufacturing philosophy. This model has two approaches, one in processes using tools such as Poka Yoke and Jidoka, another in maintenance using tools such as TPM (Total Productive Maintenance) and SMED (Matrix Change). Implementation of these tools improved the main indicators of the company. In the milling stage, productivity increased from 62.81 kg/min to 91.48 kg/min, while efficiency increased from 81% to 84.3%. In the extrusion stage, productivity increased from 13 und/min to 16 und/min, while efficiency increased from 40% to 53.39%. With the increases in productivity and efficiency of these processes, gross margin was improved from 14% to 36.7%. These results allowed these types of companies to improve their competitiveness in the market and, over time, they may have the economic and productive capacity to acquire new technologies that will improve the quality of the brick.

IEEM19-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

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.

IEEM19-P-0457

Kanban-CONWIP Hybrid Model for Improving Productivity of an Electrostatic Coating Process

Carlos GUTTI-SALAZAR, Freddy SEGURA-CHAVEZ, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

The company in this study provides metallic coating services in Peru and posted increasing losses due a spike in non-conformances. This problem is recurrent in the metal-mechanic sector in the country, because of the absence of controls to mitigate problems in production lines. The application of engineering tools including 5S, systematic layout planning (SLP), and WLC to establish a background supporting the proper application of a modified Hybrid Kanban-CONWIP system centered on tools like a line signaling process capable of optimally controlling and managing each activity until perfect finish of a product is proposed as an improvement to solve the problems. The proposed improvement reduces the operating cost by 9% and increased the company's profit by 10–15.4 %, around $5 344.11.

IEEM19-P-0553

A Sparse Leading-Eigenvalue-Driven Control Chart for Phase I Analysis of High-Dimensional Covariance Matrices

Jinyu FAN[1], Lianjie SHU[2]
[1]*Guangdong University of Finance and Economics, China*
[2]*University of Macau, Macau*

In statistical process control (SPC), a proper Phase I analysis is essential to the success of Phase II monitoring. With recent progresses in sensor technology and data collection systems, Phase I analysis of high-dimensional (HP) data is increasingly encountered. However, the high dimensionality presents a new challenge to the traditional Phase I techniques. A literature review reveals nearly no Phase I techniques in existence for analyzing HP process variability. Motivated by this, this paper develops a Sparse Leading Eigenvalue Driven control chart for retrospectively monitoring HP covariance matrices in Phase I, denoted as the SLED control chart. The key idea of it is to track changes in the sparse leading eigenvalue between two covariance matrices. Compared to the L_2-type and L_∞-type methods, the proposed method can extract stronger signal with less noise. It is shown that the proposed method can gain high detection power, especially when the shift is weak and is not very dense, which is often the case in practical applications.

IEEM19-P-0146

Order Acceptance and Scheduling Considering Lot-Spitting in seru Production System

Lili WANG[1], Zhe ZHANG[1], Yong YIN[2]
[1]*Nanjing University of Science and Technology, China*
[2]*Doshisha University, Japan*

For the manufacturing companies that take make-to-order production, due to limited production capacity, accept and process all orders may result in delayed delivery of some orders, so the companies not only have to pay a large amount of delay penalty, but also may lose a large number of customers. In this case, the order acceptance and scheduling problem in the seru production system

with limited processing capability and the promised delivery time are considered in this paper. At the same time, lot-spitting 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.

Session	Operations Research 3
Date	17/12/2019
Time	13:30 - 15:30
Room	Parisian #7301
Chairs	Tatsushi NISHI *Osaka University*, Amir SALEHIPOUR *University of Technology Sydney*

IEEM19-P-0057
Network Model Approach for Fuel Transportation Business
Manop DONMUAN, Komkrit PITIRUEK
Khon Kaen University, Thailand
This paper represents mathematical models for improving oil transportation problem with multi-products and multi-compartments. 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.

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
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, thus further achieving the purpose of guiding the residential users to consume electricity reasonably and filling in peak and valley, which has certain significance for practical application.

IEEM19-P-1112
Dynamic Vehicle Refueling Planning in Transportation Networks
Shieu-Hong LIN
Biola University, United States
Minimizing the operational cost of point-to-point delivery is a critical task for the industry of motor carriers. Given any point in the transportation network, the motor carrier needs a vehicle refueling plan that specifies (i) the path from the central depot to the destination, (ii) the intermediate stopping points for refueling along the path, and (iii) the amount of fuel to refill in each stopping point. A plan using a shortest path through the network may not minimize the refueling cost result since fuel prices along the path may be more expensive than those along a longer path. In this paper, we describe the data structures and algorithms needed for optimal refueling planning given a central depot situated in the transportation network. The computational task is to efficiently update the optimal refueling plans on the fly for point-to-point delivery from the central depot based on the latest fuel prices over the network. Given a transportation network of n vertices, we show that optimal refueling plans from the central depot to all other vertices can be efficiently updated in quadratic time of n.

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 thicknesses. 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 a 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 such as spherical shapes, cubic shapes, etc.

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 aims to formulate a generalized reliability optimization design model for the multi-state k-out-of-n system based on a suggested multi-state system reliability model. The proposed model can be solved to obtain the optimal component strength and redundancy strategies. To solve the 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.

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.

Session	Healthcare Systems and Management 2
Date	17/12/2019
Time	16:30 - 18:00
Room	Bordeaux #7.2
Chairs	Budi SANTOSA *Institut Teknologi Sepuluh Nopember*, Seung Ki MOON *Nanyang Technological University*

IEEM19-P-0251

Forecasting Lumpy Demand for Planning Inventory: The Case of Community Hospitals in Thailand

Phattaraporn KALAYA, Preecha TERMSUKSAWAD, 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(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.

IEEM19-P-0262

Investigation and Prioritization of Performance Indicators for Inventory Management in the University Hospital

Pornwasin SIRISAWAT, Narat HASACHOO, Thunwa KAEWKET
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 found that in 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, 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.

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. ABBAS
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-0114

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.

IEEM19-P-0429

Solving Deficit Funding Issues in Indonesian Health Insurance Systems

Diva KURNIANINGTYAS, 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.

Session	Project Management 3
Date	17/12/2019
Time	16:30 - 18:00
Room	Bordeaux #7.3
Chairs	Ripon CHAKRABORTTY *Capability Systems Centre, UNSW Canberra at ADFA*, Lianjie SHU *University of Macau*

IEEM19-P-0434

Managing Information Systems Requirements Volatility in Development Projects: Mapping Research and Surveying Practices

Faraz KHAN, Younes BENSLIMANE, 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.

IEEM19-P-0471

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 Fuzzy-DEMATEL 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.

IEEM19-P-0489

The Development of a Roadmap for Project Management Framework and Process

Mozhgan PAKDAMAN, Vahid DOKHTZEYNAL, 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 organizations 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 makes an integration between all parts of an organization and shows its future PMR as well.

IEEM19-P-0155

Effective Antidotes to Address Adverse Situations During Multi-Stakeholder Engagement: The Case of International ICT Projects

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[2]*National 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.

IEEM19-P-0399

Digital Twin-based Cyber Physical System for Sustainable Project Scheduling

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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.

Session	Engineering Education and Training 2
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian #7001
Chairs	Mukondeleli KANAKANA - KATUMBA *University of South Africa*, Romalyn GALINGAN *Technological Institute of the Philippines*

IEEM19-P-0186

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".

IEEM19-P-0545

Research Output on the Usage of Artificial Intelligence in Indian Higher Education – A Scientometric Study

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Indian Institute of Technology Delhi, India

Scientrometrics 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 scientrometric 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

Hongying SHAN, Chuang WANG, Lina LI, Yu YUAN
Jilin 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 domestic and foreign enterprises, and the G Motor 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 shop 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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[1]*Multimedia University, Malaysia*
[2]*Universiti 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

Mukondeleli 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 cognitivism, social constructivism and connectivism 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

Romalyn 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 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.

Session	Engineering Economy and Cost Analysis
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian #7002
Chairs	Jinyu FAN *Guangdong University of Finance & Economics*, Om Prakash YADAV *North Dakota State University*

IEEM19-P-0232

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 ES value between the new model and the traditional model.

IEEM19-P-1135

Forecasting the Diffusion of New Competitive Technologies Based on Evolutionary Game Theory : Battery Electric Vehicle and Fuel Cell Electric Vehicle

Yeonjeong LEE, Deok-Joo LEE
Seoul National University, South Korea

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

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[2]*University of Wollongong, Australia*

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.

Session	E-Business and E-Commerce 2
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian #7101
Chairs	Stanislav CHANKOV *Jacobs University Bremen*, Yan-Ling CAI *Zhengzhou University*

IEEM19-P-0284

Factors Affecting Customer Acceptance of Mobile Payment

Daniel TSE, Tianjia WEN, Ru WU, Ge YIN, Xinlu ZHAI
City University of Hong Kong, Hong Kong SAR

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

Li-Ting HUANG[1], Yu-Shiang WU[1], Jun-Der LEU[2]
[1]*Chang Gung University, Taiwan*
[2]*National Central University, Taiwan*

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' engrossment 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

Jun-Der LEU[1], Joerg PUCHAN[2], Yi-Wei HUANG[1]
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[2]*Munich University of Applied Sciences, Germany*

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 350 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.

IEEM19-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

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.

IEEM19-P-0362

E-Commerce: Stock Market Analysis Blended With Mining and Ann

Yan-Ling CAI[1], Kumar KANNAN[2], Yan-Hang XIE[1], Liang ZHAO[1]
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[2]*Vellore 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.

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

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

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 is currently conducted on a time-based approach. This paper proposes a condition-based maintenance (CBM) model for pans, which is applied to a real multi-component pan operating in an Australian sugar mill. The maintenance policy is formulated as a Markov Decision Process (MDP) and solved via approximate dynamic programming. The results show a 10% saving on total maintenance costs compared to the time-based maintenance strategy.

IEEM19-P-0277

Bayesian Estimation Method for Storage Reliability Based on Drift Brownian Motion

Xuesong YANG, Shunong ZHANG, Honglin WANG
Beihang University, China

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.

IEEM19-P-0436

Application of TPM Tools in an Automotive Battery Assembly Line

Amelia CASTILLO-REVELO, Liseth MAÑUICO-SALAS, Fernando MARADIEGUE-TUESTA, Jose C. ALVAREZ-MERINO
Universidad Peruana de Ciencias Aplicadas, Peru

This study sets out to increase the overall efficiency of equipment in the automotive battery assembly line by reducing the number of non-compliant products. To this end, the root cause analysis was performed, and it determined that disconformities are caused by the lack of standardization of processes, paucity of working methods, and inadequate maintenance plans. The proposal of this study involves the use of total productive maintenance (TPM) tools as the modal analysis of failures and effects, self-maintenance, and planned maintenance based on reliability-centric maintenance (RCM). The joint use of these tools leads to an increase in the quality of automotive batteries. The application of TPM and RCM is subject to 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 19.96%.

IEEM19-P-0017

Consequence Classification Based Spare Parts Evaluation and Control in the Petroleum Industry

R.M. Chandima RATNAYAKE
University of Stavanger, Norway

Spare parts (SPs) evaluation and control (SPE&C) has been a challenging task in the onshore and offshore petroleum industry, due to the highly hazardous and capital-intensive nature of operational assets. SPE&C requires that different phases of the petroleum asset's life cycle (i.e. commissioning, operations, modifications, and decommissioning) are taken into consideration via project execution. The requirements imposed by regulatory authorities, the recommendations suggested by classification societies and standards (i.e. national and international), and the guidelines available in the internal performance standards must be taken into consideration in an SPE&C process. SPE&C also requires contributions from several stakeholders from various disciplines, such as plant integrity, materials management, project management and package responsibility, as well as original equipment manufacturers/vendors, to establish a consensus about operational and work practices. Due to the inherent nature of the operational assets, the conventional inventory control approaches and formulae are mostly superimposed by consequence classifications and risk

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 SPA&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

Zhigang TIAN, Fangfang DING, Han ZHANG
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

Zhiqiang CAI, Chenyang 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.

Session	Manufacturing Systems 6
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian #7201
Chairs	Xin LI *Shenzhen University*, Jun-Der LEU *National Central University*

IEEM19-P-1142

Transient Analysis of Flexible Production Lines: Bernoulli Reliability Model

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Performance analysis of flexible manufacturing systems has received substantial research attention. Most of the studies focus on steady state behavior. The transient performance, which is critical for system operation, control, and improvement, is less investigated. No analytical method is available to evaluate the transients in flexible lines with unreliable machines, finite buffers, setup times, and batch operations. In this paper, analytical models are introduced to study the transient performance of such production lines with Bernoulli machine reliability models. First, one- and two-machine lines are studied to derive the formulas for performance evaluation. Then, iterative aggregation methods are introduced for longer lines using the two-machine line results as building blocks. Numerical experiments indicate that the iteration procedures are convergent and result in acceptable accuracy of performance estimation. Such methods provide quantitative tools for performance evaluation of transient behavior of flexible manufacturing systems.

IEEM19-P-0311

Proposal of a Reconfigurability Index Using Analytic Network Process

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[2]*Jinan University, China*
[3]*Federal University of Santa Catarina, Brazil*
[4]*University of Parma, Italy*

This paper proposes a reconfigurability index. Its development is based on five core characteristics, namely modularity, integrability, diagnosability, adaptability and customization. The index takes into consideration the interdependencies that may exist among them. The analytic network process (ANP) method is used to attribute importance weights to each core 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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University of Johannesburg, South Africa

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-Hoist Scheduling Problem

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The current paper deals with the cyclic multi-hoist scheduling problem in electroplating lines considering rentrance. Identical parts are produced with processing time windows. Moreover, re-entrance is also considered. These together make it more challenged 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 hoists 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?

Jun-Der LEU, Yi-Wei HUANG, Larry Jung-Hsing LEE
National Central University, Taiwan

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 Modeling) 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.

Session	Operations Research 4
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian #7301
Chairs	Haiyan XU *Institute of High Performance Computing*, Ajinkya TANKSALE *Indian Institute of Technology (BHU) Varanasi*

IEEM19-P-0043

A Goal Programming Approach for a Fuzzy Single-Source Capacitated Facility Location Problem

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In this paper, we present a new mixed-integer linear goal programming (MILGP) model for a fuzzy single-source capacitated facility location problem (F-SSCFLP), in which demands are considered as triangular fuzzy values and capacity of facilities are fuzzy constraints. At first, the basic fuzzy model for the given problem is presented. Then, utilizing goal programming (GP) approach and fuzzy principals the proposed MILGP model is introduced. Accordingly, considering a certain acceptable deviation from capacities and demands, the cost of selecting facilities and serving the demand points is minimized. Finally, to investigate the effectiveness of the presented model some large-sized problems generated randomly and all of them are solved globally in a reasonable time.

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

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In this paper, vehicle routing problems with release dates and due dates (VRPRDD) are considered. Each customer order will incur an inventory holding cost if the order is held back at the depot after its release date and a tardiness cost if the delivery happens after its due date. The mathematical model is proposed and solved using Reactive GRASP heuristics. The results from the heuristics are compared with that of the mathematical model solved by CPLEX. Results of various data sets are used to analyze the effect of cost and due date flexibility on the routes generated. The proposed heuristic method outperforms the MILP solver of CPLEX in terms of quality of solution and the computation time taken. We study the managerial implications and insights subject to flexibility in due dates, and cost structure.

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

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) in 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.

Session	Poster
Date	17/12/2019
Time	16:30 - 18:00
Room	Parisian 7202

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 the outperformed the genetic programming based fuzzy regression and the fuzzy regression analysis in terms of prediction errors.

IEEM19-P-0070

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 environmentally-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 footstep 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 RRSE).

IEEM19-P-0105

Analysing Impacts Responsible for South Africa's Energy Consumption: LMDI Application

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Durban University of Technology, South Africa

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 20016 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-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.

IEEM19-P-0126

A Study of Applying Deep Learning-based Weighted Combinations to Improve Defect Prediction Accuracy and Effectiveness

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Software errors or bugs are the primary cause of poor software quality. Thus defect prediction is a prominent approach to enhance software quality. It is a common technique for identifying defect-prone programs, which help the practitioners allocate needed quality assurance efforts (e.g., testing and debugging). An accurate prediction may bring significant benefits. However, there is still space for improvements by applying different levels of instances or using some state-of-the-art techniques to construct the prediction models. In this paper, we propose a weighted combination method of activation functions to improve the effectiveness of defect 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 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.

IEEM19-P-0132

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.

IEEM19-P-0135

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 previously consultation but picked from dream log by artificial intelligence.

IEEM19-P-0175

Influences of Parenting Style and The Teacher-Student Relationship on Self-Directed Learning of High School Students: The Mediating Effect of Core Self-Evaluations

Ju-Cong TANG, Yu-Ting ZHANG, Yi-Wen CHEN
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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.

IEEM19-P-0181

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.

IEEM19-P-0185

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 (online to offline/ offline to online) 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.

IEEM19-P-0187

Assessing Stakeholder Preferences in Urban Planning – A Multi-Attribute Utility Approach

Anna SAMSTAD, Leif SUNDBERG, Aron LARSSON
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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 criterion. 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 avoiding 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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Tongji University, China

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 mode 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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Singapore Institute of Technology, Singapore

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 makings 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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Singapore Institute of Technology, Singapore

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.

IEEM19-P-0257

A Study of Creative Concept Design Capability and Inquiry Capability Scale Development

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The use of innovative teaching methods to improve teaching effectiveness is essential for achieving education growth. The purpose of this study was tried to understand the effect of different innovative teaching methods applied among participants. Two innovative teaching methods (IGCS and ILM) were used in the fields of design and engineering students. By developing creative concept design capability and inquisitive capability scale, the researcher underwent a comparative study on the overall curriculum experiment. The participants in this study include 35 industrial design students, 39 students from the Department of Mechanical Engineering, and 109 students from the Department of Computer Science and Information Engineering, 183 students in total. According to the research results, the following conclusions were drawn: 1. The course of the teaching experiment possessed a certain degree of rigour. The research results shall serve as a reference for a creative theme-based production course; 2. Both creative concept design scale and the inquiry capability scale developed in this study were tested applicable for future teaching experiments to evaluate students' creative capability and inquiry capability.

IEEM19-P-0302

Applying FANP to Criteria Evaluation of Sports Field Project Planning

C. M. LAI, J. L. HUNG, Cheng-Che CHEN
Far East University, Taiwan

Project planning plays an important role on the sustainable development because firms become more and more project-base. Sports field project planning is complicated due to problems of due-date assignment, site characteristics, design and layout, and scheduling. This study applies FANP (fuzzy analytic network process) to evaluate and to prioritize the criteria of sports-field project planning, with the consideration of uncertainty judgement and interdependencies among criteria/sub-criteria. A case study is carried out to construct a decision-making framework for sports-field project planning. In the addressed case, there are three criteria and 12 sub-criteria. The results shall provide guidance for the firms when planning to proceed a sports-field project.

IEEM19-P-0327

Optimal Policy for Modeling of Economic Production Quantity Involving Major Repair and Preventive Maintenance

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This work presents an integrated economic production quantity (EPQ) model incorporating preventive maintenance (PM) policies for an imperfect process involving increasing hazard rate. The length of production run is determined by scheduled production run time or the time to failure during each production run, which comes first. Major repair activities are performed after failure. This study assumes that, after each PM, the system is either imperfect or perfect. The probability of perfect PM being performed depends on the number of imperfect maintenance operations performed since the last renewal cycle. Mathematical formulas are obtained for deriving the expected total cost. For the EPQ model, the scheduled production run time that minimizes total cost is discussed.

IEEM19-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

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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 kind 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 intelligent are more popular.

IEEM19-P-0358

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 depicts 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.

IEEM19-P-0395

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 support 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 hardcover 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.

IEEM19-P-0404

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

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Change is inevitable during product development lifecycle. When changes occur, all the affected items must be handled in order to maintain the consistency and integrity of the product. Thus, Engineering change (EC) has been a non-negligible issue for enterprises. We propose an object-based and attribute-oriented concept in this paper. Specifically, this paper objectifies a structure of a variant product design and characterizes the product design through items, attributes and linkages, and further defines the detail of the linkages. When changes occur during product design period, we also propose an object-oriented and recursive mechanism in deciding the effect of changes initiatively. An example is presented to verify the proposed concept and mechanism of the change impact analysis (CIA) approach.

IEEM19-P-0409

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 many existing 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-0430

Observational Learning in the Product Configuration Process: The Effect of Information Presentation Format

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With the booming of ecommerce, online product configurators have been applied in various industries to elicit customer needs and transform them into product variants. To facilitate customers' choice navigation during configuration process, some configurators provide extra information about product, such as best seller options. Previous study shows that these kinds of information significantly affect consumer decision making process, a phenomenon often referred to as observational learning. This paper attempt to study the format of the information provided in configurators affects observational learning effect. Specifically, two kinds of information are investigated, namely, the best seller choice and customers' choice distribution among all the attribute alternatives. We empirically investigate how different kinds of factors affect customers choices when the best seller and choices distribution information are provided. Our experiment shows that motivation to customize the product is significant in customers' choices. While purchasing intention is significant only when best seller information is provided. We further notice that there is no much difference between people's choices when best seller and the choice distribution information are provided.

IEEM19-P-0439

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.

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 firstly 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

A Methodological Framework of Assessing National Quality Infrastructure Efficacy for Quality Management

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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 NQI construction in Zhejiang province had achieved great progress with continuous growth. Meanwhile, the contribution analysis of each attribute parameter to general NQIE can provide scientific basis for decision makers to recognize the most and least contributed parameters for 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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"Made in China 2025" put forward the intelligent manufacturing as the direction of the development of China's manufacturing industry. According to the internal value chain and external supply chain of enterprises, starting from four aspects: main activities, supportive activities, supply chain collaboration, channel and customer collaboration, this paper puts forward the evaluation index of intelligent manufacturing enterprises, and gives the identification method of key success factors of intelligent manufacturing enterprises, which provides common success factors for the development of intelligent manufacturing enterprises.

IEEM19-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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This paper aims 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, affective factor is the public's priority consideration for the acceptance of energy-saving facilities. According to the results, we suggest that affective factor should be given priority when design 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-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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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-0550

A Review of Asset Administration Shell

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Industry 4.0 needs to dynamically adjust complex production lines made up of various assets. Asset Administration Shell (AAS) is a virtual representation of the assets of the Industry 4.0 era. It forms the industrial components under Industry 4.0 with the physical parts of the assets. This paper combs the research progress and challenges of AAS from 2016 with the theme of interoperability, modelling, and application, and looks forward to possible future research directions.

IEEM19-P-0557

Optimization and Simulation on Tanker Vessels Scheduling for Efficient Terminal Operations

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Tanker shipping is a very important operation in maritime to transport liquid cargoes across the world. Optimizing tanker ship operations to improve operation efficiency and reduce extra waiting time in ports is a pivotal task. In this study, four optimizer algorithms are proposed and examined for scheduling
tanker vessels optimally under three simulated scenarios. The optimization takes a quantified Key Performance Indicator (KPI), which is an indicator regarding to utilization of terminal, as our prime reference. The optimization and simulation results show that Max Timing First Optimizer (MaxTFO) outperforms the other three optimizers in the scenarios. The MaxTFO enhances terminal efficiency by 5.27% at most compared to Timing Sequential Optimizer (TSO), and Monte Carlo Optimizer (MCO) is more applicable and robust for limited and narrow window of future vessel and cargo information. The proposed optimizers could be further developed to handle more practical scenarios, such as multiple-cargo and multiple-terminal visits for coordinative optimization across multiple terminals in a port.

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.

Keywords: Small and Medium-sized Enterprises (SMEs), New product developments, Internal competency analysis, User evaluation, Survey method, Observation method, SNS analysis method.

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 HHI 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 superiority 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.

Keywords - Technological Innovation, market value, drug industry.

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 coalitional 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.

Keywords: Supply chain management, Cooperative game theory, Pricing game, Partition function form game.

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 $CRij=cij\Sigma cij\forall i$ where $cij=cji$ is 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: $CRi=\Sigma CRij\forall j$ 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: $CSij=CSji=CRij\cdot CRji$ 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 multinomial 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, incorporative 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 dental medical device and includes 2,592 applicants from 1976 to 2018. First, we classified 2592 firms into eight types of product portfolio by using cluster analysis. This study further analyzes product position of every firm in each cluster by correspondence 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 portfolio. The results showed that Dentsply Sirona, Ivoclar Vivaden and Argen Precious Metals are leading companies with biggest size and most diversify product portfolio. Most of the firms adopt 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-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-1068

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-1083

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 digitorum 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-1090

Condition-based Incorporation of Material Handling Time in Redesign of Production System for Scheduling

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With the rise of smart manufacturing, sensorized data can be captured which can be used in the redesign of production system. 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 vehicle (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.

IEEM19-P-1103

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.

IEEM19-P-1114

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.

IEEM19-P-1120

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 -5.9deg), 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 deeply stooping postures.

IEEM19-P-1122

Artificial Intelligence Assisted Online Tuition Platform

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The development of Internet of Things (IoT) has been changing the way of teaching and learning. According to Brandon Hall and Rosenberg (2001), e-learning can be shorter than classroom training on the same subject by up to 25-60% and has the power of increasing information retention rates by up to 60%. Increasing attention and benefits have made money spent on e-learning be doubled from 35.6 in 2011 to 2015. This talk describes our online tuition platform that is developed to provide an advanced e-learning environment for tutors and students by taking advantage of Internet of IoT. The platform allows tutors to teach at their own places and provides students with a more convenient way of studying at home while allowing parents to monitor the progress of their study. Novel features by employing new technologies are to be integrated and adapted to education curricula for enhancement of learning experience. Learning data in the platform will be collected for in-depth multi-modal quantitative analysis using Artificial Intelligence technique, which helps to identify students' strengths and weaknesses, personalize students' learning process, improve learning efficiency, and make learning journey enjoyable, effective, and efficient.

IEEM19-P-1126

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.

IEEM19-P-1132

Process Modeling and Hybrid Multi-Objective Optimization of Aerosol Jet 3D Printing

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Aerosol jet printing is a promising additive manufacturing technology for fabricating customized microelectronic devices on flexible substrates. Despite the capability of fine feature deposition, the inherent contradiction between the printed line edge roughness and line thickness will affect the printed line quality significantly. In this paper, a process modeling and hybrid multi-objective optimization approach is proposed to optimize the overall printed line quality of AJP. Considering sheath gas flow rate, carrier gas flow rate and print speed as the main process parameters, the response surface methodology is adopted to analyze and quantify the influence of the main process parameters on the printed line features. And, a desirability function approach is adopted to determine the 2D optimal operating windows for the optimization of the overall printed line quality at different print speeds. Following that, the obtained models are driven with a genetic algorithm to optimize the inherent contradictions of the AJP 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

IEEM19-P-1133

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-1150

Price Forecast by Simple Merit Order Model for JEPX Spot Market Price

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In Japan, retailing of electricity was fully liberalized in April 2016. Therefore, various operators entered the electricity retail business. Many of the new entrants do not have enough power sources of their own, so they procure electricity from Japan Electric Power Exchange (JEPX) every day. It is indispensable for them to precisely forecast JEPX spot price for efficient daily procurement plan. So far, we have examined price forecast by using a simple merit order model with only easily obtainable information. We also carried out the improvement of forecast accuracy by introducing past error information as a correction term for the price forecast value of the next day. Furthermore, we performed clustering analysis on the results to clarify the tendency of forecast error, and more effective correction method of price forecast has been clarified. In this paper, we investigate the impact of the demand forecast errors in merit order unit price calculation on the price forecast accuracy. It will contribute to further accuracy improvement of the proposed price forecasting method.

IEEM19-P-1152

Consistent Vehicle Routing Problem with Time Windows and Synchronized Visits

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The consistent vehicle routing problem with time windows and synchronized visits (ConVRPTWSyn) is addressed in this work. It is an extension of the vehicle routing problem with time windows and synchronized visits (VRPTWSyn) which has many applications in home healthcare services where some operations require multiple workers and therefore timing and coordination of workers' visits are keys to successful operations. ConVRPTWSyn extends VRPTWSyn by considering two types of consistencies, worker consistency and time consistency, to address the preference of patients for being serviced by the same worker at the same time of a day whenever possible. We formulate a mixed integer programming model and propose a Large Neighborhood Search (LNS) algorithm for ConVRPTWSyn. The results of computational studies indicate that the proposed LNS effectively solves ConVRPTWSyn.

IEEM19-P-1155

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 means of the partial least-square approach to structural equation modeling, the significant antecedent and consequence of attitudes were reported in this paper, which further provides insights on how to develop an environment that can help facilitate the formation of project partnering.

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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There has been increasing attention to whether a non-family chief executive officer (NFC) is responsible for the lack of innovativeness in family business. Rather than solely emphasizing the NFC effect on a family firm's investment in innovation, we examine how the relationship is moderated by governance arrangements. Using a sample of 6,407 firm-year observations of Taiwanese family firms 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.

IEEM19-P-1162

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.

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IEEM19-P-1163

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 relevant 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.

IEEM19-P-1164

An Intelligent Lock-Out Tag-Out System for Monitoring and Control of the Locked Device

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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.

IEEM19-P-1167

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.

IEEM19-P-1173

Security and Data Privacy in Consumer Internet of Things

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University of South Africa, South Africa

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.

Experience Macau

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.

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".

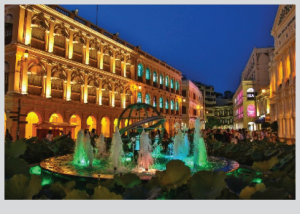
Grande Praça

"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.

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.

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.

Fisherman's Wharf

Macau Fisherman's Wharf is the largest leisure and entertainment themed complex in Macau Peninsula. The Eurpoean-themed complex features over 70 stores and restaurants, a convention and exhibition centre, two hotels and a casino.

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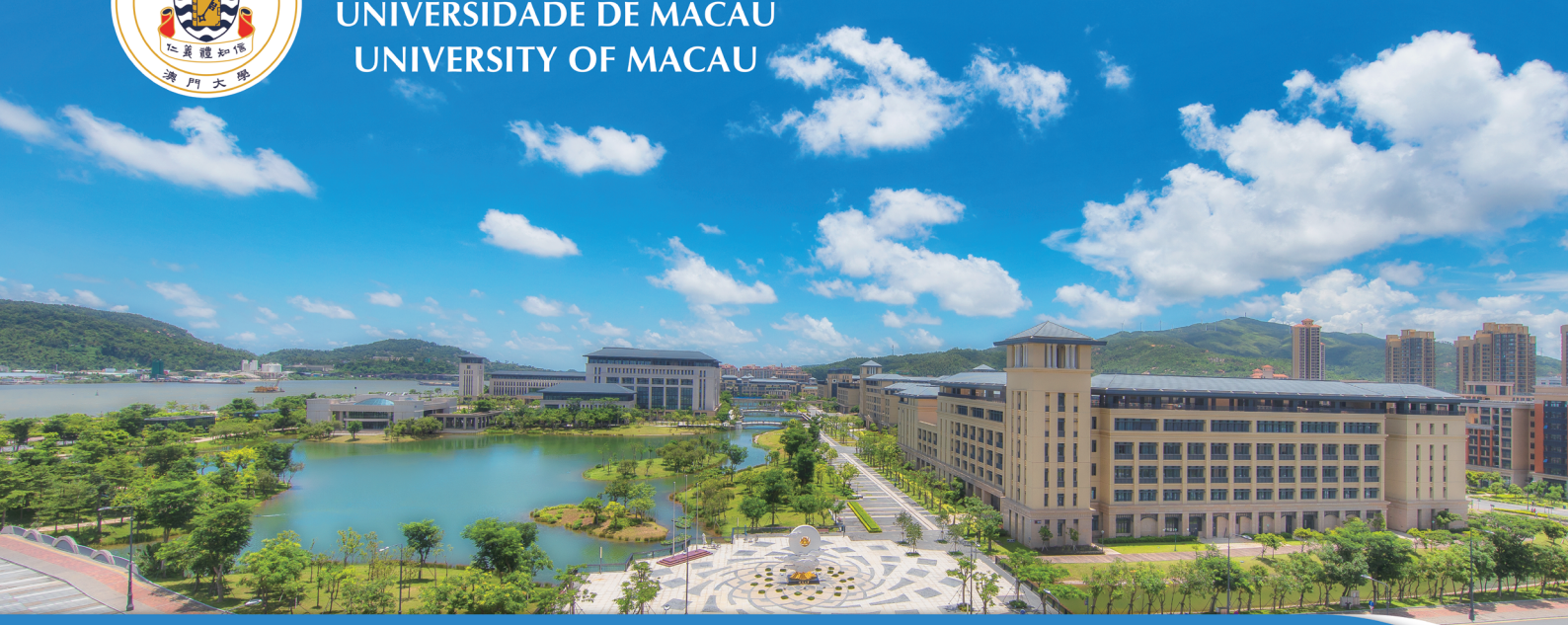

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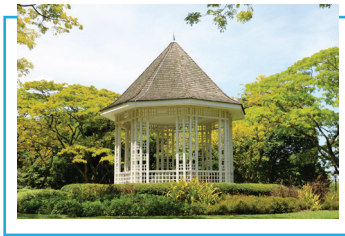

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