2018 IEEE International Conference on
Industrial Engineering & Engineering Management

# IEEE IEEM2018

## 16-19 Dec • Bangkok, Thailand

## WWW.IEEM.ORG

Organizers:
IEEE TEMS Thailand Chapter
IEEE TEMS Singapore Chapter
IEEE TEMS Hong Kong Chapter

IEEE 2019 International Conference on Industrial Engineering & Engineering Management

# IEEM2019

## 15-18 Dec 2019, Macau

## Paper Submission by 1 Jun

## www.IEEM.org

# IEEM2018 Welcome



# Highlights



# Program



# Schedule & Index



# About Bangkok



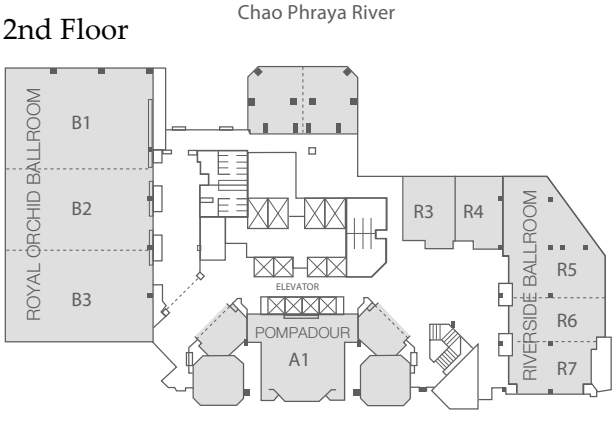
## Conference Venue

Royal Orchid Sheraton Hotel & Towers
2 Charoen Krung Road Soi 20
(Captain Bush Lane)
Siphya, Bangrak Bangkok, 10500 Thailand
Tel: +66 2660123

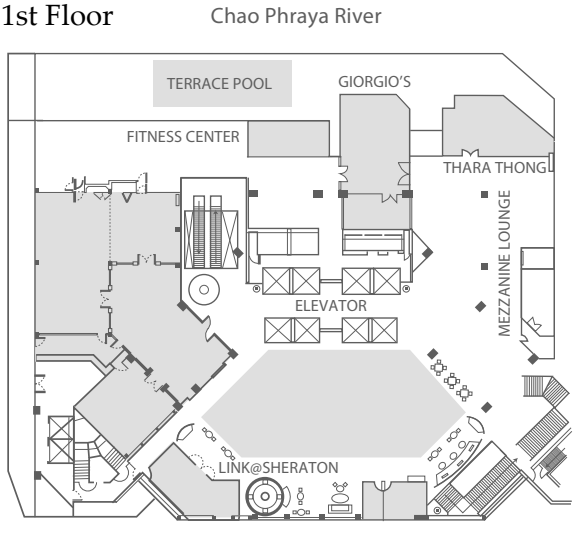
**wifi password: ieem2018**

## Function Room Layout

2nd Floor




1st Floor



# Welcome Message

Dear participants,

A very warm welcome to you to the 2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2018) to be held from 16-19 December 2018 in Bangkok, Thailand.

Since the first IEEM was held in Singapore in 2007, IEEM conference has grown into a high-quality conference in the fields of industry engineering and engineering management, with participants from all corners of the world. This year, IEEM2018 received nearly 800 submissions from about 50 countries. As in the past, each paper was sent to three to five reviewers. The acceptance decisions were based on at least two consistent recommendations, ensuring the quality and standard of the conference. These papers, organized around 20 topics, will be presented in oral and poster sessions. We are also privileged to have with us two distinguished speakers to deliver the keynote presentations:

Professor Yonghua Song, Rector, University of Macau will present on "Harmonizing Fluctuating Renewable Energy and Flexible Demand Resources: A Smart Grid Solution in Deregulated Environment".

Dr. Krithpaka BoonFueng, Deputy Executive Director (Innovation System), National Innovation Agency will discuss on "The Myth of Technology, Innovation and Startup."

We are also honored to have Professor Kay Chen Tan, Editor-in-Chief of IEEE Transactions Evolutionary Computation, to run a workshop on "How to Publish", and lead a Meet-the-Editors panel.

We would like to thank all authors and participants for their interests, contributions and continued support to IEEM. Lastly, we are also grateful to the technical program committee members and reviewers for their help in the review process.

We wish all will have a fruitful conference, and we hope that you will enjoy the cultural experiences of Bangkok.

**Tritos LAOSIRIHONGTHONG,** ***Organizing Chair***
*Thammasat University*

**Kah Hin CHAI,** ***Organizing Chair***
*National University of Singapore*

**Roger JIAO,** ***Program Chair***
*Georgia Institute of Technology*

**Min XIE,** ***Program Chair***
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# Highlights

**Yonghua SONG**

*Rector, University of Macau*

## Keynote

Mon - 17 Dec | 09:00 - 09:45 | Ballroom I

**"Harmonizing Fluctuating Renewable Energy and Flexible Demand Resources: A Smart Grid Solution in Deregulated Environment"**

Recently, the rapid growth of renewable generation poses significant challenges for securing power system and economic operations. Nowadays, the total installed capacities of wind and solar power generations in China both rank first in the world. However, due to inherent stochastic nature of renewable energy generation, a large amount of wind and solar power was curtailed, which induced great economic loss.

With the development of smart grid and information technologies, one possible approach to tackling these challenges is to aggregate the distributed flexible resources on demand side (e.g., flexible loads, distributed generation and energy storage) so as to participate in the optimal operation of power grid. This talk will introduce a solution for flexible demand resources participating in operations of smart grids. Moreover, necessary policies and mechanisms to fulfill this vision in deregulated environment will be discussed in this presentation.

**ABOUT THE SPEAKER**

Professor Yonghua Song received his B.Eng. and Ph.D. from Chengdu University of Science and Technology (now Sichuan University) and the China Electric Power Research Institute in 1984 and 1989 respectively. In 2002, he was awarded DSc by Brunel University for his outstanding contributions to power system research and knowledge. In 2014, he was awarded Honorary DEng by Bath University. Prior to joining the University of Macau, Professor Song has held a number of leadership positions at British and Chinese universities including Brunel University, the University of Liverpool, Bristol University, Bath University, John Moores University, Zhejiang University and Tsinghua University, and possessed rich experiences in higher education management at senior level. He has been actively promoting internationalization and institutional cooperation and is particularly familiar with the development and operational models of higher education institutions in Europe, the United States and Asia.

Professor Song has long been engaged in electrical power system research and elected as Fellow of the Royal Academy of Engineering (UK) since 2004 and an IEEE Fellow since 2007. He is also a Fellow of the International Euro-Asia Academy of Sciences, IET Fellow, Vice President of Chinese Society for Electrical Engineering, Vice President of Chinese Electrotechnical Society, and an expert in the World Bank Energy Program for Romania Power and for the United Nations Development Program aided project for Chinese Power Industry Reform. Professor Song also has an early connection with Macao as he has been appointed as Advisor of Science and Technology Committee of the Macao SAR Government since 2002.

# Highlights

**Krithpaka BOONFUENG**
*Deputy Executive Director (Innovation System),*
*National Innovation Agency*

## Keynote

Mon - 17 Dec | 09:45 - 10:30 | Ballroom I
**"The Myth of Technology, Innovation and Startup"**

**ABOUT THE SPEAKER**
Dr. Krithpaka Boonfueng is currently the Deputy Executive Director (Innovation System) Of National Innovation Agency (NIA), Ministry Of Science and Technology. NIA is a leader Of MOST Startup, one of Seven Ministry's Flagship Clusters.

Dr. Krithpaka Boonfueng started her career as a intellectual property specialist at National Science and Technology Agency (NSTDA). Later she worked at the Biodiversity-Based Economy Development Office (BEDO) as the Director of Legal Development and Intellectual Property Management Group. She received her Doctor of Juridical Science (S.J.D.), American University, U.S., Master of Laws (LL.M.), from University of Pennsylvania, American University and Chulalongkorn University and LL.B. (2nd Honors), Thammasat University.

**Kay Chen TAN**
*Professor, City University of Hong Kong*
*Editor-in-Chief: IEEE Transactions on Evolutionary Computation*
*Past Editor-in-Chief: IEEE Computational Intelligence Magazine*

## Workshop

**"How to Publish in Top Journals"**
Sun - 16 Dec | 13:30 - 15:30 | Riverside III

**Kay Chen TAN** (Workshop Leader)

## "Meet-the-Editors" Panel Session

Mon - 17 Dec | 11:00 - 12:45 | Pompadour

**Kay Chen TAN** (Panel Chair)

**Panelists**
**Roger JIAO**, *Georgia Institute of Technology*
**Surendra M GUPTA**, *Northeastern University*
**Kongkiti PHUSAVAT**, *Kasetsart University*
*Chief-Editor, International Journal of Innovation and Learning*

## Dinner Cruise

Date: Tue - 18 Dec 2018
Time: 19:00 - 21:00
Venue: Royal Orchid Sheraton Hotel Pier
(Please gather at the Mezzanine Lounge on 1st floor by 18:30 for departure)

*This is a ticketed event.*
*Each ticket admits one person only.*

This evening, board the Grand Chaophraya for a private dinner cruise specially arranged for IEEM2018 conference participants. Total duration is about 2 hours from 19:00 to 21:00.

A cruise along the Chaophraya River is one great way to take in the sights of Bangkok and be fascinated by the humble Thai way of living along the river bank. You will get to view main attractions and magnificent architecture including illuminated Temple of Dawn (Wat Arun) and Grand Palace; the suspension Rama VII bridge and a string of world-class waterfront hotels. Dinner will be an international buffet, catered by the Royal Orchid Sheraton Hotel.

The cruise boat consists a fully air-conditioned lower deck and an open deck on the upper floor. It is highly recommended that you wear flat-heels or comfortable walking shoes for climbing the decks on the cruise ship. Do also bring along a jacket because December weather in Bangkok is usually cool and can get windy on the open deck.

## Technical Visit

**SCG Open Innovation Centre**
Date: Wed - 19 Dec 2018
Time: 09:00 - 12:00
(Please gather at Royal Orchid Sheraton Hotel's Lobby by 08:30 for departure)

*Requires Advance Registration/Payment*

**Program:**
- Greeting, SCG Overview & Innovations
- Visit SCG Showcases
- Q&A

SCG has furthered its vision to become a leader in sustainable innovations in ASEAN by launching a centre for research and development (R&D) collaboration with government, private and education sectors worldwide.

# Overview

Note: All Happening at Royal Orchid Sheraton Hotel, Second Floor (unless otherwise specified)

| Sunday, 16 Dec 2018 (Outside Riverside Rooms) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Conference Registration Opens: 14:30 | | | | | Welcome Reception: 15:30 - 17:00 | | | |
| **Monday, 17 Dec 2018** | | | | | | | | |
| Conference Registration: 08:00 - 17:30 (Outside Riverside Rooms) | | | | | | | | |
| **Opening & Keynotes: 08:45 - 10:45 (Ballroom I)** | | | | | | | | |
| AM Break: 10:45 - 11:00 (Outside Riverside Rooms) | | | | | | | | |
| **AM2 Oral Session: 11:00 - 12:45 (Respective Rooms)** | | | | | | | | |
| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV | Riverside V | Riverside VI | Riverside VII |
| Murat KUCUKVAR | Ali SIADAT | David VALIS | "Meet-the-Editors" Panel Session Chaired by: Kay Chen TAN | Stefano FAZI | Ville ISOHERRANEN | Sambil Charles MUKWAKUNGU | Matthieu MUSEAU | Armand BABOLI |
| Aries SUSANTY | Shu Lun MAK | Abdelhakim KHATAB | | Dinh Son NGUYEN | Miao LI | Sorina MOICA | R.M. Chandima RATNAYAKE | Arnesh TELUKDARIE |
| **Supply Chain Management 1** (see also p41) | **Safety, Security and Risk Management 1** (see also p42) | **Reliability and Maintenance Engineering 1** (see also p43) | | **Systems Modeling and Simulation 1** (see also p45) | **Service Innovation and Management 1** (see also p46) | **Quality Control and Management** (see also p47) | **Manufacturing Systems 1** (see also p49) | **Decision Analysis and Methods 1** (see also p50) |
| 24 | 243 | 51 | | 556 | 523 | 117 | 31 | 8 |
| 77 | 436 | 88 | | 559 | 583 | 455 | 39 | 123 |
| 23 | 376 | 131 | | 565 | 350 | 527 | 67 | 229 |
| 306 | 185 | 215 | | 2 | 370 | 532 | 68 | 273 |
| 460 | 451 | 44 | | 93 | 80 | 18 | 71 | 220 |
| 30 | 533 | 43 | | 180 | 238 | 227 | 579 | 248 |
| 360 | 264 | 301 | | 154 | 516 | 379 | 104 | 575 |
| Lunch Buffet: 12:45 - 13:45 (First Floor) | | | | | | | | |
| **PM1 Oral Session: 13:45 - 15:30 (Respective Rooms)** | | | | | | | | |
| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV | Riverside V | Riverside VI | Riverside VII |
| Linda ZHANG | Anders THORSTENSON | Gopinath CHATTOPADHYAY | Ryan Jeffrey CURBANO | Weiwei CUI | Soo Beng KHOH | Budi HARTONO | Zhe ZHANG | Hao YU |
| Charles MBOHWA | HeeHyol LEE | Jayantha P. LIYANAGE | Tlotlollo HLALELE | Norbert TRAUTMANN | Ruth COBOS | Fan LI | Safwan ALTARAZI | Nur Aini MASRUROH |
| **Supply Chain Management 2** (see also p51) | **Production Planning and Control** (see also p52) | **Reliability and Maintenance Engineering 2** (see also p54) | **Engineering Education and Training** (see also p55) | **Operations Research 1** (see also p57) | **Big Data and Analytics 1** (see also p58) | **Project Management 1** (see also p60) | **Manufacturing Systems 2** (see also p61) | **Decision Analysis and Methods 2** (see also p62) |
| 321 | 190 | 138 | 134 | 34 | 590 | 33 | 79 | 120 |
| 338 | 613 | 146 | 284 | 56 | 381 | 414 | 133 | 433 |
| 447 | 340 | 187 | 324 | 85 | 366 | 207 | 159 | 445 |
| 129 | 566 | 206 | 508 | 184 | 49 | 192 | 569 | 144 |
| 160 | 369 | 450 | 42 | 97 | 65 | 209 | 91 | 276 |
| 561 | 380 | 98 | 271 | 386 | 72 | 27 | 226 | 322 |
| | 295 | 399 | 319 | 509 | 339 | 479 | 449 | 599 |
| PM Break: 15:30 - 15:45 (Outside Riverside Rooms) | | | | | | | | |
| **PM2 Oral Session: 15:45 - 17:30 (Respective Rooms)** | | | | | | | | |
| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV | Riverside V | Riverside VI | Riverside VII |
| Charles MBOHWA | Manutchanok JONGPRASITHPORN | Manuel De La SEN | Amnon GONEN | Reza Tavakkoli-MOGHADDAM | Yonas Zewdu AYELE | Ripon CHAKRABORTTY | Weiwei CUI | Zhaoxia GUO |
| Mohammed Woyeso GEDA | Titis WIJAYANTO | Elise VAREILLES | Michel ALDANONDO | Philipp BAUMANN | Daniel Y. MO | Budi HARTONO | Leif OLSSON | Arnesh TELUKDARIE |
| **Supply Chain Management 3** (see also p63) | **Human Factors 1** (see also p64) | **Healthcare Systems and Management 1** (see also p66) | **Technology and Knowledge Management 1** (see also p67) | **Operations Research 2** (see also p68) | **Service Innovation and Management 2** (see also p69) | **Project Management 2** (see also p71) | **Engineering Economy and Cost Analysis** (see also p72) | **Information Processing and Engineering** (see also p73) |
| 161 | 496 | 452 | 118 | 228 | 208 | 391 | 592 | 497 |
| 489 | 542 | 609 | 524 | 267 | 191 | 193 | 466 | 189 |
| 331 | 352 | 421 | 560 | 361 | 537 | 349 | 201 | 211 |
| 342 | 365 | 5 | 612 | 419 | 438 | 505 | 105 | 224 |
| 417 | 567 | 443 | 164 | 314 | 513 | 194 | 35 | 247 |
| 510 | 315 | 251 | 488 | 127 | 317 | | 463 | 529 |
| 367 | 520 | 546 | 487 | 302 | 320 | | | 407 |

# Overview

## Tuesday, 18 Dec 2018

Conference Registration: 08:00 - 16:30 (Outside Riverside Rooms)

**AM1 Oral Session: 08:45 - 10:45 (Respective Rooms)**

| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV |
|---|---|---|---|---|---|
| Kanagi KANAPATHY | R.M. Chandima RATNAYAKE | Shinji INOUE | Michel ALDANONDO | Ipseeta NANDA | Junfeng WANG |
| Murat KUCUKVAR | Jayantha P. LIYANAGE | Yonas Zewdu AYELE | Helery TASANE | Abhijeet DIGALWAR | Surendra M. GUPTA |
| **Supply Chain Management 4** (see also p74) | **Safety, Security and Risk Management 2** (see also p75) | **Reliability and Maintenance Engineering 3** (see also p76) | **Technology and Knowledge Management 2** (see also p78) | **Systems Modeling and Simulation 2** (see also p79) | **Manufacturing Systems 3** (see also p80) |
| 363 | 584 | 257 | 13 | 64 | 493 |
| 48 | 587 | 325 | 83 | 103 | 495 |
| 383 | 604 | 397 | 96 | 113 | 299 |
| 408 | 404 | 472 | 101 | 598 | 14 |
| 412 | 591 | 553 | 362 | 176 | 550 |
| 62 | 132 | 108 | 552 | 282 | 234 |
| 471 | 531 | 437 | 268 | 341 | 335 |

**Riverside Rooms**
**Poster Build-Up**
**09:00 to 12:00**

AM Break: 10:45 - 11:00 (Outside Riverside Rooms)

**AM2 Oral Session: 11:00 - 12:45 (Respective Rooms)**

| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV |
|---|---|---|---|---|---|
| Gitae KIM | Manutchanok JONGPRASITHPORN | Manuel De La SEN | Chung-Huei KUAN | Philipp BAUMANN | Ruth COBOS |
| Kanagi KANAPATHY | Antonio VERDU | Desmond WONG | Amnon GONEN | Norbert TRAUTMANN | Harekrishna MISHRA |
| **Supply Chain Management 5** (see also p82) | **Human Factors 2** (see also p83) | **Healthcare Systems and Management 2** (see also p84) | **Technology and Knowledge Management 3** (see also p86) | **Operations Research 3** (see also p87) | **Big Data and Analytics 2** (see also p89) |
| 543 | 246 | 539 | 410 | 420 | 453 |
| 557 | 272 | 547 | 347 | 588 | 573 |
| 580 | 178 | 263 | 356 | 614 | 221 |
| 597 | 619 | 608 | 307 | 78 | 249 |
| 572 | 530 | 112 | 137 | 343 | 582 |
| 212 | 298 | 37 | 337 | 70 | 287 |
| 288 | 300 | 432 | 426 | 84 | 519 |

**Riverside Rooms**
**Poster Build-Up**
**09:00 to 12:00 (cont'd)**

Lunch Buffet: 12:45 - 13:45 (First Floor)

**PM1 Oral Session: 13:45 - 15:30 (Respective Rooms)**

| Ballroom I | Ballroom II | Ballroom III | Pompadour | Riverside III | Riverside IV |
|---|---|---|---|---|---|
| Fan LI | Gai-Ge WANG | Yue WANG | Chung-Huei KUAN | Kaushik NAG | Markus HARTONO |
| Ripon CHAKRABORTTY | Benedikt MOSER | Stanislav CHANKOV | Helery TASANE | Tatsushi NISHI | Ali SIADAT |
| **Project Management 3** (see also p90) | **Intelligent Systems 1** (see also p92) | **E-Business and E-Commerce** (see also p93) | **Technology and Knowledge Management 4** (see also p94) | **Decision Analysis and Methods 3** (see also p95) | **Service Innovation and Management 3** (see also p97) |
| 290 | 102 | 318 | 165 | 534 | 241 |
| 293 | 336 | 333 | 441 | 593 | 310 |
| 244 | 351 | 429 | 475 | 581 | 225 |
| 286 | 135 | 205 | 481 | 396 | 549 |
| 610 | 431 | 231 | 528 | 474 | 564 |
| 430 | 389 | 145 | 526 | 294 | 382 |
| 398 | 167 | | 266 | 480 | 200 |

**Riverside Rooms**
**Authors Put Up Posters**
**Start Time: 12:45**
**Finish Time: Latest by 15:00**

# Overview

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<tr><td colspan="9">IEEM2018 Closing, Best Conference Paper Awards & Next Meeting Destination Presentation: 15:30 - 16:00 (Ballroom I)</td></tr>
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<tr><td colspan="6">PM2 Oral Session: 16:30 - 18:00 (Respective Rooms)</td><td colspan="3">Poster Session: 16:00 - 18:00 (see also p105)</td></tr>
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<tr><td>Aries SUSANTY</td><td>Benedikt MOSER</td><td>Tatsushi NISHI</td><td>Michel ALDANONDO</td><td>20, 94, 99, 188</td><td>26, 46, 86, 210, 258, 274, 305, 373, 483, 484, 570, 576</td><td>150, 151, 313, 326, 330</td></tr>
<tr><td>Supply Chain Management 6 (see also p98)</td><td>Intelligent Systems 2 (see also p99)</td><td>Operations Research 4 (see also p100)</td><td>Technology and Knowledge Management 5 (see also p101)</td><td>Speed Talks 1 (see also p102)</td><td>Speed Talks 2 (see also p103)</td><td>Reliability and Maintenance Engineering</td><td>Manufacturing Systems</td><td>Safety, Security and Risk Management</td></tr>
<tr><td>538</td><td>81</td><td>446</td><td>620</td><td>1008<br>1013<br>1033<br>1006<br>1027<br>1047<br>1052<br>1025<br>1040</td><td>1012<br>1022<br>1024<br>1021<br>1004<br>1001<br>1032<br>1054<br>1035</td><td rowspan="2">143, 147, 162, 179, 213, 255, 392, 501</td><td rowspan="2">195, 279, 296 375, 428, 568</td><td rowspan="2">15, 230, 499, 500</td></tr>
<tr><td>427</td><td>478</td><td>109</td><td>245</td></tr>
<tr><td>541</td><td>577</td><td>354</td><td>219</td><td colspan="2" rowspan="6"></td><td>Technology and Knowledge Management</td><td>Information Processing and Engineering</td><td>Systems Modeling and Simulation</td></tr>
<tr><td>89</td><td>371</td><td>469</td><td>334</td><td rowspan="2">203, 323, 470, 512</td><td rowspan="2">53, 115, 166, 183, 236, 303, 448, 503, 522, 594</td><td rowspan="2">136, 182, 253, 259, 275, 442, 486, 492, 555</td></tr>
<tr><td>265</td><td>58</td><td>525</td><td>603</td></tr>
<tr><td></td><td>548</td><td></td><td></td><td>Production Planning and Control</td><td colspan="2">Late-breaking Abstracts</td></tr>
<tr><td></td><td></td><td></td><td></td><td>3, 262, 411, 439, 444, 601</td><td colspan="2">1003, 1009, 1010, 1011, 1014, 1016, 1017, 1018, 1020, 1023, 1031, 1036, 1037, 1039, 1048, 1049, 1053, 1055</td></tr>
<tr><td colspan="9">Dinner Cruise: 19:00 - 21:00 (Gather at Mezzanine Lounge on 1st floor by 18:30) "Ticketed Event - 1 Ticket Admits ONE Person Only"</td></tr>
<tr><td colspan="9">Wednesday, 19 Dec 2018</td></tr>
<tr><td colspan="9">Technical Visit to SCG Open Innovation Centre: 09:00 - 12:00 (Gather at Hotel Lobby by 08:30) "Requires Advance Registration/Payment"</td></tr>
</table>

# Presenter Guides

## Oral

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

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

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

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

## Poster

Poster presentations will be held on Tue - 18 Dec 2018 in Riverside Rooms (Second Floor) from 16:00 to 18:00. 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.

1. **Poster Display and Viewing**

| | |
|---|---|
| Poster Set-up | From 12:45 to 15:00 |
| Poster Session (Presenter Attendance Required) | From 16:00 to 18:00 |
| Poster Tear-down | By 18:30 latest |

2. **Prepare Your Poster**
   Each presenter is provided with a 1m width x 2.5m 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.

3. **Set-up Your Poster (See also 1 above)**
   a. Posters should be set-up by the allocated timing of the assigned day.
   b. Your poster presentation is as shown in the session schedule and presenters are required to be at their posters during the poster viewing times.
   c. Adhesive tapes and scissors are available at the Poster Help Desk, nearby the poster boards. If you have any special needs for your poster presentation, please bring those supplies with you to the meeting.

4. **Remove Your Poster**
   a. Posters must be removed after the viewing time by 18:30 latest.
   b. After this time, posters remaining on the boards will be removed and discarded. IEEM2018 will not be responsible for posters and materials left on poster boards after the stated hours.

## Speed Talk

A speed talk is an 8-minute presentation during which you may present key-ideas, results and their meaning/implications. You will have the option of using 4 slides, timed to advance after two minutes each, or 8 slides timed to advance after 1 minute each.

BONUS CHALLENGE: use NO slides. For just eight minutes, you'll want to be very concise and slides can sometimes be a distraction.

We ask that you include:
1. Why is what you do important and valuable to society? What is the problem and how are you contributing?
2. What is one method you use that you would like others to know about, and a major finding?
3. Who will use this? What's next?

Make sure that you turn up at least 10 to 15 minutes before your session starts to meet your session chair and the other speakers. Bring with you a copy of your presentation on a USB flash drive to the room. Please upload and test your presentation in good time.

## Sessions

### Supply Chain Management 1

17/12/2018 11:00 - 12:45
Room: Ballroom I

Chairs: Murat KUCUKVAR, *Qatar University*
Aries SUSANTY, *Diponegoro University*

Abstracts: see page 41

IEEM18-P-0024
**Dedicated Agility: A New Approach for Designing Production Networks**
Günther SCHUH, Jan-Philipp PROTE, Bastian FRÄNKEN, Julian AYS, Sven CREMER
*RWTH Aachen University, Germany*

IEEM18-P-0077
**Contractual Barriers and Energy Efficiency in the Crude Oil Supply Chain**
Roar ADLAND, Haiying JIA
*Norwegian School of Economics, Norway*

IEEM18-P-0023
**Carbon Footprints of Construction Industries: A Global, Supply Chain-linked Analysis**
Parinaz TOUFANI[1], Murat KUCUKVAR[2], Nuri Cihat ONAT[2]
[1]*Bilkent University, Turkey*
[2]*Qatar University, Qatar*

IEEM18-P-0306
**An Approach for Rolling Planning of Migration in Production Networks**
Günther SCHUH, Jan-Philipp PROTE, Marco MOLITOR, Sven CREMER
*RWTH Aachen University, Germany*

IEEM18-P-0460
**Lead Time Quotation Under MTO and MTS Delivery Modes with Endogenous Demand**
Erfan ASGARI[1], Yannick FREIN[1], Ramzi HAMMAMI[2]
[1]*Université Grenoble Alpes, France*
[2]*Rennes School of Business, France*

IEEM18-P-0030
**Modelling the Causal Relationship Among Variables that Influencing the Capability of Dairy Supply Chain in Indonesia**
Aries SUSANTY, N. B. PUSPITASARI, A. BAKHTIAR, N. SUSANTO, D. KURNIA
*University of Diponegoro, Indonesia*

IEEM18-P-0360
**Building Last Mile Delivery Scenarios: A Case Study of Melbourne**
Kolawole EWEDAIRO, Prem CHHETRI, Jago DODSON, Shams RAHMAN
*RMIT University, Australia*

### Safety, Security and Risk Management 1

17/12/2018 11:00 - 12:45
Room: Ballroom II

Chairs: Ali SIADAT, *Arts et Metiers ParisTech*
Shu Lun MAK, *The Open University of Hong Kong*

Abstracts: see page 42

IEEM18-P-0243
**Safety Outcomes in Small-Size and Medium-Size Metal Enterprises in Indonesia: Are They Different?**
Nachnul ANSORI[1], Ari WIDYANTI[2], Iftikar SUTALAKSANA[2]
[1]*Bandung Institute of Technology/ University of Trunojoyo Madura, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

IEEM18-P-0436
**Process Safety and Performance Improvement in Oil Refineries Through Active Redundancy and Risk Assessment Method - A Case Study**
Loganathan MADAMPATTY KRISHNASWAMY[1], Subhas Sarma NEOG[1], Sunil RAI[2]
[1]*Kaziranga University, India*
[2]*MIT ADT University, India*

IEEM18-P-0376
**Risk Assessment Among Thai and Foreign Workers in Construction Companies**
Kosinchai PAWTHAISONG[1], Manutchanok JONGPRASITHPORN[2], Chaiporn VONGPISAL[1], Nantakrit YODPIJIT[3]
[1]*King Mongkut's University of Technology North Bangkok, Thailand*
[2]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[3]*King Mongkut's University of Technology North Bangkok, Thailand*

IEEM18-P-0185
**Fuzzy Risk Prioritization of the Failure Modes in Rolling Stocks**
Behzad GHODRATI[1], Mohammad Javad RAHIMDEL[2], Amir TAGHIZADEH VAHED[1]
[1]*Lulea University of Technology, Sweden*
[2]*Sahand University of Technology, Iran*

IEEM18-P-0451
**Performance Evaluation with a Z-number Data Envelopment Analysis: A Case Study of a Petrochemical Plant**
Shohre SADEGHSA[1], Ali SIADAT[1], Reza TAVAKKOLI-MOGHADDAM[2], Maliheh VAEZ-ALAEI[2]
[1]*Arts et Métiers ParisTech, France*
[2]*University of Tehran, Iran*

IEEM18-P-0533
**A Critical Review of Current Safety Assessment Method of Chemical Safety in Toys**
Shu Lun MAK, Winnie CHIU, H. K. LAU
*The Open University of Hong Kong, Hong Kong SAR*

IEEM18-P-0264
**Safety Barriers Against Common Cause Failure and Cascading Failure: Literature Reviews and Modeling Strategies**
Lin XIE, Mary Ann LUNDTEIGEN, Yiliu LIU
*Norwegian University of Science and Technology, Norway*

## Reliability and Maintenance Engineering 1

17/12/2018 11:00 - 12:45
Room: Ballroom III

Chairs: David VALIS, *University of Defence in Brno*
Abdelhakim KHATAB, *Lorraine University*

Abstracts: see page 43

IEEM18-P-0051
**Reliability Analysis for MOSFET Based on Wiener Process**
Huiling ZHENG, Houbao XU
*Beijing Institute of Technology, China*

IEEM18-P-0088
**Lease-oriented Opportunistic Maintenance for Series-parallel Systems by Integrating Capacity Balancing**
Bowen SUN, Tangbin XIA, Ya SONG, Wenyu GUO, Lifeng XI
*Shanghai Jiao Tong University, China*

IEEM18-P-0131
**Improved Lease-oriented Opportunistic Maintenance for Two-machine One-buffer System under Product-service Paradigm**
Wenyu GUO, Tangbin XIA, Guojin SI, Bowen SUN, Ershun PAN
*Shanghai Jiao Tong University, China*

IEEM18-P-0215
**Condition-based Selective Maintenance for Multicomponent Systems Under Environmental and Energy Considerations**
Abdelhakim KHATAB[1], El-Houssaine AGHEZZAF[2], Claver DIALLO[3], Uday VENKATADRI[3]
[1]*Universit´e de Lorraine, France*
[2]*Ghent University, Belgium*
[3]*Dalhousie University, Canada*

IEEM18-P-0044
**Mining System Degradation Assessment Based on Mathematical Analysis**
David VALIS[1], Jakub GAJEWSKI[2], Kamila HASILOVA[1], Marie FORBELSKA[3]
[1]*University of Defence, Czech Republic*
[2]*Lublin University of Technology, Poland*
[3]*Mendel University in Brno, Czech Republic*

IEEM18-P-0043
**System Condition Assessment Based on Mathematical Analysis**
David VALIS[1], Libor ZAK[2], Zdenek VINTR[1]
[1]*University of Defence, Czech Republic*
[2]*University of Technology, Czech Republic*

IEEM18-P-0301
**ACO-based Parallel Machine Scheduling Considering Both Setup Time and Run-based Preventive Maintenance with Reliability Constraints**
Siqi CHEN, Liya WANG
*Shanghai Jiao Tong University, China*

## Systems Modeling and Simulation 1

17/12/2018 11:00 - 12:45
Room: Riverside III

Chairs: Stefano FAZI, *University of Groningen*
Dinh Son NGUYEN, *University of Science and Technology, The University of Danang*

Abstracts: see page 45

IEEM18-P-0556
**A Detailed Modeling and Comparative Analysis of Hysteresis Current Controlled Vienna Rectifier and Space Vector Pulse Width Modulated Vienna Rectifier in Mitigating the Harmonic Distortion on the Input Mains**
Hari Charan NANNAM, Atanu BANERJEE
*National Institute of Technology, India*

IEEM18-P-0559
**Monte Carlo Simulation Forecasting of Maritime Ferry Safety and Resilience**
Ewa DABROWSKA, J. SOSZYŃSKA-BUDNY
*Gdynia Maritime University, Poland*

IEEM18-P-0565
**JIS: Pest Population Prognosis with Escalator Boxcar Train**
Kin-Woon YEOW, Matthias BECKER
*Gottfried Wilhelm Leibniz Universität Hannover, Germany*

IEEM18-P-0002
**Modeling the Dynamics of an Agile Scrum Team in the Development of a Single Software Project**
Phoebe Mae CHING, Jose Edgar MUTUC
*De La Salle University, Philippines*

IEEM18-P-0093
**The Stowage of Containers for Inland Shipping: A System for Maximizing Containers Allocation and Meeting Stability Requirements**
Stefano FAZI
*University of Groningen, Netherlands*

IEEM18-P-0180
**Creation of Lattice Structures for Additive Manufacturing in CAD Environment**
Dinh Son NGUYEN, Thanh Hai Tuan TRAN, Duc Kien LE, Van Than LE
*University of Science and Technology - The University of Danang, Viet Nam*

IEEM18-P-0154
**Operational Aircraft Routing Problem: Some Insights in the Capacitated Maintenance Resources**
Miner ZHONG, Felix T.S. CHAN, S. H. CHUNG
*The Hong Kong Polytechnic University, Hong Kong SAR*

## Service Innovation and Management 1

17/12/2018 11:00 - 12:45
Room: Riverside IV

Chairs: Ville ISOHERRANEN, *University of Oulu*
Miao LI, *Northwestern Polytechnical University*

Abstracts: see page 46

IEEM18-P-0523
**The Effect of Owner Creativity on Organizational Creativity: Empirical Evidence from Surakarta Indonesia**
Retno INDRIARTININGTIAS[1], Budi HARTONO[2], Subagyo SUBAGYO[2]
[1]*Trunojoyo University, Indonesia*
[2]*Gadjah Mada University, Indonesia*

IEEM18-P-0583
**A Study of Continuance Intention to Adopt Cloud Services: The Moderating Effect of Users' Motivation**
Chan-Sheng KUO[1], Yowei KANG[2]
[1]*Shih Hsin University, Taiwan*
[2]*National Taiwan Ocean University, Taiwan*

IEEM18-P-0350
**Service Innovation in Retail Industry: What Can We Learn from Target?**
Rocky REYNALDO[1], Augustina Asih RUMANTI[2], Iwan Inrawan WIRATMADJA[2]
[1]*Target Sourcing Services, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

IEEM18-P-0370
**Benefit Segmentation of Online Customer Reviews Using Random Forest**
Kenjiro TORIZUKA[1], H. OI[1], Humiaki SAITOH[2], Syohei ISHIZU[1]
[1]*Aoyama Gakuin University, Japan*
[2]*Chiba Institute of Technology, Japan*

IEEM18-P-0080
**Servitization Shift in Cloud Manufacturing Era: An Exploratory Cases Study**
Yuqiuge HAO[1], Petri HELO[1], Ville ISOHERRANEN[2]
[1]*University of Vaasa, Finland*
[2]*University of Oulu, Finland*

IEEM18-P-0238
**Government Subsidy, Industry-university-research Collaborative Innovation and Resources Allocation Efficiency**
Miao LI, Yuan HUANG
*Northwestern Polytechnical University, China*

IEEM18-P-0516
**The Use of Design-science to Define Information Content Requirements for IT Service Catalogs**
Franziska SCHORR, Lars HVAM
*Technical University of Denmark, Denmark*

## Quality Control and Management

17/12/2018 11:00 - 12:45
Room: Riverside V

Chairs: Sambil Charles MUKWAKUNGU, *University of Johannesburg*
Sorina MOICA, *Petru Maior Univeristy of Tirgu Mures*

Abstracts: see page 47

IEEM18-P-0117
**A Comparative Study of Several Group Runs Type Control Schemes**
Zhi Lin CHONG[1], Jing Yi WONG[1], Michael Boon Chong KHOO[2], Sok Li LIM[3], Wai Chung YEONG[3]
[1]*Universiti Tunku Abdul Rahman, Malaysia*
[2]*Universiti Sains Malaysia, Malaysia*
[3]*Universiti Malaya, Malaysia*

IEEM18-P-0455
**Acceptance Sampling Plans from Truncated Life Test Based on Frechet Distribution**
Shovan CHOWDHURY
*Indian Institute of Management, Kozhikode, India*

IEEM18-P-0527
**Benchmarking Quality Management Maturity in Industry**
Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
*University of Johannesburg, South Africa*

IEEM18-P-0532
**Testing the ISO 9001:2015 Process Model: An Australasian Empirical Study**
Nisansala PALLAWALA, Nihal JAYAMAHA, Nigel GRIGG
*Massey University, New Zealand*

IEEM18-P-0018
**Assessment of Quality of Service at the Main Laboratory of the LAB Aimed at Satisfying Internal Customer Needs**
Sambil Charles MUKWAKUNGU, Eric BAKAMA, Alice Kabamba LUMBWE, Magaly Madeleine BOLIPOMBO, Dorcas NIATI, Kidoge IBRAHIMU, Jonathan Eljadael KASONGO, Charles MBOHWA
*University of Johannesburg, South Africa*

IEEM18-P-0227
**Effects of Suggestion System on Continuous Improvement: A Case Study**
Sorina MOICA[1], Cristina VERES[2], Liviu MARIAN[2]
[1]*Petru Maior University of Tirgu-Mures, Romania*
[2]*Technical University of Cluj-Napoca, Romania*

IEEM18-P-0379
**Total Quality Management: A Framework for Quality Improvement in Indian Manufacturing Small and Medium Enterprises**
R. KAJA BANTHA NAVAS[1], S. PRAKASH[1], A. John RAJAN[2], Subramaniam ARUNACHALAM[3]
[1]*Sathyabama Institute of Science and Technology, India*
[2]*Vellore Institute of Technology, India*
[3]*University of East London, United Kingdom*

## Manufacturing Systems 1

17/12/2018 11:00 - 12:45
Room: Riverside VI

Chairs: Matthieu MUSEAU, *G-SCOP Laboratory - Univ. Grenoble Alpes*
R.M. Chandima RATNAYAKE, *University of Stavanger*

Abstracts: see page 49

IEEM18-P-0031
**Simultaneous Balancing and Buffer Allocation to Serial Lines with Bernoulli Stations**
Wenchong CHEN[1], Hongwei LIU[1], Wei LIU[2]
[1]*Tianjin University, China*
[2]*Nanjing Agricultural University, China*

IEEM18-P-0039
**Modeling and Simulation of MRR and Surface Roughness in EMAF**
Pankaj Kumar SHRIVASTAVA[1], Avanish Kumar DUBEY[2], Nitesh Kumar PANDEY[3]
[1]*AKS University, Satna (M.P.), India*
[2]*Motilal Nehru National Institute of Technology Allahabad, India*
[3]*Shri Ramswaroop Memorial University Lucknow, India*

IEEM18-P-0067
**Enhancement of the Design Process for Manufacturing Systems via a Multi-criteria Evaluation Method Creating a Control Loop for Guided Improvement**
Michael FELDMETH, Egon MÜLLER
*Chemnitz University of Technology, Germany*

IEEM18-P-0068
**SMED in the North American Secondary Wood Products Industry**
Urs BUEHLMANN[1], Enis KUCUK[2]
[1]*Virginia Tech, United States*
[2]*Istanbul Technical University, Turkey*

IEEM18-P-0071
**Hybridizing MJF Based Additive Layer and CNC Supported Subtractive Manufacturing for Enhancing Productivity in PD Design Iterations**
R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

IEEM18-P-0579
**Effect of Temperature on the Quality of Welding Beads Deposited with CMT Technology**
Pascal ROBERT, Matthieu MUSEAU, Henri PARIS
*University Grenoble Alpes, France*

IEEM18-P-0104
**Production Management System for Small and Medium Sized Manufacturing Enterprises**
Lei WANG, Peng LIU, Shengqian JIANG, Yiming XUE, Kun WANG, Xiangnan LI
*Jilin University, China*

## Decision Analysis and Methods 1

17/12/2018 11:00 - 12:45
Room: Riverside VII

Chairs: Armand BABOLI, *National Institute of Applied Sciences of Lyon*
Arnesh TELUKDARIE, *University of Johannesburg*

Abstracts: see page 50

IEEM18-P-0008
**A Two-layer Data Envelopment Analysis Model for Sustainable Performance Evaluation**
Willy ZALATAR, Eppie CLARK
*De La Salle University, Philippines*

IEEM18-P-0123
**A Hybrid Approach Using SWOT and AHP to Prioritize the Factors for Indigenous Production of Automobiles: A Case of Pakistani Automotive Industry**
Yasir AHMAD[1], Zaid BIN KHALID[2]
[1]*National University of Sciences and Technology (NUST), Pakistan*
[2]*University of Central Punjab, Pakistan*

IEEM18-P-0229
**World-Class Engineering: Designing for Quality, Reliability, Maintenance, and Supply Chain Management Using the Analytic Hierarchy Process**
Travis C. MALLETT
*Schweitzer Engineering Laboratories, Inc., United States*

IEEM18-P-0273
**A Predictive Approach to Define the Best Forecasting Method for Spare Parts: A Case Study in Business Aircrafts' Industry**
Reza BABAJANIVALASHEDI[1], Armand BABOLI[1], Muhammad Kashif SHAHZAD[1], Romy TONADRE[2]
[1]*Universite de Lyon, France*
[2]*Dassault Falcon Jet Corp., United States*

IEEM18-P-0220
**A New Approach to Integrate Resilience Engineering and Business Process Re-engineering Design**
Maliheh VAEZ-ALAEI[1], Armand BABOLI[2], Reza TAVAKKOLI-MOGHADDAM[1]
[1]*University of Tehran, Iran*
[2]*Universite de Lyon, France*

IEEM18-P-0248
**A Methodology to Integrate Artificial Intelligence with the Design Structure Matrix Approach**
Chuks MEDOH, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

IEEM18-P-0575
**Prediction of Critical Infrastructure Accident Losses of Chemical Releases Impacted by Climate-weather Change**
Magda BOGALECKA, Krzysztof KOŁOWROCKI
*Gdynia Maritime University, Poland*

## Supply Chain Management 2

17/12/2018 13:45 - 15:30
Room: Ballroom I

Chairs: Linda ZHANG, *IESEG School of Management*
Charles MBOHWA, *University of Johannesburg*

Abstracts: see page 51

IEEM18-P-0321
**Review of Refrigerated Inventory Control System for Perishable Products**
Dyah SATITI, Ahmad RUSDIANSYAH, Ratna Sari DEWI
*Institut Teknologi Sepuluh Nopember, Indonesia*

IEEM18-P-0338
**Supply Chain Configuration Modeling for Multi-product Multi-echelon**
Sinta SULISTYO, Derana ADILIA, Nur Aini MASRUROH
*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0447
**Supplier Selection Method: A Case-study on a Car Seat Manufacturer in Thailand**
Naragain PHUMCHUSRI, Supasit TANGSIRIWATTANA, Poom LUANGJARMEKORN
*Chulalongkorn University, Thailand*

IEEM18-P-0129
**Improving Traceability System in Indonesian Coconut Oil Company**
Ivan GUNAWAN[1], Iwan VANANY[1], Erwin WIDODO[1], Jaka MULYANA[2]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Widya Mandala Catholic University, Indonesia*

IEEM18-P-0160
**Vehicle Dispatch Problem with Precedence Constraints for Marine Container Drayage**
Etsuko NISHIMURA[1], K. SHINTANI[2], A. IMAI[1]
[1]*Kobe University, Japan*
[2]*Tokai University, Japan*

IEEM18-P-0561
**An Impact-wave Analogy for Managing Cyber Risks in Supply Chains**
Daniel SEPULVEDA ESTAY, Pablo GUERRA
*Technical University of Denmark, Denmark*

## Production Planning and Control

17/12/2018 13:45 - 15:30
Room: Ballroom II

Chairs: Anders THORSTENSON, *Aarhus University*
HeeHyol LEE, *Waseda University*

Abstracts: see page 52

IEEM18-P-0190
**A SPH Simulation Approach using the Carreau Model for the Free Surface Flow of Adhesives**
Marcus RÖHLER, Vakul KUMAR, Christoph RICHTER, Gunther REINHART
*Fraunhofer IGCV, Germany*

IEEM18-P-0613
**Capacity Allocation Among Suppliers in the Presence of Spot Market**
Tarun JAIN[1], Jishnu HAZRA[2]
[1]*Indian Institute of Management Udaipur, India*
[2]*Indian Institute of Management Bangalore, India*

IEEM18-P-0340
**A Mix Integer Programming Model for Bi-objective Single Machine with Total Weighted Tardiness and Electricity Cost Under Time-of-use Tariffs**
Bobby KURNIAWAN[1], Alfian Akbar GOZALI[1], Wei WENG[2], Shigeru FUJIMURA[1]
[1]*Waseda University, Japan*
[2]*Kanazawa University, Japan*

IEEM18-P-0566
**An Improved Multiobjective Evolutionary Algorithm for Solving the No-wait Flow Shop Scheduling Problem**
Tsung-Su YEH, Tsung-Che CHIANG
*National Taiwan Normal University, Taiwan*

IEEM18-P-0369
**Multiply-connected Neuro PID Control**
Kun-Young HAN, Hee-Hyol LEE
*Waseda University, Japan*

IEEM18-P-0380
**As Simple as Possible but no Simpler – An Inquiry into Approximations for a Re-order Point Inventory Control Model with Gamma-distributed Demand**
Anders THORSTENSON
*Aarhus University, Denmark*

IEEM18-P-0295
**Cost-model for Energy-oriented Production Control**
Martin ROESCH[1], Christoph BERGER[1], Stefan BRAUNREUTHER[2], Gunther REINHART[1]
[1]*Fraunhofer IGCV, Germany*
[2]*Augsburg University of Applied Sciences, Germany*

## Reliability and Maintenance Engineering 2

17/12/2018 13:45 - 15:30
Room: Ballroom III

Chairs: Gopinath CHATTOPADHYAY, *Federation University*
Jayantha P. LIYANAGE, *University of Stavanger*

Abstracts: see page 54

IEEM18-P-0138
**Optimum Preventive Maintenance Policy for a Mechanical System Using Semi-markov Method and Golden Section Technique**
Girish KUMAR[1], J.P. VARGHESE[2]
[1]*Delhi Technological University, India*
[2]*eHealth Inc., United States*

IEEM18-P-0146
**Remaining Fatigue Life Prediction of Topside Piping Using Response Surface Models**
Arvind KEPRATE[1], R.M. Chandima RATNAYAKE[2]
[1]*DNV GL, Norway*
[2]*University of Stavanger, Norway*

IEEM18-P-0187
**Application of Prognostics and Health Management to Low Demand Systems: Use of Condition Data to Help Determine Function Test Interval**
Pengyu ZHU, Jayantha P. LIYANAGE
*University of Stavanger, Norway*

IEEM18-P-0206
**Reliability Modeling and Analysis of Nuclear Power System with Common Signal Based on Goal-oriented (GO) Method**
Yuan-Yuan YANG[1], Hui-Na MU[1], Guang-Liang CHEN[1], Xiao-Jian YI[2], Hong-Mei YAN[1], Chen LIU[1]
[1]*Beijing Institute of Technology, China*
[2]*China North Vehicle Research Institute, China*

IEEM18-P-0450
**Low Demand Safety Instrumented System: Update of Function Test Intervals with Layer of Protection Analysis in the Operational Phase**
Pengyu ZHU, Jayantha P. LIYANAGE
*University of Stavanger, Norway*

IEEM18-P-0098
**Decision Support Tools for Preventive Maintenance Intervals and Replacement Decisions of Engineering Assets**
Madhu MENON, Gopinath CHATTOPADHYAY, Ray BEEBE
*Federation University Australia, Australia*

IEEM18-P-0399
**Maintenance Planning Based on Reliability Assessment of Multi-state Multi-component System**
Niketa JAIN[1], Ajay Pal Singh RATHORE[2], Rakesh JAIN[2], Om Prakash YADAV[3]
[1]*Manipal University, India*
[2]*Malaviya National Institute of Technology Jaipur, India*
[3]*North Dakota State University, United States*

## Engineering Education and Training

17/12/2018 13:45 - 15:30
Room: Pompadour

Chairs: Ryan Jeffrey CURBANO, *Lyceum of the Philippines Laguna*
Tlotlollo HLALELE, *University of South Africa*

Abstracts: see page 55

IEEM18-P-0134
**The Concept of Systems Thinking Education- Moving from the Parts to the Whole**
Sigal KORAL KORDOVA[1], Moti FRANK[2]
[1]*Ariel University, Israel*
[2]*Israel Academic College, Israel*

IEEM18-P-0284
**Using QFD to Normalize a Culture of Innovation in an Engineering SME**
Pearse O'GORMAN[1], Margaret MORGAN[1], Rudy VAN MERKOM[2]
[1]*Ulster University, United Kingdom*
[2]*Fortress Protec Ltd., United Kingdom*

IEEM18-P-0324
**Continuous Improvement of Industrial Engineering Education Based on PDCA Method and Structural Importance**
Yaqi GUO, Hengyi GAO, Zhiqiang CAI, Shuai ZHANG, Fangyu HU
*Northwestern Polytechnical University, China*

IEEM18-P-0508
**Effect of Needham Model Based Interactive Multimedia Material Towards Students' Achivement in Digital Logic Gates**
M.F. LEE, S.N. MAT YUSOFF
*Universiti Tun Hussein Onn Malaysia, Malaysia*

IEEM18-P-0042
**An Approach to Integrate Skills Development in Open Distance Learning (ODL) Environment: Part 2**
Tlotlollo HLALELE, Mothibeli PITA, S. SUMBANYAMBE
*University of South Africa, South Africa*

IEEM18-P-0271
**Competency-based Assessment of Industrial Engineering Graduates: Basis for Enhancing Industry Driven Curriculum**
Ryan Jeffrey CURBANO, S. G. Y. MADRID, C. T. NARVACAN, J. R. PUENTENEGRA
*Lyceum of the Philippines Laguna, Philippines*

IEEM18-P-0319
**Training in Maintenance Engineering. Curricula Proposal**
Miguel DIAZ-CACHO[1], Jorge MARCOS-ACEVEDO[1], Javier SANCHEZ-REAL[1], Salah CHIKH[2]
[1]*University of Vigo, Spain*
[2]*University of Science and Technology, Hourari Boumediene (USTHB), Algeria*

## Operations Research 1

17/12/2018 13:45 - 15:30
Room: Riverside III

Chairs: Weiwei CUI, *Shanghai University*
Norbert TRAUTMANN, *University of Bern*

Abstracts: see page 57

IEEM18-P-0034
**Generic Framework for Stress Testing of Real-time Systems**
Afshan NASEEM, Asad Waqar MALIK, Shoab Ahmed KHAN
*National University of Sciences and Technology (NUST), Pakistan*

IEEM18-P-0056
**A Distributionally Robust Chance Constrained Model to Hedge Against Uncertainty in Steelmaking-continuous Casting Production Process**
Shengsheng NIU, Shiji SONG, Jian-Ya DING
*Tsinghua University, China*

IEEM18-P-0085
**Capacitated Assortment Optimization with Pricing under the Paired Combinatorial Logit Model**
Daihan ZHANG[1], Zhenghe ZHONG[1], Chuning GAO[1], Rui CHEN[2]
[1]*Sparkzone Institute, China*
[2]*Tsinghua University, China*

IEEM18-P-0184
**A Lagrange Multiplier-based Regularization Algorithm for Image Super-resolution**
Bai LI, Lixin MIAO, Canrong ZHANG, Wenming YANG
*Tsinghua University, China*

IEEM18-P-0097
**A Genetic Algorithm for Generating Travel Itinerary Recommendation with Restaurant Selection**
Budhi WIBOWO, Monica HANDAYANI
*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0386
**A Continuous-Time Unit-Based MILP Formulation for the Resource-Constrained Project Scheduling Problem**
Mario GNÄGI, Adrian ZIMMERMANN, Norbert TRAUTMANN
*University of Bern, Switzerland*

IEEM18-P-0509
**A Rule-based Greedy Algorithm to Solve Stowage Planning Problem**
Dalia RASHED, Mohamed GHEITH, Amr ELTAWIL
*Egypt-Japan University of Science and Technology, Egypt*

## Big Data and Analytics 1

17/12/2018 13:45 - 15:30
Room: Riverside IV

Chairs: Soo Beng KHOH, *Innovation 360 Group*
Ruth COBOS, *Universidad Autonoma de Madrid*

Abstracts: see page 58

IEEM18-P-0590
**Sentiment Analysis of Airport Customer Reviews**
Arian DHINI, Dita Anggraeni KUSUMANINGRUM
*Universitas Indonesia, Indonesia*

IEEM18-P-0381
**Understanding Adoption of Big Data Analytics in China: From Organizational Users Perspective**
Kin Meng SAM[1], Chris CHATWIN[2]
[1]*University of Macau, China*
[2]*University of Sussex, United Kingdom*

IEEM18-P-0366
**A Local-branching Heuristic for the Best Subset Selection Problem in Linear Regression**
Tamara BIGLER, Oliver STRUB
*University of Bern, Switzerland*

IEEM18-P-0049
**Early Detection of Events as a Decision Support in the Milk Collection Planning**
Atefe ZAKERI, Morteza SABERI, Omar KHADEER HUSSAIN, Elizabeth CHANG
*University of New South Wales, Australia*

IEEM18-P-0065
**Smart City Application and Analysis: Real-time Urban Drainage Monitoring by IoT Sensors: A Case Study of Hong Kong**
Kin Lok KEUNG, Carman Ka Man LEE, Kam Hung NG, Chun Kit YEUNG
*The Hong Kong Polytechnic University, Hong Kong SAR*

IEEM18-P-0072
**Cultivating Growth and Radical Innovation Success in the Fourth Industrial Revolution with Big Data Analytics**
Magnus PENKER[1], Soo Beng KHOH[2]
[1]*Innovation 360 Group AB, Sweden*
[2]*Innovation 360 Group AB, Malaysia*

IEEM18-P-0339
**Clustering Subway Station Arrival Patterns Using Weighted Dynamic Time Warping**
Rui WANG[1], Nan CHEN[1], Chen ZHANG[2]
[1]*National University of Singapore, Singapore*
[2]*Tsinghua University, China*

## Project Management 1

17/12/2018 13:45 - 15:30
Room: Riverside V

Chairs: Budi HARTONO, *Universitas Gadjah Mada*
Fan LI, *Tsinghua University*

Abstracts: see page 60

IEEM18-P-0033
**Hybridization of Development Projects Through Process-related Combination of Agile and Plan-driven Approaches**
Michael RIESENER, Christian DÖLLE, Johanna AYS, Julian AYS
*RWTH Aachen University, Germany*

IEEM18-P-0414
**Risk of Quantity Increase in Vietnamese Construction Projects**
Soo Yong KIM[1], Ha Duy KHANH[2], Van Thanh BINH[2]
[1]*Pukyong National University, South Korea*
[2]*Ho Chi Minh City University of Technology and Education, Viet Nam*

IEEM18-P-0207
**A Literature Review on Approaches for the Retrospective Utilisation of Data in Engineering Change Management**
Armin TALE-YAZDI, Niklas KATTNER, Lucia BECERRIL, Udo LINDEMANN
*Technical University of Munich, Germany*

IEEM18-P-0192
**Data Analysis in Engineering Change Management – Improving Collaboration by Assessing Organizational Dependencies Based on Past Engineering Change Information**
Niklas KATTNER, Jan MEHLSTAEUBL, Lucia BECERRIL, Udo LINDEMANN
*Technical University of Munich, Germany*

IEEM18-P-0209
**Dimensioning a Product Development Project Portfolio Using a Closed Queueing Network**
Jesper FINK ANDERSEN[1], Carsten LAURIDSEN[2], Bo Friis NIELSEN[1]
[1]*Technical University of Denmark, Denmark*
[2]*Novozymes, Denmark*

IEEM18-P-0027
**The Contextual Utility of Agile Project Management Maturity**
Budi HARTONO[1], Dennis KUNARSITO[2], Citra NUDIASARI[2]
[1]*Gadjah Mada University, Indonesia*
[2]*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0479
**A BIM-based Labor Crew Moving Path Obstruction Detection Approach**
Qiankun WANG , Zeng GUO, Qianyao LI, Tingting MEI, Shi QIAO, Weiwei ZUO
*Wuhan University of Technology, China*

## Manufacturing Systems 2

17/12/2018 13:45 - 15:30
Room: Riverside VI

Chairs: Zhe ZHANG, *Nanjing University of Science and Technology*
Safwan ALTARAZI, *German-Jordanian University*

Abstracts: see page 61

IEEM18-P-0079
**An Application of Just-in-time as a Strategy for Competitive Advantage: The Case of a Non-alcoholic Company in South Africa**
Sambil Charles MUKWAKUNGU, Eric BAKAMA, Magaly Madeleine BOLIPOMBO, Charles MBOHWA
*University of Johannesburg, South Africa*

IEEM18-P-0133
**Environmental Management Systems in Thai Small and Medium-Sized Manufacturing Firms**
Pittawat UEASANGKOMSATE[1], Chidchanok WONGSUPATHAI[2]
[1]*Kasetsart University, Thailand*
[2]*Electricity Generating Authority of Thailand, Thailand*

IEEM18-P-0159
**Similarity-search and Prediction Based Process Parameter Adaptation for Quality Improvement in Interlinked Manufacturing Processes**
Jacqueline SCHMITT, Jochen DEUSE
*TU Dortmund University, Germany*

IEEM18-P-0569
**An Integer Linear Programming Approach for the Combined Cell Layout Problem**
Miguel F. ANJOS[1], Philipp HUNGERLAENDER[2], Kerstin MAIER[2]
[1]*Polytechnique Montreal, Canada*
[2]*Alpen-Adria-Universität Klagenfurt, Austria*

IEEM18-P-0091
**Reliability Analysis for a Divisional Seru Production System with Stochastic Capacity**
Xinzi HAN[1], Zhe ZHANG[1], Yong YIN[2]
[1]*Nanjing University of Science and Technology, China*
[2]*Doshisha University, Japan*

IEEM18-P-0226
**Predicting the Tensile Strength of Extrusion-blown High Density Polyethylene Film Using Machine Learning Algorithms**
Firas ALHINDAWI, Safwan ALTARAZI
*German-Jordanian University, Jordan*

IEEM18-P-0449
**Investigation of Assessment and Maturity Stage Models for Assessing the Implementation of Industry 4.0**
Marco UNTERHOFER[1], Erwin RAUCH[1], Dominik T. MATT[1], Salinee SANTITEERAKUL[2]
[1]*Free University of Bozen-Bolzano, Italy*
[2]*Chiang Mai University, Thailand*

## Decision Analysis and Methods 2

17/12/2018 13:45 - 15:30
Room: Riverside VII

Chairs: Hao YU, *UiT The Arctic University of Norway*
Nur Aini MASRUROH, *Gadjah Mada University*

Abstracts: see page 62

IEEM18-P-0120
**Data-driven Defense Strategies for an Infrastructure Network against Multiple Interdictions**
Jing JIANG, Xiao LIU
*Shanghai Jiao Tong University, China*

IEEM18-P-0433
**Solving the Bidirectional Multi-Period Full Truckload Vehicle Routing Problem with Time Windows and Split Delivery for Bulk Transportation Using a Covering Model**
Apichit MANEENGAM, Apinanthana UDOMSAKDIGOOL
*King Mongkut's University of Technology Thonburi, Thailand*

IEEM18-P-0445
**Using Multicriteria Decision Making Methods to Manage Systems Obsolescence**
Imen ZAABAR, Yvan BEAUREGARD, Marc PAQUET
*École de Technologie Supérieure, Canada*

IEEM18-P-0144
**Assessing Information Security Risk Using Markov Chain**
Daniel TSE, Xiaoting PAN, Yuan ZONG, Jiaxi LIU, Qinyan YANG
*City University of Hong Kong, Hong Kong SAR*

IEEM18-P-0276
**A Comparison of Two Location Models in Optimizing the Decision-making on the Relocation Problem of Post Offices at Narvik, Norway**
Hao YU, Wei Deng SOLVANG
*University of Tromsø – The Arctic University of Norway, Norway*

IEEM18-P-0322
**The Effect of Decision Maker's Risk Attitude on Inventory Policy: An Empirical Studies**
Nur Aini MASRUROH, Elok PITALOKA, Wangi PANDAN SARI
*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0599
**Quantitative Assessment of Economic, Social and Environmental Impacts of Critical Infrastructure Disruptions**
Agnieszka BLOKUS
*Gdynia Maritime University, Poland*

## Supply Chain Management 3

17/12/2018 15:45 - 17:30
Room: Ballroom I

Chairs: Charles MBOHWA, *University of Johannesburg*
Mohammed Woyeso GEDA, *The Hong Kong Polytechnic University*

Abstracts: see page 63

IEEM18-P-0161
**Redistribution Problem of Relief Supply for Post-disasters**
Etsuko NISHIMURA, Kentaro UCHIDA
*Kobe University, Japan*

IEEM18-P-0489
**Analysis of Warranty Policy in Reverse Supply Chain Environment for Circular Economy**
Ammar ALQAHTANI[1], Surendra M. GUPTA[2]
[1]*King Abdulaziz University, Saudi Arabia*
[2]*Northeastern University, United States*

IEEM18-P-0331
**A Green Vehicle Routing Method for the Regional Logistics Center**
Jun-Der LEU[1], Andre KRISCHKE[2], Yi-Ping LEE[1], Larry Jung-Hsing LEE[1], Yi-Wei HUANG[1]
[1]*National Central University, Taiwan*
[2]*Munich University of Applied Sciences, Germany*

IEEM18-P-0342
**Multi-period Maximal Covering Location Problem with Modular Facilities for Locating Emergency Facilities with Back-up Services**
Roghayyeh ALIZADEH, Tatsushi NISHI
*Osaka University, Japan*

IEEM18-P-0417
**Intelligent Transport Systems and its Impact on Performance of Road Freight Transport in Zimbabwe**
Wiseman MUCHAENDEPI[1], Charles MBOHWA[1], James KANYEPE[2]
[1]*University of Johannesburg, South Africa*
[2]*Chinhoyi University of Technology, Zimbabwe*

IEEM18-P-0510
**Supply Chain Risk Mitigation Strategies in Automotive Industry: A Review**
Ehsan DEHDAR[1], Amir AZIZI[1], Salar AGHABEIGI[2]
[1]*Islamic Azad University Science and Research, Iran*
[2]*Islamic Azad University Tehran-North Branch, Iran*

IEEM18-P-0367
**Customer Value Chain Analysis for Sustainable Reverse Logistics Implementation: Indonesian Mobile Phone Industry**
Hesti MAHESWARI, Gatot YUDOKO, Akbar ADHIUTAMA
*Institut Teknologi Bandung, Indonesia*

## Human Factors 1

17/12/2018 15:45 - 17:30
Room: Ballroom II

Chairs: Manutchanok JONGPRASITHPORN, *King Mongkut's Institute of Technology Ladkrabang*
Titis WIJAYANTO, *Universitas Gadjah Mada*

Abstracts: see page 64

IEEM18-P-0496
**Barriers to Flexible Work Arrangements (FWA) in Malaysian Knowledge-based Industries**
Arnifa ASMAWI, Noor Shahaliza OTHMAN
*Multimedia University, Malaysia*

IEEM18-P-0542
**A Study on Developing Customer Groups in Consolidated Financial Services Using Qualitative and Quantitative Analysis**
Yoonki KIM, Kyung-Jun LEE, Joong Hee LEE, Jihwan LEE, Yong Min KIM, Huamin JIN, Jaeyoon KANG, Myung Hwan YUN
*Seoul National University, South Korea*

IEEM18-P-0352
**Human Factors Approach for Powered Transfemoral Prostheses Conceptual Design**
Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Jutamat PINITLERTSAKUN[3], Juthamas SIRIWATSOPON[3], Gary GUERRA[3], Teppakorn SITTIWANCHAI[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*
[3]*Mahidol University, Thailand*

IEEM18-P-0365
**Evaluation of Activation Function Capability for Intent Recognition and Development of a Computerized Prosthetic Knee**
Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Gary GUERRA[3], Uttapon KHAWNUAN[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*
[3]*Mahidol University, Thailand*

IEEM18-P-0567
**Effect of Coffee Intake on Heat Rate Variability and Driving Performance in Sleep-deprived Condition**
Titis WIJAYANTO, Tasya ALMA, Bonifatius Bramantya WISNUGRAHA, Syam Rachma MARCILLIA, Galang LUFITYANTO
*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0315
**Dealing with Aging and Multigeneration Workforce Topics at Top Global Companies: Evidence from Public Disclosure Information**
Igancio CASTELLUCCI[1], Pedro AREZES[2], Martin LAVALLIERE[3], Nelson COSTA[2], Olivia DADALT[3], Joseph COUGHLIN[3]
[1]*Universidad de Valparaíso, Chile*
[2]*University of Minho, Portugal*
[3]*MIT AgeLab, United States*

IEEM18-P-0520
**User Experience Analysis in Industry 4.0 - The Use of Biometric Devices in Engineering Design and Manufacturing**
Yuri BORGIANNI, Erwin RAUCH, Lorenzo MACCIONI, Benedikt Gregor MARK
*Free University of Bozen-Bolzano, Italy*

## Healthcare Systems and Management 1

17/12/2018 15:45 - 17:30
Room: Ballroom III

Chairs: Manuel De La SEN, *IIDP, EHU/UPV*
Elise VAREILLES, *Ecole Nationale Superieure des Mines Albi*

Abstracts: see page 66

IEEM18-P-0452
**Inventory Management Information System in Blood Transfusion Unit**
Fitra LESTARI[1], Ulfah ULFAH[2], Fitri ROZA APRIANIS[1], Suherman SUHERMAN[1]
[1]*Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia*
[2]*Kampar Regency, Indonesia*

IEEM18-P-0609
**Modified Model of Radiographer Scheduling Problem for Sequential Optimization**
Toshiyuki MIYAMOTO[1], Kuniyuki HIDAKA[2]
[1]*Osaka University, Japan*
[2]*Osaka University Hospital, Japan*

IEEM18-P-0421
**Women in Informatics Engineering Career: Perspective from Hofstede Cultural Dimension and Dayak Tribe's Cultural Values**
Ika WINDIARTI[1], Agung PRABOWO[2], Muhammad Haris QAMARUZZAMAN[1], Sam'ani SAM'ANI[1]
[1]*Muhammadiyah University of Palangkaraya, Indonesia*
[2]*STMIK Palangkaraya, Indonesia*

IEEM18-P-0005
**On a Discrete-time Epidemic Model based on a Continuous-time SEIR Model Under Feedback Vaccination Controls**
Marta FERNANDEZ-FERNANDEZ, Santiago ALONSO-QUESADA, Manuel DE LA SEN, Aitor J. GARRIDO
*University of the Basque Country, Spain*

IEEM18-P-0443
**Training System for the Medical Procedure of Cannulation**
Olga Katherine VERA BONILLA[1], Maria del Mar CHAVARRO CEBALLOS[1], Andres Felipe BARCO SANTA[1], Elise VAREILLES[2]
[1]*Universidad de San Buenaventura Cali, Colombia*
[2]*Université de Toulouse, France*

IEEM18-P-0251
**Managing Product Recalls in Healthcare Supply Chain**
Raja JAYARAMAN, Fatima ALHAMMADI, Mecit Can Emre SIMSEKLER
*Khalifa University, United Arab Emirates*

IEEM18-P-0546
**Pareto Optimization for Hospital Alliance Reverse Referral Decision**
De TENG, Na LI
*Shanghai Jiao Tong University, China*

## Technology and Knowledge Management 1

17/12/2018 15:45 - 17:30
Room: Pompadour

Chairs: Amnon GONEN, *Academic Ramat Gan*
Michel ALDANONDO, *Toulouse University / IMT-Mines Albi*

Abstracts: see page 67

IEEM18-P-0118
**Green Manufacturing's Adoption by Indonesian SMEs: A Conceptual Model**
Ira SETYANINGSIH, Nurul INDARTI, Wakhid CIPTONO
*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0524
**A Database Administration Tool to Model the Configuration Projects**
Sara SHAFIEE[1], Steffan Callesen FRIIS[2], Lukasz LIS[2], Ulf HARLOU[2], Yves WAUTELET[3], Lars HVAM[1]
[1]*Technical University of Denmark, Denmark*
[2]*Center for Product Customization, Denmark*
[3]*KU Leuven, Belgium*

IEEM18-P-0560
**An Application of Agent-based Modeling and Simulation in Tacit Knowledge Transfer Effectiveness and Individual Performance through the Consideration of Feedback Mechanism**
Fadillah RAMADHAN[1], Afrin Fauzya RIZANA[2], Rayinda Pramudtya SOESANTO[2], Amelia KURNIAWATI[2], Iwan Inrawan WIRATMADJA[3]
[1]*Institut Teknologi Nasional Bandung, Indonesia*
[2]*Telkom University, Indonesia*
[3]*Bandung Institute of Technology, Indonesia*

IEEM18-P-0612
**Application of Last Planner® System in Product Concept Development Phase: Use of Lean Concepts in Academic Project Work**
Prashanth SIVAGANESH, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

IEEM18-P-0164
**Project Success as a Function of Organizational Knowledge Management**
Uriel ISRAELI[1], Amnon GONEN[2]
[1]*Holon Institute of Technology, Israel*
[2]*The Israel Academic College, Ramat Gan, Israel*

IEEM18-P-0488
**How Much "Talent" is Needed for Organizational Learning? A Study of Labor Market Entrants in an Innovation-oriented Country**
Mait RUNGI
*Tallinn University of Technology, Estonia*

IEEM18-P-0487
**Foundation of Project Interdependencies: Perspective of Organizational Theories**
Mait RUNGI
*Tallinn University of Technology, Estonia*

## Operations Research 2

17/12/2018 15:45 - 17:30
Room: Riverside III

Chairs: Reza Tavakkoli-MOGHADDAM, *University of Tehran*
Philipp BAUMANN, *University of Bern*

Abstracts: see page 68

IEEM18-P-0228
**An MILP Model for the Internal Audit Scheduling Problem**
Volkan YILDIRIM[1], M. Ebru ANGÜN[2], Temel ÖNCAN[2]
[1]*Turkish Technic, Turkey*
[2]*Galatasaray University, Turkey*

IEEM18-P-0267
**Stochastic Storage/retrieval Scheduling Considering Shuttle Failure in Multi-shuttle Automated Storage and Retrieval System**
Jun WEN, Xinglu LIU, Peng YANG
*Tsinghua University, China*

IEEM18-P-0361
**A Continuous-Time MILP Formulation for the Multi-Mode Resource-Constrained Project Scheduling Problem**
Mario GNÄGI, Tom RIHM, Norbert TRAUTMANN
*University of Bern, Switzerland*

IEEM18-P-0419
**Exact Method for Single Vessel and Multiple Quay Cranes to Solve Scheduling Problem at Port of Tripoli - Lebanon**
Ali SKAF[1], Sid LAMROUS[1], Zakaria HAMMOUDAN[2], Marie-Ange MANIER[1]
[1]*Université Bourgogne Franche-Comté, France*
[2]*Université Libano-Française, Lebanon*

IEEM18-P-0314
**Mathematical Modelling for a Semi-obnoxious Inverse Line Location Problem**
Mehdi GOLPAYEGANI[1], Haleh MORADI[1], Reza TAVAKKOLI-MOGHADDAM[2]
[1]*Islamic Azad University, Iran*
[2]*University of Tehran, Iran*

IEEM18-P-0127
**A Diagonalization-Dantzig-Wolfe Decomposition Method to Solve a Class of Variational Inequality Problems**
William CHUNG
*City University of Hong Kong, Hong Kong SAR*

IEEM18-P-0302
**Aggregate Production Framework for Efficiency Analysis and its Implementation by Linear Programming**
Soobin CHOI, Jaedong KIM
*Korea Institute for Defense Analyses, South Korea*

## Service Innovation and Management 2

17/12/2018 15:45 - 17:30
Room: Riverside IV

Chairs: Yonas Zewdu AYELE, *Ostfold University College*
Daniel Y. MO, *Hang Seng Management College*

Abstracts: see page 69

IEEM18-P-0208
**Event-driven Architecture for Sensor Data Integration for Logistics Services**
Jens LEVELING[1], Luise WEICKHMANN[1], Christian NISSEN[1], Christopher KIRSCH[2]
[1]*Fraunhofer Institute for Material Flow and Logistics, Germany*
[2]*BEUMER Group GmbH & Co. KG, Germany*

IEEM18-P-0191
**Reaching Project Success Through Vision and Artifact and the Mediating Role of Team Spirit**
Sayed Muhammad FAWAD SHARIF[1], Naiding YANG[1], Fouzia KANWAL[2], Sayed Kifayat SHAH[1]
[1]*Northwestern Polytechnical University, China*
[2]*Southwest Jiaotong University, China*

IEEM18-P-0537
**A Human Centered Design Framework to Support Product-service Systems**
Thomson Chi Shing WONG[1], Moon Kyoung JANG[1], Seung Ki MOON[1], Zhong Yang CHUA[1], Haining ZHANG[1], Hyung Sool OH[2]
[1]*Nanyang Technological University, Singapore*
[2]*Kangwon National University, South Korea*

IEEM18-P-0438
**Marketing Management Challenges – A Nordic Small and Medium Size Enterprises (SMEs) Perspective**
Yonas Zewdu AYELE[1], Abbas BARABADI[2]
[1]*Østfold University College, Norway*
[2]*University of Tromsø – The Arctic University of Norway, Norway*

IEEM18-P-0513
**Consolidating Orders in a Crowdsourcing Delivery Network**
Daniel Y. MO, Yue WANG, Nicole CHAN
*Hang Seng Management College, Hong Kong SAR*

IEEM18-P-0317
**Co-creation of Value Using Social Media in the Service Industry: An Empirical Case Study of Service Innovation in a Banking and Finance Company**
Asle FAGERSTRØM[1], Ravi VATRAPU[2], J. OTRE STØRKSEN[1]
[1]*Kristiania University College, Norway*
[2]*Copenhagen Business School, Denmark*

IEEM18-P-0320
**Innovation Models for Public and Private Organizations: A Literature Review**
Tariq AL HAWI[1], Imad ALSYOUF[1], Mickael GARDONI[2]
[1]*University of Sharjah, United Arab Emirates*
[2]*École de Technologie Supérieure ÉTS, Canada*

## Project Management 2

17/12/2018 15:45 - 17:30
Room: Riverside V

Chairs: Ripon CHAKRABORTTY, *University of New South Wales*
Budi HARTONO, *Universitas Gadjah Mada*

Abstracts: see page 71

IEEM18-P-0391
**Decision Criteria for Contractor Selection in Construction Industry: A Literature Review**
Maria Creuza BORGES DE ARAUJO[1], Luciana ALENCAR[2], Caroline MOTA[2]
[1]*Universidade Federal de Campina Grande, Brazil*
[2]*Universidade Federal de Pernambuco, Brazil*

IEEM18-P-0193
**A Review of Methods, Tools and Techniques Used for Risk Management in Transport Infrastructure Projects**
Indra GUNAWAN, Tiep NGUYEN, Leonie HALLO
*The University of Adelaide, Australia*

IEEM18-P-0349
**The Influence of IM Use on Job Satisfaction in Cross-organizational Projects**
Ziyue WANG[1], Yali ZHANG[1], Jun SUN[2], Chrissie Diane TAN[1], Menghua LU[1]
[1]*Northwestern Polytechnical University, China*
[2]*University of Texas Rio Grande Valley, United States*

IEEM18-P-0505
**Key Influencing Factors for Cross-organizational R&D Project Stakeholder Management**
Chrissie Diane TAN[1], Yali ZHANG[1], Jun SUN[2], Ziyue WANG[1], Ganggang ZHENG[1]
[1]*Northwestern Polytechnical University, China*
[2]*University of Texas Rio Grande Valley, United States*

IEEM18-P-0194
**Robust Project Scheduling with Unreliable Resources: A Variable Neighbourhood Search Based Heuristic Approach**
Ripon K CHAKRABORTTY, Alireza ABBASI, Michael J RYAN
*University of New South Wales, Australia*

## Engineering Economy and Cost Analysis

17/12/2018 15:45 - 17:30
Room: Riverside VI

Chairs: Weiwei CUI, *Shanghai University*
Leif OLSSON, *Mid Sweden University*

Abstracts: see page 72

IEEM18-P-0592
**A Systematic Literature Review of the Implementation of Cost of Quality**
Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
*University of Johannesburg, South Africa*

IEEM18-P-0466
**Integrated Controlling Tool with Plan-fact Analysis**
Zoltan SEBESTYEN[1], Tamas TOTH[2]
[1]*Budapest University of Technology and Economics, Hungary*
[2]*Eötvös Loránd University, Hungary*

IEEM18-P-0201
**Decision Making on Sustainable Forest Harvest Production Using Goal Programming Approach (Case Study: Iranian Hyrcanian Forest)**
Soma ETEMAD[1], Soleiman MOHAMMADI LIMAEI[1], Leif OLSSON[2], Rasoul YOUSEFPOUR[3]
[1]*University of Guilan, Iran*
[2]*Mid Sweden University, Sweden*
[3]*University of Freiburg, Germany*

IEEM18-P-0105
**Operational Management of the Microgrid System for the Energy-sensitive Manufacturing Plant**
Weiwei CUI, Yujie YANG
*Shanghai University, China*

IEEM18-P-0035
**Analysis on Influence Factors of Enterprises' Costs for Compliance to Consumer Product Standard**
Xia LIU[1], Ruan LI[2], Xiaolei FENG[3], Bisong LIU[1], Qian WU[1]
[1]*China National Institution of Standardization, China*
[2]*Taizhou Supervision and Inspection Institute, China*
[3]*Zhejiang Research Institute of Product Quality Inspection, China*

IEEM18-P-0463
**American Productivity Center Method for Measuring Productivity in Palm Oil Milling Industry**
Fitra LESTARI[1], Irsan NUARI[2], Vera DEVANI[2]
[1]*Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia*
[2]*Sultan Syarif Kasim State Islamic University, Indonesia*

## Information Processing and Engineering

17/12/2018 15:45 - 17:30
Room: Riverside VII

Chairs: Zhaoxia GUO, *Sichuan University*
Arnesh TELUKDARIE, *University of Johannesburg*

Abstracts: see page 73

IEEM18-P-0497
**Latent Variable Structured Bayesian Network for Cyanobacterial Risk Pre-control**
Peng JIANG[1], X. LIU[1], J. ZHANG[2], S. H. TE[2], K. Y. H. GIN[2]
[1]*Shanghai Jiao Tong University, China*
[2]*National University of Singapore, Singapore*

IEEM18-P-0189
**Identifying and Defining Knowledge-work Waste in Product Development: A Case Study on Lean Maturity Assessment**
Felix P SANTHIAPILLAI, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

IEEM18-P-0211
**Regional Freight Volume Forecasting with Incomplete Data of Origin/Destination Freight Volumes**
Jiahao LIU, Guangxin OU, Zhaoxia GUO
*Sichuan University, China*

IEEM18-P-0224
**Application of Industry 4.0 Towards Achieving Business Sustainability**
Megashnee MUNSAMY[1], Arnesh TELUKDARIE[2]
[1]*Mangosuthu University of Technology, South Africa*
[2]*University of Johannesburg, South Africa*

IEEM18-P-0247
**Enterprise Definition for Industry 4.0**
Arnesh TELUKDARIE, Michael SISHI
*University of Johannesburg, South Africa*

IEEM18-P-0529
**Classification System for Egyptian Heritage Buildings**
Mohamed MARZOUK[1], Noha SALEEB[2], M. M. ELSHARKAWY[1], Asmaa EID[1], Mohamed ALI[1], Mahmoud METAWIE[1]
[1]*Cairo University, Egypt*
[2]*Middlesex University, United Kingdom*

IEEM18-P-0407
**Development of Halal Audit Information System (HAIS) and its Implementation Evaluation Based on Time–cost Trade–off Using Integer Linear Programming (ILP)**
Iwan VANANY, Diesta Iva MAFTUHAH, Adi SOEPRIJANTO, Faiz Rahman ARIFIN
*Institut Teknologi Sepuluh Nopember, Indonesia*

## Supply Chain Management 4

18/12/2018 08:45 - 10:45
Room: Ballroom I

Chairs: Kanagi KANAPATHY, *University of Malaya*
Murat KUCUKVAR, *Qatar University*

Abstracts: see page 74

IEEM18-P-0363
**Understanding Influential Factors in Selecting Sustainable Third-party Logistics Providers: An Interpretive Structural Modeling and MICMAC Analysis**
Xiangce MENG[1], Zhaojun YANG[1], Jun SUN[2]
[1]*Xidian University, China*
[2]*University of Texas Rio Grande Valley, United States*

IEEM18-P-0048
**Scenarios in Intermodal Transportation Planning**
Wichitsawat SUKSAWAT NA AYUDHYA
*King Mongkut's Institute of Technology, Thailand*

IEEM18-P-0383
**Inventory Analysis on a Single-Echelon Supply Chain System by Considering Carbon Emissions**
Petrus Setya MURDAPA[1], I. Nyoman PUJAWAN[2], Putu Dana KARNINGSIH[2], Arman Hakim NASUTION[2]
[1]*Institut Teknologi Sepuluh Nopember (ITS) - Widya Mandala Catholic University Madiun, Indonesia*
[2]*Institut Teknologi Sepuluh Nopember (ITS), Indonesia*

IEEM18-P-0408
**Application of Mathematical Model for Raw Material Storage Management**
Chompoonoot KASEMSET, Aunchalee PETCHALALAI
*Chiang Mai University, Thailand*

IEEM18-P-0412
**Biomass Supply Chain Design, Planning and Management: A Review of Literature**
Fitri AGUSTINA, Iwan VANANY, Nurhadi SISWANTO
*Institut Teknologi Sepuluh Nopember, Indonesia*

IEEM18-P-0062
**Forecasting of Used Product Returns for Remanufacturing**
Mohammed Woyeso GEDA, C.K. KWONG
*The Hong Kong Polytechnic University, China*

IEEM18-P-0471
**Supplier Integration Roles in New Product Development: The Automotive Suppliers' Perspective**
Kanagi KANAPATHY, Kooi Onn CHU
*University of Malaya, Malaysia*

## Safety, Security and Risk Management 2

18/12/2018 08:45 - 10:45
Room: Ballroom II

Chairs: R.M. Chandima RATNAYAKE, *University of Stavanger*
Jayantha P. LIYANAGE, *University of Stavanger*

Abstracts: see page 75

IEEM18-P-0584
**Critical Infrastructure Impacted by Climate Change Safety and Resilience Indicators**
Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI
*Gdynia Maritime University, Poland*

IEEM18-P-0587
**Critical Infrastructure Impacted by Operation and Climate Change Safety and Resilience Indicators**
Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI
*Gdynia Maritime University, Poland*

IEEM18-P-0604
**Longtime Prediction of Climate-weather Change Influence on Critical Infrastructure Safety and Resilience**
Mateusz TORBICKI
*Gdynia Maritime University, Poland*

IEEM18-P-0404
**Information Privacy Practices in Organizations: Activities, Knowledge and Skill Requirements for Information Technology Professionals**
Yasaman ATEFI MONFARED, Younes BENSLIMANE, Zijiang YANG
*York University, Canada*

IEEM18-P-0591
**On Context, Issues, and Pitfalls of Expert Judgement Process in Risk Assesment of Arctic Offshore Installations and Operations**
Masoud NASERI, Abbas BARABADI
*University of Tromsø – The Arctic University of Norway, Norway*

IEEM18-P-0132
**Food Safety and Halal Food Risks in Indonesian Chicken Meat Products: An Exploratory Study**
Hana Catur WAHYUNI, Iwan VANANY, Udisubakti CIPTOMULYONO
*Institut Teknologi Sepuluh Nopember, Indonesia*

IEEM18-P-0531
**IMU Based Real Time Underground Soil Movement Detection System: An Illustrative Investigation**
R. M. WEERASINGHE[1], D. BUDDIKA[1], R.M. Chandima RATNAYAKE[2]
[1]*Industrial Technology Institute, Sri Lanka*
[2]*University of Stavanger, Norway*

## Reliability and Maintenance Engineering 3

18/12/2018 08:45 - 10:45
Room: Ballroom III

Chairs: Shinji INOUE, *Kansai University*
Yonas Zewdu AYELE, *Ostfold University College*

Abstracts: see page 76

IEEM18-P-0257
**Environmental Sustainability in Maintenance Management of Public Transport Systems: Literature Review**
Iyad ALAWAYSHEH, Imad ALSYOUF
*University of Sharjah, United Arab Emirates*

IEEM18-P-0325
**Reliability Assessment for Multi-area Load Frequency Control Systems with Degraded Components**
Zhiying WU[1], Huadong MO[2], Junlin XIONG[1]
[1]*University of Science and Technology of China, China*
[2]*ETH Zurich, Switzerland*

IEEM18-P-0397
**Spectral Graph Wavelet based Component Clustering for System Reliability Analysis**
Ping ZHANG[1], Xiaoyan ZHU[2]
[1]*City University of Hong Kong/ University of Chinese Academy of Sciences, China*
[2]*University of Chinese Academy of Sciences, China*

IEEM18-P-0472
**Preparation of Preventive and Predictive Maintenance Guidelines for Emulsion Preparation and Processing Plant Using Risk Management Techniques**
Dushan I. JAYASINGHE
*Monash University, Australia*

IEEM18-P-0553
**Reliability Analysis of the Crude Oil Transfer System in the Oil Port Terminal**
Agnieszka BLOKUS, B. KWIATUSZEWSKA-SARNECKA
*Gdynia Maritime University, Poland*

IEEM18-P-0108
**Debugging Process Oriented Software Reliability Models and Their Goodness-of-Fit**
Shinji INOUE[1], Shigeru YAMADA[2]
[1]*Kansai University, Japan*
[2]*Tottori University, Japan*

IEEM18-P-0437
**Mixture Lognormal Cox Regression Repair Model for Prediction of the Repair Time**
Yonas Zewdu AYELE[1], Abbas BARABADI[2], Fuqing YUAN[2]
[1]*Østfold University College, Norway*
[2]*University of Tromsø – The Arctic University of Norway, Norway*

## Technology and Knowledge Management 2

18/12/2018 08:45 - 10:45
Room: Pompadour

Chairs: Michel ALDANONDO, *Toulouse University / IMT-Mines Albi*
Helery TASANE, *Tallinn University of Technology*

Abstracts: see page 78

IEEM18-P-0013
**Developing the Strategies for AI Products based on the Technology Decomposition Framework**
Song-Kyoo KIM
*Khalifa University, United Arab Emirates*

IEEM18-P-0083
**Brain Utilization of MNCs in Japan Compared with that of Japanese Companies Overseas**
Masayuki KONDO
*Tokyo Denki University, Japan*

IEEM18-P-0096
**Integration of Scenarios in Product-service System Development - Combining Scenarios, Use Cases and Requirements Traceability**
Dominik WEIDMANN[1], Felix SEIBEL[1], Lucia BECERRIL[1], Niklas KATTNER[1], Jona LEHR[2], Markus MOERTL[1], Udo LINDEMANN[1]
[1]*Technical University of Munich, Germany*
[2]*MVG, Germany*

IEEM18-P-0101
**Integration of Scenario-based Requirements Forecast into Model-based Product-service System Planning**
Dominik WEIDMANN, Stefan WINKLER, Markus MOERTL
*Technical University of Munich, Germany*

IEEM18-P-0362
**Methodology for Digitalization – A Conceptual Model**
Huey Yuen NG, Puay Siew TAN, Y. G. LIM
*Singapore Institute of Manufacturing Technology, Singapore*

IEEM18-P-0552
**Value Chain from Good to Great: Multiple-case Study of Estonian Companies**
Kadri MÄNNASOO, Mait RUNGI, Heili HEIN, Helery TASANE
*Tallinn University of Technology, Estonia*

IEEM18-P-0268
**How to Use Configuration Software in "Less Routine Design" Situations? Some Modelling Propositions**
Abdourahim SYLLA, Delphine GUILLON, Luis GARCES MONGE, Elise VAREILLES, Michel ALDANONDO, Thierry COUDERT, Laurent GENESTE
*Université de Toulouse, France*

## Systems Modeling and Simulation 2

18/12/2018 08:45 - 10:45
Room: Riverside III

Chairs: Ipseeta NANDA, *NIIT University*
Abhijeet DIGALWAR, *BITS PILANI*

Abstracts: see page 79

IEEM18-P-0064
**Simulation-based Multiple Automated Guided Vehicles Considering Charging and Collision-free Requirements in Automatic Warehouse**
C.K.M. LEE, K.L. KEUNG, K.K.H. NG, Daniel C.P. LAI
*The Hong Kong Polytechnic University, China*

IEEM18-P-0103
**Simulation and Optimization of Production Line in Em-plant based Assembly Workshop**
Hongying SHAN, Lina LI, Yu YUAN, C. WANG
*Jilin University, China*

IEEM18-P-0113
**Lean, Simulation and Optimization: The Case of Steering Knuckle Arm Production Line**
Hongying SHAN, Yu YUAN, Yanxiang ZHANG, Lina LI, Chuang WANG
*Jilin University, China*

IEEM18-P-0598
**Efficient Modular Product Platform Design of Mechatronic Systems**
Günther SCHUH, Christian DÖLLE, Sebastian BARG, Maximilian KUHN, Stefan BREUNIG
*RWTH Aachen University, Germany*

IEEM18-P-0176
**Informational Approach to Global Optimization with Input Uncertainty for Homoscedastic Stochastic Simulation**
Haowei WANG[1], Jun YUAN[2], Szu Hui NG[1]
[1]*National University of Singapore, Singapore*
[2]*Shanghai Maritime University, China*

IEEM18-P-0282
**Energy Efficient Motion Planning of Dual-Armed Robots with Pickup Point Determination for Transportation Tasks**
Tatsushi NISHI, Yuki MORI
*Osaka University, Japan*

IEEM18-P-0341
**System Dynamics Approach for the Assessment of Leanness of Organizations**
Abhijeet K. DIGALWAR, Akshay BEDEKAR, Mohit AGRAWAL
*Birla Institute of Technology and Science, Pilani, India*

## Manufacturing Systems 3

18/12/2018 08:45 - 10:45
Room: Riverside IV

Chairs: Junfeng WANG, *Huazhong University of Science and Technology*
Surendra M. GUPTA, *Northeastern University*

Abstracts: see page 80

IEEM18-P-0493
**A Modified MOEA/D for Energy-efficient Flexible Job Shop Scheduling Problem**
Enda JIANG, Ling WANG
*Tsinghua University, China*

IEEM18-P-0495
**Radical Product Innovation in the New Zealand Food and Beverage Industry: The Effect of Company Age, Size, and Foreign Ownership**
Julawit PITRCHART, Nihal JAYAMAHA, Allan ANDERSON
*Massey University, New Zealand*

IEEM18-P-0299
**Integrated Simulation Optimization for Layout Problems**
Henri PIERREVAL
*SIGMA Clermont, France*

IEEM18-P-0014
**Implementing FPGA based PID-controller for Extrusion to Reduce Raw Material Wastage**
Samreen HUSSAIN[1], Muhammad ISMAEEL[2], Adnan WAQAR[2], Muhammad Ali AMJAD[2], Muhammad Mubeen IQBAL[2], Muhammad SHAUR[2], Rimsha ARSHAD[2]
[1]*Ziauddin University, Pakistan*
[2]*Dawood University of Engineering & Technology, Pakistan*

IEEM18-P-0550
**Rapid Thermal Simulation of Powder Bed Additive Manufacturing**
Frédéric VIGNAT[1], Nicolas BERAUD[2], Francois VILLENEUVE[1]
[1]*University of Grenoble Alps, France*
[2]*DP Research Institute, France*

IEEM18-P-0234
**Energy Consumption Control of One Machine Manufacturing System with Stochastic Arrivals Based on Fuzzy Logic**
Eliana TORRES DUQUE[1], Zicheng FEI[1], Junfeng WANG[1], Shiqi LI[1], Yuanfang LI [2]
[1]*Huazhong University of Science and Technology, China*
[2]*China Academy of Launch Vehicle Technology, China*

IEEM18-P-0335
**Analysis of Product Designs for Product Recovery Using Linear Physical Programming**
Aditi D. JOSHI, Surendra M. GUPTA
*Northeastern University, United States*

## Supply Chain Management 5

18/12/2018 11:00 - 12:45
Room: Ballroom I

Chairs: Gitae KIM, *Hanbat National University*
Kanagi KANAPATHY, *University of Malaya*

Abstracts: see page 82

IEEM18-P-0543
**Locating Facility with Multi-period and Dynamic Demand: A Case Study of Chemical Fertilizer Store in Thailand**
Natdabhorn SAPKHOKING, Arthit APICHOTTANAKUL, Komkrit PITIRUEK
*Khon Kaen University, Thailand*

IEEM18-P-0557
**Alignment Between Enterprise Green Supply Chain and Green Information System: An Analysis of Four Cases**
Zheng WU[1], Zhaojun YANG[1], Jun SUN[2], Yu ZOU[1]
[1]*Xidian University, China*
[2]*University of Texas Rio Grande Valley, United States*

IEEM18-P-0580
**Decision Support System of the Single Track Railway Rescheduling with Predictive Delay**
Ahmad RUSDIANSYAH, Kurnia ISWARDANI
*Sepuluh Nopember Institute of Technology, Indonesia*

IEEM18-P-0597
**The Identification of Supplier Selection Criteria Within a Risk Management Framework Towards Consistent Supplier Selection**
Tumelo LESISA, Annlize MARNEWICK, Hannelie NEL
*University of Johannesburg, South Africa*

IEEM18-P-0572
**Optimal Vehicle Routing for Parcel Delivery with Considering Two Time Periods**
Gitae KIM
*Hanbat National University, South Korea*

IEEM18-P-0212
**Revenue and Cost Sharing Mechanism for Effective Remanufacturing Supply Chain**
Tatsuya INABA
*Kanagawa Institute of Technology, Japan*

IEEM18-P-0288
**The Robustness of Warranty: Wholesale Pricing Contract vs Two-part Tariff**
Houping TIAN[1], Qingqing YAN[1], Changxian LIU[2]
[1]*Nanjing University of Science and Technology, China*
[2]*Nanjing University of Posts and Telecommunications, China*

## Human Factors 2

18/12/2018 11:00 - 12:45
Room: Ballroom II

Chairs: Manutchanok JONGPRASITHPORN, *King Mongkut's Institute of Technology Ladkrabang*
Antonio VERDU, *University Miguel Hernandez*

Abstracts: see page 83

IEEM18-P-0246
**Impact of Socioeconomic Factors on the Levers Influencing Households' Participation in Recycling Programs in Zambia**
Bupe G. MWANZA[1], Arnesh TELUKDARIE[2], Charles MBOHWA[2]
[1]*Cavendish University Zambia, Zambia*
[2]*University of Johannesburg, South Africa*

IEEM18-P-0272
**Evaluation of Physical and Motor Function in an Aging Female Population – Preliminary Results**
Marek BURES, Jana BENESOVA, Martin KABA
*University of West Bohemia, Czech Republic*

IEEM18-P-0178
**Age-related Differences in Work Motivations: The Case of SMEs**
Riitta FORSTEN-ASTIKAINEN[1], Susanna KULTALAHTI[2], Matti MUHOS[1]
[1]*University of Oulu, Finland*
[2]*University of Vaasa, Finland*

IEEM18-P-0619
**What Humans Act in Robotic Surgery**
Fabio FRUGGIERO[1], Marcello FERA[2], Alfredo LAMBIASE[3], Salvatore MIRANDA[3]
[1]*University of Basilicata, Italy*
[2]*University of Campania Luigi Vanvitelli, Italy*
[3]*University of Salerno, Italy*

IEEM18-P-0530
**The Influence of Family on Self-reflexive and Emotional Antecedents of the Transformational Leader**
Lirios ALOS-SIMO, Antonio VERDU-JOVER, Jose Maria GOMEZ-GRAS, Marina ESTRADA-DE-LA-CRUZ
*University of Miguel Hernandez, Spain*

IEEM18-P-0298
**Risk Reduction Among Adult Walker Users: An Ergonomic Innovation**
Ezrha C. GODILANO, Edgardo M. BALDOVINO JR., Jeizel Abbigael D. CAHENDE, Marielle B. TERRIBLE
*Malayan Colleges Laguna, Philippines*

IEEM18-P-0300
**WMSD Risk Reduction Among Grocery Shoppers and Clerks by Redesigning Double Basket Shopping Carts**
Ezrha C. GODILANO, Joshua John G. ALMORO, Al John D.P. BULAHAN, Edward Kenneth Allen C. GARCIA
*Malayan Colleges Laguna, Philippines*

## Healthcare Systems and Management 2

18/12/2018 11:00 - 12:45
Room: Ballroom III

Chairs: Manuel De La SEN, *IIDP, EHU/UPV*
Desmond WONG, *University of Hull*

Abstracts: see page 84

IEEM18-P-0539
**Preoperative Analysis for Clinical Features of Unsuspected Gallbladder Cancer Based on Random Forest**
Zhen ZHANG[1], Na LI[2], Hengyi GAO[1], Zhiqiang CAI[1], Shubin SI[1], Zhimin GEMG[2]
[1]*Northwestern Polytechnical University, China*
[2]*Xi'an Jiaotong University, China*

IEEM18-P-0547
**Developing Customer Perception Based Organization Performance Measurement Framework for Healthcare Service**
I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN
*Indonesian Institute of Sciences, Indonesia*

IEEM18-P-0263
**Data Accessibility for Biotech and Medicine Industries: A Cross-stakeholder Perspective**
Zih-Han WANG[1], Wei JENG[2]
[1]*University of Washington, United States*
[2]*National Taiwan University, Taiwan*

IEEM18-P-0608
**'Strategy Making', Not Re-engineering: Thinking Ahead, Again, and Across for Process Innovation in Home Care**
Desmond WONG[1], Yee Lin HIEW[2]
[1]*University of Hull, United Kingdom*
[2]*National University of Singapore, Singapore*

IEEM18-P-0112
**A Bi-objective Credibility-based Fuzzy Mathematical Programming Model for a Healthcare Facility Location-network Design Problem**
Reza TAVAKKOLI-MOGHADDAM, Pooya POURREZA, Ali BOZORGI-AMIRI, Nastaran OLADZAD
*University of Tehran, Iran*

IEEM18-P-0037
**Implementing and Using New Information Technology in Hospital Logistics**
D. KRITCHANCHAI[1], Per ENGELSETH[2], Sirirat SRISAKUNWAN[1]
[1]*Mahidol University, Thailand*
[2]*Molde University College, Norway*

IEEM18-P-0432
**Design and Development of a Prototype for Measuring Range of Motion**
Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Thachamaporn CHANAROON[1], Thunjira PAIBOONRATTANAKORN[1], Teppakorn SITTIWANCHAI[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*

## Technology and Knowledge Management 3

18/12/2018 11:00 - 12:45
Room: Pompadour

Chairs: Chung-Huei KUAN, *National Taiwan University of Science and Technology*
Amnon GONEN, *Academic Ramat Gan*

Abstracts: see page 86

IEEM18-P-0410
**Network Structure and Positional Relationship of the External and Internal Technology Acquisition based on the Firm Self-citation Patent Network**
Chao-Chih HSUEH
*National Pingtung University of Science and Technology/ National Taiwan University, Taiwan*

IEEM18-P-0347
**Appropriate Technology and Management for Sustainability**
Jayshree PATNAIK, Bhaskar BHOWMICK
*Indian Institute of Technology Kharagpur, India*

IEEM18-P-0356
**Social Network Analysis in Lean Thinking: A Method for Improving Information Flow in Technical Integrity Management System Development**
Andika RACHMAN, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

IEEM18-P-0307
**Engineering Management Qualification: A Comparative Study for South African Universities**
Samuel MLANGENI, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

IEEM18-P-0137
**Measuring Product Success: A Literature Study**
Trifandi LASALEWO[1], Subagyo SUBAGYO[2], Hari Agung YUNIARTO[3], Budi HARTONO[2]
[1]*Universitas Negeri Gorontalo, Indonesia*
[2]*Gadjah Mada University, Indonesia*
[3]*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0337
**Determinant of Startups' Fund-raising Value: Entrepreneur and Firm Characteristic**
Pimolrat SATHAWORAWONG, Natcha THAWESAENGSKULTHAI, Kanis SAENGCHOTE
*Chulalongkorn University, Thailand*

IEEM18-P-0426
**Configuration Lifecycle Management – Future of Product Configurators**
Anna MYRODIA[1], Thomas RANDRUP[1], Lars HVAM[2]
[1]*Configit A/S, Denmark*
[2]*Technical University of Denmark, Denmark*

## Operations Research 3

18/12/2018 11:00 - 12:45
Room: Riverside III

Chairs: Philipp BAUMANN, *University of Bern*
Norbert TRAUTMANN, *University of Bern*

Abstracts: see page 87

IEEM18-P-0420
**Protecting a Sensitive Queue from Arrival Variability**
Mathieu VANDENBERGHE, Stijn DE VUYST, El-Houssaine AGHEZZAF, Herwig BRUNEEL
*Ghent University, Belgium*

IEEM18-P-0588
**Multi-criteria Mathematical Model for Partial Double Track Railway Scheduling in Urban Rail Network**
Erlangga BAYU SETYAWAN, Dida Diah DAMAYANTI, Anton Abdulbasah KAMIL
*Telkom University, Indonesia*

IEEM18-P-0614
**Vehicle Routing: Application of Travelling Salesman Problem in a Dairy Distributor**
Rafael PALHARES[1], Maria Creuza BORGES DE ARAUJO[2]
[1]*Universidade Federal do Rio Grande do Norte, Brazil*
[2]*Universidade Federal de Campina Grande, Brazil*

IEEM18-P-0078
**Enhanced Metaheuristic Algorithm for Multidimensional Optimization of Structural Engineering Problems**
Jui-Sheng CHOU[1], Ngoc-Tri NGO[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*The University of Danang - University of Science and Technology, Viet Nam*

IEEM18-P-0343
**A Matheuristic for a Real-world Variant of the Multiple Traveling Salesman Problem**
Philipp BAUMANN
*University of Bern, Switzerland*

IEEM18-P-0070
**Robust Periodic Vehicle Routing Problem with Service Time Uncertainty**
Mingyao QI, Wangqi XIONG, Qingte ZHOU, Shijia HUA
*Tsinghua University, China*

IEEM18-P-0084
**Picking Station Location in Traditional and Flying-V Aisle Warehouses for Robotic Mobile Fulfillment System**
Lijuan FENG, Xinglu LIU, Mingyao QI, Shijia HUA, Qingte ZHOU
*Tsinghua University, China*

## Big Data and Analytics 2

18/12/2018 11:00 - 12:45
Room: Riverside IV

Chairs: Ruth COBOS, *Universidad Autonoma de Madrid*
Harekrishna MISHRA, *Institute of Rural Management Anand*

Abstracts: see page 89

IEEM18-P-0453
**Evidences of Technological Advantage Gains: The Case of Mergers and Acquisitions in the Agrichemical Industry**
Chun-Chieh WANG, Mu-Hsuan HUANG, Yu-Wei CHANG
*National Taiwan University, Taiwan*

IEEM18-P-0573
**Do Long-term Patents Have a Higher Citation Impact?**
Huei-Ru DONG[1], Dar-Zen CHEN[2], Mu-Hsuan HUANG[2]
[1]*Fu Jen Catholic University, Taiwan*
[2]*National Taiwan University, Taiwan*

IEEM18-P-0221
**Categorization of Mergers and Acquisitions in Japan Using Corporate Databases: A Fundamental Research for Prediction**
Bohua SHAO, Kimitaka ASATANI, Ichiro SAKATA
*The University of Tokyo, Japan*

IEEM18-P-0249
**Distributed-based Hierarchical Clustering System for Large-scale Semiconductor Wafers**
Seungchul LEE, Daeyoung KIM
*BISTEL Inc., South Korea*

IEEM18-P-0582
**A Learning Analytics Tool for Predictive Modeling of Dropout and Certificate Acquisition on MOOCs for Professional Learning**
Ruth COBOS, Lara OLMOS
*Universidad Autonoma de Madrid, Spain*

IEEM18-P-0287
**Study on Unbalanced Binary Classification with Unknown Misclassification Costs**
Jun GAO, Lin GONG, JinYi WANG, ZhenChong MO
*Beijing Institute of Technology, China*

IEEM18-P-0519
**Data Analytics Framework for State Owned Enterprise of Bhutan**
Yadap SUBERI[1], Devi Bhakta SUBERI[2]
[1]*Druk Green Power Corporation, Bhutan*
[2]*Royal University of Bhutan, Bhutan*

## Project Management 3

18/12/2018 13:45 - 15:30
Room: Ballroom I

Chairs: Fan LI, *Tsinghua University*
Ripon CHAKRABORTTY, *University of New South Wales, Canberra*

Abstracts: see page 90

IEEM18-P-0290
**Development and Evaluation of a Workshop Concept to Support Tailoring of Complex Product Development Processes**
Christoph HOLLAUER, Julia RAST, Udo LINDEMANN
*Technical University of Munich, Germany*

IEEM18-P-0293
**Scrum Agile Project Management Methodology Application for Workflow Management: A Case Study**
Laura CARNEIRO, Ana Carolina SILVA, Luciana ALENCAR
*Universidade Federal de Pernambuco, Brazil*

IEEM18-P-0244
**The Mediating Effect of Knowledge Internalization on the Relationship Between Dual Learning Behaviors and Technological Innovation Performance in the High-tech Enterprises**
Fangmei WANGDU, Naiding YANG, Sayed Muhammad FAWAD SHARIF
*Northwestern Polytechnical University, China*

IEEM18-P-0286
**"I Want it That Way" and Other Aspects of the Application of Performance Reviews that Negatively Affect Project Outcomes**
H.J. Christian VAN DER KRIFT, Arjan J. VAN WEELE, Josette M.P. GEVERS
*Eindhoven University of Technology, Netherlands*

IEEM18-P-0610
**Visualised Decision Support in Industrial Project Monitoring and Control**
Fan LI[1], François VERNADAT[2], Ali SIADAT[3], Li ZHENG[1]
[1]*Tsinghua University, China*
[2]*University of Lorraine, France*
[3]*Arts et Métiers ParisTech, France*

IEEM18-P-0430
**Assessing the Agility of Teams within Mechatronic Product Development**
Lucia BECERRIL, Christoph HOLLAUER, Udo LINDEMANN
*Technical University of Munich, Germany*

IEEM18-P-0398
**The Role of Participation in the Factory Planning Process**
Uwe DOMBROWSKI, Alexander KARL, Christoph IMDAHL
*Technische Universität Braunschweig, Germany*

## Intelligent Systems 1

18/12/2018 13:45 - 15:30
Room: Ballroom II

Chairs: Gai-Ge WANG, *Ocean University of China*
Benedikt MOSER, *Institute for Industrial Management at RWTH Aachen University*

Abstracts: see page 92

IEEM18-P-0102
**Towards a Knowledge based Support for Risk Engineering When Elaborating Offer in Response to a Customer Demand**
Rania AYACHI[1], Delphine GUILLON[2], Francois MARMIER[3], Elise VAREILLES[2], Michel ALDANONDO[2], Thierry COUDERT[2], Laurent GENESTE[2], Yvan BEAUREGARD[4]
[1]*Toulouse University – IMT Mines Albi/ INP-ENIT , France*
[2]*Université de Toulouse, France*
[3]*Toulouse University – IMT Mines Albi, France*
[4]*École de Technologie Supérieure, Canada*

IEEM18-P-0336
**A Cooperative Multi-agent-based Musical Scoring System for Tsugaru and Nambu Shamisen**
Juichi KOSAKAYA[1], Reiko KAWAMORITA[1], Ming-Fang HSU[2]
[1]*Hachinohe Institute of Technology, Japan*
[2]*Central Taiwan University of Science and Technology, Taiwan*

IEEM18-P-0351
**Contact Coordinate Measurements of Free-form Surfaces: A FIS for Optimal Distribution of Measurement Points**
Marek MAGDZIAK[1], R.M. Chandima RATNAYAKE[2]
[1]*Rzeszów University of Technology, Poland*
[2]*University of Stavanger, Norway*

IEEM18-P-0135
**Particle-swarm Krill Herd Algorithm**
Gai-Ge WANG[1], Wenyin GONG[2], Xiaobo LIU[2], Danyu BAI[3], Teng REN[4], Xuesong YAN[2]
[1]*Ocean University of China, China*
[2]*China University of Geosciences, China*
[3]*Nanjing Forestry University, China*
[4]*Central South University of Forestry and Technology, China*

IEEM18-P-0431
**Industrial Smart Services: Types of Smart Service Business Models in the Digitalized Agriculture**
Achim KAMPKER, Philipp JUSSEN, Benedikt MOSER
*RWTH Aachen University, Germany*

IEEM18-P-0389
**Construction Resource Localization Based on UAV-RFID Platform Using Machine Learning Algorithm**
Daeyoun WON[1], Man-Woo PARK[2], Seokho CHI[1]
[1]*Seoul National University, South Korea*
[2]*Myongji University, South Korea*

IEEM18-P-0167
**Industry 4.0 in Practice – Identification of Industry 4.0 Success Patterns**
Jörg PUCHAN[1], Alexander ZEIFANG[1], Jun-Der LEU[2]
[1]*Munich University of Applied Sciences, Germany*
[2]*National Central University, Taiwan*

## E-Business and E-Commerce

18/12/2018 13:45 - 15:30
Room: Ballroom III

Chairs: Yue WANG, *Hang Seng Management College*
Stanislav CHANKOV, *Jacobs University Bremen*

Abstracts: see page 93

IEEM18-P-0318
**e-Commerce Logistics – Contemporary Literature**
Hamid JAFARI
*Jönköping University, Sweden*

IEEM18-P-0333
**An ERP-based Solution for the Supply Chain Planning of Medium-sized Global Manufacturing Company**
Jun-Der LEU[1], Andre KRISCHKE[2], Yi-Ping LEE[1], Larry Jung-Hsing LEE[1], Yi-Wei HUANG[1]
[1]*National Central University, Taiwan*
[2]*Munich University of Applied Sciences, Germany*

IEEM18-P-0429
**Integration of Small and Medium Enterprises for Industry 4.0 in the South African Water Services Sector: A Case Study for Johannesburg Water**
Pholo NTHUTANG, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

IEEM18-P-0205
**Observational Learning in the Product Configuration Process: An Empirical Study**
Yue WANG
*Hang Seng Management College, Hong Kong SAR*

IEEM18-P-0231
**Drone-delivery Using Autonomous Mobility: An Innovative Approach to Future Last-mile Delivery Problems**
HoJoon David YOO, Stanislav CHANKOV
*Jacobs University Bremen, Germany*

IEEM18-P-0145
**Robust Password-keeping System Using Block-chain Technology**
Daniel TSE, Kaicheng LIANG, Bin CAI, Kecong HUANG
*City University of Hong Kong, Hong Kong SAR*

## Technology and Knowledge Management 4

18/12/2018 13:45 - 15:30
Room: Pompadour

Chairs: Chung-Huei KUAN, *National Taiwan University of Science and Technology*
Helery TASANE, *Tallinn University of Technology*

Abstracts: see page 94

IEEM18-P-0165
**Multiple Helix Approach in Advancing Sustainable Urban Energy Ecosystems**
Nina TURA[1], Ville OJANEN[1], Tuomas PALOVIITA[2], Sini PIIPARINEN[2]
[1]*Lappeenranta University of Technology, Finland*
[2]*Fortum Oyj, Finland*

IEEM18-P-0441
**Time Estimation for Product Configuration Systems Projects**
Katrin KRISTJANSDOTTIR, Amartya GHOSH, Loris BATTISTELLO, Lars HVAM
*Technical University of Denmark, Denmark*

IEEM18-P-0475
**Changes of Technological Knowledge Diversification within a Group of Inventors and Patent Value Corresponding to Technology Lifecycle**
Ryo TAKEMURA, Noritomo OUCHI
*Aoyama Gakuin University, Japan*

IEEM18-P-0481
**Improving Modularization in Industry by Introducing a New Model for Module Classification**
Dag RAUDBERGET, Fredrik ELGH
*Jönköping University, Sweden*

IEEM18-P-0528
**Two-dimensional Technology Profiling of Patent Portfolio**
Chung-Huei KUAN[1], Wei-Ming TU[1], Dar-Zen CHEN[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*National Taiwan University, Taiwan*

IEEM18-P-0526
**Industry 4.0 Implementation Barriers in Small and Medium Sized Enterprises: A Focus Group Study**
Guido ORZES[1], Erwin RAUCH[1], Slavomir BEDNAR[2], Robert POKLEMBA[2]
[1]*Free University of Bozen-Bolzano, Italy*
[2]*Technical University of Kosice, Slovakia (Slovak Republic)*

IEEM18-P-0266
**Channel-based Phase and Power Controllable Intelligent Wireless Power Transfer Architecture Using 4 by 4 Planar Array Antennas**
Kwonhong LEE[1], Jinhyoung KIM[2], Jinwook SEO[2], Hyunyong YU[1], Cheolung CHA[2]
[1]*Korea University, South Korea*
[2]*Korea Electronics Technology Institute, South Korea*

## Decision Analysis and Methods 3

18/12/2018 13:45 - 15:30
Room: Riverside III

Chairs: Kaushik NAG, *American University of the Middle East*
Tatsushi NISHI, *Osaka University*

Abstracts: see page 95

IEEM18-P-0534
**Novel SKU Classification Approach for Autonomous Inventory Planning**
Fengyu WANG, Huey Yuen NG, Thai Ee NG
*Singapore Institute of Manufacturing Technology, Singapore*

IEEM18-P-0593
**Fundamental Design Types of Modular Product Platforms**
Sebastian BARG, Günther SCHUH, Christian DÖLLE
*RWTH Aachen University, Germany*

IEEM18-P-0581
**Optimal Overbooking Decision for Perishable Resources with Jointly Stochastic Booking and Show-up Requests**
Suppasit JONGCHEVEEVAT, Naragain PHUMCHUSRI, Amonsiri VILASDAECHANONT
*Chulalongkorn University, Thailand*

IEEM18-P-0396
**Multicriteria Inventory Classification of Diabetes Drugs Using a Comparison of AHP and Fuzzy AHP Models**
Kaushik NAG, Magdy HELAL
*American University of the Middle East, Kuwait*

IEEM18-P-0474
**Data-Based Identification Method for Jobshop Scheduling Problems Using Timed Petri Nets**
Tatsushi NISHI, Naoki SHIMAMURA
*Osaka University, Japan*

IEEM18-P-0294
**Development of a Methodology to Design Product Portfolios in Accordance to Corporate Goals Using an Evolutionary Algorithm**
Michael RIESENER, Christian DÖLLE, Lukas SCHMITT, Merle-Hendrikje JANK
*RWTH Aachen University, Germany*

IEEM18-P-0480
**Public Perception of the Nuclear Research Reactor in Thailand**
Sarasinee TANTITAECHOCHART[1], Naraphorn PAOPRASERT[1], Kampanart SILVA[2]
[1]*Kasetsart University, Thailand*
[2]*Thailand Institute of Nuclear Technology (Public Organization), Thailand*

## Service Innovation and Management 3

18/12/2018 13:45 - 15:30
Room: Riverside IV

Chairs: Markus HARTONO, *University of Surabaya*
Ali SIADAT, *Arts et Metiers ParisTech*

Abstracts: see page 97

IEEM18-P-0241
**Multinational Enterprises R&D in China, Government Subsidy Effect: An Empirical Research Based on Simultaneous Equations**
Jian WANG, Peng GUO, Qilei LIU
*Northwestern Polytechnical University, China*

IEEM18-P-0310
**Sustainability-oriented Innovation (SOI) in Emerging Economies: A Preliminary Investigation from Indonesia**
Budi HARSANTO, Roula MICHAELIDES, Helga DRUMMOND
*University of Liverpool, United Kingdom*

IEEM18-P-0225
**Business Logistics Optimization using Industry 4.0: Current Status and Opportunities**
Bag SURAJIT, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

IEEM18-P-0549
**Testing and Extending P-Transqual Public Transport Service Quality Model: A Causal Approach**
I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN
*Indonesian Institute of Sciences, Indonesia*

IEEM18-P-0564
**How Kano's Performance Mediates Perceived SERVQUAL Impact on Kansei**
Markus HARTONO
*University of Surabaya, Indonesia*

IEEM18-P-0382
**A Study Regarding the Gap Between the Industry and Academia Expectations for College Student's Employability**
Feng-Ming SUI[1], Jen-Chia CHANG[2], Hsi-Chi HSIAO[3], Su-Chang CHEN[4], Dyi-Cheng CHEN[5]
[1]*Hwa Hsia University of Technology, Taiwan*
[2]*National Taipei University of Technology, Taiwan*
[3]*Cheng Shiu University, Taiwan*
[4]*National Penghu University of Science and Technology, Taiwan*
[5]*National Changhua University of Education, Taiwan*

IEEM18-P-0200
**Visualize Organizational Perception of Core Value in the Company: An Experiment Employing Multi-dimensional Scaling and the Competing Value Framework**
Sanetake NAGAYOSHI[1], Jun NAKAMURA[2]
[1]*Shizuoka University, Japan*
[2]*Shibaura Institute of Technology, Japan*

**Supply Chain Management 6**

18/12/2018 16:30 - 18:00
Room: Ballroom I

Chairs: Gitae KIM, *Hanbat National University*
Aries SUSANTY, *Diponegoro University Indonesia*

Abstracts: see page 98

IEEM18-P-0538
**Sustainable Dynamic Pricing for Perishable Food with Stochastic Demand**
Ghada MOUSTAFA, Noha GALAL, Khaled EL-KILANY
*Arab Academy for Science, Technology & Maritime Transport, Egypt*

IEEM18-P-0427
**Who Has More Incentive to Make Sustainable Investment, Supplier or Manufacturer?**
Qian YUAN, Xiutian SHI
*Nanjing University of Science and Technology, China*

IEEM18-P-0541
**Supplier Selection Model Development for Modular Product with Substitutability and Controllable Lead Time**
Yosi Agustina HIDAYAT, Tota SIMATUPANG
*Bandung Institute of Technology (ITB), Indonesia*

IEEM18-P-0089
**Factors Affecting Sustainable Supply Chain Management: The Indian Steel Sector**
Dayal S. PRASAD, Rudra P. PRADHAN, Kunal GAURAV, Saurav DASH
*Indian Institute of Technology Kharagpur, India*

IEEM18-P-0265
**An Incentive-based Bi-level Optimization Model for Collaborative Green Product Line Design**
Shuang MA[1], Songlin CHEN[2], Xiaotian CAI[3]
[1]*Beijing Institute of Technology, China*
[2]*Nanyang Technological University, Singapore*
[3]*Chinese Academy of Science and Technology for Development, China*

**Intelligent Systems 2**

18/12/2018 16:30 - 18:00
Room: Ballroom II

Chairs: Gai-Ge WANG, *Ocean University of China*
Benedikt MOSER, *Institute for Industrial Management at RWTH Aachen University*

Abstracts: see page 99

IEEM18-P-0081
**Combining IOT and Android APP System for Upper Limb Stroke Rehabilitation**
Keng-Chieh YANG[1], Chia-Hui HUANG[2], Chieh-Yow CHIANGLIN[1]
[1]*National Kaohsiung University of Science and Technology, Taiwan*
[2]*National Taipei University of Business, Taiwan*

IEEM18-P-0478
**Traffic Voting System to Achieve the Balance Between Privacy and Trip Chain Data Acquisition**
Wentian CHEN, Kai ZHANG, Zhiheng LI
*Tsinghua University, China*

IEEM18-P-0577
**A Predictive Model for Forecasting Spare Parts Demand in Military Logistics**
Hanjun LEE[1], Jaedong KIM[2]
[1]*Hannam University, South Korea*
[2]*Korea Institute for Defense Analyses, South Korea*

IEEM18-P-0371
**Advanced Automation for SMEs in the I4.0 Revolution: Engineering Education and Employees Training in the Smart Mini Factory Laboratory**
Luca GUALTIERI, Rafael ROJAS, Giovanni CARABIN, Ilaria PALOMBA, Erwin RAUCH, Renato VIDONI, Dominik T. MATT
*Free University of Bozen-Bolzano, Italy*

IEEM18-P-0058
**A Real Time Stare in Market Strategy for Supply Chain Financing Pledge Risk Management**
Benhe GAO, Qian ZHOU, Shigang LI, Xinglu LIU
*Tsinghua University, China*

IEEM18-P-0548
**Involving the Manufacturing System within its Planning Phase**
Matthias BARTELT, Bernd KUHLENKÖTTER
*Ruhr-Universität Bochum, Germany*

## Operations Research 4

18/12/2018 16:30 - 18:00
Room: Ballroom III

Chairs: Reza Tavakkoli-MOGHADDAM, *University of Tehran*
Tatsushi NISHI, *Osaka University*

Abstracts: see page 100

IEEM18-P-0446
**Lease Contract with Availability Target and Price Discount**
Hennie HUSNIAH[1], Rachmawati WANGSAPUTRA[2], Bermawi P. ISKANDAR[2]
[1]*Langlangbuana University, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

IEEM18-P-0109
**Profit Maximization in Inventory Routing Problems**
Anna ZAITSEVA[1], Lars Magnus HVATTUM[1], Sebastián URRUTIA[2]
[1]*Molde University College, Norway*
[2]*Universidade Federal de Minas Gerais, Brazil*

IEEM18-P-0354
**Using Iterated Greedy with a New Population Approach for the Flexible Job-shop Scheduling Problem**
Ghiath AL AQEL[1], Xinyu LI[1], Liang GAO[1], Wenyin GONG[2], Rui WANG[3], Teng REN[4], Guohua WU[5]
[1]*Huazhong University of Science and Technology, China*
[2]*China University of Geosciences, China*
[3]*National University of Defense Technology, China*
[4]*Central South University of Forestry and Technology, China*
[5]*Central South University, China*

IEEM18-P-0469
**Research on Overall Improvement of Production Efficiency: A Case Study Based on Value Stream Mapping Analysis in Automobile Decoration Products Manufacturing Industry**
Huang LI[1], Chunming YE[1], Zhenbin ZHOU[2], Xinyu ZHOU[2], Xiaoxue FU[2], Lingling PENG[2]
[1]*University of Shanghai for Science and Technology, China*
[2]*University of Panzhihua, China*

IEEM18-P-0525
**Challenges of Digital Transformation: The Case of the Non-profit Sector**
Saeedeh SHAFIEE NAHRKHALAJI[1], Sara SHAFIEE[1], Mitra SHAFIEE NAHRKHALAJI[2], Lars HVAM[1]
[1]*Technical University of Denmark, Denmark*
[2]*Shahid Beheshti University, Iran*

## Technology and Knowledge Management 5

18/12/2018 16:30 - 18:00
Room: Pompadour

Chairs: Chung-Huei KUAN, *National Taiwan University of Science and Technology*
Michel ALDANONDO, *Toulouse University / IMT-Mines Albi*

Abstracts: see page 101

IEEM18-P-0620
**Content Analysis Approach: A Review on the Extent of Science and Engineering Curriculum Meet Competency Requirements for Testing, Inspection and Certification Industry**
Fanny TANG
*The Open University of Hong Kong, Hong Kong SAR*

IEEM18-P-0245
**A Conceptual Interaction Cycle Between Individual and Group Absorptive Capacity with Social Integration Mechanism and Cohesive Learning Group as Moderating Variables**
Andy Susilo LUKITO-BUDI[1], Nurul INDARTI[2]
[1]*Universitas Gadjah Mada/ Atma Jaya Catholic University of Indonesia, Indonesia*
[2]*Universitas Gadjah Mada, Indonesia*

IEEM18-P-0219
**The Complexity of Megaprojects in Developing Countries: A Literature Review**
Retno Wulan DAMAYANTI, Budi HARTONO, Andi Rahadiyan WIJAYA
*Gadjah Mada University, Indonesia*

IEEM18-P-0334
**A Novel Concept for Solid Debris Extraction Technique from Used Lubricants for Predictive Maintenance**
Sontinan INTASONTI[1], Tadpon KULLAWONG[1], Surapol RAADNUI[2]
[1]*Pathumthani University, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*

IEEM18-P-0603
**A Method and Rules to Design Supports for Ebm Parts**
Christelle GRANDVALLET[1], Julie MAISONNEUVE[2], Frédéric VIGNAT[1]
[1]*University of Grenoble Alps, France*
[2]*G-SCOP, France*

**Speed Talks 1**

18/12/2018 16:30 - 18:00
Room: Riverside III

Chairs: Seung Ki MOON, *Nanyang Technological University*

Abstracts: see page 102

IEEM18-P-1008
**An Analysis General Extended Cournot Duopoly Model with Mixture Strategic Concept**
Shih-Ting LIN, Tyrone T. LIN
*National Dong Hwa University, Taiwan*

IEEM18-P-1013
**Multi-criteria Evaluation Approach to Select a Suitable Market-based Instrument for Reducing CO2 Emissions in International Shipping**
Xin Ni LEE
*National University of Singapore, Singapore*

IEEM18-P-1033
**Development of Bio-briquette Production Equipment for Indonesia's Rural Communities**
Haryono SETIADI
*Sebelas Maret University, Indonesia*

IEEM18-P-1006
**Multi-material Finite Element Analysis of 3D Printed PLA**
Enea SACCO
*Nanyang Technological University, Singapore*

IEEM18-P-1027
**Lean Manufacturing Implementation in Management of Residues from Automotive Industry**
Mercedes Estefanía MERCEDES ESTEFANÍA
*Universidad San Francisco de Quito, Ecuador*

IEEM18-P-1047
**A Guideline for Digitalizing Visual Management as Lean Toolbox Innovation**
Koichi MURATA
*Nihon University, Japan*

IEEM18-P-1052
**Air Conditioning Load Prediction Using Recurrent Neural Network**
Sungzoon CHO
*Seoul National University, South Korea*

IEEM18-P-1025
**Faults Diagnosis Under Time-varying Speed Conditions with Combination of Order Tracking and Extreme Learning Machines**
Zhixin YANG
*University of Macau, Macau*

IEEM18-P-1040
**An Optimization Model for Multiple Objective Supply Chain Master Planning**
Supachart IAMRATANAKUL
*Kasetsart University, United States*

**Speed Talks 2**

18/12/2018 16:30 - 18:00
Room: Riverside IV

Chairs: Carman Ka Man LEE, *The Hong Kong Polytechnic University*

Abstracts: see page 103

IEEM18-P-1012
**How Older Drivers Experience Visual Difficulties in a Real-driving Situation?**
Sang Yoon UM
*Yonsei University, South Korea*

IEEM18-P-1022
**Evaluating Novelty of Patent with Graph Based Semi-supervised Learning**
Dooseob YUN
*Dongguk University, South Korea*

IEEM18-P-1024
**Lean, Six Sigma and ToC Application in a Dairy Industry**
Ana Maria FLORIDO, Miriam GAVILANEZ
*Universidad San Francisco de Quito, Ecuador*

IEEM18-P-1021
**Maintenance Scheduling Optimization in Continuous Processing Plants: A Case Study in Particleboard Production Plant**
Asgele Gebrekidan KAHSAY
*Waseda University, Japan*

IEEM18-P-1004
**A Lower Bound Heuristic for the LNG Bunkering Facility Location in Inland Waterways**
Evrim URSAVAS
*University of Groningen, Netherlands*

IEEM18-P-1001
**Costly Information Acquisition Under Horizontal Competition**
Qi FU
*University of Macau, Macau*

IEEM18-P-1032
**The Identification of Features Influencing the Human's Perception of Similar Drugs**
Minji PARK, Jinhyung KIM, Choeun KIM, Taezoon PARK
*Soongsil University, South Korea*

IEEM18-P-1054
**A New Model in Waste Management City Logistics**
Shahrooz SHAHPARVARI
*RMIT University, Australia*

IEEM18-P-1035
**Residential Load Prediction Based on Load Data of Other Residential Communities**
Junya MATSUNAGA
*Waseda University, Japan*

**Posters**

18/12/2018 16:00 - 18:00
Room: Riverside

p.105 IEEM18-P-0020
**Managing Outsourced Logistics Service Projects as Complex Networked Resources**
Fahad AWALEH[1], Per ENGELSETH[2]
[1]*University College of Southeast Norway, Norway*
[2]*Molde University College, Norway*

p.105 IEEM18-P-0094
**Location Analysis of Regional Disaster Relief Material Reserve Center: A Case Study in Sichuan Province, China**
Xuedong LIANG, Ruyun ZHANG, Canmian LIU
*Sichuan University, China*

p.105 IEEM18-P-0099
**Hospital Capacity Planning for Special Economic Zone in Thailand: A Case Study in Kanchanaburi Province**
Sao Theary AN, D. KRITCHANCHAI
*Mahidol University, Thailand*

p.105 IEEM18-P-0188
**Optimizing (r, Q) Decisions Considering Misplaced Items: Lost-sales and Backorder Cases**
Linda L. ZHANG[1], G. Yazgi TUTUNCU[2], Ceki FRANKO[2]
[1]*IESEG School of Management, France*
[2]*Izmir University of Economics, Turkey*

p.106 IEEM18-P-0026
**Analysis of Stackelberg Leadership Model Output Behavior under the Mechanism of Expanding Market Price**
Tyrone T. LIN[1], Shu Yen HSU[1], Chiao Chen CHANG[2]
[1]*National Dong Hwa University, Taiwan*
[2]*Taipei Medical University, Taiwan*

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Hui-Tzu YEN, Tyrone T. LIN
*National Dong Hwa University, Taiwan*

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Xuedong LIANG, Yangjingjing ZHANG, Yue LU, Canmian LIU
*Sichuan University, China*

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*The University of Tokyo, Japan*

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**Using Time-dependent Attractiveness to Evaluate Dynamic Place-based Accessibility**
William H. K. LAM, Bi Yu CHEN, Agachai SUMALEE
*The Hong Kong Polytechnic University, Hong Kong SAR*

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Shin-Guang CHEN
*Tungnan University/ Kaohsiung Medical University, Taiwan*

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YIfan HE, Pingping WEN, Yongquan LAN, Zhaowei MIAO
*Xiamen University, China*

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Zhonghao WANG[1], ZhengGuo XU[2]
[1]*Zhejiang University and City University of Hong Kong, Hong Kong SAR*
[2]*Zhejiang University, China*

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Roger J. JIAO, James Y. TSUI
*Georgia Institute of Technology, United States*

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Tianyi LU[1], Jun DU[2], Roger J. JIAO[1]
[1]*Georgia Institute of Technology, United States*
[2]*Tianjin University, China*

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Jaedong KIM
*Korea Institute for Defense Analyses, South Korea*

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Magda BOGALECKA, Krzysztof KOŁOWROCKI
*Gdynia Maritime University, Poland*

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Delin HUANG, Shichang DU, Guilong LI, Tangbin XIA
*Shanghai Jiao Tong University, China*

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Kim Phuc TRAN[1], Huu Du NGUYEN[2], Quoc Thong NGUYEN[2], Wichai CHATTINNAWAT[3]
[1]*GEMTEX Laboratory, France*
[2]*Dong A University, Viet Nam*
[3]*Chiang Mai University, Thailand*

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Suyi LI
*Beijing Institute of Technology, China*

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Yuliang ZHOU, Shenghan ZHOU, YiYong XIAO, Wenbing CHANG
*Beihang University, China*

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Weikang XUE, Weiwei CUI, Xiao HU, Xiaodong MA, Yao WANG
*China Academy of Launch Vehicle Technology, China*

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Yingxiang ZHONG[1], Fan HONG-LI[1], Jiping LU[1], Lu PANG[1], Yuanfang LI[2]
[1]*Beijing Institute of Technology, China*
[2]*China Academy of Launch Vehicle Technology, China*

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Hansi CHEN, Lei ZHANG, Xuening CHU
*Shanghai Jiao Tong University, China*

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**An Approach to Multidimensional Medical Data Analysis Based on the Skyline Operator**
Min CHE, Liya WANG, Zhibin JIANG
*Shanghai Jiao Tong University, China*

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**Asynchronous Multi-sensor Data Fusion with Decentralized IMM-PDAF**
Woo Jung PARK, Chang Ho KANG, Sun Young KIM, Chan Gook PARK
*Seoul National University, South Korea*

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**Support Reuse and Maintenance of Design Information in a Development Process of Custom Engineered Product**
Morteza POORKIANY, Joel JOHANSSON, Fredrik ELGH
*Jönköping University, Sweden*

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**Comparison of Clustering Methods for Obesity Classification**
Sung Hee AHN, Cai WANG, Gee Won SHIN, Donggun PARK, Yohan KANG, Jaramier JOIBI, Myung Hwan YUN
*Seoul National University, South Korea*

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**Building Material Price Forecasting Based on Multi-method in China**
Qiankun WANG [1], Tingting MEI[1], Zeng GUO[1], Lingwei KONG[2]
[1]*Wuhan University of Technology, China*
[2]*Hubei Province Engineering Consulting Co. Ltd., China*

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Loris BATTISTELLO, Katrin KRISTJANSDOTTIR, Lars HVAM
*Technical University of Denmark, Denmark*

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Uwe DOMBROWSKI, Alexander KARL, Alexander REISWICH
*Technische Universität Braunschweig, Germany*

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Cheuk Hang AU[1], Wai Ki YIU[2], Walter S. L. FUNG[2]
[1]*The University of Sydney, Australia*
[2]*The Hong Kong Polytechnic University, Hong Kong SAR*

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Peng YANG, Wenjun XU, Shilu WANG
*Tsinghua University, China*

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Sungjun JIN[1], Hyoungtae KIM[2], Tae Hyun KIM[2], Hansol SHIN[2], Kyuhyeong KWAG[2], Wook KIM[2]
[1]*Korea Land & Housing Corporation, South Korea*
[2]*Pusan National University, South Korea*

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Jakob ROTT[1], Julian WEIXLER[1], Alexander RABL[2], Peter SANDL[2], Mario WEIß[1], Birgit VOGEL-HEUSER[1]
[1]*Technical University of Munich, Germany*
[2]*Airbus Defence & Space, Germany*

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Weidong LIN, Y.H. LOW, Y.T. CHONG, C.L. TEO
*Singapore Institute of Technology, Singapore*

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**Multi-objective Design Space Exploration for the Integration of Advanced Analytics in Cyber-physical Production Systems**
Romuald Jupiter BAKAKEU NGASSAM[1], Jonathan FUCHS[1], Tallal JAVIED[1], Matthias BROSSOG[1], Jorg FRANKE[1], Hans-Henning KLOS[2], Werner EBERLEIN[2], Schirin TOLKSDORF[2], Joern PESHKE[2], Lars JAHN[2]
[1]*Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Germany*
[2]*Siemens AG, Germany*

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**Building Energy Conservation Strategies Evaluation and Simulation**
B-I WANG, Chien Ming LO, Min-Der LIN
*National Chung Hsing University, Taiwan*

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**Analysis and Optimization of Bottlenecks via Simulation**
Ji'ao YUAN, Runtong ZHANG
*Beijing Jiaotong University, China*

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**Community Detection and Growth Potential Prediction Using the Stochastic Block Model and the Long Short-term Memory from Patent Citation Networks**
Kensei NAKAI[1], Hirofumi NONAKA[1], Asahi HENTONA[1], Yuki KANAI[1], Takeshi SAKUMOTO[1], Shotaro KATAOKA[1], Elisa Claire ALEMÁN CARREÓN[1], Toru HIRAOKA[2]
[1]*Nagaoka University of Technology, Japan*
[2]*University of Nagasaki, Japan*

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**An Integrated Scheduling Strategy in Dynamic Scheduling of Manufacturing Execution System**
Hui DU[1], Dacheng LIU[1], Chuanshen WANG[2]
[1]*Tsinghua University, China*
[2]*Zaozhuang University, China*

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**Simple and Cost Effective System for Overall Equipment Efficiency Measurement**
Timo RAUTIO, Kari KUTUNIVA, Jarmo MÄKIKANGAS, Kari MÄNTYJÄRVI
*University of Oulu, Finland*

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**Solving Profit Maximization Problem in Case of the Cobb-Douglas Production Function via Weighted AG Inequality and Geometric Programming**
Vedran KOJIĆ, Zrinka LUKAČ
*University of Zagreb, Croatia (local name: Hrvatska)*

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**Agile Project Management: Successful Solutions**
ALBERTO POLZONETTI[1], Matteo SAGRATELLA[2]
[1]*ELIOS, Italy*
[2]*elios, Italy*

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**Collaborative Innovation Using Bi-processes Cross-functional Team on New Product Development**
Yueen LI[1], Jiacheng ZHANG[1], Haiyan ZHANG[2]
[1]*Shandong Jianzhu University, China*
[2]*Purdue University, United States*

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**Systematic Selection, Adaptation and Integration of Quality Management Methods Into Quality Management Reporting**
Cosima Nadine FITZ, Guanwei HUANG
*Tongji University, China*

p.114 IEEM18-P-0439
**Optimizing Production and Inventory Decisions for Mixed Make-to-order/Make-to-stock Ready-made Garment Industry**
Aya Elmehanny[1], Tamer Abdelmaguid[1], Amr Eltawil[2]
[1]*American University in Cairo, New Cairo, Egypt*
[2]*Egypt-Japan University of Science and Technology (E-JUST), Egypt*

**Posters (Late Breaking Abstracts)**

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**Industry 4.0 Support for Lean Production in the Semi-process Industry**
Philipp SPENHOFF
*Norwegian University of Science and Technology, Norway*

p.114 IEEM18-P-1020
**Printing Process Modeling and Uncertainty Quantification in Aerosol Jet Printing**
Haining ZHANG
*Nanyang Technological University, Singapore*

p.114 IEEM18-P-1023
**Application of Promethee I in Projects' Selection for Public Constructions in a Small Municipality in Northeast Brazil**
Camila FAMA
*Universidade Federal de Pernambuco, Brazil*

p.115 IEEM18-P-1031
**Is R&D Engineers' Overseas Experience Really Good for Their Creative Behaviors/attitude?**
Hideki SHIMIZU-TANAKA
*Kyoto Gakuen University, Japan*

p.115 IEEM18-P-1037
**Prediction of PV Output Transition Based on Stochastic Evaluation**
Naohiro KOURA
*Waseda University, Japan*

p.115 IEEM18-P-1039
**Why Do Consumers Will Apply Block Chain Technology in Internet Shopping?**
Hsin-Yuan CHANG
*Takming University of Science and Technology, Taiwan*

p.115 IEEM18-P-1048
**A Human Factor Analysis for Developed Foot Rowing Type Wheelchair - Questionnaire Analysis with Elderly People -**
Naohisa HASHIMOTO[1], Yusuke TAKINAMI[1], Hiroto KAKUTA[2]
[1]*National Institute of Advanced Industrial Science and Technology, Japan*
[2]*Aguri Kogyo Corporation, Japan*

p.115 IEEM18-P-1053
**Collaborative Network Design for Irregular Parcels in Courier Services**
Chang Seong KO
*Kyungsung University, South Korea*

p.115 IEEM18-P-1003
**Recall Data Analysis for Quality Risk Management**
Changmuk KANG
*Soongsil University, South Korea*

p.115 IEEM18-P-1009
**Speed Reduction and Optimization for International Shipping to Reduce Greenhouse Gas Emission**
Jinjing HUANG
*National University of Singapore, Singapore*

p.116 IEEM18-P-1010
**Solving the Component Sequencing and Feeder Assignment Problems for a Chip Shooter Machine with an Improved Shuffled Frog-leaping Algorithm**
Hsien-Pin HSU
*National Kaohsiung University of Science and Technology, Taiwan*

p.116 IEEM18-P-1011
**Hotelling Queue Competition Models with Probabilistic Service**
Zhaotong LIAN
*University of Macau, Macau*

## Abstracts

| | |
|---|---|
| **Session** | Supply Chain Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom I |
| **Chairs** | Murat KUCUKVAR, *Qatar University*,<br>Aries SUSANTY, *Diponegoro University* |

IEEM18-P-0024

**Dedicated Agility: A New Approach for Designing Production Networks**

Günther SCHUH, Jan-Philipp PROTE, Bastian FRÄNKEN, Julian AYS, Sven CREMER
*RWTH Aachen University, Germany*

Production networks face new challenges in today's volatile world. Rapidly changing internal and external conditions require a new type of production network design that enables quick adjustments after implementation. It is necessary to design the adaptability of the network explicitly. To meet these challenges an agile production network is needed. Thus, this paper proposes a systematic approach to design the necessary degree of agility in production networks. The idea of the presented approach is to determine a dedicated agility level for a network between flexibility in adaption and corresponding costs, based on specific volatilities.

IEEM18-P-0077

**Contractual Barriers and Energy Efficiency in the Crude Oil Supply Chain**

Roar ADLAND, Haiying JIA
*Norwegian School of Economics, Norway*

We show how the concept of demurrage - a core principle of commercial shipping contracts - is at odds with efficient and environmentally friendly vessel operation and represents barriers to improving energy efficiency in maritime transportation. Because demurrage rates are higher than freight earnings in poor markets, shipowners order their ships to "rush-to-wait", resulting in higher fuel consumption and ship-to-air emissions. We propose a new speed optimization model where demurrage is properly accounted for and show that the observed behaviour is rational for a profit-maximizing shipowner. Using a numerical example for Aframax crude oil tankers, we illustrate the economic effects of demurrage on vessel earnings and optimal speed.

IEEM18-P-0023

**Carbon Footprints of Construction Industries: A Global, Supply Chain-linked Analysis**

Parinaz TOUFANI[1], Murat KUCUKVAR[2], Nuri Cihat ONAT[2]
[1]*Bilkent University, Turkey*
[2]*Qatar University, Qatar*

The global construction industry is predicted to grow rapidly over the next decades by developing globalization, urbanization, and infrastructure renewal. Global Construction 2020 forecasts that China, USA, India, Japan, and Canada will have the most contribution to construction development. Sustainability analyses (analysis of environmental, economic, and social) of construction sectors are highlighted by increasing trend in this industry. In this study, we analyze environmental impact, particularly carbon footprints, of five leading construction markets using a global carbon footprint accounting tool based on the World Input-Output Database (WIOD). To this end, we examine direct and indirect carbon emissions within sector itself and at national and global scales employing scope-based carbon footprint, production-consumption based, and global impact distribution analyses. According to these analyses, we identified the notable hotspots where carbon reduction is required. This way, governments are able to manage and reduce carbon footprints on parts, which are increasingly important in the construction sector.

IEEM18-P-0306

**An Approach for Rolling Planning of Migration in Production Networks**

Günther SCHUH, Jan-Philipp PROTE, Marco MOLITOR, Sven CREMER
*RWTH Aachen University, Germany*

The planning of production networks and their migration is a complex planning task that faces highly complex interdependencies within a dynamic global setting. Today's migration planning approaches are either large projects or isolated local investments. As such they are not suited to cope with the interdependencies and the continuity at the same time. The proposed approach introduces a conceptual methodology that incorporates description and evaluation modelling approaches into an overall systematic process for rolling migration planning, thus allowing for integrated consideration of interdependencies in continuous planning of production network migration.

IEEM18-P-0460

**Lead Time Quotation Under MTO and MTS Delivery Modes with Endogenous Demand**

Erfan ASGARI[1], Yannick FREIN[1], Ramzi HAMMAMI[2]
[1]*Université Grenoble Alpes, France*
[2]*Rennes School of Business, France*

We consider the case of a company that sells two substitutable varieties of the same product in a lead time-sensitive market. The regular product is manufactured and delivered with a make-to-order (MTO) system. The express product is delivered with a make-to-stock (MTS) system. The products (express and regular) are substitutable, so the demand of each product depends not only on his lead time but also on the lead time of the other product. We focus on the lead time decision of the MTO system (the other parameters are assumed to be known). We determine analytically the optimal solution and derive some insights.

IEEM18-P-0030

**Modelling the Causal Relationship Among Variables that Influencing the Capability of Dairy Supply Chain in Indonesia**

Aries SUSANTY, N. B. PUSPITASARI, A. BAKHTIAR, N. SUSANTO, D. KURNIA
*University of Diponegoro, Indonesia*

The primary object of this research is to explain and demonstrate the complex structure that links each variable within the dairy milk supply chain in Indonesia through the causal loop diagram (CLD). Referring to the structure of the National Model developed by Forrester (1989), there were six CLDs which belong to six sub-systems used to describe the relationship between variables in the dairy supply chain. The first CLD belong to population and consumption sub-system. The second until sixth CLD belong to milk production sub-system, dairy cattle sub-system, dairy cattle population sub-system, dairy farmer's income sub-system, and government sub-system. According to CLD, there are minimal one important drivers in each sub-system. The findings in this paper put forward some important issues that require for running the full simulation of some proposed scenarios.

IEEM18-P-0360

**Building Last Mile Delivery Scenarios: A Case Study of Melbourne**

Kolawole EWEDAIRO, Prem CHHETRI, Jago DODSON, Shams RAHMAN
*RMIT University, Australia*

This paper aims to build plausible scenarios to formulate the future of last mile delivery using planning and transport infrastructure attributes as key drivers of last mile bottlenecks. The scenario thinking method is applied to understand and analyse apparent perverse last mile challenges with 'critical uncertainties' associated with projection of future patterns. Key stakeholders associated with last mile delivery in an urban setting were identified and their positioning assessed on power and interest. The state and local government with HighPower:LowInterest (HP:LI), and truck associations/drivers LowPower:HighInterest (LP:HI) were identified as key stakeholders with different levels of power and interest. Players such as VicRoads and Traders Associations represent the quadrant of HP:HI who could play a vital role to gain support for more infrastructure investment and technological innovation to help improve the efficiency of city logistics operations. Four plausible urban scenarios were identified using two extracted dimensions: Infrastructure Supply and Intensive Land use. The worst/worst scenario highlighted the area of need for strategic planning to mitigate risk associated with damaged products, congestion, last mile delivery stagnation and ageing infrastructure.

| | |
|---|---|
| **Session** | Safety, Security and Risk Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom II |
| **Chairs** | Ali SIADAT, *Arts et Metiers ParisTech*,<br>Shu Lun MAK, *The Open University of Hong Kong* |

IEEM18-P-0243

**Safety Outcomes in Small-Size and Medium-Size Metal Enterprises in Indonesia: Are They Different?**

Nachnul ANSORI[1], Ari WIDYANTI[2], Iftikar SUTALAKSANA[2]
[1]*Bandung Institute of Technology/ University of Trunojoyo Madura, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

Safety outcomes, the performance that often used to show the workplace safety, can be measured not only by a work accident but also based on day-off and injury. This study aims to analyze safety outcomes in SMEs. A total of 67 workers in 18 SMEs: 38 workers from 15 small-scale enterprises (SEs) and 29 workers from 3 medium-scale enterprises (MEs) of metal manufacturing are involved in this study. The data were collected through self-report of safety outcomes as experienced by workers during their last 12 months of work. The results show that the safety outcomes in SEs are worse than in MEs. In addition, workers who have long work experience and family relationships with the owner shows worse safety outcomes in SEs, as compared to safety outcomes in MEs. Furthermore, it is found that in both SEs and MEs, the common cause of low safety outcomes is the contacts between the workers' body parts and metal materials.

IEEM18-P-0436

**Process Safety and Performance Improvement in Oil Refineries Through Active Redundancy and Risk Assessment Method - A Case Study**

Loganathan MADAMPATTY KRISHNASWAMY[1], Subhas Sarma NEOG[1], Sunil RAI[2]
[1]*Kaziranga University, India*
[2]*MIT ADT University, India*

Safety and performance improvement of oil refineries are of paramount importance as far as plant throughput is concerned. The refineries do have several critical units, one such unit is Hydrocracker Unit (HCU), which is used in petroleum refineries to produce mainly diesel and other middle distillates. Maintenance of specified temperature of these products is a real challenge as far as the safety is concerned. During high throughput, the cooler used for cooling the outgoing products like diesel becomes ineffective, which results in increased diesel temperature, leading to unsafe condition and reduced performance. The critical parts of the cooler will further worsen the situation. The case study presents the excerpts of process safety and performance improvement of a HCU cooling system by installing an additional cooler as an active redundancy to reduce the diesel outlet temperature. An effective risk assessment method, FMEA (Failure Mode and Effects Analysis) has been carried out to identify the critical units of the cooler unit.

IEEM18-P-0376

**Risk Assessment Among Thai and Foreign Workers in Construction Companies**

Kosinchai PAWTHAISONG[1], Manutchanok JONGPRASITHPORN[2], Chaiporn VONGPISAL[1], Nantakrit YODPIJIT[3]
[1]*King Mongkut's University of Technology North Bangkok, Thailand*
[2]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[3]*King Mongkut's University of Technology North Bangkok, Thailand*

Construction is one of the most hazardous industries compared to others. Although, system safety has been adopted, accidents continually occur with Thai and foreign workers. Particularly, the number accidents of foreign workers that trend increased due to language differences. The purpose of this research is to assess risks among Thai and foreign workers in construction companies using the Risk Assessment Model (RAM) to assess risk levels of each careers and accident types that happen to Thai and Foreign workers. The results from this study showed a different risk level between Thai and foreign workers of each careers, including types of construction accidents. In conclusion, this was found to be beneficial for predicting high-risk construction activities and preventing accidents that further happen.

IEEM18-P-0185

**Fuzzy Risk Prioritization of the Failure Modes in Rolling Stocks**

Behzad GHODRATI[1], Mohammad Javad RAHIMDEL[2], Amir TAGHIZADEH VAHED[1]
[1]*Lulea University of Technology, Sweden*
[2]*Sahand University of Technology, Iran*

Failure Mode and Effects Analysis (FMEA) is extensively used to identify and eliminate the potential failures in products, processes, designs, and services. In this approach, the detectability, occurrence and the severity of each identified failure mode need to be determined usually by a FMEA team. This paper aims to prioritize the failure modes of rolling stocks by integrating Analytical Hierarchy Process (AHP) and Risk Priority Number (RPN). To reduce the uncertainties and ambiguities, all calculations are done in the fuzzy environment instead of the crisp values. The importance degree of each failure mode is determined and then the overall fuzzy RPN is calculated. In this way, the critical failure modes are defined to make an efficient maintenance decision.

IEEM18-P-0451

**Performance Evaluation with a Z-number Data Envelopment Analysis: A Case Study of a Petrochemical Plant**

Shohre SADEGHSA[1], Ali SIADAT[1], Reza TAVAKKOLI-MOGHADDAM[2], Maliheh VAEZ-ALAEI[2]
[1]*Arts et Métiers ParisTech, France*
[2]*University of Tehran, Iran*

Petrochemical plants face several incidents and accidents throughout their cycle time. Integrated resilience engineering (IRE) can be used to control and reduce such incidents and accidents. In a petrochemical plant, it includes flexibility, self-organization, teamwork and fault-tolerant in addition to conventional RE indicators. This study proposes a Z-number data envelopment analysis (ZDEA) method for the performance evaluation of IRE. It deals with a deep uncertainty of the collected data to obtain better results. Data are collected through a standard questionnaire in a real petrochemical plant in Iran. The obtained results are verified and validated against a fuzzy data envelopment analysis (FDEA) method through 50 independent experiments. Perturbation and noise analysis are used to show the superiority and applicability of the proposed method. The results show the most important indicators through the sensitivity analysis are teamwork, management commitment and learning culture.

IEEM18-P-0533

**A Critical Review of Current Safety Assessment Method of Chemical Safety in Toys**

Shu Lun MAK, Winnie CHIU, H. K. LAU
*The Open University of Hong Kong, Hong Kong SAR*

Chemical safety of toys was not the main concerns of customers because they think that toys in the market are safe. However, recall cases pointed out that there may be some problems in the current chemical safety assessment method in toys. This paper explained the problem with some toy safety recall examples and discussed the current mandatory safety regulations and standards. The safety assessment methodologies were evaluated and their limitations were discussed. Finally a proposed chemical safety evaluation approach was suggested.

IEEM18-P-0264

**Safety Barriers Against Common Cause Failure and Cascading Failure: Literature Reviews and Modeling Strategies**

Lin XIE, Mary Ann LUNDTEIGEN, Yiliu LIU
*Norwegian University of Science and Technology, Norway*

Safety barriers are required in many technical systems to reduce initiating negations, suppress failure propagations, or mitigate the consequences of common cause failures and cascading failures. Based on a thorough literature review, this paper explores the functions of safety barriers within an extended bow-tie model. The safety barriers to prevent common cause failures are important to eliminate the coupling effects on multiple components simultaneously, whereas the safety barriers against cascading failures are functional with stopping or alleviating the failure propagation by intervening coupling paths. Then, an illustrative example is introduced to demonstrate the how such two types of safety barriers are modeled and how their effects are evaluated.

| | |
|---|---|
| **Session** | Reliability and Maintenance Engineering 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom III |
| **Chairs** | David VALIS, *University of Defence in Brno*, Abdelhakim KHATAB, *Lorraine University* |

IEEM18-P-0051

**Reliability Analysis for MOSFET Based on Wiener Process**

Huiling ZHENG, Houbao XU
*Beijing Institute of Technology, China*

In this paper, we study a kind of accelerated degradation model, and put forward a statistic to test the homogeneous of the variance based on Wiener process. Firstly, Wiener process is applied to model the degradation process of the deteriorating system, and the analytical expressions of probability density function and reliability function for such system are derived. The MLE (Maximum Likelihood Estimation) algorithm is also presented to estimate the model parameters. Then, by means of homogeneity test of variance, we can judge whether the failure mechanism of the products is changed or not, which is the basis for the extrapolation of the characteristic quantity. A simulation study is given to illustrate the effectiveness of the proposed method. Finally, we use this method to analyze the degradation data of the MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) and get its reliability under normal working condition.

IEEM18-P-0088

**Lease-oriented Opportunistic Maintenance for Series-parallel Systems by Integrating Capacity Balancing**

Bowen SUN, Tangbin XIA, Ya SONG, Wenyu GUO, Lifeng XI
*Shanghai Jiao Tong University, China*

In the modern industry, there has been a trend that manufacturing machines are leased with maintenance service from the lessors, rather than be purchased. Combining the structure of series-parallel systems, this paper proposes an improved lease-oriented opportunistic maintenance policy to achieve the leasing profit maximization in the view of capacity balancing. Preventive maintenance (PM) opportunity is triggered when related machines are scheduled to be performed PM actions. The improved leasing profit optimization (LPO) policy is used to calculate the leasing profit saving by considering the capacity balancing of the whole system to make real-time PM decisions. Further case study demonstrated the economic effectiveness of this novel policy.

IEEM18-P-0131

**Improved Lease-oriented Opportunistic Maintenance for Two-machine One-buffer System under Product-service Paradigm**

Wenyu GUO, Tangbin XIA, Guojin SI, Bowen SUN, Ershun PAN
*Shanghai Jiao Tong University, China*

With the development of the product-service paradigm, a manufacturing system consists of degradation machines and buffers between them begins to be leased in the practical industry. The leasing profit opportunity (LPO) policy is thus extended to optimize preventive maintenance (PM) actions for this type of two-machine one-buffer system. During the LPO procedure, each machine's PM time point is dynamically scheduled by minimizing the cost rate. Moreover, one machine's PM can create a maintenance opportunity for the other because of the relationship of the series structure. Taking the buffer level and different kinds of maintenance cost into consideration, the improved LPO policy evaluates the leasing profit savings to decide whether to take the PM opportunity and execute an Early PM for the other machine. The effectiveness of this improved LPO policy is validated through a case study and the comparison with two traditional policies has been provided.

IEEM18-P-0215

**Condition-based Selective Maintenance for Multicomponent Systems Under Environmental and Energy Considerations**

Abdelhakim KHATAB[1], El-Houssaine AGHEZZAF[2], Claver DIALLO[3], Uday VENKATADRI[3]
[1]*Universit´e de Lorraine, France*
[2]*Ghent University, Belgium*
[3]*Dalhousie University, Canada*

This work develops a new variant of selective maintenance (SM) optimization model for multicomponent systems running multiple alternating sequences of missions and breaks. A component deteriorates randomly and fails when the corresponding failure threshold is exceeded. Components' failures impact the quality of the environment and increase the energy consumption. Thus, failures induce penalty costs. Improving the system reliability during the following mission is achieved by performing maintenance activities on its elements during the breaks. A condition-based SM optimization problem (CBSMP) is developed to minimize the total expected cost subject to the limited break durations and required reliability for the next mission. A model's solution determines an optimal SM plan which minimize the total expected cost resulting from inspection, maintenance, and costs due to impact of components' failures on the environment and energy requirements. The proposed approach is tested on a numerical example.

IEEM18-P-0044

**Mining System Degradation Assessment Based on Mathematical Analysis**

David VALIS[1], Jakub GAJEWSKI[2], Kamila HASILOVA[1], Marie FORBELSKA[3]
[1]*University of Defence, Czech Republic*
[2]*Lublin University of Technology, Poland*
[3]*Mendel University in Brno, Czech Republic*

System technical condition is a very important information source. When in operation, it is not always possible to find out about the system condition directly. However, indirect diagnostic values and operation measures can help to estimate technical condition. In our article we focus on applying measured operation characteristics. We are going to use the information from the operation of a mine digging machine. Changes in these characteristics indicate that drilling head cutting edges deteriorate making them dependent. When modelling the cutting edges deterioration, we use the advanced methods of time series modelling and diffusion processes, namely a novel approach to Kalman filter and Wiener process with drift used for technical diagnostic data. The aim is to estimate i) trend in head cutting edges degradation, ii) critical value first hitting time, iii) first hitting time distribution.

IEEM18-P-0043

**System Condition Assessment Based on Mathematical Analysis**

David VALIS[1], Libor ZAK[2], Zdenek VINTR[1]
[1]*University of Defence, Czech Republic*
[2]*University of Technology, Czech Republic*

When determining a system technical condition, it is possible to use multiple approaches. For practical reasons it is convenient to use an indirect diagnostic signal. In our article we focus on applying oil field data collected from a few tens of heavy vehicle engines. The aim is to get a picture of how quickly oil polluting particles are made and consequently how quickly the degradation progresses. This leads to system condition monitoring. When modelling the occurrence of the oil polluting particles, advanced linear regression methods are used. When analysing the diagnostic data, we use mainly a novel quantile regression approach. The aim is to estimate i) the course of trend in the development of polluting particles, ii) critical threshold time hitting iii) distribution of first hitting time of occurrence of soft failure.

IEEM18-P-0301

**ACO-based Parallel Machine Scheduling Considering Both Setup Time and Run-based Preventive Maintenance with Reliability Constraints**

Siqi CHEN, Liya WANG
*Shanghai Jiao Tong University, China*

This paper studied the problem of parallel processing machine scheduling, taking both set up time and run-based preventive maintenance with reliability constraints into consideration. The objective is to minimize makespan. For this NP-hard problem, an Ant Colony Optimization (ACO) algorithm is proposed. The node selecting probability equation is set based on characteristics of this problem. The objective value obtained by the proposed algorithm is compared to that of the classical LPT rule through numerical experiments. The experiment results imply that the proposed ACO algorithm has better performance than the LPT rule.

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| **Session** | Systems Modeling and Simulation 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside III |
| **Chairs** | Stefano FAZI, *University of Groningen*,<br>Dinh Son NGUYEN, *University of Science and Technology, The University of Danang* |

IEEM18-P-0556

**A Detailed Modeling and Comparative Analysis of Hysteresis Current Controlled Vienna Rectifier and Space Vector Pulse Width Modulated Vienna Rectifier in Mitigating the Harmonic Distortion on the Input Mains**

Hari Charan NANNAM, Atanu BANERJEE
*National Institute of Technology, India*

In this paper, modeling and principle of operation of Vienna rectifier is explained in detail. In order to turn-on the power electronic semiconductor switches in Vienna rectifier, two control strategies are implemented, one is hysteresis current controller and the other is State Vector Pulse Width Modulation control. A detailed explanation and analysis of the controllers were presented. Finally, MATLAB /SIMULINK was used as a platform to compare the performance of the two controllers.

IEEM18-P-0559

**Monte Carlo Simulation Forecasting of Maritime Ferry Safety and Resilience**

Ewa DABROWSKA, J. SOSZYŃSKA-BUDNY
*Gdynia Maritime University, Poland*

Monte Carlo simulation method application to safety prediction of complex system related to its operation process is presented. Theoretical backgrounds concerned with safety analysis of complex system impacted by its operating conditions are proposed to construct Monte Carlo simulation approach to system safety characteristics evaluation. Next, this approach is applied to safety prediction of maritime ferry technical system operating at variable conditions and the considered system main safety characteristics are determined. Moreover, the maritime ferry safety and resilience indicators are evaluated. The values of these characteristics are compared with their values determined analytically.

IEEM18-P-0565

**JIS: Pest Population Prognosis with Escalator Boxcar Train**

Kin-Woon YEOW, Matthias BECKER
*Gottfried Wilhelm Leibniz Universität Hannover, Germany*

Pest population prognosis helps the growers in the greenhouse to keep the pest population below the threshold efficiently. INSIM is one of the recognized pest population simulators. However, the implementation of the INSIM simulation faces some difficulties to be executed as a web service. Thus, we propose a Java-based web application using the mathematical model used in INSIM. Additionally to the known model, our implementation is able to give prognosis boundaries based on uncertainty of the temperature development and pest count. The proposed JIS gives lower and upper estimation of the pest population with the mean accuracy of 66.67% against our experimental validation data. Furthermore, the relationship between the area coverage for each yellow sticky trap and its accuracy percentage is investigated.

IEEM18-P-0002

**Modeling the Dynamics of an Agile Scrum Team in the Development of a Single Software Project**

Phoebe Mae CHING, Jose Edgar MUTUC
*De La Salle University, Philippines*

In software development, Agile Scrum is practiced with the intention of increasing the developers' productivity, and improving the quality of their output [3]. However, difficulties persist which prevent development teams' from reaping the full benefit of practicing Agile. From a review of case studies of Agile applications, it was observed that developers' ceased to practice Agile methods in aspects that related to working in teams. In these aspects, they regressed to waterfall methods, in the sense that developers worked in functional silos with little communication as the project progressed. As an attempt to resolve this, the system dynamics framework was applied in analyzing the Agile case studies. This allowed for an assessment of the progression of the problem over time, as an outcome of feedback loops caused by developers reacting to the outcomes of their previous actions. From doing so, the quietly escalating problem of information being withheld between developers in a single project team was understood to be the primary cause of failure. The study concludes by recommending the importance of open communication between developers, and acknowledging work done beyond the team's plan.

IEEM18-P-0093

**The Stowage of Containers for Inland Shipping: A System for Maximizing Containers Allocation and Meeting Stability Requirements**

Stefano FAZI
*University of Groningen, Netherlands*

In many countries worldwide, inland shipping is a reliable and viable option to transport maritime containers inland. This modality comes with a set of operational challenges, among which the stowage of containers, i.e. the positioning of a set of containers on-board, is a complex and delicate task. In this paper, we develop a DSS to support the generation of feasible stowage plans, with the goal of maximizing the amount of containers onboard, while guaranteeing stability and complying with a set of rules. In this regard, we propose the case of inland shipping in the Netherlands. The stowage problem is solved via a mixed integer linear programming mathematical formulation. Numerical experiments validate the model and give insights on the complexity of the problem for real-world size instances.

IEEM18-P-0180

**Creation of Lattice Structures for Additive Manufacturing in CAD Environment**

Dinh Son NGUYEN, Thanh Hai Tuan TRAN, Duc Kien LE, Van Than LE
*University of Science and Technology - The University of Danang, Viet Nam*

Lattice structure is a network of truss including struts or plates interconnected to each other. The lattice structures have many inherent advantages due to their ability to reduce the weight of the product whilst still ensure high specific strength and stiffness of materials. They have been used in many industrial engineering applications such as improvement of material properties, thermal engineering, and biomedical application. However, the generation of lattice structure model in Computer Aided Design (CAD) environment has many difficulties using the current commercial CAD software. Therefore, this paper presents an application of CAD to create a model of lattice structure for additive manufacturing technologies. An interface to generate a model of lattice structure has been developed in Visual Basic programming language based on the API functions in SolidWorks® software. The interface helps product designers generating automatically a complex model of lattice structure of designed product in CAD environment.

IEEM18-P-0154

**Operational Aircraft Routing Problem: Some Insights in the Capacitated Maintenance Resources**

Miner ZHONG, Felix T.S. CHAN, S. H. CHUNG
*The Hong Kong Polytechnic University, Hong Kong SAR*

In aviation industry, airlines solve operational aircraft routing problems (OARP) to assign maintenance-feasible routes to a fleet of aircraft. Note that the scheduled aircraft must be provided with sufficient maintenance resources to prevent costly recovery. Most existing OARP models assume that airlines are given fixed amount of maintenance resources. However, in the case of a capacitated maintenance stations serving more than one airline, resources available to an airline may be highly susceptible to the resource allocation scheme of maintenance providers (MPs). This paper aims to capture the uncertain supply of maintenance resources by modelling the market-based resource allocation schemes of MPs. In particular, two possible scenarios in maintenance stations are explored: (1) each airline has no information about other airlines that shares the same maintenance station; and (2) each airline has complete information about other airlines. This paper discusses game-theoretic models that can be used in these scenarios. It is shown that the equilibrium strategies of airlines in such games contribute to make proper OARP decisions by reducing maintenance misalignments.

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| **Session** | Service Innovation and Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside IV |
| **Chairs** | Ville ISOHERRANEN, *University of Oulu,*<br>Miao LI, *Northwestern Polytechnical University* |

IEEM18-P-0523

**The Effect of Owner Creativity on Organizational Creativity: Empirical Evidence from Surakarta Indonesia**

Retno INDRIARTININGTIAS[1], Budi HARTONO[2], Subagyo SUBAGYO[2]
[1]*Trunojoyo University, Indonesia*
[2]*Gadjah Mada University, Indonesia*

Creativity in any organizations are vital to its successful performance. In small size creative industries, the owner functions as a determinant of decisions, including the process of creativity in organization. This main objective of this study to examine the possible association between owner creativity and its organization creativity. The author makes the city of Surakarta as a place of research because Surakarta is one of the creative cities in Indonesia. By using three variables, owner's expertise in the area, owner's personality and leadership style, the researcher spread the questionnaire to 50 creative industries in Surakarta. By using regression analysis, the result shows that personality and leadership style of owner have significance correlation with organizational creativity. It show that personality and leadership style are important factors for owner to manage their organization.

IEEM18-P-0583

**A Study of Continuance Intention to Adopt Cloud Services: The Moderating Effect of Users' Motivation**

Chan-Sheng KUO[1], Yowei KANG[2]
[1]*Shih Hsin University, Taiwan*
[2]*National Taiwan Ocean University, Taiwan*

With the advancement of mobile and other information-communication technologies, the Cloud application services have gained increasing usage in recent years. The study of adoption factors is a topic worthy of further exploration. This research investigates critical factors, affecting users' continuance intention to use Cloud services. Our research is based on the model of continuous using information system to explore these relationships. Results were obtained from 313 valid samples, using an online survey test the research model. Empirical results from the SEM conclude that (1) innovation acceptance, perceived safety, confirmation, and perceived usefulness positively affect satisfaction; (2) confirmation positively affect perceived usefulness; (3) knowledge sharing, perceived usefulness, and satisfaction positively affect continuance intention; (4) users' motivation has a moderating effect between satisfaction and continuance intention. Practical suggestions to the vendors of Cloud application service are provided.

IEEM18-P-0350

**Service Innovation in Retail Industry: What Can We Learn from Target?**

Rocky REYNALDO[1], Augustina Asih RUMANTI[2], Iwan Inrawan WIRATMADJA[2]
[1]*Target Sourcing Services, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

Retailers have been facing a new height of competition ever since the birth of e-commerce disrupted the conventional, brick-and-mortar business model. With the success of turning a disastrous security incident into a financial success, a case study is built to analyze Target's innovative approach using Lawson and Samson's model of organizational innovation capability, which then linked with the concept of customer and brand loyalty. An insight from consumers was also analyzed through the concept of consumer behavior that provides a deeper discussion over the overall service innovation initiatives.

IEEM18-P-0370

**Benefit Segmentation of Online Customer Reviews Using Random Forest**

Kenjiro TORIZUKA[1], H. OI[1], Humiaki SAITOH[2], Syohei ISHIZU[1]
[1]*Aoyama Gakuin University, Japan*
[2]*Chiba Institute of Technology, Japan*

The purpose of this study is to propose a new benefit segmentation method based on customer reviews existing on the web. With the diversification in customer needs, it is difficult to accurately identify the needs of customers with market segmentation using demographic information. Therefore, it is important in marketing to segment the customer market based on the benefits that customers receive for products or services. In this research, we use the random forest algorithm for benefit segmentation, as this algorithm identifies training data with high accuracy even if noise and outliers exist, and it is widely used for analysis of text data. In our experiment, we analyzed customer reviews for hotels. We treated the reason for using hotels as the benefit, and analyzed topics based on word frequency in the text data as explanatory variables. We extracted factors that influenced each benefit to determine customer needs.

IEEM18-P-0080

**Servitization Shift in Cloud Manufacturing Era: An Exploratory Cases Study**

Yuqiuge HAO[1], Petri HELO[1], Ville ISOHERRANEN[2]
[1]*University of Vaasa, Finland*
[2]*University of Oulu, Finland*

In recent decade, many companies apt to cloud computing because of its advantages in both business and technology. In the cloud environment, it is possible to provide their internal resources/capabilities as services to other stakeholders in their collaborative relationship. It's critical to realize this transformation for companies, especially in the servitization shift process. Therefore, the current status of cloud-based solutions development and the innovation in the role of servitization are discussed in this research paper, particular in manufacturing industry. A multiple cases analysis will be performed to understand how companies are using cloud as an enabler in their servitization shift process. Various cloud-based services were implemented in the case companies to understand the servitization. In the end, some advice and suggestions on their servitization strategies will be provided for companies from different aspects.

IEEM18-P-0238

**Government Subsidy, Industry-university-research Collaborative Innovation and Resources Allocation Efficiency**

Miao LI, Yuan HUANG
*Northwestern Polytechnical University, China*

Industry-university-research collaboration plays an important role in realizing effective allocation of scientific and technological resources. Government subsidy has proven an effective tool to promote effective allocation of resources. The paper divides resources allocation efficiency into market allocation efficiency, technology allocation efficiency and knowledge allocation efficiency. And then, the method of stochastic frontier approach (SFA) is used to measure allocation efficiency of resources of enterprises' self-innovation and collaborative innovation. Based on the panel data of innovation input and output of 211 high-tech enterprises from 2015 to 2017, it is found that the efficiency of resources allocation of collaborative innovation is higher than self-innovation. Government subsidy promotes both knowledge allocation efficiency and technologies allocation efficiency of the two models of innovations, while insignificantly promote market allocation efficiency.

IEEM18-P-0516

**The Use of Design-science to Define Information Content Requirements for IT Service Catalogs**

Franziska SCHORR, Lars HVAM
*Technical University of Denmark, Denmark*

An information technology (IT) service catalog is a knowledge management system that provides information about IT services to both customers and service providers. When designing and implementing an IT service catalog as part of the IT service management, firms often struggle with defining the scope of the information content required for such a knowledge management system. Whereas information is an expensive resource, scholars did not determine how the information content of an IT service catalog can be determined to fit the expected use of the service catalog. This study explores the use of design science methods to define and evaluate requirements for the information content of IT service catalogs. The use of this method in the early stage of the IT service catalog design process led to a justification of design objectives and a proactive reduction of the scope of the IT service catalog.

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| **Session** | Quality Control and Management |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside V |
| **Chairs** | Sambil Charles MUKWAKUNGU, *University of Johannesburg,*<br>Sorina MOICA, *Petru Maior Univeristy of Tirgu Mures* |

IEEM18-P-0117

**A Comparative Study of Several Group Runs Type Control Schemes**

Zhi Lin CHONG[1], Jing Yi WONG[1], Michael Boon Chong KHOO[2], Sok Li LIM[3], Wai Chung YEONG[3]
[1]*Universiti Tunku Abdul Rahman, Malaysia*
[2]*Universiti Sains Malaysia, Malaysia*
[3]*Universiti Malaya, Malaysia*

The Group Runs (GR) scheme is suggested as an improved version of the synthetic scheme for the detection of process mean shifts. The Side Sensitive Group Runs (SSGR) scheme is an improvement of the GR scheme with side sensitivity. Moreover, the Modified Group Runs (MGR) and the Side Sensitive Modified Group Runs (SSMGR) schemes are the modified and improved versions of the GR scheme, without and with the inclusion of side sensitivity. It is well-known that these four schemes are effective in detecting shifts in the process mean. However, the current literature lacks a comprehensive performance comparison between the GR, SSGR, MGR and SSMGR schemes. Hence, in this paper, the performance of the GR, SSGR, MGR and SSMGR schemes, in terms of the average time to signal (ATS) metric is compared. The results showed that the SSMGR scheme has the best ATS performance, followed by the MGR scheme. Moreover, we permit the sample size n to be fixed at a desired value such as 3 and 5 as industrial applications favour the use of small sample sizes.

IEEM18-P-0455

**Acceptance Sampling Plans from Truncated Life Test Based on Frechet Distribution**

Shovan CHOWDHURY
*Indian Institute of Management, Kozhikode, India*

In this paper, we develop acceptance sampling plan when the lifetime experiment is truncated at a pre-assigned time. The minimum sample size required to ensure a specified median life of the experimental unit is provided when the lifetimes of the units follow Frechet distribution. The operating characteristic values of the sampling plans as well as the producer's risk are also presented. Examples are provided for illustrative purposes.

IEEM18-P-0527

**Benchmarking Quality Management Maturity in Industry**

Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
*University of Johannesburg, South Africa*

Quality management is integral to business development; and literature indicates that technology advancement and customer expectations strongly influence quality. Current authors in the field suggest that quality management approaches are outdated. Desktop benchmarking was employed to identify the constructs that assess quality management maturity, and systematic literature review was applied to analyze publications between 2007 and 2018. Customer satisfaction, process management, strategic alignment, measurement and controls, continuous improvement, partnerships, information management, corporate culture and cost of quality are significant concepts in the assessment of quality management maturity. Innovation, flexibility, factual approach to decision making, and organisational learning are starting to gain momentum in ascertaining the maturity of quality management in firms. The research contributes to identifying the constructs that are currently employed to determine the maturity of a firm's quality management.

IEEM18-P-0532

**Testing the ISO 9001:2015 Process Model: An Australasian Empirical Study**

Nisansala PALLAWALA, Nihal JAYAMAHA, Nigel GRIGG
*Massey University, New Zealand*

As part of an ongoing project on adoption of the ISO 9001:2015 quality management system (QMS) standard in an international context, this study empirically tested the validity of the PLAN-DO-CHECK-ACT (PDCA) continual improvement sequence implied in the ISO 9001:2015 process model, along with the notion "ISO 9001 certification leads to customer satisfaction and product quality improvement". The theoretical model was empirically tested using partial least squares path modeling, via questionnaire responses received from 93 ISO 9001 certified manufacturing companies in Australia and New Zealand. The study found that the major clauses of the standard are a good fit to PDCA cycle and that the process model predicts and explains QMS results to a sufficient degree (R2 values corresponding to customer satisfaction, product quality improvement, and nonconformity reduction were 36.8% 40.1% and 44.2% respectively). The scope of this study will be extended to cover different countries to demonstrate the external validity of ISO 9001 and to test cultural effects on continual improvement based on ISO 9001.

IEEM18-P-0018

**Assessment of Quality of Service at the Main Laboratory of the LAB Aimed at Satisfying Internal Customer Needs**

Sambil Charles MUKWAKUNGU, Eric BAKAMA, Alice Kabamba LUMBWE, Magaly Madeleine BOLIPOMBO, Dorcas NIATI, Kidoge IBRAHIMU, Jonathan Eljadael KASONGO, Charles MBOHWA
*University of Johannesburg, South Africa*

This paper's objectives are to establish and document internal clients' perception about the quality of service received at the Main Laboratory of the LAB, a national laboratory dealing with transmittable diseases in South Africa. The study followed a quantitative design approach with cross functional examinations. Data collection tool was based on "SERVQUAL" model. Findings show that in terms of the quality dimensions, the LAB's centres performed variably in many aspects and to a varying degree in different quality dimensions measured. Each centre had its own unique set of challenges. The recommendations made in this study can be implemented as a solution to the problems faced by the LAB and other similar departments. This study viewed from a South African perspective, is first of its kind as it explores the effectiveness of the implementation of a Quality Management System at a bio-safety level 4, the only one on the African continent.

IEEM18-P-0227

**Effects of Suggestion System on Continuous Improvement: A Case Study**

Sorina MOICA[1], Cristina VERES[2], Liviu MARIAN[2]
[1]*Petru Maior University of Tirgu-Mures, Romania*
[2]*Technical University of Cluj-Napoca, Romania*

Striving to achieve company performance, we often choose to describe strategies, modern management instruments, goals and results, shading the huge importance of the human factor in achieving improvement. In each organization, the course of creating value has employees on its base. Nevertheless, how do we encourage people to contribute to overall firm's success? How do we maintain their interest, motivation and involvement? Is it worth investing in human resource and what exactly do we attain in return? This case study presents a system of getting the best of people by investing minimal resources, describing the steps of the process and highlighting the long-term results and impact. After analyzing the key production indicators of the firm, we conducted a deductive analysis of the main financial indicators, which demonstrates the positive evolution of the company after implementing the motivational system. The results are presented for a period of six years starting with 2011. The effect of a suggestion system will increase and will develop a company, but only if it is linked to a foundation that supports the fundamental values of continuous improvement.

IEEM18-P-0379

**Total Quality Management: A Framework for Quality Improvement in Indian Manufacturing Small and Medium Enterprises**

R. KAJA BANTHA NAVAS[1], S. PRAKASH[1], A. John RAJAN[2], Subramaniam ARUNACHALAM[3]
[1]*Sathyabama Institute of Science and Technology, India*
[2]*Vellore Institute of Technology, India*
[3]*University of East London, United Kingdom*

The present research study aims to develop the quality improvement frame work model by Indian Manufacturing Small and Medium Enterprises (SMES) in the view of quality professional, manufacturing professional, Managers and top management people. So, it takes a shape of analytical study and it tries to explain the present status of Indian manufacturing SMES in respect of the different quality parameters like financial measures, operational measures, customer satisfaction measures and employee satisfaction measures. Survey is conducted by using questionnaire techniques and data analyzed through statistical analytical software SPSS. From the factor analysis and regression analysis, we have framed and validated quality improvement frame work model for Indian manufacturing small and medium enterprises.

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| **Session** | Manufacturing Systems 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside VI |
| **Chairs** | Matthieu MUSEAU, *G-SCOP Laboratory - Univ. Grenoble Alpes*,<br>R.M. Chandima RATNAYAKE, *University of Stavanger* |

IEEM18-P-0031

**Simultaneous Balancing and Buffer Allocation to Serial Lines with Bernoulli Stations**

Wenchong CHEN[1], Hongwei LIU[1], Wei LIU[2]
[1]*Tianjin University, China*
[2]*Nanjing Agricultural University, China*

Numerous studies have investigated the buffer allocation problems (BAPs) and the serial production line balancing problems (SPLBPs) to improve system performance. There are two main disadvantages in many of these studies: (1) the BAPs and SPLBPs have been approached separately; (2) the objectives are calculated in traditional steady-state, and their errors are great when the volume of a production run is small. This paper considers the two optimized problems simultaneously in serial production line with transient analysis. The production run is finite, and the stations are in Bernoulli reliability. The objective is to maximize profit that includes both revenue per unit of throughput and cost per unit of storage (WIP and buffer space). A computationally efficient algorithm based on aggregation is developed to approximate the objective function. Then, a genetic algorithm is proposed to find an optimal task assignment and buffer allocation. The results of extensive experimentation demonstrate that some unpaced unreliable serial production lines can never be entirely balanced, and using buffer can improve line efficiency.

IEEM18-P-0039

**Modeling and Simulation of MRR and Surface Roughness in EMAF**

Pankaj Kumar SHRIVASTAVA[1], Avanish Kumar DUBEY[2], Nitesh Kumar PANDEY[3]
[1]*AKS University, Satna (M.P.), India*
[2]*Motilal Nehru National Institute of Technology Allahabad, India*
[3]*Shri Ramswaroop Memorial University Lucknow, India*

The need for high accuracy and high efficiency machining of difficult to cut materials is making the applications of abrasive finishing technologies increasingly important. It is almost impossible to achieve high quality surface finish and high efficiency simultaneously using single traditional machining processes. Thus, a compound machining process that integrates several processes to meet these demands represents the current trend in the field of finishing. Electrolytic magnetic abrasive finishing (EMAF) process is a hybrid machining process which consists of traditional magnetic abrasive machining process and electrolytic process. EMAF can be a better alternative to achieve excellent surface finish in advanced materials. In the present work a derivational mathematical model of EMAF has been developed for material removal and surface roughness by considering abrasion, electrochemical dissolution and abrasion-assisted dissolution. A derivational model for material removal has also been derived by considering electrode gap

IEEM18-P-0067

**Enhancement of the Design Process for Manufacturing Systems via a Multi-criteria Evaluation Method Creating a Control Loop for Guided Improvement**

Michael FELDMETH, Egon MÜLLER
*Chemnitz University of Technology, Germany*

The manufacturing industry is an important pillar of the global economy and a main driver for future prosperity. To achieve operational competitiveness, it is necessary to design manufacturing systems along guidelines put forth by the Toyota production system, or lean principles. The somewhat sluggish adoption of these principles by manufacturing companies indicates a need for methodical support. One of the main obstacles can be found in the design process of manufacturing systems, which is often guided by evaluation criteria that are not aligned with lean principles. The research paper provides methodical support by applying models from control theory to manufacturing system design. The developed process model enables the effective use of evaluation as a key element in a control loop for guided improvement. The results are going to help companies by improving their manufacturing system design process and by achieving lean design results.

IEEM18-P-0068

**SMED in the North American Secondary Wood Products Industry**

Urs BUEHLMANN[1], Enis KUCUK[2]
[1]*Virginia Tech, United States*
[2]*Istanbul Technical University, Turkey*

To minimize the negative impact of set-up activities on production, Lean manufacturing focuses on reducing set-up time through targeted Kaizen (SMED) efforts. Successful set-up time reduction efforts allow manufacturers to reduce their lead-time and their work in process inventory (WIP), while increasing their capacity, among other things. To find out about practices in the secondary wood products industry, a survey conducted by Virginia Tech in collaboration with a trade magazine investigated the secondary wood products industry practices and the success rate of set-up time reduction efforts on widely used basic woodworking machines including moulders, table saws, shapers, and band saws. Overall, participants indicated their set-up time reduction efforts were successful and resulted in quite sizable degrees of improvement. Only 14% of respondents indicated that no improvements were made through set-up time reduction efforts in their facility. Eighty-six percent of respondents, conversely, indicated improvements ranging from “0-4.9%” to “More than 15%.” Participants also indicated that their set-up time reduction efforts paid back in the form of productivity gains and increased responsiveness to customer demand.

IEEM18-P-0071

**Hybridizing MJF Based Additive Layer and CNC Supported Subtractive Manufacturing for Enhancing Productivity in PD Design Iterations**

R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

Job-shop type production plays a vital role in the manufacturing industry when delivery of low-volume production is required. Prototyping and testing in product development (PD), especially, need low-volume production to perform design iterations and testing. Job-shop production has been less productive due to the inherent nature of traditional subtractive manufacturing (SM). Additive layer manufacturing (ALM) and computer numerical control (CNC) supported SM enable the salient features of computer aided engineering (CAE) developments to be used for increasing productivity, especially in job-shop production. Although CNC controllers have evolved to use conversational programming, SM remains unproductive in job-shop production. This manuscript first illustrates the basic notion of multi jet fusion (MJF) technology based ALM (MJF-ALM). Secondly, it illustrates the pros and cons of CNC-SM. Thirdly, it demonstrates how it is possible for CNC-SM to be supplemented with MJF-ALM in enhancing the productivity of job-shop production. Finally, it demonstrates the potential benefits in hybridizing MJF-ALM with CNC-SM, especially: focusing on job-shop production and PD-related design iterations and testing.

IEEM18-P-0579

**Effect of Temperature on the Quality of Welding Beads Deposited with CMT Technology**

Pascal ROBERT, Matthieu MUSEAU, Henri PARIS
*University Grenoble Alpes, France*

Cold Metal Transfer (CMT) welding process can be applied for Wire and Arc Additive Manufacturing (WAAM) to produce metal parts, thanks to its ability to deposit regular welding beads and its low projections rate. The different modes of welding developed around this technology make it possible to control the quantity of heat brought during the welding and are considered interesting for additive manufacturing. The objective of this paper is to evaluate the effect of different welding parameters on the shape of the deposited 4043 aluminum alloy welding beads. The temperature of the part is also a determining parameter to master the quality of the deposited welding beads. An experimental campaign has been conducted to correlate the temperature of the part and the quality of the welding beads in relation to the welding parameters. The results of the campaign are applied to determine an effective strategy for building a cylinder.

IEEM18-P-0104

**Production Management System for Small and Medium Sized Manufacturing Enterprises**

Lei WANG, Peng LIU, Shengqian JIANG, Yiming XUE, Kun WANG, Xiangnan LI
*Jilin University, China*

With industrial internet increasingly used in manufacturing industry, the traditional manufacturing industry can no longer meet the needs of the development of manufacturing and producing, which brought both an opportunity and a huge challenge for small and medium-sized manufacturing enterprises. After investigations and consultations with many small and medium-sized enterprise, developed a set of production management systems for small and medium-sized enterprises. The system includes three layers: physical layer, network layer and system layer. At the physical layer, field data is collected through photoelectric sensors and a model is established to found high-precision sensor node method. At the network layer, ZigBee wireless transmission network protocol is used to develop a wireless transmission module with strong anti-interference ability and data confidentiality. At the system layer, a production management system is developed according to characteristics of mobile terminals and PC in order to achieve equipment failure repair, alarm message push and other functions in the mobile terminal and to realize visual board and other functions. The system and technologies proposed is important for information-based manufacturing industries.

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| **Session** | Decision Analysis and Methods 1 |
| **Date** | 17/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside VII |
| **Chairs** | Armand BABOLI, *National Institute of Applied Sciences of Lyon*,<br>Arnesh TELUKDARIE, *University of Johannesburg* |

IEEM18-P-0008

**A Two-layer Data Envelopment Analysis Model for Sustainable Performance Evaluation**

Willy ZALATAR, Eppie CLARK
*De La Salle University, Philippines*

Data envelopment analysis is a popular method of evaluating the performance of almost all types of organizations. The aim of this paper is to construct a two-layer DEA model which can be utilized to evaluate the sustainable performance of a manufacturing company based on its degree of leanness. The lean indices are treated as virtual inputs while the sustainability indices are considered as virtual outputs. Empirical results indicated that efficient companies scored high in Human Resources and Supplier and Customer Relationships as well as in Economic and Social Performance. This paper highlights the positive effects of adopting lean manufacturing practices on a company's sustainable performance.

IEEM18-P-0123

**A Hybrid Approach Using SWOT and AHP to Prioritize the Factors for Indigenous Production of Automobiles: A Case of Pakistani Automotive Industry**

Yasir AHMAD[1], Zaid BIN KHALID[2]
[1]*National University of Sciences and Technology (NUST), Pakistan*
[2]*University of Central Punjab, Pakistan*

Pakistan Automotive Industry has been dominated by Japanese Companies and new entrants face tough conditions even in presence of great local market demand. The industry has few unsuccessful attempts of production of truly "Made in Pakistan" automobiles. Several qualitative studies are being carried out by government and non-government institutions as well as independent researchers to understand the underlying causes for the slow growth of this industry. However, quantification of internal (strengths and weaknesses) and external (opportunities and threats) factors of this industry is lacking. The study initially identifies Strengths, Weaknesses, Opportunities and Threats (SWOT) factors for indigenous production of automobiles in Pakistan and subsequently utilizes Analytic Hierarchy Process (AHP) to determine the importance ranking for SWOT factors. Weakness group has found be the most significant among SWOT factors. The approach offers a "bigger picture" yet with necessary details to make critical decisions.

IEEM18-P-0229

**World-Class Engineering: Designing for Quality, Reliability, Maintenance, and Supply Chain Management Using the Analytic Hierarchy Process**

Travis C. MALLETT
*Schweitzer Engineering Laboratories, Inc., United States*

Designing products to meet world-class manufacturing (WCM) objectives requires the consideration of many factors beyond immediate design requirements. Design topology and component selection are integral aspects of the design process that strongly influence performance. They are complex tasks, and the complexity increases dramatically when WCM considerations such as product maintenance and supply chain management are included. This paper demonstrates that multiple-criteria decision analysis techniques such as the analytic hierarchy process (AHP) are well-suited to integrating WCM principles into the design process while alleviating the increased complexity of design decisions. An example is provided based on electronic hardware design. Systematic use of AHP in circuit design increases the quality and value of designs while reducing the cost of development—all of which are WCM objectives.

IEEM18-P-0273

**A Predictive Approach to Define the Best Forecasting Method for Spare Parts: A Case Study in Business Aircrafts' Industry**

Reza BABAJANIVALASHEDI[1], Armand BABOLI[1], Muhammad Kashif SHAHZAD[1], Romy TONADRE[2]
[1]*Universite de Lyon, France*
[2]*Dassault Falcon Jet Corp., United States*

The cost-effective management of spare parts is an important objective for all manufacturing and service companies. One of the most difficult challenges, for this objective, is accurate demand forecasting and optimized supply planning decisions to achieve best availability level for the spare parts. The main objective of this paper is to propose a predictive approach to identify the best forecasting method with least error cost. Moreover, in business aircraft industry the best forecasting method for a part can change due to the high-level uncertainty in demand. To this purpose, a methodology to select the best forecasting method based on binary classifier machine learning is developed. Proposed methodology is applied in a real case for a well-known business aircraft. The results indicate that neural network is the best machine learning method for 98% of demand and random forest is the best machine learning method for only 2% of parts.

IEEM18-P-0220

**A New Approach to Integrate Resilience Engineering and Business Process Re-engineering Design**

Maliheh VAEZ-ALAEI[1], Armand BABOLI[2], Reza TAVAKKOLI-MOGHADDAM[1]
[1]*University of Tehran, Iran*
[2]*Universite de Lyon, France*

This paper presents an integrated optimization approach based on resilience engineering (RE) and business process re-engineering (BPR) in an oil company. The previous studies do not consider the impact of BPR on RE that is quite important for complex systems. A new standard questionnaire by respecting the traditional questionnaire of RE, adding new questions and respecting BPR concept is designed and completed by a an oil company. These questions are firstly verified and validated by experts and by statistical methods. Then, the best fuzzy data envelopment analysis model is selected based on p-value. A sensitivity analysis is used to identify the most influential factors. Validation and verification of the proposed model is examined by deterministic and stochastic DEA methods. Finally, the weight of each factor is calculated. The result of this study helps the decision makers to have a perfect understanding of integrated performance and interaction of BPR and RE.

IEEM18-P-0248

**A Methodology to Integrate Artificial Intelligence with the Design Structure Matrix Approach**

Chuks MEDOH, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

Large multinationals execute business functions based on complex Business Processes (BP). Business Units (BU) have undertaken numerous measures towards enhancing the optimization of complex BP. Intricate relationships exist in presenting the information flow of complex BP. BU employ a variety of techniques to optimize the complex relationships of BP. The Design Structure Matrix (DSM) techniques and Artificial Intelligence (AI) system present an efficient methodology for defining and optimizing collaborative BP. This research presents the applications of both approaches for complex BP modelling and management. The research results demonstrate the effectiveness of integrating AI and DSM as an enhanced decision support for optimizing complex BP.

IEEM18-P-0575

**Prediction of Critical Infrastructure Accident Losses of Chemical Releases Impacted by Climate-weather Change**

Magda BOGALECKA, Krzysztof KOŁOWROCKI
*Gdynia Maritime University, Poland*

General model of critical infrastructure accident consequences is presented. Its application to the prediction of environment losses associated with the chemical releases generated by ship critical infrastructure network operating at the Baltic Sea is presented. The cost analysis of these environment losses, without and with considering the climate-weather impact, is performed.

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| **Session** | Supply Chain Management 2 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom I |
| **Chairs** | Linda ZHANG, *IESEG School of Management*, Charles MBOHWA, *University of Johannesburg* |

IEEM18-P-0321

**Review of Refrigerated Inventory Control System for Perishable Products**

Dyah SATITI, Ahmad RUSDIANSYAH, Ratna Sari DEWI
*Institut Teknologi Sepuluh Nopember, Indonesia*

We reviewed several studies related to inventory control in perishable products. This work is the earliest stage in determining the direction of further research of refrigerated inventory system. We classify the paper based on the decision variable, demand type, quality deterioration function, and method of settlement used. We also provide a brief review of cold storage. The purpose of this work not only provides the latest description, but also shows a gap in research that can still be developed in the inventory control study for perishable products.

IEEM18-P-0338

**Supply Chain Configuration Modeling for Multi-product Multi-echelon**

Sinta SULISTYO, Derana ADILIA, Nur Aini MASRUROH
*Universitas Gadjah Mada, Indonesia*

The cost of the new product development (NPD) process takes a significant amount of the total cost. Manufacturers need to implement the right strategy to avoid losses due to the failure. The integration of the selection of products, processes, and supply chain elements can be one of the means. In this research, the model of product, process, and supply chain configuration was built; consisting of three echelons of component suppliers, manufacturers, and distributors. This model resulted in a mixed integer linear programming model that can be solved using the branch and bound method. The model can help the manufacturers in deciding when to start the NPD process and the production activities. This model will also help the companies in determining the product type to be produced, the quantity of production, the selected supply chain element and the distribution allocation so that the profits of the manufacturers will be maximized. The model is tested using a numerical example and is implemented using data from a creative industry engaged in fashion.

IEEM18-P-0447

**Supplier Selection Method: A Case-study on a Car Seat Manufacturer in Thailand**

Naragain PHUMCHUSRI, Supasit TANGSIRIWATTANA, Poom LUANGJARMEKORN
*Chulalongkorn University, Thailand*

The objective of this research is to develop a model for a case-study car seat manufacturer for evaluating steel pipe and steel sheet suppliers, known as raw material suppliers, by applying Analytic Hierarchy Process (AHP), and a model for selecting the suitable raw material supplier for each part. These models aim to maximize overall part makers' satisfaction. The evaluators are chosen from purchasing management team from 10 part makers. These assessors will evaluate 8 raw material suppliers. This research is divided into 2 parts. The first part is the evaluation of raw material suppliers using Analytic Hierarchy Process. This part weights the importance of decision criteria complying with part makers' satisfaction. The second part proposes a decision model for supplier selection using integer programming. The weight of each criterion from the first part will be considered along with raw material consumption to select the suitable raw material suppliers that maximize overall part makers' satisfaction. The results from the first part of this study show that the most important criterion is cost which is about 41%. Quality, Delivery, Service, and Risk factors are 24%, 14%, 12% and 9%, respectively. The second part shows that the model can match material suppliers to part makers according to their preference. Comparing with current situation, the satisfaction is increased by 26% with this proposed model. It means that the proposed model can help increase satisfactions between car seat makers and their suppliers, which benefit the parts supplied to the case-study company.

IEEM18-P-0129

**Improving Traceability System in Indonesian Coconut Oil**

**Company**

Ivan GUNAWAN[1], Iwan VANANY[1], Erwin WIDODO[1], Jaka MULYANA[2]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Widya Mandala Catholic University, Indonesia*

To improve a traceability system, both the internal and the chain one, the first important step is to identify the Critical Traceability Points (CTPs) along the supply chain. Therefore, the purpose of this study is to map out the CTPs of the Indonesian coconut oil company as the basis for improving the traceability system. Process mapping was used as the method to capture the CTPs in the production of Refined Bleached Deodorized Coconut Oil (RBDCNO). Critical Traceability Point Analysis (CTPA) was performed to find the feasible traceability improvement strategies. The process mapping successfully identified 13 CTPs from the reception of raw materials to the dispatch of finished products. The recommended improvement strategies are to integrate the identification record of material flow along the process and to develop an internal code system that allows the company to trace and track. This recommendation can be implemented by converting the information system into a digital system.

IEEM18-P-0160

**Vehicle Dispatch Problem with Precedence Constraints for Marine Container Drayage**

Etsuko NISHIMURA[1], K. SHINTANI[2], A. IMAI[1]
[1]*Kobe University, Japan*
[2]*Tokai University, Japan*

CO2 occupies over 90% of artificially emitted the Greenhouse Gas (GHG). As related in CO2 emission from road traffic, we focus on a vehicle routing for marine container transport. There are three container conditions: inbound trip, outbound trip and empty condition. And also there are two situations for vehicles: trailer truck (with full or empty container loaded) and empty truck (as tractor only). In this study, we address the tractor head assignment to trailers (chassis) with full/empty container with considering the precedence constraints for visiting customers, as to minimize CO2 emissions. As the computational results, there are around 25 % reductions of CO2 emissions in our proposed MIP model.

IEEM18-P-0561

**An Impact-wave Analogy for Managing Cyber Risks in Supply Chains**

Daniel SEPULVEDA ESTAY, Pablo GUERRA
*Technical University of Denmark, Denmark*

Supply chains are dependent on Information Technology (IT) and cyberspace processes. Yet, despite the advantages of its increased connectivity and systems integration with suppliers and customers, this also opens the door to new risks from and to supply chain partners. Literature in this nascent research area is limited, with few frameworks available to complement traditional risk management methods. This paper shows the current results of a literature review on the field of supply chain cyber risk management (SCCRM), with the aim of gathering and structuring its extant literature and proposing a taxonomy that will give a better overview of the approaches found in the scientific literature. This taxonomy is then used to propose a novel SCCRM framework. Finally, a novel Impact-Wave analogy is presented to provide a graphical understanding of the application of this framework.

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| **Session** | Production Planning and Control |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom II |
| **Chairs** | Anders THORSTENSON, *Aarhus University*,<br>HeeHyol LEE, *Waseda University* |

IEEM18-P-0190

**A SPH Simulation Approach using the Carreau Model for the Free Surface Flow of Adhesives**

Marcus RÖHLER, Vakul KUMAR, Christoph RICHTER, Gunther REINHART
*Fraunhofer IGCV, Germany*

Adhesives are gaining importance in different industries, but the planning of the bonding process is subject to a high degree of uncertainty caused by the complex flow behavior of adhesives. Therefor the shear-thinning behavior which characterizes many types of adhesives is integrated into the Implicit Incompressible Smoothed Particles Hydrodynamix (IISPH) approach, which is ideally suited for free surface flow scenarios through its mesh-less characteristics. While these particle-based methods are already being used in the real-time simulation of Newtonian fluids in computer graphics, their applicability in engineering disciplines and simulation of complex fluid flows still has to be tested. The Carreau model has already been validated experimentally for accurately portraying the shear-thinning behavior of adhesives. In this work the Carreau model is integrated into the IISPH solver and the simulation results are compared to an analytical solution of the Poiseuille pipe flow. This approach can then be applied to lower the uncertainty in the early phase of manufacturing planning and for simulation-based optimization approaches involving rheological flow behavior.

IEEM18-P-0613

**Capacity Allocation Among Suppliers in the Presence of Spot Market**

Tarun JAIN[1], Jishnu HAZRA[2]
[1]*Indian Institute of Management Udaipur, India*
[2]*Indian Institute of Management Bangalore, India*

We consider a supply chain with two suppliers and one buyer. The buyer faces uncertain demand decides to reserve some capacity through the two suppliers. The buyer also sources the remaining capacity from the spot market if demand exceeds the reserved capacity. The suppliers have finite capacity and both have access to a third-party client market. We analytically analyze this problem and characterize its solution.

IEEM18-P-0340

**A Mix Integer Programming Model for Bi-objective Single Machine with Total Weighted Tardiness and Electricity Cost Under Time-of-use Tariffs**

Bobby KURNIAWAN[1], Alfian Akbar GOZALI[1], Wei WENG[2], Shigeru FUJIMURA[1]
[1]*Waseda University, Japan*
[2]*Kanazawa University, Japan*

With the rapid growth of electricity demand, many governments around the world have implemented the energy-conscious policy such as time-of-use policy. This paper addresses a bi-objective single machine scheduling with the total tardiness and electricity cost minimization under time-of-use tariffs. The problem is formulated as a mixed integer programming model. The CPLEX solver solves a small size instance to validate the model. We also describe the procedure to obtain the set of non-dominated solution using commercial solver. The complexity of the model is tested on several problem instances. The results show that the problem is hard to solve even for medium size instances. Hence, we propose a genetic algorithm with random insertion to obtain the set of Pareto solutions for large instances.

IEEM18-P-0566

**An Improved Multiobjective Evolutionary Algorithm for Solving the No-wait Flow Shop Scheduling Problem**

Tsung-Su YEH, Tsung-Che CHIANG
*National Taiwan Normal University, Taiwan*

The no-wait flow shop extends the classical flow shop by considering a practical constraint (in steel, plastic, and several industries) that operations of each job should be processed continuously on machines. In this paper, we propose to use a multiobjective evolutionary algorithm based on decomposition (MOEA/D) for no-wait flow shop scheduling with minimization of makespan and maximum tardiness as two objectives. First, we propose a crossover operator that inherits gene blocks with smaller machine idle time from parent solutions. Second, we investigate the effects of initial population by using different job ordering rules. Third, we generate ninety problem instances and conduct experiments on these instances. Experimental results confirm that our idle-time-based crossover and multi-rule initialization lead to good solution quality. We make all data of problem instances and sets of solutions publicly accessible to promote future research on this topic.

IEEM18-P-0369

**Multiply-connected Neuro PID Control**

Kun-Young HAN, Hee-Hyol LEE
*Waseda University, Japan*

An ultra-compact binary power plant converts thermal energy into electric power using low temperature difference thermal energy between heat source and cooling source. In control of the binary power plant, changes of characteristic due to environmental condition, corrosion of related equipment and coupling between control loops are the main difficulties in designing a controller and fine-tuning its parameters. In order to realize the stable power generation it is necessary to consider a control system to keep control performance when the changes of characteristic for binary power plant, and to compensate coupling in multi-inputs and multi-outputs (MIMO) systems. A Multiply-Connected (MC) Neuro PID control system using a neural network architecture connected directly by neurons of each control loop is proposed to overcome above difficulties, and its strategy for design of the control system is introduced. The proposed MC Neuro PID control system is compared to traditional PID control systems to show the effectiveness of the MC Neuro PID control through simulations in this paper.

IEEM18-P-0380

**As Simple as Possible but no Simpler – An Inquiry into Approximations for a Re-order Point Inventory Control Model with Gamma-distributed Demand**

Anders THORSTENSON
*Aarhus University, Denmark*

The basic single item, continuous review, reorder point inventory control model with given order quantities and a fixed lead time is considered. The objective is to minimize inventory holding cost for the safety stock by determining the reorder point subject to a fill-rate constraint. Several approximations have been suggested for this model. Many of them assume that demand during the lead time follows a normal distribution. In this paper, model approximations assuming normal distributions are contrasted with gamma distributed lead-time demand. It is confirmed numerically, that the simplest approximation is quite accurate under some fairly restrictive conditions. However, it is found that considerable errors can be expected when demand uncertainty is increased, especially when the gamma distribution is applied. Fortunately, the more precise model specification with only marginally increased complexity works quite well, also for the gamma distribution.

IEEM18-P-0295

**Cost-model for Energy-oriented Production Control**

Martin ROESCH[1], Christoph BERGER[1], Stefan BRAUNREUTHER[2], Gunther REINHART[1]
[1]*Fraunhofer IGCV, Germany*
[2]*Augsburg University of Applied Sciences, Germany*

Decarbonisation and the ongoing increase in renewable and unsteady power generation are leading to rising and fluctuating electricity prices. Consequently, companies can decrease energy costs by using production control to flexibly reduce energy demand during periods of high energy costs and vice versa. However, such measures influence the general production objectives and can cause follow-up costs, as for example products may not be finished on time if machines are temporarily shut down to achieve lower energy costs. This paper presents an approach for evaluating the impacts of energy-oriented actions within production control using a cost-model.

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| **Session** | Reliability and Maintenance Engineering 2 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom III |
| **Chairs** | Gopinath CHATTOPADHYAY, *Federation University*,<br>Jayantha P. LIYANAGE, *University of Stavanger* |

IEEM18-P-0138

**Optimum Preventive Maintenance Policy for a Mechanical System Using Semi-markov Method and Golden Section Technique**

Girish KUMAR[1], J.P. VARGHESE[2]
[1]*Delhi Technological University, India*
[2]*eHealth Inc., United States*

This paper presents a method to determine an opportune time interval to carry out preventive maintenance for a two component series system to maximize system availability. Owing to the fact that the failure and repair distributions of most of the systems follow non-exponential distributions such as Weibull, Log-normal, Gamma, etc. and preventive maintenance is carried out at fixed intervals of time, the Markov method becomes inapplicable. The Semi-Markov approach which can handle non-exponential distributions provides a realistic analysis of such systems. The Semi Markov process model is solved to evaluate steady state system availability using the two-stage analytical approach. The resultant system availability result is validated using the Monte Carlo Simulation. The preventive maintenance interval time for optimal system availability is then determined using the Golden Section Search technique.

IEEM18-P-0146

**Remaining Fatigue Life Prediction of Topside Piping Using Response Surface Models**

Arvind KEPRATE[1], R.M. Chandima RATNAYAKE[2]
[1]*DNV GL, Norway*
[2]*University of Stavanger, Norway*

A significant amount of topside piping on the offshore oil and gas (OOG) platforms on the Norwegian continental shelf (NCS) are either approaching or have exceeded their intended design life. In order to extend the fatigue life of the aforementioned asset it is vital to preform their remaining fatigue life (RFL) assessment. The paper proposes the use of response surface models (RSMs) to estimate the RFL of offshore piping. The paper examines the applicability of various RSMs, namely, multi-linear regression (MLR), polynomial regression (PR) (with interaction), Gaussian process regression (GPR), gradient boosting regression (GBR), and support vector regression (SVR), for estimating RFL. The training and testing data is generated using Monte Carlo simulation (MCS). The accuracy of the RSMs, is compared using, Root Mean Square Error (RMSE), Average Absolute Error (AAE), Maximum Absolute Error (AAE), and Coefficient of Determination (R^2). Based on the results presented in the paper, GPR was selected as the best RSM for estimating the RFL of topside piping.

IEEM18-P-0187

**Application of Prognostics and Health Management to Low Demand Systems: Use of Condition Data to Help Determine Function Test Interval**

Pengyu ZHU, Jayantha P. LIYANAGE
*University of Stavanger, Norway*

Many safety instrumented systems (SIS) such as emergency shut down (ESD) are designed as low demand systems, whose functionalities are only triggered under certain conditions once or fewer times a year. Reliability levels of several critical low demand systems were observed to be high on the Norwegian continental shelf (NCS) over the last 15 years [1]. In general terms, there is a lack of confidence in whether the functionality of a low demand system can be initiated and how well the system can perform upon a real demand. This paper studies such challenges and suggests the application of prognostics and health management (PHM) to evaluate the function test interval instead of remaining useful lifetime. The value of condition data is justified and reflected in the estimation of failure rate and function test interval. The application of PHM to low demand systems can help enhance a company's confidence in system availability and operational reliability and its adherence to a predictive maintenance practice.

IEEM18-P-0206

**Reliability Modeling and Analysis of Nuclear Power System with Common Signal Based on Goal-oriented (GO) Method**

Yuan-Yuan YANG[1], Hui-Na MU[1], Guang-Liang CHEN[1], Xiao-Jian YI[2], Hong-Mei YAN[1], Chen LIU[1]
[1]*Beijing Institute of Technology, China*
[2]*China North Vehicle Research Institute, China*

Through the investigation of the research status of commonly used system reliability modeling and analysis methods, this paper mainly gives a new definition and rules for more stringent system reliability common signals. At the same time, the precise algorithm for the common signals of the existing GO method is improved. Furthermore, a reliability modeling and analysis method for nuclear power systems with common signals based on GO method is established. Finally, the lifting mechanism inside the nuclear island was selected as a system analysis case with common signals, and the reliability modeling and analysis are performed using the method proposed in this paper. The results of the analysis were compared with the results of quantitative analysis of the Monte Carlo method, which verified the correctness and applicability of the proposed method.

IEEM18-P-0450

**Low Demand Safety Instrumented System: Update of Function Test Intervals with Layer of Protection Analysis in the Operational Phase**

Pengyu ZHU, Jayantha P. LIYANAGE
*University of Stavanger, Norway*

In the oil & gas industry, the estimation and updating of function test intervals of critical safety instrumented systems (SIS) are critical for safe production. The definition of the new test interval of a SIS is closely related to its failure rate and average probability of failure on demand (PFD). In current practice, the evaluation process is employed on each individual SIS, and the overall safety level is usually not justified. When such analyses are performed on multiple safety instrumented protection layers, there is a tendency for the overall safety level of the protection system to be increased to a very high level, i.e. overprotection. This paper aims to suggest an alternative approach to estimating test intervals, with a focus on overall safety level. The results show the potential to extend function test intervals in a more ambitious way, without degrading the safety level of the overall protection system or each specific SIS.

IEEM18-P-0098

**Decision Support Tools for Preventive Maintenance Intervals and Replacement Decisions of Engineering Assets**

Madhu MENON, Gopinath CHATTOPADHYAY, Ray BEEBE
*Federation University Australia, Australia*

Prognostic models for maintenance decisions have inherent limitations due to quality & quantity of historical data, assumptions made, and time required in validating models. In this paper, Preventive Maintenance (PM) Intervals, Failure events, cost and maintenance records from Computerized Maintenance Management System (CMMS) are analyzed for reducing downtimes and Operating Expenditure (OPEX). The proposed methodologies for maintenance intervals and replacements with acceptable level of confidence are articulated to asset maintenance of a City Council of Australian Local Government organisation as a case of improved decision making under limited information.

IEEM18-P-0399

**Maintenance Planning Based on Reliability Assessment of Multi-state Multi-component System**

Niketa JAIN[1], Ajay Pal Singh RATHORE[2], Rakesh JAIN[2], Om Prakash YADAV[3]
[1]*Manipal University, India*
[2]*Malaviya National Institute of Technology Jaipur, India*
[3]*North Dakota State University, United States*

Effective maintenance planning plays a significant role in increasing life and productivity of physical systems or equipment. For products such as automotive vehicles, the warranty planning is also a crucial decision for the automaker as they have to set aside the budget to deal with warranty claims. Both warranty decision and maintenance planning aspects depend on the reliability of the product. Higher reliability means fewer warranty claims and maintenance issues. This necessitates the more realistic reliability assessment of the product not only for design improvement but also for maintenance planning and warranty decisions. This paper provides degradation based reliability assessment considering component dependency and presenting a framework for maintenance planning. The critical role of the individual component in enabling system function is also included in this paper. Further, an improved preventive maintenance and warranty plan are suggested with the help of an automotive vehicle case study.

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| **Session** | Engineering Education and Training |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Pompadour |
| **Chairs** | Ryan Jeffrey CURBANO, *Lyceum of the Philippines Laguna*,<br>Tlotlollo HLALELE, *University of South Africa* |

IEEM18-P-0134

**The Concept of Systems Thinking Education- Moving from the Parts to the Whole**

Sigal KORAL KORDOVA[1], Moti FRANK[2]
[1]*Ariel University, Israel*
[2]*Israel Academic College, Israel*

Systems thinking is as a general description for a wide range of phenomena rather than a specific concept. In the business arena, for example, managers and engineers at all levels need strategic and holistic vision. Systems thinking is useful on all levels of the organization. Recently, we are witnessing a new system thinking research area- research approaches to identify the capabilities of systems thinking professionals, including their cognitive characteristics, and personal abilities. The study defined the aspects that impact the reinforcement of systems thinking among students and graduates of technology management [17]. Quantitative and qualitative methods are implemented: A survey for evaluating the systems thinking competence, The MBTI questionnaire and managers estimate. The study shows that systems thinking is a blending of acquired and innate skills. It can be developed through learning, training, and experience. Systems thinking is a measurable and consistent personality trait which may be used to distinguish between individuals.

IEEM18-P-0284

**Using QFD to Normalize a Culture of Innovation in an Engineering SME**

Pearse O'GORMAN[1], Margaret MORGAN[1], Rudy VAN MERKOM[2]
[1]*Ulster University, United Kingdom*
[2]*Fortress Protec Ltd., United Kingdom*

This paper discusses the introduction of a formalized design process, Quality Function Deployment (QFD), into a small-to-medium sized company (SME) for the design and manufacture of an innovative 'hybrid' door. QFD, originally developed in large organizations, is a powerful link tool for capturing customer requirements and aspirations and evaluating how well these can be met or exceeded using product attributes. The extent to which the approach can be adapted to suit SME requirements and successfully embedded within such a company to promote a cultural shift in design thinking is not well understood. A strategic partnership was formed between Ulster University and a local engineering SME through the UK's Knowledge Transfer Partnership (KTP) programme to design and bring to market an innovative door system. The QFD philosophy has been used to transform the in-house design process and to embed this new approach within the company. The problems and challenges encountered, such as training needs, cultural change, SME inertia, and the generalist nature of roles typical of an SME are explored and the success factors for successfully embedding the QFD approach are identified and explained.

IEEM18-P-0324

**Continuous Improvement of Industrial Engineering Education Based on PDCA Method and Structural Importance**

Yaqi GUO, Hengyi GAO, Zhiqiang CAI, Shuai ZHANG, Fangyu HU
*Northwestern Polytechnical University, China*

Industrial engineering has played an important role in all fields of industry since its emergence in the early 20th century. The industrial engineering education in universities of China originated in 1992. Although it has developed rapidly, there is still a far distance from foreign universities. Industrial engineering education must be improved continuously. This is the only way to make the industrial engineering students meet the requests of industrial manufacturing. First of all, the industrial engineering teaching program of Northwestern Polytechnical University, China is studied in this paper using the PDCA (plan-do-check-action) cycle model. Next, we analysis structural importance of different courses that to obtain their influence degrees on undergraduate education. Then, the optimization of industrial engineering education can be optimized. Finally, correctness and validity of this model can be verified through the comparative analysis of questionnaires and the 2013, 2014 industrial engineering teaching program of Northwestern Polytechnical University.

IEEM18-P-0508

**Effect of Needham Model Based Interactive Multimedia Material Towards Students' Achivement in Digital Logic Gates**

M.F. LEE, S.N. MAT YUSOFF
*Universiti Tun Hussein Onn Malaysia, Malaysia*

This study aims to evaluate the effect of using interactive multimedia material towards students' performance in logic gates of Electrical and Electronic subjects. The content delivery method in this interactive multimedia material was employed a constructivist theory approach, which is Needham Model. Meanwhile, ADDIE model was used as guideline during the material development process. Quasi-experimental that involved of four teachers and 56 students was employed as research design for this study. Questionnaire, pretest and posttest were used as research instrument. The data were analyzed using mean score, standard deviation, paired-sample t-test, and ANCOVA. Findings showed that the perception of the users towards the aspects of content, teaching strategy design, presentation design and technical of this interactive multimedia material were at the high level. Evaluation on the effectiveness of the interactive multimedia material from the aspect of students' performance showed that there was an improvement in academic performance. As a conclusion, teachers were encouraged to use interactive multimedia material based on Needham Model to enhance student performance in digital logic gates as well as other topics in Electronic Engineering.

IEEM18-P-0042

**An Approach to Integrate Skills Development in Open Distance Learning (ODL) Environment: Part 2**

Tlotlollo HLALELE, Mothibeli PITA, S. SUMBANYAMBE
*University of South Africa, South Africa*

ODL education has been developing rapidly in Southern Africa recently. The system involves study that is not limted by geographical boundaries and in practice tend to extend knowledge beyond that is offered by contact or tradional univeristies. At the University of South Africa (UNISA), adoption of this method on theoretical knowledge has been successful. The practical component has not been effective, particularly in Electrical and Mechanical Engineering Curriculum. This has resulted in high volume of dropouts, contributed to unskilled graduates and unemployment growth within the academic space. In this paper, an emerging centered learner and a developed centered learner method is proposed. These two methods simulate unemployed and employed students who study part-time at the university in their first entry level. Employed are classified as developed centered learner (DCL) and unemployed, newly matriculated, as emerging centered learner (ECL). The results show a measure of correlation between the two groups of students in their learning method. Developed centered learner attained a better pass-rate than an emerging centered learner. A conclusion is made by drawing attention to the integration of practical curriculum elements and lasting understanding of theory in practice for ODL graduates.

IEEM18-P-0271

**Competency-based Assessment of Industrial Engineering Graduates: Basis for Enhancing Industry Driven Curriculum**

Ryan Jeffrey CURBANO, S. G. Y. MADRID, C. T. NARVACAN, J. R. PUENTENEGRA
*Lyceum of the Philippines Laguna, Philippines*

The main objective of the study was to assess the competency, skills, and values of Industrial Engineering graduates as well as courses relevant to the industry need. The researchers used purposive sampling as research design of the study. Due to limited time of the study a total of 142 respondents answered the survey questionnaire through online. The statistical treatment used in the study were frequency percentage, weighted mean and chi-square. Results showed that majority of the respondents working at Electronics industry, college degree holder, 1-3 years of service, quality assurance engineer and working as technical. The assessment in terms of competency production planning and control function was highly important. In terms of skills having strategic and critical thinking was considered highly important. In terms of values industry considered highly important having moral values in the workplace. The courses identified as highly important are the strategic planning and control, engineering ethics and values, safety management, and probability and statistics. It was found out that in terms of relationship skills and values were significant while competencies was not significant to job classification.

IEEM18-P-0319

**Training in Maintenance Engineering. Curricula Proposal**

Miguel DIAZ-CACHO[1], Jorge MARCOS-ACEVEDO[1], Javier SANCHEZ-REAL[1], Salah CHIKH[2]
[1]*University of Vigo, Spain*
[2]*University of Science and Technology, Hourari Boumediene (USTHB), Algeria*

Industrial maintenance is a key activity to be considered in the productive process. Despite its importance, the specific studies to train highly qualified professionals in industrial maintenance are null or rare. Therefore, this paper suggests the topics and subjects to be included in an University Curricula to train Industrial Maintenance Engineers. This paper focuses on a practical feature of the training by presenting an already tested Project Based Learning (PBL) methodology where the local companies are involved. Results show the feasibility of the methodology and specially suggest the implementation of this methodology into the proposed Maintenance Engineering Curricula.

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| **Session** | Operations Research 1 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside III |
| **Chairs** | Weiwei CUI, *Shanghai University*,<br>Norbert TRAUTMANN, *University of Bern* |

IEEM18-P-0034

**Generic Framework for Stress Testing of Real-time Systems**

Afshan NASEEM, Asad Waqar MALIK, Shoab Ahmed KHAN
*National University of Sciences and Technology (NUST), Pakistan*

The development and sustainability of military equipment for a country is much dynamic for its national interests. Although this practice is not easy, because in this technology drenched milieu, the military environment is evolving and changing constantly. It is expensive and time consuming as well. Modeling and simulation are used in logistic real-time systems to make them more effective. Many studies have used these techniques for testing of real- time systems. No specific study has been found performing the stress testing of time-critical situations of real-time. With no exaggeration, stress testing of real time systems is crucial to define its characteristics. Such systems are difficult to test in a real environment because it requires a lot of incursions. The attack angle and formation are some other perilous functions. This article not only presents an innovative framework for the stress testing of an Air Defense System in which modular tactic is adopted to design and implement the system, but also performs tests to prove its validity. This framework is proposed to test an air defense system. The proposed framework will provide decision makers with prophylactic situations and help in making decisions more effective in time-critical situations of Air Defense avoiding unnecessary loss in extreme stress environments.

IEEM18-P-0056

**A Distributionally Robust Chance Constrained Model to Hedge Against Uncertainty in Steelmaking-continuous Casting Production Process**

Shengsheng NIU, Shiji SONG, Jian-Ya DING
*Tsinghua University, China*

This paper proposes a distributionally robust chance constrained (DRCC) model to handle the daily small disruptions in steelmaking and continuous casting process. The processing time of each charge is assumed to be a random variable belonging to an ambiguous distribution set which is described by support set, mean and variance information. The proposed DRCC model aims to minimize the objective function and at the same time ensure each constraint is established with a certain probability, i.e., distributionally robust individual chance constrained (DRICC) model, or all constraints together are established with a certain probability, i.e., distributionally robust joint chance constrained (DRJCC) model even when the uncertain parameters are in their worst cases. We transform DRICC model into a linear programming model and propose an iterative improvement method to tackle the DRJCC model. To test the robustness of the models, we evaluate the obtained robust schedules under different distributions of the processing time. Experimental results show that both DRCC models are able to provide more robust schedules than compared to the deterministic model.

IEEM18-P-0085

**Capacitated Assortment Optimization with Pricing under the Paired Combinatorial Logit Model**

Daihan ZHANG[1], Zhenghe ZHONG[1], Chuning GAO[1], Rui CHEN[2]
[1]*Sparkzone Institute, China*
[2]*Tsinghua University, China*

In this paper, we investigate the capacitated assortment optimization problem with pricing under the paired combinatorial logit model, whose goal is to identify the revenue-maximizing subset of products as well as their selling prices subject to a known capacity limit. We model customers' purchase behavior using the paired combinatorial logit model, which allows for covariance among any pair of products. We formulate this problem as a non-linear mixed integer program. Then, we propose a two-step approach to obtain the optimal solution based on solving a mixed integer program and Lambert-W function. To further improve its performance, we design a greedy heuristic algorithm and a greedy randomized adaptive search procedure to obtain high-quality solutions so as to balance the tradeoff between accuracy and computational efficiency. A series of numerical experiments are conducted to gauge the efficiency and quality of our proposed approaches.

IEEM18-P-0184

**A Lagrange Multiplier-based Regularization Algorithm for Image Super-resolution**

Bai LI, Lixin MIAO, Canrong ZHANG, Wenming YANG
*Tsinghua University, China*

In this article, we propose a Lagrange multiplier-based model for the regularization problem encountered in the image super-resolution. By establishing the equivalent relationship between the regularization model and the Lagrange multiplier-based model, we provide another version of the physical meaning of the regularization parameter. The nonlinearly monotonic relationship between the regularization parameter and the Lagrange multiplier is proved by contradiction. To solve the regularization parameters, a two-phase iterative method based on the Lagrange multiplier-based model is presented. Furthermore, we apply the propagation filtering method to smoothen the super-resolution image. A QR code image super-resolution is employed to validate the effectiveness of the proposed method.

IEEM18-P-0097

**A Genetic Algorithm for Generating Travel Itinerary Recommendation with Restaurant Selection**

Budhi WIBOWO, Monica HANDAYANI
*Universitas Gadjah Mada, Indonesia*

Experiencing local food while making a trip has a significant impact on the overall tourist experience. No wonder that visiting local restaurants has become an integral part of a tourist itinerary. Nevertheless, manually planning a travel itinerary is a complicated and time-consuming task. This study aims to introduce and solve a planning problem for generating a high-quality itinerary consisting of an efficient route to visit tourist attractions and restaurants at a proper time. We modeled this problem as a rooted orienteering problem with time windows, where the selected restaurants should be scheduled within lunch and dinner time. The objective is to maximize the total collected utility in each visited locations while maintaining the total travel time under a specific constraint. We developed a Genetic Algorithm to solve the problem and presented Yogyakarta city as a case study. The result suggested that the developed algorithm can effectively solve the problem and generate a satisfactory solution with a high total utility value.

IEEM18-P-0386

**A Continuous-Time Unit-Based MILP Formulation for the Resource-Constrained Project Scheduling Problem**

Mario GNÄGI, Adrian ZIMMERMANN, Norbert TRAUTMANN
*University of Bern, Switzerland*

In the basic resource-constrained project scheduling problem RCPSP, one aims at selecting starting times for the tasks of a project such that the project makespan is minimized and the project schedule is precedence- and resource-feasible. There is a considerable body of literature about problem-specific solution methods; recently, mixedinteger linear programming (MILP) formulations for the RCPSP have received increasing attention. We suggest a new MILP formulation that utilizes a set of continuous variables indicating the starting times of the project tasks, and three sets of binary variables indicating the assignment of resource units to the project tasks, the potential overlapping of the project tasks, and the sequencing of the project tasks. In a comparison with ten reference formulations from the literature, it is found that the advantages of this new formulation are its simple structure, enhanced flexibility, and superior or comparable performance, particularly when the range of the tasks' durations is relatively high.

IEEM18-P-0509

**A Rule-based Greedy Algorithm to Solve Stowage Planning Problem**

Dalia RASHED, Mohamed GHEITH, Amr ELTAWIL
*Egypt-Japan University of Science and Technology, Egypt*

The Stowage Planning problem is the problem of allocating containers to specific slots on the vessel in each container terminal on the vessel's route. The objective is to minimize the total number of container loading and unloading movements. Sometimes an unnecessary movement occurs when the desired container is located beneath another one that is not desired at the moment. This unnecessary movement is called shift, shifts are time and money consuming. In this paper, a rule-based greedy algorithm was applied to solve the problem. The algorithm was tested against 45 instances found in the literature and proved its efficiency and effectiveness.

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| **Session** | Big Data and Analytics 1 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside IV |
| **Chairs** | Soo Beng KHOH, *Innovation 360 Group*,<br>Ruth COBOS, *Universidad Autonoma de Madrid* |

IEEM18-P-0590

**Sentiment Analysis of Airport Customer Reviews**

Arian DHINI, Dita Anggraeni KUSUMANINGRUM
*Universitas Indonesia, Indonesia*

Customer satisfaction plays an important factor for the business' success, particularly in aviation industries. One way to measure customer satisfaction level is using customer reviews. This study evaluates and analyzes customer reviews of services and facilities of Soekarno-Hatta Airport as the largest airport in Indonesia using text mining approach of sentimental analysis. Support vector machine and Naïve Bayes classifier are classification techniques used to identify positive or negative sentiments contained in review sentence. The results of classification techniques for sentiment analysis in this study indicate that support vector machine has higher accuracy value than Naïve Bayes Classifier in analyzing sentiments. The output of this study is evaluation in improving the quality of airport services and facilities, identification of service aspect and airport facility which become the strength and weakness as well as improvement prioritization of aspects that still become weakness in achieving desired level of customer satisfaction.

IEEM18-P-0381

**Understanding Adoption of Big Data Analytics in China: From Organizational Users Perspective**

Kin Meng SAM[1], Chris CHATWIN[2]
[1]*University of Macau, China*
[2]*University of Sussex, United Kingdom*

Big data is a recent technology employed by companies to achieve competitive advantage. The investment of big data technologies in USA was estimated at more than 30 billion USD in 2016. However, the investment of big data technologies in China was relatively small in 2016. Grounded in the Technology-Organization-Environment (TOE) framework, this study analyzes the factors that can affect Big Data Readiness, which further affect attitudes and intention of adopting big data. The industries can make use of the results as reference to utilize big data for a more productive business.

IEEM18-P-0366

**A Local-branching Heuristic for the Best Subset Selection Problem in Linear Regression**

Tamara BIGLER, Oliver STRUB
*University of Bern, Switzerland*

The best subset selection problem in linear regression consists of selecting a small subset with a given maximum cardinality of a set of features, i.e explanatory variables, to build a linear regression model that is able to explain a given set of observations of a response variable as exactly as possible. The motivation in building linear regression models that include only a small number of features is that these models are easier to interpret. In this paper, we present a heuristic based on the concept of local branching. Such a heuristic repeatedly performs local-search iterations by applying mixed-integer programming. In each local-search iteration, we consider a different randomly selected subset of the features to reduce the required computational time. The results of our computational tests demonstrate that the proposed local-branching heuristic delivers better linear regression models than a pure mixed-integer programming approach within a limited amount of computational time.

IEEM18-P-0049

**Early Detection of Events as a Decision Support in the Milk Collection Planning**

Atefe ZAKERI, Morteza SABERI, Omar KHADEER HUSSAIN, Elizabeth CHANG

*University of New South Wales, Australia*

Milk is a highly perishable product which needs to go through an almost perfect cold chain in a milk supply chain to maintain its highest quality. To satisfy the ever-increasing demand from dairy processors to be provided with raw milk at highest quality, transporters need to ensure the milk which is collected from farms has been stored properly before the pickup occurs; i.e., from the starting point of the production in the farm until the pickup event. To address this issue, in this paper, we have proposed a model for early detection of events in a milking cycle. Using the online data coming from IoT sensors, we detect and recognize various events in a milking cycle as close as possible to their real happening in the tank. This provides the transporter with a comprehensive, clear picture of the milk cooling performance while being stored in the farm. It also assists them in making smart decisions on pickup planning and scheduling.

IEEM18-P-0065

**Smart City Application and Analysis: Real-time Urban Drainage Monitoring by IoT Sensors: A Case Study of Hong Kong**

Kin Lok KEUNG, Carman Ka Man LEE, Kam Hung NG, Chun Kit YEUNG

*The Hong Kong Polytechnic University, Hong Kong SAR*

Heavy downpours always bring trouble to Hong Kong during the rainy season. Severe rainfalls and flooding will delay the transportation, cause the loss of property or even kill lives. However, there is limited research that investigated the problems of the drainage system and stormwater management. Regarding the Internet of Things (IoT) development and successful example of IoT application, Hong Kong has the potential to become a smart city. The smart drainage system is one of the possible research directions. A prototype IoT system is decided with hardware and software. Experiments are conducted to collect the data. The data is then used to train the Artificial Neural Network. The analysis and predictive maintenance solutions are proposed to help the stormwater and drainage management. The results show that a well-trained algorithm can predict the drainage situations. The cross-validated results showed that it is reliable and able to predict most of the testing inputs. This paper aims at benefit to Hong Kong drainage service and the society.

IEEM18-P-0072

**Cultivating Growth and Radical Innovation Success in the Fourth Industrial Revolution with Big Data Analytics**

Magnus PENKER[1], Soo Beng KHOH[2]

[1]*Innovation 360 Group AB, Sweden*

[2]*Innovation 360 Group AB, Malaysia*

Innovation is key for any organization's continued success. Some companies are more successful than others, so what are their secret formulas? The authors investigated data on innovation collected during a 52-month period (1 January 2014 to 1 May 2018) from more than 2,900 companies in 105 countries. They found that two distinct innovation strategies (incremental and radical) are widely practiced. An in-depth investigation and innovation analytics were performed on those organizations using the data collected by the InnoSurvey® tool with help from licensed practitioners worldwide. It was concluded that radical innovators are better at linking organizational strategy and capabilities than incremental innovators. As the link between strategy and capability is highly correlated to financial performance (Jaruzelski, Staack, and Goehle, 2014), radical innovators, therefore, have better chances of success in future business than incremental innovators, which is a new insight, since incremental innovators are often perceived as being more stable, more mature, and more risk averse.

IEEM18-P-0339

**Clustering Subway Station Arrival Patterns Using Weighted Dynamic Time Warping**

Rui WANG[1], Nan CHEN[1], Chen ZHANG[2]

[1]*National University of Singapore, Singapore*

[2]*Tsinghua University, China*

To better plan and schedule public transportation resources, it is crucial to understand the travel demand from any location at any time. In this article, we focus on analyzing the demand patterns for subway stations based on the tap in data at each station entrance. It has been reported that accurately predicting the arrival rates can help improve the travel experience, and prevent over-crowding in train carriages or platforms. We proposed a weighted dynamic time warping approach (WDTW) to adaptively cluster similar patterns from multiple stations. These similarities can be exploited in improving the prediction performance because spatial temporal information is better utilized. We demonstrated our approach and its effectiveness through a real data example.

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| **Session** | Project Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside V |
| **Chairs** | Budi HARTONO, *Universitas Gadjah Mada*,<br>Fan LI, *Tsinghua University* |

IEEM18-P-0033

**Hybridization of Development Projects Through Process-related Combination of Agile and Plan-driven Approaches**

Michael RIESENER, Christian DÖLLE, Johanna AYS, Julian AYS
*RWTH Aachen University, Germany*

In times of volatile markets and heterogeneous customer demands, it now seems inevitable for the manufacturing industry to deal with iterative development cycles in order to maintain process flexibility and to be able to react to unforeseen environmental changes. Since the implementation of agile methods is not purposive for every development process of a physical product, the usage of hybrid approaches, a development procedure resulting of the combination of agile and plan-driven methods, is emerging as an alternative. According to that, this paper presents a research framework that shows how hybrid development processes can enable the effective and efficient implementation of physical product development projects by ensuring a target-conform and context-based combination of agile and plan-driven approaches.

IEEM18-P-0414

**Risk of Quantity Increase in Vietnamese Construction Projects**

Soo Yong KIM[1], Ha Duy KHANH[2], Van Thanh BINH[2]
[1]*Pukyong National University, South Korea*
[2]*Ho Chi Minh City University of Technology and Education, Viet Nam*

Quantity increase is a common problem in the construction sector. The main purpose of this study is to determine potential factors causing quantity increase in construction projects using governmental budgets. This study then points out some relevant solutions to reduce the occurrence of quantity increase. There were totally 18 factors causing quantity increase found from the literature review and expert's opinion. A structured questionnaire, which was designed with the 5-point Likert scale, was used to collect data. The results of analysis showed that these factors have strong impact on the quantity increase of the construction projects. The consensus level between project parties in ranking the factors of quantity increase according to frequency index, severity index, and importance index are quite high. In addition, the risk of cost due to the quantity increases was quantitatively analyzed by using Monte Carlo simulation through 21 school construction projects.

IEEM18-P-0207

**A Literature Review on Approaches for the Retrospective Utilisation of Data in Engineering Change Management**

Armin TALE-YAZDI, Niklas KATTNER, Lucia BECERRIL, Udo LINDEMANN
*Technical University of Munich, Germany*

The paper provides a comprehensive literature research regarding the field of data analysis in engineering change management. The focus is on a posteriori analysis methods of engineering change data. After an introduction to the topic, identified a posteriori data analysis procedures in the engineering change management are listed and supplemented by further a priori analysis procedures. Furthermore, the a posteriori data analysis methods presented are compared on the basis of a catalogue of requirements.

IEEM18-P-0192

**Data Analysis in Engineering Change Management – Improving Collaboration by Assessing Organizational Dependencies Based on Past Engineering Change Information**

Niklas KATTNER, Jan MEHLSTAEUBL, Lucia BECERRIL, Udo LINDEMANN
*Technical University of Munich, Germany*

Successful communication and collaboration within companies is crucial for competitive product development. Hence, this paper presents an approach to identify organizational dependencies based on past engineering change information using structural complexity management and graph-based analysis. It therefore introduces a meta-model describing the interrelations in change information and defines rules to identify dependencies. Furthermore, it applies the method on a data set of engineering change requests to evaluate the approach.

IEEM18-P-0209

**Dimensioning a Product Development Project Portfolio Using a Closed Queueing Network**

Jesper FINK ANDERSEN[1], Carsten LAURIDSEN[2], Bo Friis NIELSEN[1]
[1]*Technical University of Denmark, Denmark*
[2]*Novozymes, Denmark*

New product development processes are difficult to model as they are subject to high variability and are hard to monitor. In multi-project environments, one particular problem is to quantify the effects of changing the number of projects that run concurrently. In this paper, a closed queueing network model of the flow of projects in a product development system is presented. The model is evaluated using discrete-event simulation. Using a relation between a project's monetary value and the time it spends in the system, an optimal number of concurrent projects is determined. Application of the model and results are shown for a case study of a Danish biotechnology company. Results show, that the value generated by the system can be increased by 17.5 percent by adjusting the total number of concurrent projects and by terminating low-value projects midway. Though the model is tailored to a specific system, it contains many features relevant for new product development systems in general.

IEEM18-P-0027

**The Contextual Utility of Agile Project Management Maturity**

Budi HARTONO[1], Dennis KUNARSITO[2], Citra NUDIASARI[2]
[1]*Gadjah Mada University, Indonesia*
[2]*Universitas Gadjah Mada, Indonesia*

This study offers both theoretical proposition and empirical evidence on the efficacy or utility of agile project management maturity within the project-based organization context of Information and Communication Technology (ICT) firms in Indonesia. It is conjectured that the association between maturity and performance of the respective firms is moderated by project attributes – i.e. criticality, and emergent complexity. A cross-sectional survey is carried out with targeted respondents of senior management and project practitioners of ICT firms which implement agile approaches at varying maturity levels. Around 34% of response rate is achieved for 355 invitations with a final sample size of 59. The result suggests that the association between agile maturity and performance is positively moderated by project emergent complexity. Project criticality is not found to be a moderating variable.

IEEM18-P-0479

**A BIM-based Labor Crew Moving Path Obstruction Detection Approach**

Qiankun WANG , Zeng GUO, Qianyao LI, Tingting MEI, Shi QIAO, Weiwei ZUO
*Wuhan University of Technology, China*

The Architecture/Engineering/Construction industry is labor-intensive. There are numerous labor crews working on site within confined workspaces. As labor crews often move from one place to another due to workspace alternation or material transportation, it is very important to detect and eliminate the potential obstacles that obstructs their moving paths in advance. This paper proposed a Building-Information-Modelling (BIM) based labor crew path analysis approach which contains five main steps: labor crew modelling, building component classification, site map generation, automated path searching and path obstruction detection. The correctness of the method is verified by a validation test. The result of this paper shows that the proposed approach is capable of detecting potential path obstructions so as to provide support for in-door or out-door moving path optimization for labor crews.

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| **Session** | Manufacturing Systems 2 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside VI |
| **Chairs** | Zhe ZHANG, *Nanjing University of Science and Technology*,<br>Safwan ALTARAZI, *German-Jordanian University* |

IEEM18-P-0079

**An Application of Just-in-time as a Strategy for Competitive Advantage: The Case of a Non-alcoholic Company in South Africa**

Sambil Charles MUKWAKUNGU, Eric BAKAMA, Magaly Madeleine BOLIPOMBO, Charles MBOHWA
*University of Johannesburg, South Africa*

This paper's main objective is to enlighten the readers on the benefits of a good application the Just-In-Time (JIT) approach in a local South African soft drink manufacturing plant with the aim of improving the company's performance. The study followed a mixed approach, combining both the qualitative and quantitative design approach. In order to collect data, interviews with the employees that constituted the sample were conducted before they later responded to a questionnaire to collect qualitative data. Results demonstrates that the company does not use JIT as a manufacturing strategy. This explained the difficulty experienced with many aspects of the production such as: demand management and forecasting, supply chain relationship and inventory control. A recommendation made in this study was to actively apply JIT in the manufacturing process as this practice would help the company improve its performance as far as the inventory control, the relationship with suppliers and the demand management and forecasting are concerned.

IEEM18-P-0133

**Environmental Management Systems in Thai Small and Medium-Sized Manufacturing Firms**

Pittawat UEASANGKOMSATE[1], Chidchanok WONGSUPATHAI[2]
[1]*Kasetsart University, Thailand*
[2]*Electricity Generating Authority of Thailand, Thailand*

This study is aimed at examining the internal and external factors influencing the implementation of an environmental management system (EMS) in Thai small and medium-sized manufacturing firms. Questionnaires were used to gather survey data, with 100 responses being received through random sampling. Multiple-regression was deployed for statistical analysis based on the research framework. The results show that thinking/perception, awareness, and legislation are the critical factors influencing EMS implementation. However, it also emerged that the level of such implementation in Thai small and medium-sized manufacturing is quite low. Hence, it is recommended that Thai SMEs should aim to enhance their EMS implementation through focusing on the identified critical factors, thereby ensuring an environmentally friendly manufacturing industry in the future.

IEEM18-P-0159

**Similarity-search and Prediction Based Process Parameter Adaptation for Quality Improvement in Interlinked Manufacturing Processes**

Jacqueline SCHMITT, Jochen DEUSE
*TU Dortmund University, Germany*

Due to the steadily increasing global competition, manufacturing companies are forced to constantly improve their products and processes. In this context, real-time process adaptation based on inline quality monitoring using predictive data mining techniques presents a promising approach to sustainably increase manufacturing process efficiency and improve product quality. This paper presents an approach to improve process and product quality in manufacturing through process parameter adaptations utilizing quality prediction models and similarity search algorithms. The approach enables a data-driven decision support for process control in interlinked manufacturing processes.

IEEM18-P-0569

**An Integer Linear Programming Approach for the Combined Cell Layout Problem**

Miguel F. ANJOS[1], Philipp HUNGERLAENDER[2], Kerstin MAIER[2]
[1]*Polytechnique Montreal, Canada*
[2]*Alpen-Adria-Universität Klagenfurt, Austria*

The Combined Cell Layout Problem aims to minimize the material handling costs in a cellular manufacturing system with at least two cells where processing occurs, and in the presence of pieces that need to be processed in more than one cell. The alignment of the machines in each cell can follow a row or a circular layout. We propose an Integer Linear Programming approach for solving this problem. In a computational study we show that our approach is able to solve instances with up to 240 machines arranged in 10 cells to optimality within one minute.

IEEM18-P-0091

**Reliability Analysis for a Divisional Seru Production System with Stochastic Capacity**

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

The system reliability plays an important role for evaluating the stability of a production system. Seru production system has been proven to be more flexible, efficient, and responsive than traditional assembly lines. This paper measures the system reliability of a seru production system, in which the capacity of each worker is not certain but stochastic by reason of the possibilities such as worker absences, contingent physical and/or emotional influences. In today's fast-paced society, time has naturally become an important factor in business competition. In this paper, the reliability is defined as the probability that a seru production system with stochastic capacity can satisfy the makespan for the demand within the due date. An efficient solution method is designed to acquire the system reliability for seru production systems. A numerical example with three cases (i.e. three different seru construction) is presented. The relevant higher reliability will be found by comparing the results under different seru constructions and different order allocations in case one.

IEEM18-P-0226

**Predicting the Tensile Strength of Extrusion-blown High Density Polyethylene Film Using Machine Learning Algorithms**

Firas ALHINDAWI, Safwan ALTARAZI
*German-Jordanian University, Jordan*

This paper explores the utility of supervised machine learning algorithms in predicting the tensile strength of high density polyethylene film produced by extrusion-blown molding process. Three algorithms were used: Artificial Neural Networks, Decision Tree, and k-Nearest Neighbors. Eleven input parameters, five materials related and six process related; were modeled in the algorithms. The application of algorithms demonstrated their capability in predicting the intended property of the extrusion-blown process products.

IEEM18-P-0449

**Investigation of Assessment and Maturity Stage Models for Assessing the Implementation of Industry 4.0**

Marco UNTERHOFER[1], Erwin RAUCH[1], Dominik T. MATT[1], Salinee SANTITEERAKUL[2]
[1]*Free University of Bozen-Bolzano, Italy*
[2]*Chiang Mai University, Thailand*

The proclamation of the fourth industrial revolution shocked the industrial world. Suddenly almost every modern enterprise aspired to become a proper "Industry 4.0" factory. In the industrial environment, a curious feeling of uncertainty grew. In order to overcome the negative perception, proper means, which establish the implementation grade and the needs for a specific Industry 4.0 measure of enterprises, have to be identified and scrutinised. The root cause can be explained quite straightforwardly: improvements in an Industry 4.0 perspective can be achieved if and only if the measurability is provided. This work analyses the state of art of existing Industry 4.0 assessment and maturity stage models. Results of this research will be used in further research to develop a specific assessment model for small and medium-sized enterprises in order to assess their progress in implementing Industry 4.0.

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| **Session** | Decision Analysis and Methods 2 |
| **Date** | 17/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside VII |
| **Chairs** | Hao YU, *UiT The Arctic University of Norway*,<br>Nur Aini MASRUROH, *Gadjah Mada University* |

IEEM18-P-0120

**Data-driven Defense Strategies for an Infrastructure Network against Multiple Interdictions**

Jing JIANG, Xiao LIU
*Shanghai Jiao Tong University, China*

Critical infrastructures are significant for national security, economic development and social stability. With the development of economic globalization and information technology, the increasing network complexity and dynamic information have brought challenges to generate data-driven defense strategies for an infrastructure network against multiple interdictions. In order to optimize the defense strategy dynamically, we develop a data-driven finite Bayesian Stackelberg game model among a defender and multiple interdictors. In this model, the defender, with incomplete information on the interdictors' risk attitude and objective weight, initiates to improve the network performance in the most cost-effective way; whereas the interdictor, with incomplete information on the valuation of components and effectiveness ratio, follows to destroy the network structure in the most cost-effective way. Over the dynamic interactions among the defender and multiple interdictors, the interdictor's knowledge of the effectiveness ratio is updated by Bayesian updating rule. In order to solve the proposed model, smallest-depth binary-partition based hierarchical algorithm is developed to obtain the strong Stackelberg equilibrium. Finally, the practical applicability is demonstrated by a case study of Zhi Jiang network.

IEEM18-P-0433

**Solving the Bidirectional Multi-Period Full Truckload Vehicle Routing Problem with Time Windows and Split Delivery for Bulk Transportation Using a Covering Model**

Apichit MANEENGAM, Apinanthana UDOMSAKDIGOOL
*King Mongkut's University of Technology Thonburi, Thailand*

In this paper, a covering model based on a route representation was developed for bi-directional, full truckload vehicle routing problems with time windows and split delivery of bulk transportation. The aim is to select the best routes from feasible solutions with minimum total cost. Computational experiments carried out in real-life instances indicated that the proposed algorithm was able to perform effectively.

IEEM18-P-0445

**Using Multicriteria Decision Making Methods to Manage Systems Obsolescence**

Imen ZAABAR, Yvan BEAUREGARD, Marc PAQUET
*École de Technologie Supérieure, Canada*

Systems obsolescence may cause huge invisible internal cost through mis-judgment. It leads to many defects related to the manufacturing system and its environment. While its management is complex, composed by multiple factors and stakeholders, the current tools are still minimal and purely quantitative using cost optimization only. Considering different actors seems essential to ensure a reliable mitigation and resolution strategy. This paper aims to develop an MCDM model specific to obsolescence management by expanding decision criteria and using a non-compensatory and dynamically weighted ELECTRE III approach. The goal is to ensure a robust, sustainable and green manufacturing ecosystem. The MCDM tool was applied to the problem and performed in two case studies from the literature, using DIVIZ platform. The model results were compared to those from previous studies. They show that the decision made changes significantly affecting the manufacturing performance.

IEEM18-P-0144

**Assessing Information Security Risk Using Markov Chain**

Daniel TSE, Xiaoting PAN, Yuan ZONG, Jiaxi LIU, Qinyan YANG
*City University of Hong Kong, Hong Kong SAR*

[1] Information leakage occurs several times in universities in recent years. In this article, we propose a risk assessment method based on Markov chain for universities to evaluate risks using menace index. After identifying the assets and threats in universities, we use a survey data of university risks to find out the probability of the occurrence of each threat. Markov chain is used to indicate the probability of future. The result of a predicted severity sequence of risks can be useful to universities which risks they should pay more attention to. Two methods are used in the Markov part: One is the traditional way to set the initial probability matrix; the other is a statistical probability to present each menace in the initial probability matrix. After comparison, we found that the second method is more precise for risk assessment.

IEEM18-P-0276

**A Comparison of Two Location Models in Optimizing the Decision-making on the Relocation Problem of Post Offices at Narvik, Norway**

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

Since 2013, the postal service provider in Norway: Posten has implemented a new strategic plan to close their large post offices across the country for improving the cost and operational efficiency. Instead, with the cooperation with large retailers, the local postal service is provided at the Posten sub-branches at some supermarkets. In this paper, an optimization problem for relocating the post offices at local supermarkets at Narvik, Norway, is investigated. For resolving the optimization problem, two classical location models: p-median problem and maximal covering problem, are employed. The problems are coded and resolved with Lingo optimization solver. The result has provided the optimal relocation plans for the sub-branches of Posten at Narvik with respect to different scenarios. In addition, a comparison between the optimal strategy and the current relocation plan is given in order to show the improvement on the system performance.

IEEM18-P-0322

**The Effect of Decision Maker's Risk Attitude on Inventory Policy: An Empirical Studies**

Nur Aini MASRUROH, Elok PITALOKA, Wangi PANDAN SARI
*Universitas Gadjah Mada, Indonesia*

Conventional inventory models assumed that the decision makers are risk neutral. However, in reality, some are risk seeking, and the other are risk averse persons. This personal degree of risk preference may result in different policy. This paper investigate the effect of decision makers' risk attitude in determining the inventory policy. Two case studies are used. Each case study represents different conditions. Optimal order quantity decisions for restaurants are used as the first case study. For restaurants, inventory should be managed efficiently since their business manage perishable goods and has short selling period. Twenty restaurants with similar market segments are observed. In the second case study, we observe how a multinational company determine its raw materials servive levels. Based on the two case studies, it shows that risk attitudes do influence the inventory policy. Also we found that personal risk attitude may not constant. It may change for some reasons.

IEEM18-P-0599

**Quantitative Assessment of Economic, Social and Environmental Impacts of Critical Infrastructure Disruptions**

Agnieszka BLOKUS
*Gdynia Maritime University, Poland*

Metrics for critical infrastructure resilience quantification and performability assessment are proposed to help in understanding the infrastructure resilience and identifying its weak spots. Analysis of critical infrastructure performance and its behavior during and after the occurrence of malfunctions and negative impacts of disruptive event of infrastructure functioning is performed through quantitative assessment. Interactions between infrastructures using indices of impact of malfunctions in them are analyzed. Proposed metrics are also concerned with demands ranging and operating and environmental conditions having influence on unrealized tasks.

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| **Session** | Supply Chain Management 3 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Ballroom I |
| **Chairs** | Charles MBOHWA, *University of Johannesburg*, Mohammed Woyeso GEDA, *The Hong Kong Polytechnic University* |

IEEM18-P-0161

**Redistribution Problem of Relief Supply for Post-disasters**

Etsuko NISHIMURA, Kentaro UCHIDA
*Kobe University, Japan*

The great earthquakes have occurred in various places of Japan after an interval of several years. After the disaster occurred, it seems that some shelters have relief oversupply, others have lacked them. Since some survivors cannot stay at shelters for some private reasons, they must stay at their home even if the lifeline stops. This paper proposes a methodology to redistribute the relief oversupply at a shelter to other locations such as other shelters and elderly care homes with relief shortage around one week passed from the disaster occurrence as the beginning of the planning horizon. From the computational results, regardless of the balance between total volume of relief oversupply and that of relief shortage, our approach can find the locations with or without relief supply.

IEEM18-P-0489

**Analysis of Warranty Policy in Reverse Supply Chain Environment for Circular Economy**

Ammar ALQAHTANI[1], Surendra M. GUPTA[2]
[1]*King Abdulaziz University, Saudi Arabia*
[2]*Northeastern University, United States*

The fact that a consumer is frequently uncertain about the quality of a remanufactured product that is purchased, and unsure if the product will render adequate services, might lead to a decision of not buying it. With such apprehension on the part of consumers, manufacturers could try to assure consumers about the durability of the remanufactured products by offering them warranties on such products. This paper presents an approach to determine how to predict a renewable one-dimensional Pro-Rata Warranty (PRW) period for the components, materials and products derived from EOL products using the information about the usage of each and every EOL product on hand to meet components, recycled materials and products demands while minimizing the cost associated with warranty and maximizing manufacturer's profit. A simulation model is proposed to optimize the system and predict, the optimum warranty period that should be assigned to each and every disassembled component and the remanufactured products. Different scenarios are examined using simulation and a case example is presented to illustrate model's applicability.

IEEM18-P-0331

**A Green Vehicle Routing Method for the Regional Logistics Center**

Jun-Der LEU[1], Andre KRISCHKE[2], Yi-Ping LEE[1], Larry Jung-Hsing LEE[1], Yi-Wei HUANG[1]
[1]*National Central University, Taiwan*
[2]*Munich University of Applied Sciences, Germany*

A regional logistics center is to provide an effective distribution service using the least transportation capacity to fulfill local demands. According to the MOBILE5 Vehicle Emissions Model provided by the US Environmental Protection Agency, traveling distance and speed is significant influence factors to the carbon emissions of transportation. The logistics planning issues defined by mathematical planning models or by discrete mathematics methods, on which optimization algorithms or heuristics are developed. In reality, the traffic situations are not stable all the time. When facing traffic problems, vehicles move in low speed, in which situation the carbon emissions will increase. However, most of these models are static ones, which follow the assumptions of stable traffic and fixed traveling speed on the network so that a significant error might happened when they applied to the green logistics directly. Again, these models do not consider the issue of oil consumption and carbon emission caused by the dynamic traveling speed. In this research, the cargo flows modeling approach is developed to analyze the logistics planning scenario of the single logistics center to many demand depots in the market region, wherein both of distribution effectiveness and carbon emission will be well considered. The planning algorithms or heuristics was developed, and the computer simulation method was applied to validate the solution quality in terms of different transportation scales and traffic situations. Finally, the issue of integration of the developed methods within the framework of a logistics planning software is discussed.

IEEM18-P-0342

**Multi-period Maximal Covering Location Problem with Modular Facilities for Locating Emergency Facilities with Back-up Services**

Roghayyeh ALIZADEH, Tatsushi NISHI
*Osaka University, Japan*

In this paper, an extension of Maximal Covering Location Problem (MCLP) has been developed for locating emergency facilities, composed of discrete structural components. These components are called modules of facilities. In the developed model, demand nodes are assigned to modules first and then modules are allocated to facilities. As the demands in emergency cases vary in different time periods, the problem is studied in multi-time periods. The problem is formulated as an integer programming model. We utilize a genetic algorithm to solve the problem because of this metaheuristic's strength to solve binary optimization problems and other extension of MCLP. Computational experiments are conducted to derive managerial insights.

IEEM18-P-0417

**Intelligent Transport Systems and its Impact on Performance of Road Freight Transport in Zimbabwe**

Wiseman MUCHAENDEPI[1], Charles MBOHWA[1], James KANYEPE[2]
[1]*University of Johannesburg, South Africa*
[2]*Chinhoyi University of Technology, Zimbabwe*

The aim of this research study is to investigate on how ITS influence the overall performance of organizations in the commercial road transport sector in Zimbabwe and to analyze the challenges being faced in adopting intelligent transport systems. The study population was comprised of 50 registered road freight transport companies in Harare, Zimbabwe. Judgmental sampling method was employed. The researchers used the Krejcie and Morgan formula to determine the sample size. The sample size for the study was 44. The research established that most companies in the road freight transport sector have not implemented intelligent transport systems due to various challenges such as stiff competition from foreign transporters. The researchers recommended that companies in the road freight transport sector should use consultants to train in the proper usage of the ITS; complement vehicle tracking systems technologies with other effective traditional methods; use appropriate penalties if there is proof of vandalism; employing qualified and experienced personnel; research and development programs, change in management culture as well as accessing loans from banks and creditors for acquiring the ITS.

IEEM18-P-0510

**Supply Chain Risk Mitigation Strategies in Automotive Industry: A Review**

Ehsan DEHDAR[1], Amir AZIZI[1], Salar AGHABEIGI[2]
[1]*Islamic Azad University Science and Research, Iran*
[2]*Islamic Azad University Tehran-North Branch, Iran*

This paper studies supply chain management (SCM) of automotive industry and investigates about the types of risks that threaten automotive supply chain. These risks are identified in a way which all causes and mitigation strategies classified dependently. This study has adapted from 29 ISI and reputable journals which are indexed in Scopus (2008-2018). Based on previous researches, 10 risks, causes and mitigation strategies are identified in this industry which the most important ones include: supply risk, demand uncertainty and shortage of materials. Finally, the relevant causes and mitigation strategies for all 10 risks are identified. Later the methodologies such as Multi-Criteria Decision Making (MCDM), Multi-Objective Decision Making (MODM) and standards like ISO 31000 for handling the risks are extensively presented in this paper. For further study the authors recommended that the critical risks should be ranked and new methods and strategies and methodologies should be developed specially for the mitigation of uncertainty and fluctuation.

IEEM18-P-0367

**Customer Value Chain Analysis for Sustainable Reverse Logistics Implementation: Indonesian Mobile Phone Industry**

Hesti MAHESWARI, Gatot YUDOKO, Akbar ADHIUTAMA
*Institut Teknologi Bandung, Indonesia*

Mobile phone products contribute the largest amount of e-waste compared with other electronic devices. This is caused by the shortest product life cycle, consumptive behavior, and unintegrated linkage among stakeholders to conduct sustainable reverse logistics. They implement it separately and without considering other interest, role, needs and values as well as ignore the sound relationship. Therefore, from literature review, this research aims to identify comprehensively the expectation, values and relationship each stakeholder in doing the program by using customer value chain analysis. The result is showing the big different values and role among stakeholders but it is still needed a tight interaction among them even though they must play their own role in order to solve the severity of e-waste problems through sustainable reverse logistics implementation.

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| **Session** | Human Factors 1 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Ballroom II |
| **Chairs** | Manutchanok JONGPRASITHPORN, *King Mongkut's Institute of Technology Ladkrabang*, Titis WIJAYANTO, *Universitas Gadjah Mada* |

IEEM18-P-0496

**Barriers to Flexible Work Arrangements (FWA) in Malaysian Knowledge-based Industries**

Arnifa ASMAWI, Noor Shahaliza OTHMAN
*Multimedia University, Malaysia*

Flexible work arrangement (FWA) is a logical work design in an emerging digital economy such as Malaysia. While employee demand for greater work flexibility has been steadily increasing, the extent of actual FWA implementation in Malaysia is not equally encouraging. Hence, this exploratory study aims to investigate the barriers that are hindering the implementation of FWA in Malaysian knowledge-based industries. Self-administered questionnaire was distributed to a total of 170 managers from MSC Malaysia Status (formerly known as Multimedia Super Corridor (MSC) Status) companies. The study finds insufficient evidence to explain the low level of FWA implementation in MSC Malaysia Status knowledge-based companies. To address the knowledge gap, future research can focus on a more comprehensive assessment of the implications of FWA on both employers and employees.

IEEM18-P-0542

**A Study on Developing Customer Groups in Consolidated Financial Services Using Qualitative and Quantitative Analysis**

Yoonki KIM, Kyung-Jun LEE, Joong Hee LEE, Jihwan LEE, Yong Min KIM, Huamin JIN, Jaeyoon KANG, Myung Hwan YUN
*Seoul National University, South Korea*

Modern structure of financial services incorporates an extensive range of businesses related to money. The purpose of this research is to outline customer needs and intentions to enhance user experience in modern financial services by proposing methodology of developing customer groups in consolidated financial services. This study examines user context of consolidated financial services with methodology in extracting customer groups based on data collected through Day Reconstruction Method and Focus Group Interview. The collected data was analyzed through qualitative and quantitative approach, identifying various user contexts. This study illustrates the framework of extracting customer groups in consolidated financial services to enhance user experience in the evolving form of financial services.

IEEM18-P-0352

**Human Factors Approach for Powered Transfemoral Prostheses Conceptual Design**

Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Jutamat PINITLERTSAKUN[3], Juthamas SIRIWATSOPON[3], Gary GUERRA[3], Teppakorn SITTIWANCHAI[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*
[3]*Mahidol University, Thailand*

Prostheses are designed to replace the missing parts of body, and to increase abilities to perform daily activities. Research suggests that using powered prostheses will help improve the quality of life for the end users. Many powered prostheses have focused on only technical approaches, resulting on a lack of user acceptance. The major purpose of this research project is to provide the design of powered transfemoral prosthesis based upon human factors engineering and ergonomics approach for product design and development. Results from this study indicate that this method can be utilized to aid in the design of a microprocessor-controlled powered transfemoral prosthesis and play a significant role for product development.

IEEM18-P-0365

**Evaluation of Activation Function Capability for Intent Recognition and Development of a Computerized Prosthetic Knee**

Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Gary GUERRA[3], Uttapon KHAWNUAN[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*
[3]*Mahidol University, Thailand*

Intent recognition is a basic requirement for computerized control of the prosthetic knee. Many scholars have used an ANN (Artificial Neural Network) and applied to a computerized prosthesis with good results. Determining an appropriate activation function in artificial neural networks is an essential issue. The main objective of this paper was to investigate the appropriate ANN activation function for intent recognition via accelerometer and gyroscope sensor data to develop a computerized prosthesis. The Feed-Forward Artificial Neural Networks (FFANN) with back-propagation learning method was used to recognize activity patterns. Efficiency of two activation functions were compared to choose an appropriate ANN activation function. Results indicate that log sigmoid function (LOGSIG) performs better than a tangent sigmoid function (TANSIG).

IEEM18-P-0567

**Effect of Coffee Intake on Heat Rate Variability and Driving Performance in Sleep-deprived Condition**

Titis WIJAYANTO, Tasya ALMA, Bonifatius Bramantya WISNUGRAHA, Syam Rachma MARCILLIA, Galang LUFITYANTO
*Universitas Gadjah Mada, Indonesia*

This driving simulation study investigates the effect of coffee intake as a countermeasure on sleepiness and driving performance decrement in sleep-deprived condition. Twelve university students (mean age of 21.2 ± 0.2 years) drove following an urban route after 24 h sleep deprivation without drinking coffee or with a cup coffee containing 89.4 mg caffeine in two separate days and random order. Sleepiness level was assessed employing a subjective sleepiness scale and heart rate variability. The results show that consuming a cup of coffee before driving in sleep-deprived condition may enhance sympathetic nerve activities and improve driving performance. From these findings, it suggests that consuming coffee may be useful as sleepiness countermeasure in a sleep-deprived condition.

IEEM18-P-0315

**Dealing with Aging and Multigeneration Workforce Topics at Top Global Companies: Evidence from Public Disclosure Information**

Igancio CASTELLUCCI[1], Pedro AREZES[2], Martin LAVALLIERE[3], Nelson COSTA[2], Olivia DADALT[3], Joseph COUGHLIN[3]
[1]*Universidad de Valparaíso, Chile*
[2]*University of Minho, Portugal*
[3]*MIT AgeLab, United States*

The way organizations deal with aging employees and the way they manage the existence of a multigenerational gap within the workforce falls well within the scope some public information reporting practices, such as corporate responsibility. The aim of this study is to ascertain the level and characteristics of reporting practices on aging and multigenerational workforce among the top 50 global companies. The analysis of the public information disclosure was carried out using a quantitative approach by applying a three-stage data collection procedure. It can be concluded that companies' information disclosure about aging workforce topics is markedly low and, accordingly, it appears at a low level of relevancy on their institutional websites structure/content, as well as in their public reports. The main finding pointed out to the fact that top global companies do not widely report the way they take actions to deal with aging and multigenerational workforce challenges.

IEEM18-P-0520

**User Experience Analysis in Industry 4.0 - The Use of Biometric Devices in Engineering Design and Manufacturing**

Yuri BORGIANNI, Erwin RAUCH, Lorenzo MACCIONI, Benedikt Gregor MARK
*Free University of Bozen-Bolzano, Italy*

Biometric devices and especially eye tracking systems have been used in various sectors such as neuroscience, clinical research, training and learning, linguistics, biomechanics, ergonomics and market research. So far, there are only a few applications of eye tracking in industrial environments such as engineering design and manufacturing or assembly. The aim of this research is to review why and to what extent biometric devices such as eye tracking systems can be used in industry. The research provides an overview of the state of the art in using these technologies in industrial engineering with a special focus to design and manufacturing. In addition, this paper briefly describes two currently running test series of the research team to investigate the usability of these systems in industrial engineering.

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| **Session** | Healthcare Systems and Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Ballroom III |
| **Chairs** | Manuel De La SEN, *IIDP, EHU/UPV*,<br>Elise VAREILLES, *Ecole Nationale Superieure des Mines Albi* |

IEEM18-P-0452

**Inventory Management Information System in Blood Transfusion Unit**

Fitra LESTARI[1], Ulfah ULFAH[2], Fitri ROZA APRIANIS[1], Suherman SUHERMAN[1]
[1]*Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia*
[2]*Kampar Regency, Indonesia*

There are several blood components at the Blood Transfusion Unit to improve health services in Indonesia including Whole Blood, Packet Red Cell, Liquid Plasma, Fresh Frozen Plasma, Thrombocyte Concentrate, Kriopresipitat and Washed Erythrocyte. To provide services to consumers, this unit faces problem in the form of unbalance blood supply information and consumer demand. Consequently, management of this unit was difficult to manage the blood inventory. Aims of this study is to build an information system model using the system development life cycle approach in order to manage blood demand. Furthermore, this case adopted continuous review model to conduct the inventory policies involving safety stock, reorder point, and order quantity on each blood components. This study is able to provide benefits for Blood Transfusion Unit in order to increase service level to the customer. Further study is suggested to consider blood inventory simulation in developing several scenarios to manage blood demand.

IEEM18-P-0609

**Modified Model of Radiographer Scheduling Problem for Sequential Optimization**

Toshiyuki MIYAMOTO[1], Kuniyuki HIDAKA[2]
[1]*Osaka University, Japan*
[2]*Osaka University Hospital, Japan*

Radiographers/radiology technicians, who operate medical image diagnostic apparatuses used for examination and treatment of patients in hospitals, are limited human resources. Appropriately allocating radiographers working on a variety of medical image diagnostic apparatuses considering their skills lead to providing high-quality services to patients and providing a good working environment to staff. On the other hand, staff training is also an important issue from the long-term perspective of hospital administration. We construct a new integer programming model of radiographer scheduling for sequential optimization; we conduct a case study of the radiographer scheduling problem using a realistic instance for one month. The proposed sequential optimization is useful in terms of computation time.

IEEM18-P-0421

**Women in Informatics Engineering Career: Perspective from Hofstede Cultural Dimension and Dayak Tribe's Cultural Values**

Ika WINDIARTI[1], Agung PRABOWO[2], Muhammad Haris QAMARUZZAMAN[1], Sam'ani SAM'ANI[1]
[1]*Muhammadiyah University of Palangkaraya, Indonesia*
[2]*STMIK Palangkaraya, Indonesia*

Dayak tribe as one of biggest tribes in Indonesia has many positive cultural values for the next generation. One of the values is that women has no inferiority compare to men. Women also always encouraged being responsible and hard work in any situation as the example from their ancestor. This study investigates by details factors influencing women engineer with Dayak cultural background in performing their work in engineering field. Some interesting finding emerged include the contra productive facts that Dayak values in one of Hofstede Cultural Dimension namely Masculinity that different with national culture of Indonesia which has Femininity. Some evidences explained in this reports based on the interviews with 5 (five) women IT engineer genuinely Dayak cultural background. The research participants involve in the research as this is a phenomenological approach that means they doing live report on the research questions. The finding would be useful to develop a model of cultural dissemination about positive cultural values for the next generation.

IEEM18-P-0005

**On a Discrete-time Epidemic Model based on a Continuous-time SEIR Model Under Feedback Vaccination Controls**

Marta FERNANDEZ-FERNANDEZ, Santiago ALONSO-QUESADA, Manuel DE LA SEN, Aitor J. GARRIDO
*University of the Basque Country, Spain*

This paper discusses a discrete-time epidemic model which is based on a continuous- time SEIR (susceptible-exposed-infections-recovered) one. The equilibrium points are obtained and their local stability properties are characterized in both the vaccination- free case and the vaccination control one. The vaccination control is of an additive full linear feedback- type one involving constant gains for all the subpopulations.

IEEM18-P-0443

**Training System for the Medical Procedure of Cannulation**

Olga Katherine VERA BONILLA[1], Maria del Mar CHAVARRO CEBALLOS[1], Andres Felipe BARCO SANTA[1], Elise VAREILLES[2]
[1]*Universidad de San Buenaventura Cali, Colombia*
[2]*Université de Toulouse, France*

This document presents a learning system architecture for the practice of the cannulation procedure for medical students in cardiovascular specialization. The architecture is composed of three modules that support the practice and learning of this surgical procedure; surgical instrumentation, hygiene and simulation of the cannulation. The architecture rests on different multimedia technologies that allow an autonomous practice but that may be supervised by the teacher. In the document are discussed the context, the need for tools for this medical practice, an architectural design of the proposed system and a comparison with the current practices in medicine programs.

IEEM18-P-0251

**Managing Product Recalls in Healthcare Supply Chain**

Raja JAYARAMAN, Fatima ALHAMMADI, Mecit Can Emre SIMSEKLER
*Khalifa University, United Arab Emirates*

Product recalls in the healthcare industry contribute to significant supply chain disruptions. In the absence of a reliable product tracking communicating recall information and to recover or safe disposal of the product is extremely challenging. Healthcare product recalls are more generally classified based on severity of risk to patient life and such a classification often does not help supply chain community to assess the impact of recalls and develop alternative sourcing strategies. Hence there is critical need to assess and review healthcare product recalls with an emphasis on supply chain and logistics. In this paper we review the extant literature to identify and categorize factors that often lead to product recalls, and propose a potential approach to enable effective product tracking and recall communication using blockchain technology. The resulting information can aid research and practice community to develop suitable frameworks, models and strategies to mitigate product recalls.

IEEM18-P-0546

**Pareto Optimization for Hospital Alliance Reverse Referral Decision**

De TENG, Na LI
*Shanghai Jiao Tong University, China*

Reverse referral strategy, i.e. transferring patients from the upper-level hospital (ULH) to the lower-level hospital (LLH) in the same Hospital Alliance, has been proposed to deal with the problem of inappropriate use of medical resource in health care systems. Despite these actions have brought some positive effects, the problem of making optimal decisions for the cooperating hospitals to enforce the reverse referral strategy at an operational level and how the cooperated hospitals will react to each other remains unclear. In this study, we consider a Hospital Alliance comprising an ULH and a LLH with reverse referral. We study how these cooperating hospitals can compromise with each other when both adopt a threshold control policy. The Pareto front and corresponding optimal control policies are obtained through multi-fidelity optimization.

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|---|---|
| **Session** | Technology and Knowledge Management 1 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Pompadour |
| **Chairs** | Amnon GONEN, *Academic Ramat Gan*,<br>Michel ALDANONDO, *Toulouse University / IMT-Mines Albi* |

IEEM18-P-0118

**Green Manufacturing's Adoption by Indonesian SMEs: A Conceptual Model**

Ira SETYANINGSIH, Nurul INDARTI, Wakhid CIPTONO
*Universitas Gadjah Mada, Indonesia*

Green Manufacturing (GM) is one innovation that has attracted the attention of the industry. This paper is part of some research aimed at developing a framework for the adoption of GM by SMEs. The purpose of this study is to create a model that explains the influences of the determinant factors on an SME's decision to adopt GM in its operation. Individually, GM will be grouped in the operational, tactical and strategic levels of the firms to investigate whether, and at which level, SMEs have adopted GM. The Technological, Organization and Environment (TOE) framework is used as the basis of the conceptual model. Besides, the Resource-Based View (RBV) theory and institutional theory are used as a basis for the internal and external focus of this construct's development. The output of this research is a comprehensive model that describes a framework to be tested empirically.

IEEM18-P-0524

**A Database Administration Tool to Model the Configuration Projects**

Sara SHAFIEE[1], Steffan Callesen FRIIS[2], Lukasz LIS[2], Ulf HARLOU[2], Yves WAUTELET[3], Lars HVAM[1]
[1]*Technical University of Denmark, Denmark*
[2]*Center for Product Customization, Denmark*
[3]*KU Leuven, Belgium*

Maintenance of the configuration projects, their on-going development, evaluation of system quality and communication with domain experts requires up-to-date product knowledge modelling, documentation, and validation. In configuration projects, the main tools used for documentation and communication are product models. Furthermore, the CASE tools concentrate on supporting the software development and documentation process and they also play a critical role in improving quality and productivity by assessing tasks in IT projects. Moreover, due to the reported amount of the complexity in configuration project and the needed time and resources, CASE tools can be applied to solve the challenges of development, documentation and communication. This paper aims to demonstrate the possibility of developing a CASE tool for configurators and apply the CASE tool in one case example at a case company.

IEEM18-P-0560

**An Application of Agent-based Modeling and Simulation in Tacit Knowledge Transfer Effectiveness and Individual Performance through the Consideration of Feedback Mechanism**

Fadillah RAMADHAN[1], Afrin Fauzya RIZANA[2], Rayinda Pramudtya SOESANTO[2], Amelia KURNIAWATI[2], Iwan Inrawan WIRATMADJA[3]
[1]*Institut Teknologi Nasional Bandung, Indonesia*
[2]*Telkom University, Indonesia*
[3]*Bandung Institute of Technology, Indonesia*

Tacit knowledge transfer is essential since it is considered as a source of sustainable competitive advantage in an organization. According to the previous study, source, recipient, knowledge characteristic and transfer mechanism play important role in determining the effectiveness of tacit knowledge transfer. Moreover, this study also considered the relationship between tacit knowledge transfer effectiveness and individual performance. An agent-based modeling approach was employed in this study since the approach is considered perfectly qualified in dealing with a complex system like knowledge transfer. This study aimed to investigate the change of individual work performance with the consideration of the feedback loop mechanism in the model using the agent-based approach. Data used in this study were collected from 15 university laboratories in a university in Indonesia. Three scenarios with various conditions are generated in this study. The result of all scenarios indicates that several strategies can be implemented in real condition to enhance organization member work performance based on the simulation output. In addition, there is a finding that recipient characteristic like absorptive capacity is a key driver to enhance knowledge transfer effectiveness and individual performance.

IEEM18-P-0612

**Application of Last Planner® System in Product Concept Development Phase: Use of Lean Concepts in Academic Project Work**

Prashanth SIVAGANESH, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

The Last Planner® System (LPS) supports the proactive planning and control of project activities. This allows project teams to improve teamwork in a methodical, structured, effective and productive manner, whilst enhancing continuous improvement efforts. Also, insufficient utilization of resources leads to a final product which is undesirable to the end customer. It is therefore crucial to investigate the use of emerging product concept development (PCD) approaches, such as Kanban, which are inherited from Lean philosophy, to increase the value in customized PCD processes. PCD mainly involves knowledge work. This study presents the use of LPS in a PCD process in an academic project that involves knowledge work. It also demonstrates that it is not possible to deliver desirable results just by implementing LPS; however, to achieve successful PCD outcomes, close cooperation between all members of the project is essential.

IEEM18-P-0164

**Project Success as a Function of Organizational Knowledge Management**

Uriel ISRAELI[1], Amnon GONEN[2]
[1]*Holon Institute of Technology, Israel*
[2]*The Israel Academic College, Ramat Gan, Israel*

The current paper describes recent results examining the relationship between knowledge management and project success and whether knowledge management can contribute to project success. For this purpose, a questionnaire was distributed among project managers, IT professionals and other professionals who participate in technological projects or technological organizations. The questionnaire consisted of four main parts: the classification of the organization, the classification of the project, the section on organizational knowledge management, and the last part, which examined the issue of project success. The sample size consisted of 50 respondents. .Statistical analysis of the collected data shows a positive and significant relationship exists between knowledge management indices and project success indices.

IEEM18-P-0488

**How Much "Talent" is Needed for Organizational Learning? A Study of Labor Market Entrants in an Innovation-oriented Country**

Mait RUNGI
*Tallinn University of Technology, Estonia*

While absorptive capacity helps companies to learn better, the intangible nature of absorptive capacity indicates its psychological nature. This paper is the first to examine the phenomenon at the individual level from a psychological perspective. Quantitative perceptional pre-tested questionnaires were used with 1,509 student respondents. A similar psychological profile is suitable for most absorptive capacity components ("acquisition", "assimilation", and "exploitation"), i.e. an achievement-oriented, open-minded bold team worker, and only the "transformation" component of absorptive capacity requires prior experience with complexity, combined with an open-minded non-pleasure orientation. The study shows that traits appear to influence how learning takes place more than values.

IEEM18-P-0487

**Foundation of Project Interdependencies: Perspective of Organizational Theories**

Mait RUNGI
*Tallinn University of Technology, Estonia*

Interdependency is seen here as any contingent relationship among projects. Interdependencies have been the key issue in some influential organization and management theories. People have been investigating interdependencies at higher level (between alliances and companies) for decades. Despite of having roots in sixties and several benefits from interdependency theory, it is still less researched field and no theoretical foundation exists. This paper presents a literature review to find out theoretical base for this phenomenon. Literature review focused on some 20 famous management theories and tried to analyse their relevance to interdependency theory.

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| **Session** | Operations Research 2 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Riverside III |
| **Chairs** | Reza Tavakkoli-MOGHADDAM, *University of Tehran*,<br>Philipp BAUMANN, *University of Bern* |

IEEM18-P-0228

**An MILP Model for the Internal Audit Scheduling Problem**

Volkan YILDIRIM[1], M. Ebru ANGÜN[2], Temel ÖNCAN[2]
[1]*Turkish Technic, Turkey*
[2]*Galatasaray University, Turkey*

In this study we develop a Mixed Integer Linear Programming (MILP) formulation for the internal Audit Scheduling Problem (ASP) which arises in many organizations. The developed model consists of tailor-made constraints for the ASP in the context of management system standards. An illustrative real-world problem has been introduced and solved by a state-of-the-art commercial solver. The computational efficiency of the proposed MILP formulation is promising to solve large-scale and complex problems.

IEEM18-P-0267

**Stochastic Storage/retrieval Scheduling Considering Shuttle Failure in Multi-shuttle Automated Storage and Retrieval System**

Jun WEN, Xinglu LIU, Peng YANG
*Tsinghua University, China*

Uncertainty has great impact on the original schedules of multi-shuttle Automated Storage and Retrieval Systems (AS/RSs). When shuttle failure occurs during planning horizon, scheduling solution under deterministic circumstance will become infeasible and the reschedule work is needed. It will result into extra expense or loss. In our study, we propose a stochastic integer programming model to handle scheduling problem under shuttle failure in multi-shuttle AS/RS. Numerical experiments are designed to validate the robustness of our solution to tackle various uncertainty of shuttle failure.

IEEM18-P-0361

**A Continuous-Time MILP Formulation for the Multi-Mode Resource-Constrained Project Scheduling Problem**

Mario GNÄGI, Tom RIHM, Norbert TRAUTMANN
*University of Bern, Switzerland*

The well-known multi-mode resource-constrained project scheduling problem aims at selecting for each project task a start time and an execution mode to obtain a precedence and resource-feasible schedule with minimal project duration. The available execution modes for the tasks differ in their durations and demands for some scarce resources. Numerous problem-specific solution methods and several mixed-integer linear programming (MILP) formulations have been described in the literature. We introduce a new continuous-time MILP formulation that employs continuous start-time variables and three types of binary variables: mode-selection, resource-assignment and sequencing variables. The results of our computational analysis indicate that the proposed formulation achieves superior performance than two formulations from the literature when the range of the tasks' durations is relatively high.

IEEM18-P-0419

**Exact Method for Single Vessel and Multiple Quay Cranes to Solve Scheduling Problem at Port of Tripoli - Lebanon**

Ali SKAF[1], Sid LAMROUS[1], Zakaria HAMMOUDAN[2], Marie-Ange MANIER[1]
[1]*Université Bourgogne Franche-Comté, France*
[2]*Université Libano-Française, Lebanon*

This paper discusses the Quay Crane Scheduling Problem (QCSP) at port of Tripoli - Lebanon, determines the unloading/loading sequences of bays for quay cranes assigned to a single container vessel, provides a mixed integer programming model for the quay crane scheduling problem and proposes a dynamic programming algorithm to solve the QCSP. The objective of this paper is to minimize the completion time of unloading/loading containers and therefore to reduce the docking time of the vessel in the terminal. Finally the results of this paper are compared to the port results.

IEEM18-P-0314

**Mathematical Modelling for a Semi-obnoxious Inverse Line Location Problem**

Mehdi GOLPAYEGANI[1], Haleh MORADI[1], Reza TAVAKKOLI-MOGHADDAM[2]
[1]*Islamic Azad University, Iran*
[2]*University of Tehran, Iran*

This paper is the first study considering the inverse median line location problem in the plane with positive and negative weights by using Euclidean and rectilinear norms. A positive weight means that the line has desirable effects on the existing facilities, whereas a negative weight represents undesirable effects of the line to the facilities. When a feasible solution for a line location problem is given, an inverse line location problem is related to improve the problem parameters at the minimum total cost. The problem is considered for two cases. If the inverse line location problem with modifying the vertex weight is concerned, a linear model is presented to study the problem. And if coordinates of demand points are given to be modified by using rectilinear and Euclidean norms, a linear and a nonlinear models are provided to investigate the problem, respectively. Then, a numerical example is presented to illustrate the problem.

IEEM18-P-0127

**A Diagonalization-Dantzig-Wolfe Decomposition Method to Solve a Class of Variational Inequality Problems**

William CHUNG
*City University of Hong Kong, Hong Kong SAR*

We present a diagonalization-Dantzig-Wolfe decomposition method for variational inequality problems (VI) with linear constraints. First, we use Dantzig-Wolfe method to decompose the VI into of one subproblem (which is linear programming, LP) and one master program, which is a VI problem. Second, we propose to solve the master-VI problem approximately by one iteration of the diagonalization algorithm of VI, the resulting algorithm simply consists of the computational sequence of solving an LP subproblem and the NLP master problem in an iterative manner. That is, the diagonalization method and the DW decomposition method are combined into a single iterative solution method. Some properties of the resulting algorithm are investigated. A numerical example is provided to illustrate this method.

IEEM18-P-0302

**Aggregate Production Framework for Efficiency Analysis and its Implementation by Linear Programming**

Soobin CHOI, Jaedong KIM
*Korea Institute for Defense Analyses, South Korea*

Traditional approaches to efficiency analysis have focused on similar firms that use the same technology. However, firms in various applications operate with different technologies, adapting to different production environments. In this paper, we propose aggregate production framework for measuring the efficiency of firms having different technologies. We introduce the concept of aggregate production sets that describe all possible activities in the economy and show how to use it for evaluating efficiency scores. Then, we specify two aggregate production models, which provide upper and lower bounds on efficiency scores. For use in practice, we incorporate Data Envelopment Analysis into our framework. This enables to implement our framework through linear programming.

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| **Session** | Service Innovation and Management 2 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Riverside IV |
| **Chairs** | Yonas Zewdu AYELE, *Ostfold University College*, Daniel Y. MO, *Hang Seng Management College* |

IEEM18-P-0208

**Event-driven Architecture for Sensor Data Integration for Logistics Services**

Jens LEVELING[1], Luise WEICKHMANN[1], Christian NISSEN[1], Christopher KIRSCH[2]
[1]*Fraunhofer Institute for Material Flow and Logistics, Germany*
[2]*BEUMER Group GmbH & Co. KG, Germany*

Sensor data offers a massive potential for the logistics sector. To achieve an optimal, effective and productive supply chain, operators and manufacturers are challenged to use this information and extract value from it. They have to comply with the main task of efficiently managing logistics processes as well as fulfilling requirements and guidelines. To do so, it is necessary to monitor all processes and understand exceptions and anomalies. Sensor and Internet of Things (IoT) data is the key for these tasks. Currently, the data is available but not (sufficiently) used. The heterogeneity of sensor data is a major obstacle for the usage. Therefore, we present an architecture, which addresses these challenges by integrating heterogenic data in well-formed data sets.

IEEM18-P-0191

**Reaching Project Success Through Vision and Artifact and the Mediating Role of Team Spirit**

Sayed Muhammad FAWAD SHARIF[1], Naiding YANG[1], Fouzia KANWAL[2], Sayed Kifayat SHAH[1]
[1]*Northwestern Polytechnical University, China*
[2]*Southwest Jiaotong University, China*

Recently the informal and behavioral, structures of the organizations have received significant attention in the literature, as key variables, in reaching project success. In the current study, authors have examined the less studied constructs, project artifacts and team spirit, to achieve project success in project based organizations. Data were collected from the local and foreign practitioners working in project based organizations in china. The hypotheses were tested through SPSS 23 and AMOS 23. Researchers concluded that team spirit partially mediated the relationship of vision and project success; whereas, a complete mediation effect was observed between artifacts and project success.

IEEM18-P-0537

**A Human Centered Design Framework to Support Product-service Systems**

Thomson Chi Shing WONG[1], Moon Kyoung JANG[1], Seung Ki MOON[1], Zhong Yang CHUA[1], Haining ZHANG[1], Hyung Sool OH[2]
[1]*Nanyang Technological University, Singapore*
[2]*Kangwon National University, South Korea*

The synchronized development of products and services become crucial to the success of product-service systems (PSSs). Nevertheless, the number of service-specific approaches has been scarce. A human centered design (HCD) approach can provide designers with a feasible design methodology that is integrated into the development of PSSs by understanding about human needs and emerging cultural social trends. In this paper, we propose a human-centered design framework to support the development of PSSs by integrating the international standards with HCD selection and product/service design methods. The proposed framework can be a starting point to guide the development of PSSs for improving user acceptance and satisfaction. In addition, the proposed framework can assist existing businesses with product-oriented PSSs by identifying areas of service improvement and strengthening the long-term relationship with their customers. Furthermore, to investigate the significance of HCD in PSSs, we use an exploratory case study involving a wearable activity tracker, Fitbit.

IEEM18-P-0438

**Marketing Management Challenges – A Nordic Small and Medium Size Enterprises (SMEs) Perspective**

Yonas Zewdu AYELE[1], Abbas BARABADI[2]
[1]*Østfold University College, Norway*
[2]*University of Tromsø – The Arctic University of Norway, Norway*

In a competitive market, large businesses & small and medium size enterprises (SMEs) compete with each other. Further, the regulatory requirements are often the same for SMEs and large enterprises. However, SMEs have usually fewer resources to develop strategic marketing management and business plan. These include market research (market segmentation, targeting, competitive environment, etc.) and tactical marketing (market positioning & strategy, marketing & selling model, etc.). The purpose of this paper is to study the main marketing management challenges of the SMEs operating in the Nordic region. Furthermore, the other objective is investigating the factors that may influence the SMEs' international competitiveness. To fulfil the objectives, we have developed a questionnaire; and, carried out a survey for a selected number of local SMEs. The questionnaires are aiming for evaluating the effectiveness of the local SMEs marketing strategies; and, consequently to help local SMEs in developing a smarter marketing management strategy.

IEEM18-P-0513

**Consolidating Orders in a Crowdsourcing Delivery Network**

Daniel Y. MO, Yue WANG, Nicole CHAN
*Hang Seng Management College, Hong Kong SAR*

In this study, we explore the effects of consolidating orders on a crowdsourcing baggage delivery company. We use an empirical study of customers' preferences, a benchmarking study of pricing models, and an optimization tool for consolidating orders to show that a crowdsourcing strategy that includes order consolidation provides a competitive advantage to companies offering baggage delivery services. As order consolidation enhances the efficiency of the transportation network, drivers can increase revenue, and customers can save on the cost of delivering goods. Statistical analysis and numerical experiments are conducted to support these findings.

IEEM18-P-0317

**Co-creation of Value Using Social Media in the Service Industry: An Empirical Case Study of Service Innovation in a Banking and Finance Company**

Asle FAGERSTRØM[1], Ravi VATRAPU[2], J. OTRE STØRKSEN[1]
[1]*Kristiania University College, Norway*
[2]*Copenhagen Business School, Denmark*

Companies have adopted and used social media channels for collaboration and engagement with potential customers, customer dialog management, and, creation of user communities for the customer support and co-creation. This study aims to expand understanding of social business processes for co-creation in the service industry. Findings from a case study showed that the banking and finance company in Norway manage to co-create value together with their users. Several new online products and services have been launched since the co-creation lab was launched. The banking and finance companies' co-creation lab has a small, but stabile group of users. There are, however, findings that indicate that there could been achieved even more value in co-creation process through more and better interaction from the company's side, as well as introducing an incentive arrangement for the users of the co-creation lab.

IEEM18-P-0320

**Innovation Models for Public and Private Organizations: A Literature Review**

Tariq AL HAWI[1], Imad ALSYOUF[1], Mickael GARDONI[2]
[1]*University of Sharjah, United Arab Emirates*
[2]*École de Technologie Supérieure ÉTS, Canada*

Private and public organizations need to innovate in order to survive. Therefore, various innovation management models have been developed. The purpose of this paper is to conduct a literature review of the different innovation management models. This paper reviews twelve innovation models used in the private sector and five innovation models used in the public sector. It compares the models with a focus on extracting the practical usage of relevant stages and introducing new stages. The main results indicate that most innovation models share common stages such as idea creation, idea conceptualization, concept development, evaluation and selection, development and implementation, however in the public sector there is not much of an emphasis on the commercialization and practical utilization stages. At the end, a conclusion is made taking into consideration the major differences between the public and private innovation models.

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| **Session** | Project Management 2 |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Riverside V |
| **Chairs** | Ripon CHAKRABORTTY, *University of New South Wales, Canberra,*<br>Budi HARTONO, *Universitas Gadjah Mada* |

IEEM18-P-0391

**Decision Criteria for Contractor Selection in Construction Industry: A Literature Review**

Maria Creuza BORGES DE ARAUJO[1], Luciana ALENCAR[2], Caroline MOTA[2]
[1]*Universidade Federal de Campina Grande, Brazil*
[2]*Universidade Federal de Pernambuco, Brazil*

The choose of appropriate contractors is essential to the success of a project since the suppliers are responsible for the core activities to execute it. Choose the adequate criteria for this process is important to achieving a result according to the decision-making preferences. Therefore, this research shows the outcomes of a literature review of the factors used in the choice of contractors in the construction sector, considering sixty-one studies published from 1993 to 2015. The papers are categorized into eight classes according to the subsector of construction segment. The results summarize a list of criteria that can be employed by the managers in the contractor selection since the literature indicated that they are very important in this specific context.

IEEM18-P-0193

**A Review of Methods, Tools and Techniques Used for Risk Management in Transport Infrastructure Projects**

Indra GUNAWAN, Tiep NGUYEN, Leonie HALLO
*The University of Adelaide, Australia*

Physical infrastructure projects are important in the integration of transport networks among states. Infrastructure network development is one of the major factors contributing to economic growth. However, infrastructure projects are often extremely expensive in resources including capital, and thus it is important to recognize potential impacts of project implementation; otherwise these projects may suffer critical issues related to cost overrun, time delays and benefit shortfalls. Although several studies present separate methods, tools and techniques used for risk management in transport infrastructure projects, only a few research papers focus on documenting those methods for users. Hence this paper firstly reviews methods used for project risk management and then justifies the differences posed by applied contexts to propose tools and techniques for project risk management. The significance of this paper is to support experts and practitioners in selecting appropriate methods, tools and techniques suitable for the use in risk management, as well as increasing the effectiveness of decision making processes.

IEEM18-P-0349

**The Influence of IM Use on Job Satisfaction in Cross-organizational Projects**

Ziyue WANG[1], Yali ZHANG[1], Jun SUN[2], Chrissie Diane TAN[1], Menghua LU[1]
[1]*Northwestern Polytechnical University, China*
[2]*University of Texas Rio Grande Valley, United States*

Instant messaging (IM) tools have been used by more and more companies for cross–organizational projects. They face two choices: dedicated systems in form of enterprise IM and public platforms like WeChat. This study conducts a comparative analysis of WeChat and enterprise IM. It examines the impact of IM usage on job satisfaction in cross-organizational projects, and uses IM Motivation as a moderator. Research shows that for WeChat, hedonic motivation plays a significant negative moderation role in the impact of instant messaging usage on job satisfaction. For enterprise IM, utilitarian motivation plays a significant positive moderation role in the impact of IM usage on job satisfaction.

IEEM18-P-0505

**Key Influencing Factors for Cross-organizational R&D Project Stakeholder Management**

Chrissie Diane TAN[1], Yali ZHANG[1], Jun SUN[2], Ziyue WANG[1], Ganggang ZHENG[1]
[1]*Northwestern Polytechnical University, China*
[2]*University of Texas Rio Grande Valley, United States*

Nowadays, the focus of project management is no longer limited to the three traditional elements – time, quality, and cost, whereas project stakeholder management has received more and more attention. Based on an extensive review of the domestic and international literature on the project stakeholder management, this study identifies 16 factors that affect the effective management of cross- organizational research and development (R&D) project stakeholders. Factors were derived from interviews of Cross-organizational R&D project managers from different industries, and a questionnaire was designed based on the interview results. Finally, a management framework for inter-organizational R&D project stakeholders was established based on the result of the principal component analysis. This study integrates the findings with relevant theoretical knowledge of stakeholder management and provides some suggestions for cross-organization management of R&D project stakeholders.

IEEM18-P-0194

**Robust Project Scheduling with Unreliable Resources: A Variable Neighbourhood Search Based Heuristic Approach**

Ripon K CHAKRABORTTY, Alireza ABBASI, Michael J RYAN
*University of New South Wales, Australia*

Approaches for proactive project scheduling under limited resource condition has been widely researched by many researchers. In real world situations, the parameters of projects are vulnerable to uncertainty, change or disruption, which necessitates that the initial baseline schedule must be revised. With this in mind, in order to protect an existing schedule from any possible future disruptions as a result of single and/or multiple resource breakdowns and to make that schedule robust, we have proposed a semantic approach to effectively design proactive schedules. To solve that proactive schedule, a variable neighbourhood search-based heuristic (VNSH) is proposed, which can generate robust schedules after absorbing all possible resource uncertainties. Benchmark instances from the Project Scheduling Library (PSLIB) for 30 and 120 activities are considered to demonstrate the feasibility of our proposed approach.

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| **Session** | Engineering Economy and Cost Analysis |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Riverside VI |
| **Chairs** | Weiwei CUI, *Shanghai University*,<br>Leif OLSSON, *Mid Sweden University* |

IEEM18-P-0592

**A Systematic Literature Review of the Implementation of Cost of Quality**

Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS
*University of Johannesburg, South Africa*

Quality management and the practices associated with quality improvement continue to shape global business. One such practice is reducing the Cost of Quality (CoQ) in companies; yet both research and industry indicate that CoQ as a competitive tool for continuous improvement is not yet fully adopted by firms. The objective of this study is to assess the factors that prevent the successful implementation of CoQ. The study adopted systematic literature review as the research methodology and the review was conducted on papers published over an eleven year period in the Emerald Insight database between 2007 and 2018. The findings suggest that multiple factors affect the implementation of CoQ programmes. Twenty key factors were identified, with measurement and improvement, return on investment, management support, awareness, and strategic alignment as the most listed contributors to poor CoQ implementation. The paper concludes with key findings and recommendation.

IEEM18-P-0466

**Integrated Controlling Tool with Plan-fact Analysis**

Zoltan SEBESTYEN[1], Tamas TOTH[2]
[1]*Budapest University of Technology and Economics, Hungary*
[2]*Eötvös Loránd University, Hungary*

The importance of project risk management has been proved not only by the numerous articles published by the academic and scientific community, but also by practitioners, by the establishment of risk-related certifications, and standards by international project management associations and institutions. This article, which covers this area, follows a threefold structure. First, the concept of an integrated controlling tool is defined, and the purposes of the process are presented. This section tries to publicize the original ideas, which were not widely publicized; and helps the professionals sort the specified steps in a logical order. Secondly, we used a sample project to validate the viability of the new tool. Comparing the results provided by the conventional project risk management analysis and the integrated tool with data from a sample project is able to justify the results of this research. Lastly, potential future directions for research are proposed.

IEEM18-P-0201

**Decision Making on Sustainable Forest Harvest Production Using Goal Programming Approach (Case Study: Iranian Hyrcanian Forest)**

Soma ETEMAD[1], Soleiman MOHAMMADI LIMAEI[1], Leif OLSSON[2], Rasoul YOUSEFPOUR[3]
[1]*University of Guilan, Iran*
[2]*Mid Sweden University, Sweden*
[3]*University of Freiburg, Germany*

This paper aims to determine the optimal stock level in Hyrcanian forest of Iran. In this study, a goal programming techniques used to estimate the optimum stock level of different tree species considering economics, environmental and social issues. We consider multiple objectives in the process of decision making to realize the balance of maximizing annual growth, net present value, carbon sequestration and labor. We use regression analysis to develop a forest growth model using allometric functions for the quantification of carbon budget. The expected mean price was estimated to determine the net present value of forest harvesting. We use Expert knowledge to weight the goals in order to generate the optimal stock level. Results show that the total optimum stock is 0.5%lower than based on questioners. The results indicate that goal programming is a suitable methodology in this case.

IEEM18-P-0105

**Operational Management of the Microgrid System for the Energy-sensitive Manufacturing Plant**

Weiwei CUI, Yujie YANG
*Shanghai University, China*

The penetration of renewable energy sources brings a new opportunity to tackle the environment problem due to the fossil fuels. This paper considers a multiunit system consisting of the production system, the external electric grid system, the microgrid system including renewable energy system and energy storage system. A multistage stochastic programming model is established to allocate the energy generated by the renewable energy system during a finite horizon considering the uncertainty of the microgrid system due to the varied weather. Since the model is computationally intractable, an algorithm combining the Fibonacci search and the estimation of the second-stage cost is proposed. The numerical results validate the effectiveness of the solution approach.

IEEM18-P-0035

**Analysis on Influence Factors of Enterprises' Costs for Compliance to Consumer Product Standard**

Xia LIU[1], Ruan LI[2], Xiaolei FENG[3], Bisong LIU[1], Qian WU[1]
[1]*China National Institution of Standardization, China*
[2]*Taizhou Supervision and Inspection Institute, China*
[3]*Zhejiang Research Institute of Product Quality Inspection, China*

Standard and standardization can reduce product cost, promote scale effect and improve product quality, while realization of these indexes is one part to improve performance of enterprises. This paper, based on review on studies about enterprises' compliance to consumer product standards, analyzes cost of 143 enterprises in China applying the consumer product standards by means of questionnaire in order to acquire influence factors for enterprises' costs by applying consumer product standards.

IEEM18-P-0463

**American Productivity Center Method for Measuring Productivity in Palm Oil Milling Industry**

Fitra LESTARI[1], Irsan NUARI[2], Vera DEVANI[2]
[1]*Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia*
[2]*Sultan Syarif Kasim State Islamic University, Indonesia*

The main products of palm oil milling in this case are Crude Palm Oil and Kernels. This industry shows production targets are not achieving that cause fluctuations in profits due to not optimal use of resources in production activities. The aim of this study is to measure the productivity of palm oil milling industry and identify its factors. Integration of American Productivity Center (APC) method and Failure Modes and Effect Analysis (FMEA) was used to measure productivity. The finding in year 2015 to 2016 showed that there were decreasing of productivity index (9.81% to 0.68%) and profitability index (-7.23% to -20.27%) which both of them were caused by variable input of labor. Then, focus of improvements should be done in the sterilizer process, boiler process and sorting process. Further research is suggested to direct in maintenance case in order to know the effect of each machine on industry.

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| **Session** | Information Processing and Engineering |
| **Date** | 17/12/2018 |
| **Time** | 15:45 - 17:30 |
| **Room** | Riverside VII |
| **Chairs** | Zhaoxia GUO, *Sichuan University*,<br>Arnesh TELUKDARIE, *University of Johannesburg* |

IEEM18-P-0497

**Latent Variable Structured Bayesian Network for Cyanobacterial Risk Pre-control**

Peng JIANG[1], X. LIU[1], J. ZHANG[2], S. H. TE[2], K. Y. H. GIN[2]
[1]*Shanghai Jiao Tong University, China*
[2]*National University of Singapore, Singapore*

Cyanobacterial blooms increasingly pose threats to ecosystems and human health. This paper is aimed to propose systematic risk pre-control schemes by understanding the complex causalities between cyanobacteria and multiple influencing variables. This research remains a challenge for three reasons. Firstly, the time-series evolution of cyanobacteria is characterized by deep uncertainties and nonlinear dynamics. Secondly, latent variables with hidden information usually exist in this kind of complex aquatic system. Thirdly, it is difficult to identify an efficient pre-control scheme that specifies variables for preferential regulation. To address these problems, we propose a latent variable structured Bayesian network model and a corresponding parameter learning algorithm. The model is tested by real-time spatio-temporal data. The computational results reveal that the proposed model demonstrates better performance in terms of inference accuracy and degree of system understanding. Based on sensitivity analysis and combination-effect analysis, a systematic risk pre-control scheme is proposed for decision-makers to prevent cyanobacterial blooms under the scenario of global warming.

IEEM18-P-0189

**Identifying and Defining Knowledge-work Waste in Product Development: A Case Study on Lean Maturity Assessment**

Felix P SANTHIAPILLAI, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

Product development (PD) involves highly multi-disciplinary tasks that need to be accomplished in project mode. PD projects mainly involve knowledge work; due to the inherent nature of knowledge work, it is a a challenging task to use formal Lean concepts and definitions in the PD context. This manuscript first identifies and defines waste related to knowledge work in the PD context in general. Then, it proposes a methodology for assessing the status of PD maturity in relation to Lean concepts. A case study was carried out in an Oil & Gas (O&G) organization providing engineering services [i.e. an engineering contractor (EC)] that involves PD activities. The knowledge work related critical waste categories were identified using the suggested methodology as presented.

IEEM18-P-0211

**Regional Freight Volume Forecasting with Incomplete Data of Origin/Destination Freight Volumes**

Jiahao LIU, Guangxin OU, Zhaoxia GUO
*Sichuan University, China*

Regional freight volume forecasting is crucial to road network planning and making relevant policies. This research examines the effectiveness of the RAS algorithm to forecast freight volumes between an origin region and all its destination regions based on incomplete data of freight volumes for all origin/destination (O/D) pairs. Given the reasonable economic growth rates and the historical freight volumes between the specific origin region and all its destination regions in a base year, a large number of numerical experiments show that the future freight volumes between the corresponding O/D pairs can be forecasted effectively by the RAS algorithm. The effects of different economic growth rates on the forecasting performances are also examined. We find that the maximum forecasting error is within 20% and the error of 85% sample is kept within 10% if the maximum ratio of economic growth rates is generally less than 3.

IEEM18-P-0224

**Application of Industry 4.0 Towards Achieving Business Sustainability**

Megashnee MUNSAMY[1], Arnesh TELUKDARIE[2]
[1]*Mangosuthu University of Technology, South Africa*
[2]*University of Johannesburg, South Africa*

Industry is at a precipice of change driven by sustainability and the fourth industrial revolution, known as Industry 4.0. Industry 4.0 adopts a system of systems and data centric approach to develop smart businesses, smart factories and smart products. The Process Centric Energy Model, which adopts a system of systems approach is applied to optimize total business energy demand and GHG emissions. The model comparatively analyses the impacts of application of Industry 4.0 technologies of internet of things, cyber physical systems, big data analytics, automation and mobility on energy demand, GHG emissions and personnel requirements of a maintenance process. The model results demonstrate that integration of Industry 4.0 technologies enables significant reduction in energy demand, GHG emissions and personnel requirements. The results affirm the model's capability in optimizing business energy demand and evaluating the impacts of Industry 4.0 technologies on business energy demand. The model findings affirms the application of Industry 4.0 in reducing business energy demand, towards attaining business sustainability.

IEEM18-P-0247

**Enterprise Definition for Industry 4.0**

Arnesh TELUKDARIE, Michael SISHI
*University of Johannesburg, South Africa*

In the modern world of mining and manufacturing, it is pivotal for information to flow from the enterprise level, i.e., Business Intelligence (BI) and Enterprise Resource Planning (ERP), down to the shop floor. Information generated from the shop floor should conversely be shared with the enterprise level in real or semi real-time. Business partners should be integrated to form a value chain that self-adjusts, generates and shares information. The absence of real-time flow of information makes it difficult to inform business decisions. The introduction of Industry 4.0 yields the convergence of fragmented business systems and partners. This results in the seamless integration and communication in delivering premium operations. This paper proposes an architecture of a fully integrated enterprise. The architecture comprises systems from such levels as decision making, operations management, and shop floor. Big Data, Data Analytics, and Cyber Physical Systems (CPS) are harnessed to accomplish a 4th industrial revolution.

IEEM18-P-0529

**Classification System for Egyptian Heritage Buildings**

Mohamed MARZOUK[1], Noha SALEEB[2], M. M. ELSHARKAWY[1], Asmaa EID[1], Mohamed ALI[1], Mahmoud METAWIE[1]
[1]*Cairo University, Egypt*
[2]*Middlesex University, United Kingdom*

To create a classification system for heritage buildings, it is essential to delve into the architectural components of the buildings following a specific procedure. First, the different objects' properties (including their architectural style, geometric characteristics and ratio, condition, construction method, cultural value, material, color, reflectance characteristics) are identified. Second, creating a systematic framework that identifies the lifestyle of each element, stating the grouping principle of heritage elements and the design composition of tables that identifies the geometrical form, material and functional features whether insulation or load tolerance. This paper presents the challenges in creating a unified classification system for an Egyptian heritage palace built in 1896 with different architectural styles; i.e Rocco, Baroque, Islamic and even architectural customized elements with Royal slogan; through different historical periods, where multiple elements and sections were detached and attached to the place during its lifetime. The formulated classification system can be generalized in similar heritage buildings built in the same era.

IEEM18-P-0407

**Development of Halal Audit Information System (HAIS) and its Implementation Evaluation Based on Time–cost Trade–off Using Integer Linear Programming (ILP)**

Iwan VANANY, Diesta Iva MAFTUHAH, Adi SOEPRIJANTO, Faiz Rahman ARIFIN
*Institut Teknologi Sepuluh Nopember, Indonesia*

As the most Muslim populated country in the world, the availability of the Halal product in Indonesia become critical. In 2014 there are only 11.63% of marketed products in Indonesia are halal certified. The existence of a new system and software will be on-site and follow up audits stages that are essential to do. The purposes of this study are to develop the Halal Audit information system (HAIS) and evaluate the HAIS implementation based on the time-cost Trade-off approach using integer linear programming (ILP). In the development of HAIS, The HAIS architecture of a system was described using Unified Model Language (UML). A single case study in chicken slaughtering company was carried to apply the HAIS software and evaluate the HAIS implementation. The results indicate that Integer Linear Programming can be used to calculate the trade-off between time and cost of HAIS implementation activities, such as software programming activity and software testing activity.

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| **Session** | Supply Chain Management 4 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Ballroom I |
| **Chairs** | Kanagi KANAPATHY, *University of Malaya*,<br>Murat KUCUKVAR, *Qatar University* |

IEEM18-P-0363

**Understanding Influential Factors in Selecting Sustainable Third-party Logistics Providers: An Interpretive Structural Modeling and MICMAC Analysis**

Xiangce MENG[1], Zhaojun YANG[1], Jun SUN[2]
[1]*Xidian University, China*
[2]*University of Texas Rio Grande Valley, United States*

For sustainable development in the fierce market competition, enterprises outsource non-core business to third-party logistics (3PL) providers. Choosing suitable 3PL providers can help enterprise improve core competitiveness and corporate sustainability. This paper combines traditional influencing factors and new ones under the concept of sustainable development to examine the choice of 3PL providers. Based on the review, relevant literature and the interviews with scholars and experts, it summarizes 15 influencing factors that affect choice of sustainable 3PL providers. Interpretative structural modeling (ISM) and MICMAC, including the hierarchy diagram and driving-dependence classification analysis chart, were used to analyze the influential factors. Based on this, the best practices in the process of selecting sustainable 3PL providers are proposed.

IEEM18-P-0048

**Scenarios in Intermodal Transportation Planning**

Wichitsawat SUKSAWAT NA AYUDHYA
*King Mongkut's Institute of Technology, Thailand*

An economic integration has created a great opportunity for cross-broader trade among their members. Thai government implemented a plan to upgrade infrastructure such as dual-track rails and intermodal transport system. Intermodal transport system provides the advantage for shippers in term of cost and flexibility. Another benefit for intermodal is to avoid the transportation network disruptions and uncertainties. A route selection for intermodal freight transport is very important under unforeseen events. A mathematical model for the routing selection of commodities freight. A goal programming is formulated to minimize conflicting objectives such as transportation cost, penalty cost for either early or late delivery, and time variability. The disruption scenarios in intermodal transportation links is addressed and analyzed by using a case study in Thailand.

IEEM18-P-0383

**Inventory Analysis on a Single-Echelon Supply Chain System by Considering Carbon Emissions**

Petrus Setya MURDAPA[1], I. Nyoman PUJAWAN[2], Putu Dana KARNINGSIH[2], Arman Hakim NASUTION[2]
[1]*Institut Teknologi Sepuluh Nopember (ITS) - Widya Mandala Catholic University Madiun, Indonesia*
[2]*Institut Teknologi Sepuluh Nopember (ITS), Indonesia*

In this paper we incorporate carbon emissions in the performance model for a single-echelon supply chain system. The system consists of a retailer ordering goods from a supplier to satisfy demand that follows a Poisson distribution. The source and cost of carbon emissions together with the inventory cost are included in the response function. The model is able to determine the optimum inventory policy, which includes reorder point and order quantity that take into account both costs and carbon emissions.

IEEM18-P-0408

**Application of Mathematical Model for Raw Material Storage Management**

Chompoonoot KASEMSET, Aunchalee PETCHALALAI
*Chiang Mai University, Thailand*

This study proposed the mathematical model to obtain the appropriate storage methods for raw material at a case study company. Three classes of raw material as A, B, and C were stored using three types of storage equipment: pallet, shelf, and roller rack. The optimal solution showed that 94.60% of the storage area was used for current volume of raw material. After that, the amount of raw material was increased by 20% due to the expected customer

demand. The optimal solution cannot be obtained because the storage area was not sufficient. The optimal solution indicated that the current storage area can handle up to 13.6% increment. Then, the sensitivity analyses were carried out. The results from the tests showed that to handle 20% increment as forecast, an additional storage area of increment 128.55 m2 should be added to the current.

IEEM18-P-0412
**Biomass Supply Chain Design, Planning and Management: A Review of Literature**
Fitri AGUSTINA, Iwan VANANY, Nurhadi SISWANTO
*Institut Teknologi Sepuluh Nopember, Indonesia*
Biomass is one of the most important renewable energy sources besides geothermal, wind, hydropower and solar, which can substitute fossil energy. Over the years, researchers have been investigating the process of producing and converting biomass into bioenergy, but the importance of logistics was detected recently. Critical parameters of supply chain management and logistics are efficiency and effectiveness. This paper presents a literature review of articles published in journal articles from 1992 to 2017, which includes the bioenergy production interface and logistical issues and supply chain management. Finally, this review will contribute to researchers and practitioners in understanding the design, planning and management of biomass supply chains by considering detailed modeling analysis.

IEEM18-P-0062
**Forecasting of Used Product Returns for Remanufacturing**
Mohammed Woyeso GEDA, C.K. KWONG
*The Hong Kong Polytechnic University, China*
To meet the demand for remanufactured products, accurate forecasting of used product returns is needed. The quantity and timing of the returns of used products for remanufacturing depend on the quantity of new products sold in previous periods. Conventional time series forecasting techniques are not able to capture the relationship between past sales and future returns and hence cannot be used to predict used product returns for remanufacturing. Distributed lag models (DLMs) which can model the dependence of future returns on past sales has been proposed in previous studies for forecasting used product returns. However, the choice of an appropriate lag function for the DLM and estimation of the parameters of the lag function were the main challenges in previous studies. In this research, a DLM with a negative binomial lag function is proposed for forecasting used product returns, and Bayesian Markov Chain Monte Carlo simulation is used to estimate of the parameters of the lag function. To validate the forecasting model, the mean absolute error (MAE) and the mean absolute percent error (MAPE) are computed. Numerical experiments were conducted to illustrate the proposed forecasting model and the parameter estimation approach. The results showed the proposed forecasting model predicts used product returns with good accuracy.

IEEM18-P-0471
**Supplier Integration Roles in New Product Development: The Automotive Suppliers' Perspective**
Kanagi KANAPATHY, Kooi Onn CHU
*University of Malaya, Malaysia*
This research examined supplier integration in New Product Development (NPD) from the suppliers' perspectives. The level of supplier involvement in NPD practices and the drivers and barriers of supplier integration in NPD were explored. In this case study based qualitative research; data were gathered from interviews conducted with ten automotive suppliers directly involved in NPD with customer firms. The suppliers to national automakers acquired higher level of integration (in terms of design responsibility, product complexity, specifications provides, influences on specifications, stage of involvement, component testing responsibility, and technological capacities) compared to the suppliers to MNC automakers. Market competition was found to be the main driver for suppliers' involvement in NPD while limited knowledge transfer was the major barrier for suppliers' NPD integration with customers.

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| **Session** | Safety, Security and Risk Management 2 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Ballroom II |
| **Chairs** | R.M. Chandima RATNAYAKE, *University of Stavanger*,<br>Jayantha P. LIYANAGE, *University of Stavanger* |

IEEM18-P-0584
**Critical Infrastructure Impacted by Climate Change Safety and Resilience Indicators**
Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI
*Gdynia Maritime University, Poland*
Modelling a climate-weather change process effect on the resilience/safety of a critical infrastructure (CI) is presented. The model of the CI resilience/safety affected by dependences between its assets and subsystems and by outside climate-weather hazards is created. CI resilience/safety indices are defined and a way of their determination for the considered model is proposed. Procedures are used to the resilience/safety indices determination of the piping affected by the climate-weather change.

IEEM18-P-0587
**Critical Infrastructure Impacted by Operation and Climate Change Safety and Resilience Indicators**
Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI
*Gdynia Maritime University, Poland*
Comprehensive modelling the operation and climate-weather change effect on the critical infrastructure (CI) safety is presented. The model of the CI safety affected by its outside dependences like climate-weather hazards and operating environment threats is created. Resilience/safety indicators for a CI are defined and a way how to evaluate them in the case of the introduced model is proposed. The procedures are used to the resilience/safety indices determination of the piping affected by the operation and climate-weather change

IEEM18-P-0604
**Longtime Prediction of Climate-weather Change Influence on Critical Infrastructure Safety and Resilience**
Mateusz TORBICKI
*Gdynia Maritime University, Poland*
The model of a longtime prediction of the climate-weather change influence on a critical infrastructure is presented. Models of a longtime prediction of climate-weather change process limit transient probabilities at its states and coefficients of the climate-weather change impact on the critical infrastructure safety are proposed. The procedures based on these models are applied to the longtime forecasting of the resilience and safety of the port oil piping transportation system impacted by the climate-weather change. The piping resilience and safety indicators are evaluated.

IEEM18-P-0404
**Information Privacy Practices in Organizations: Activities, Knowledge and Skill Requirements for Information Technology Professionals**
Yasaman ATEFI MONFARED, Younes BENSLIMANE, Zijiang YANG
*York University, Canada*
This paper focuses on governance and daily operation activities information technology (hereafter IT) professionals carry out to protect information privacy in organizations. Its objective is to identify these activities and the knowledge and skills they require. Content analysis of 120 relevant job postings is used to provide a picture of such practices. Findings help assess and update an existing body of knowledge available to IT professionals working in the area of information privacy protection. Findings help also identify the relative importance of the different domains of knowledge and skills hence required. Implications for practice and research are discussed.

IEEM18-P-0591

**On Context, Issues, and Pitfalls of Expert Judgement Process in Risk Assesment of Arctic Offshore Installations and Operations**

Masoud NASERI, Abbas BARABADI
*University of Tromsø – The Arctic University of Norway, Norway*

Decisions to be made in the Arctic offshore operations rely extensively on risk assessment outputs, which require a great deal of historical data and information. However, at the current stage of operating in the Arctic offshore – compared to normal-climate regions – such data is scarce due to the limited industrial activities to date. Lack of data on the probability of the occurrence of an unwanted event and, given severe Arctic environmental conditions, the extent of potential severe consequences pose a great deal of challenges and issues for decision-makers. A widely acceptable alternative is the use of expert judgement process. However, this is faced with some issues and pitfalls, which may raise questions regarding the objectivity and level of uncertainty of risk assessment outputs. In this paper, we discuss such issues and pitfalls associated with expert judgement application in risk assessment of Arctic offshore operations.

IEEM18-P-0132

**Food Safety and Halal Food Risks in Indonesian Chicken Meat Products: An Exploratory Study**

Hana Catur WAHYUNI, Iwan VANANY, Udisubakti CIPTOMULYONO
*Institut Teknologi Sepuluh Nopember, Indonesia*

Food safety and halal food is an important for quality of food. Food safety affects human health, while halal affects in Islam regions. This study aims to: explore issues in food safety and halal risk in Indonesian chicken meat products. Two cases of chicken meat companies that have implemented food safety and halal food are observed and compared. The data were collected through observation and interviews. Through this data collection, critical factors and importance issues of food safety and halal food risks in Indonesian chicken meat products can be exposed. The expectation of this study is results of this study to understand the extent to food safety and halal food risks, the critical point, critical processes, and integration between food safety and halal food issues in chicken meat products.

IEEM18-P-0531

**IMU Based Real Time Underground Soil Movement Detection System: An Illustrative Investigation**

R. M. WEERASINGHE[1], D. BUDDIKA[1], R.M. Chandima RATNAYAKE[2]
[1]*Industrial Technology Institute, Sri Lanka*
[2]*University of Stavanger, Norway*

Real-time landslide hazard threat assessments (LHTAs) are vital, as landslides in mountainous regions are the costliest and deadliest natural disasters. Landslides are significantly difficult to predict, due to the high variability of slope stability in relation to both space and time. Intrinsic factors (i.e. topography, geology, soil condition, engineering properties, etc.) and extrinsic factors (i.e. rainfall, land cover, earthquakes, volcanoes, etc.) influence the slope stability and landslide triggering. To date, precipitation estimation, high-resolution imagery, and elevation maps enable the threat of rainfall-triggered landslides to be predicted. It is vital to assess soil 'movement distance' and 'velocity', as the potential for a landslide depends on the non-uniform nature of the structural forces that hold a slope together and on the physical mechanisms that trigger the landslide. This manuscript demonstrates the development of a sensor network that enables LHTAs by detecting landslides' related 'movement distance' and 'velocity' in real time. The sensor network consists of underground sensors (i.e. an accelerometer, a gyroscope and a magnetometer) that enable the movements of the bottom soil layers to be detected. The aim is to capture the soil 'movement distance' and 'velocity' in a landslide, using acceleration and relative angular movement data, via the concept used in an inertial measurement unit (IMU).

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| **Session** | Reliability and Maintenance Engineering 3 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Ballroom III |
| **Chairs** | Shinji INOUE, *Kansai University*,<br>Yonas Zewdu AYELE, *Ostfold University College* |

IEEM18-P-0257

**Environmental Sustainability in Maintenance Management of Public Transport Systems: Literature Review**

Iyad ALAWAYSHEH, Imad ALSYOUF
*University of Sharjah, United Arab Emirates*

The aim of this paper is to review the maintenance management literature and identify how it deals with sustainability issues in the public transport context. The topics that are covered in the review include maintenance strategies, Maintenance Strategy Selection (MSS), decision-making techniques used in MSS, maintenance performance, and environmental sustainability. It was found that MSS is typical multiple criteria decision making problem, and identifying selection criteria is very important step in this context. However, none of the reviewed literature has covered a complete and comprehensive set of sustainability criteria pertaining to automotive in transport systems. Although, there are several decision-making techniques that are being used in MSS, there is a need for further research on selecting the right decision-making model that is suitable for transport systems. It is clear that a holistic approach covering all sustainability criteria pertaining automotive means of transport systems is needed.

IEEM18-P-0325

**Reliability Assessment for Multi-area Load Frequency Control Systems with Degraded Components**

Zhiying WU[1], Huadong MO[2], Junlin XIONG[1]
[1]*University of Science and Technology of China, China*
[2]*ETH Zurich, Switzerland*

The paper evaluates system reliability performance for multi-area load frequency control systems with degraded components. Some key components including turbines and frequency sensors in load frequency control systems suffer degradation. As a result, the reliability of load frequency control systems is jeopardized. First, a dynamic model is proposed for multi-area load frequency control systems with degraded components. Degradation paths of components are considered as unit-to-unit variability due to different operation environments. Then, a series of operational performance indicators are used to quantify reliability performance. In addition, quantitative reliability analysis is carried out using Monte Carlo simulation method. Finally, a three-area load frequency control system is used to demonstrate the effectiveness of the proposed method.

IEEM18-P-0397

**Spectral Graph Wavelet based Component Clustering for System Reliability Analysis**

Ping ZHANG[1], Xiaoyan ZHU[2]
[1]*City University of Hong Kong/ University of Chinese Academy of Sciences, China*
[2]*University of Chinese Academy of Sciences, China*

Components symmetry commonly exists in complex systems, which usually leads to considerable redundant computations in reliability analysis. Mining and making use of symmetry information can improve computational efficiency and reduce computational cost that is related to reliability analysis of complex systems. However, few literatures provide attention to this issue in reliability area. This paper proposes a graph learning based method to measure the similarity among the components' local topological structure in a system. Based on the learned structural role similarity, components are clustered into different groups to reduce the complexity of the system. Application of the proposed method is presented in reducing computation effort of system survival signature, and a nearly 77% decrease of computation times demonstrates the effectiveness of the proposed method.

IEEM18-P-0472

**Preparation of Preventive and Predictive Maintenance Guidelines for Emulsion Preparation and Processing Plant Using Risk Management Techniques**

Dushan I. JAYASINGHE
*Monash University, Australia*

This paper presents preparation of preventive and predictive maintenance guidelines for emulsion preparation and processing (EPP) plant using risk management techniques at GrainCorp Foods Melbourne, Australia. The EPP plant consists of three margarine and spreads production lines, one shortening processing line, a cleaning in place (CIP) system and an auxiliary plant for hot water generation. Currently, there is no preventive maintenance and predictive maintenance (PM and PdM) plan in place. A generic risk management standard A/S NZS ISO 31000:2009 to prioritize the PM and PdM required based on the level of risk to the defined plant objectives. A comprehensive PM and PdM guideline was compiled using industry experts' input, instructions from plant equipment manuals, current practices and best practices in the industry.

IEEM18-P-0553

**Reliability Analysis of the Crude Oil Transfer System in the Oil Port Terminal**

Agnieszka BLOKUS, B. KWIATUSZEWSKA-SARNECKA
*Gdynia Maritime University, Poland*

The crude oil transfer process in the oil port terminal including its statistical identification is described. Potential causes and possible scenarios of oil spill accidents and incidents are analyzed highlighting oil overflow and leakage. Used Fault Tree Analysis indicates the importance of human factor for the safety of crude oil transfer in oil port terminal. Further, multistate approach is proposed to the reliability analysis of a crude oil transfer system. For the crude oil transfer system, four reliability states have been distinguished, whereas its components are assumed to have four, three or two reliability states. The reliability states of the system and its components are differently defined depending on the type of element and the specificity of its failure. Finally, the reliability analysis of the crude oil transfer system is performed, assuming its components have exponential reliability functions.

IEEM18-P-0108

**Debugging Process Oriented Software Reliability Models and Their Goodness-of-Fit**

Shinji INOUE[1], Shigeru YAMADA[2]
[1]*Kansai University, Japan*
[2]*Tottori University, Japan*

Debugging process oriented software reliability growth modeling by using a phase type probability distribution is discussed. The accuracy of model-based software reliability assessment can be conducted by developing more plausible models. As to the approaches, generalized and discretized modeling schemes and reflecting testing environment are often discussed so far. This paper focuses on a debugging process for developing software reliability growth model. Concretely, we propose a few specific models for software reliability assessment by considering several debugging processes respectively based on the notion of a phase-type probability distribution. We show our approaches are expected to get better fitting performance compared with well-known existing model after model comparisons using actual software counting data, and clear the usefulness of a phase-type modeling approach.

IEEM18-P-0437

**Mixture Lognormal Cox Regression Repair Model for Prediction of the Repair Time**

Yonas Zewdu AYELE[1], Abbas BARABADI[2], Fuqing YUAN[2]
[1]*Østfold University College, Norway*
[2]*University of Tromsø – The Arctic University of Norway, Norway*

As complexity of mechanical systems increases, it has become prevailing to observe multiple failure modes. The system failure, generally, is considered as the effect of competition and interaction among dissimilar failure modes. Hence, when analyzing the maintainability of a system, it is necessary to combine the repair time of multiple failure modes. However, in the majority of the available repair-time prediction models, the influence of the operating environment on the failure modes and repair time is not considered. The purpose of this paper is thus to propose a Mixture Lognormal Cox Regression Repair Model for predicting the repair time of a system with multiple failure modes. In the proposed model, the maintainability is predicted by proportionally mixing the maintainability of multiple failure modes. The model identifies the subpopulation of combined repair data as well as the effect of operational condition on each subpopulation.

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| **Session** | Technology and Knowledge Management 2 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Pompadour |
| **Chairs** | Michel ALDANONDO, *Toulouse University / IMT-Mines Albi,*<br>Helery TASANE, *Tallinn University of Technology* |

IEEM18-P-0013

**Developing the Strategies for AI Products based on the Technology Decomposition Framework**

Song-Kyoo KIM

*Khalifa University, United Arab Emirates*

The purpose of the paper explains how the framework of the technology decomposition could be applied for the recent technology to develop the proper strategies by demonstrating in the case study of a major high tech company in the world. The technology decomposition framework is recently designed and it is targeted to analyze the new technology in the technology management. This new framework provides for better understanding the technologies to bring the strategic fits in the high-tech industry sector. The Artificial Intelligent technology is one of popular technologies and many high-tech companies are involved in this business. This research explains the reasons for failing to enter the market based on the actual company case which has been selected for applying the technology decomposition framework and it proposes the better strategic decisions for the company to enter the artificial intelligent technology business. The paper will give the guideline how the technology management is properly applied by using the innovative way to analyze technologies.

IEEM18-P-0083

**Brain Utilization of MNCs in Japan Compared with that of Japanese Companies Overseas**

Masayuki KONDO

*Tokyo Denki University, Japan*

Multi-national Companies (MNCs) globalize their operation including research and development (R&D). They utilize local brains when conducting R&D. This paper discuss their brain utilization in Japan compared with that of Japanese companies overseas by analyzing the locations of inventors of intellectual property rights (IPRs) registered in the United States. The paper found out that MNCs started using Japanese brains to create IPRs very early and that Japanese companies started using overseas brains to create IPRs quite late. However, Japanese companies are very active in using overseas brains recently.

IEEM18-P-0096

**Integration of Scenarios in Product-service System Development - Combining Scenarios, Use Cases and Requirements Traceability**

Dominik WEIDMANN[1], Felix SEIBEL[1], Lucia BECERRIL[1], Niklas KATTNER[1], Jona LEHR[2], Markus MOERTL[1], Udo LINDEMANN[1]

[1]*Technical University of Munich, Germany*

[2]*MVG, Germany*

In product development, a current innovation driver is the integration of services through a shift towards product-service systems (PSS). Therefore, products are extended by additional services, whereas this discipline integration, combined with a necessary future oriented perspective, requires a systematic support for planning and handling complexity. In this context, increasing transparency as well as a better preparation for future evolvements are key aspects. This contribution supports with a procedure that connects the systematic analysis of the future environment with the product-service system and a corresponding case study. Requirements traceability based on a PSS-model is applied to support the impact assessment of future contextual influences on the PSS. Thereby, planning information is transferred into an engineering perspective.

IEEM18-P-0101

**Integration of Scenario-based Requirements Forecast into Model-based Product-service System Planning**

Dominik WEIDMANN, Stefan WINKLER, Markus MOERTL

*Technical University of Munich, Germany*

Due to various benefits, Product-Service Systems are becoming an increasingly important concept in industry and research. However, the integration of products and services in one system increases complexity. Far-reaching decisions must be made under uncertain conditions within the planning phase. Additionally, there is increasing pressure on development and planning departments because of intense competition and short development cycles. Therefore, this contribution picks up a procedural and modeling support for the planning of Product-Service Systems and focuses their interaction. Moreover, the concept of descriptors as connection elements is established. Finally, an academic case study proofs the feasibility of the concept and an interview study assesses the industrial applicability.

IEEM18-P-0362

**Methodology for Digitalization – A Conceptual Model**

Huey Yuen NG, Puay Siew TAN, Y. G. LIM

*Singapore Institute of Manufacturing Technology, Singapore*

This paper reviews the business model and digital capability literatures for tools and techniques related to digital transformation. The theoretical gap identified from the review, combined with findings gathered from a preliminary study with 20 companies in the manufacturing and logistics sector of Singapore highlight the market need for a methodology for digitalization. Based on the inputs gathered from experts familiar with the digital technologies and business transformation, this paper presents a 5-stage conceptual model for a digitalization methodology. The conceptual provides a general structure that defines the key stages of digitalization and their interdependencies, and highlights some future research directions for refining the model for the development of a practical methodology for digitalization.

IEEM18-P-0552

**Value Chain from Good to Great: Multiple-case Study of Estonian Companies**

Kadri MÄNNASOO, Mait RUNGI, Heili HEIN, Helery TASANE

*Tallinn University of Technology, Estonia*

How companies advance in value creation hinges on their life-cycle stage and on their role in global value chains. Globalisation and advances in technology warrant new concepts for progress in firm value advancement. Synthesising the literature and a multiple case study of firms from different value chain levels gives rise to a new concept, the company value advancement model (CVAM). The model contains six stages that are triggered by value leaps in production: 'price-competing subcontractor' → 'renowned supplier' → 'innovator' → 'market inventor' → 'global brand' → 'ecosystem leader'. The model describes the strategic priorities and investment needed to help companies reach higher levels of value creation.

IEEM18-P-0268

**How to Use Configuration Software in "Less Routine Design" Situations? Some Modelling Propositions**

Abdourahim SYLLA, Delphine GUILLON, Luis GARCES MONGE, Elise VAREILLES, Michel ALDANONDO, Thierry COUDERT, Laurent GENESTE

*Université de Toulouse, France*

This paper considers the configuration of physical systems in a business to business environment (machine tool, aerospace equipment, cranes …). In this kind of business, knowledge-based configuration software are frequently used when dealing with "infinitely routine design" situations where the entire customer's requirements can be fulfilled with standard systems. However, in "less routine design" situations where non-standard systems must be designed in order to fulfill the entire customers' requirements, existing knowledge-based configuration software cannot be used. In fact, the configuration hypothesis state that all configured systems are assembled from standard sub-systems and components. The aim of this paper is therefore to investigate how the existing products/systems configuration hypothesis, problems' definitions, and models can be modified or adapted in order to allow the use of configuration software in "less routine design" situations. In this purpose, first, the main differences between standard and non-standards systems are analyzed. Then, six cases of systems configuration that differentiate "less routine design" from "infinitely routine design" are identified and discussed. Finally, some Constraint Satisfaction Problems (CSP) based modeling extensions are proposed to allow the use of configuration software in these situations.

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| **Session** | Systems Modeling and Simulation 2 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Riverside III |
| **Chairs** | Ipseeta NANDA, *NIIT University*,<br>Abhijeet DIGALWAR, *BITS PILANI* |

IEEM18-P-0064

**Simulation-based Multiple Automated Guided Vehicles Considering Charging and Collision-free Requirements in Automatic Warehouse**

C.K.M. LEE, K.L. KEUNG, K.K.H. NG, Daniel C.P. LAI
*The Hong Kong Polytechnic University, China*

The deployment of automated guided vehicles in the automated warehouse has a great impact on the capacity in handling logistics activities. Simulation offers practical feedback and analytical solution at a designing stage of engineering applications. As for automated warehouse system, the optimal set of the combination of automated guided vehicles and workstations are highly depended on the size, dimensions, layout structure of the warehouse and working process. In this paper, the operations in the automatic warehouse were simulated to determine possible scenarios of the warehouse setting regarding the demand pattern of the packaging order. In the automatic warehouse, the racks are transferred by the automated guided vehicles to the workstations. The contribution of the study is that it not only considers the optimal number of AGV but also the optimal number of workstation for automatic warehouse. To estimate the possible setting with the highest order turn-over rate, varies scenarios were considered in the model. As a result, the estimated layout and warehouse setting were suggested.

IEEM18-P-0103

**Simulation and Optimization of Production Line in Em-plant based Assembly Workshop**

Hongying SHAN, Lina LI, Yu YUAN, C. WANG
*Jilin University, China*

Taking the dynamic production of a line in the assembly shop of a company's rear axle as an example, the on-site investigation confirmed the basic data and analyzed the assembly process. Em-plant software was used to model the dynamic simulation of each station on the assembly line. According to the simulation results, the bottleneck process is improved, and combined with ECRS principles in lean production, it is eliminate, combine, rearrange and simplify. Under the actual production conditions, an optimization scheme was proposed. After the improvement plan was implemented, the simulation results showed that the production capacity was significantly improved, the assembly line imbalance was improved, and the company's efficiency was improved.

IEEM18-P-0113

**Lean, Simulation and Optimization: The Case of Steering Knuckle Arm Production Line**

Hongying SHAN, Yu YUAN, Yanxiang ZHANG, Lina LI, Chuang WANG
*Jilin University, China*

This paper studies the application of simulation software and integrates system simulation technology and lean theory. Based on the abstract entity of the knuckle arm line, the existing production line simulation model is established by Flexsim simulation software. We use the theory of production line balance to analyze production line through the process--'modeling simulation--improvement and optimization--modeling simulation'. Exerting lean theory, we explore the process which analyzes and solves problems through simulation software. This line is improved by ECRS principle. The results show that the improvement effect is significant. This paper provides method of reference and practical basis for doing the improvement and simulation optimization of production lines.

IEEM18-P-0598

**Efficient Modular Product Platform Design of Mechatronic Systems**

Günther SCHUH, Christian DÖLLE, Sebastian BARG, Maximilian KUHN, Stefan BREUNIG
*RWTH Aachen University, Germany*

In today's unpredictable business environment, manufacturing companies are exposed to increasingly dynamic market conditions and volatilely changing customer expectations. Therefore, the modular product platform approach is increasingly gaining the focus of many industries in order to enable standardization and high level of product individuality at the same time. Especially in the development of new mechatronic products the fulfillment of product functions is realized in mechanics, electronics and software. Therefore, this paper presents a methodology for an increased efficiency of modular product platforms for mechatronic systems. In the first partial model, mechatronic systems are decomposed into individual mechatronic function modules. Subsequently, a classification for degrees of freedom in mechatronic systems is developed. In the third partial model, interactions of the specific degrees of freedom with regard to function fulfilment, costs and interdependencies are examined and represented by key figures. The restriction of systemic degrees of freedom is realized by means of a change propagation algorithm. In a final step, the overall system, consisting of individual mechatronic function modules, can be configured.

IEEM18-P-0176

**Informational Approach to Global Optimization with Input Uncertainty for Homoscedastic Stochastic Simulation**

Haowei WANG[1], Jun YUAN[2], Szu Hui NG[1]
[1]*National University of Singapore, Singapore*
[2]*Shanghai Maritime University, China*

In real applications, decision makers usually make use of simulation models to study the real-world complex systems and make optimal decisions. Simulation optimization is a procedure to find optimal design via simulation model. When the simulation model itself is complex and time-consuming to run, it will be preferable to use fewer simulation runs to find optimal design. Under this setting, Gaussian process based optimization algorithms, including the Efficient Global Optimization (EGO) and the Informational Approach to Global Optimization (IAGO) have been well developed for both deterministic and stochastic simulation optimization problems. Recently, the EGO algorithm was extended to solve the stochastic simulation optimization problem when input uncertainty is considered. However, the stochastic IAGO algorithm with input uncertainty has not yet been carefully studied. This paper contributes to refining the current IAGO algorithm to make it applicable for simulation optimization when homoscedastic stochastic noise and input uncertainty are considered. Details about the model formulation and the refined IAGO algorithm are provided. Numerical comparisons between EGO with input uncertainty and IAGO with input uncertainty show that IAGO with input uncertainty can find the optimal design more accurately when budget constraints are present.

IEEM18-P-0282

**Energy Efficient Motion Planning of Dual-Armed Robots with Pickup Point Determination for Transportation Tasks**

Tatsushi NISHI, Yuki MORI
*Osaka University, Japan*

In this paper, we propose energy efficient, conflict-free motion planning of a dual-armed robot arm for transportation works. The determination of picking points and conflict-free motion planning are simultaneously optimized. We formulate a nonlinear optimization problem which aims to minimize the weighted sum of the energy consumption and the total completion time when the dynamics of the robot arms are given. The proposed method is implemented in an experimental system. The computational results show that the proposed method can save energy consumption and optimize the points for picking up workpieces while minimizing the total completion time. The performance of the dual-armed robot is shown to be more effective than that of a single armed robot under various situations.

IEEM18-P-0341

**System Dynamics Approach for the Assessment of Leanness of Organizations**

Abhijeet K. DIGALWAR, Akshay BEDEKAR, Mohit AGRAWAL
*Birla Institute of Technology and Science, Pilani, India*

Due to highly competitive, volatile and dynamic business environment, lean manufacturing is being seen as a winning strategy by manufacturers. Successful implementation of lean manufacturing can give an edge over their competitors, but during this implementation, they often fail to identify the direction in which the implementation should proceed. In order to help the organizations to progress in the right direction, there is a need to identify the variables and factors that affect the lean implementation process. A system dynamics approach has been applied to analyze the implementation process and help an organization towards becoming an effective lean organization. In this research, 17 variables are identified, through literature review and discussion with practitioners. A causal loop has been developed among the variables using system dynamics approach which represents "enablers" and "results". This causal loop provides a visual representation of various cause and effect relationships and feedback loops to understand various factors and variables in a better way. It is probably one of the leading attempts to provide road map for implementation and assessment of leanness of organizations.

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| **Session** | Manufacturing Systems 3 |
| **Date** | 18/12/2018 |
| **Time** | 08:45 - 10:45 |
| **Room** | Riverside IV |
| **Chairs** | Junfeng WANG, *Huazhong University of Science and Technology*,<br>Surendra M. GUPTA, *Northeastern University* |

IEEM18-P-0493

**A Modified MOEA/D for Energy-efficient Flexible Job Shop Scheduling Problem**

Enda JIANG, Ling WANG
*Tsinghua University, China*

With the developing of green economy, energy-efficient scheduling has raised great interest recently. In our paper, we propose a modified multiobjective evolutionary algorithm based on decomposition (MMOEA/D) for the energy-efficient flexible job shop scheduling problem (EEFJSP) to optimize makespan and total energy consumption. A cooperative search operator is designed to improve the exploration. At the same time, a local intensification based on the properties of this problem is added to enhance the exploitation. Besides, the effect of parameter setting is investigated by the design-of-experiment. Finally, comparison experiments are carried out between the MMOEA/D and the shuffled frog-leaping algorithm (SFLA). The results have shown that the MMOEA/D outperforms SFLA on this problem.

IEEM18-P-0495

**Radical Product Innovation in the New Zealand Food and Beverage Industry: The Effect of Company Age, Size, and Foreign Ownership**

Julawit PITRCHART, Nihal JAYAMAHA, Allan ANDERSON
*Massey University, New Zealand*

This paper presents some results of a broader empirical study that examined radical product innovation determinants in the New Zealand food and beverage (F&B) industry involving 137 F&B companies. Radical product innovation is defined as the introduction of a new product that involves a new-to-market core technology and core value proposition and is an important driver of company growth and new market creation. Three company characteristics–the age, size, and the ownership base–that are posited to influence product innovativeness are investigated. The results show that the company age and size have an effect on product innovativeness. However, the two factors did not show a two-way interaction, implying that their effects are additive. The findings are important because companies grow in size as they age and often attract capital investment from foreign countries.

IEEM18-P-0299

**Integrated Simulation Optimization for Layout Problems**

Henri PIERREVAL
*SIGMA Clermont, France*

Most optimization approaches used for designing layouts of such systems as manufacturing systems or hospitals facilities use deterministic mathematical models to compute the transportation costs or other performance measures. As a consequence, the dynamic behavior of these systems (queuing phenomena, blocking, etc.) and the stochastic issues are neglected, so that the solution found may not be relevant. Simulation optimization has been identified as an efficient approach to address this type of problem. Unfortunately, it requires merging an optimization tool and a simulation engine, which can be difficult and can necessitate time consuming programming tasks (front end, synchronization, interface, model generation, etc.). We suggest an approach that allows several types of layout problems to be solved directly using popular simulation packages, avoiding such shortcomings. An example illustrates the proposed integrated and generic approach. Its benefits and limitations are discussed and research directions are suggested.

IEEM18-P-0014

**Implementing FPGA based PID-controller for Extrusion to Reduce Raw Material Wastage**

Samreen HUSSAIN[1], Muhammad ISMAEEL[2], Adnan WAQAR[2], Muhammad Ali AMJAD[2], Muhammad Mubeen IQBAL[2], Muhammad SHAUR[2], Rimsha ARSHAD[2]
[1]*Ziauddin University, Pakistan*
[2]*Dawood University of Engineering & Technology, Pakistan*

In this paper SIMULINK and Xilinx System Generator is deployed to develop a digital PID-controller, which can provide efficient temperature control for industrial extrusion process. The modelled controller was simulated to determine the effectiveness of PID-control algorithm; however, the PID tuning is done manually. After tuning for best response, the netlist for PID-controller is generated and then implemented using VHDL to develop prototype on FPGA. The experimental implementation and testing were carried out on an industrial extrusion process plant. The prototype plant was also developed as a test bench. This paper presents a low cost solution for implementing PID-control in automation processes to reduce the wastage of raw material as in burning and decolourization due to delay in temperature control. Using FPGA as processing chip, the control process gets speed, accuracy, reliability and re-configurability. The quality of product was compared under three conditions namely Without PID, Un-tuned PID and Tuned PID. The burning effect was maximum without PID, slightly better with Un-tuned PID and minimum with tuned PID hence saving the wastage of raw material and overall production cost.

IEEM18-P-0550

**Rapid Thermal Simulation of Powder Bed Additive Manufacturing**

Frédéric VIGNAT[1], Nicolas BERAUD[2], Francois VILLENEUVE[1]
[1]*University of Grenoble Alps, France*
[2]*DP Research Institute, France*

Controlling thermal history is a key factor for the success of an additive manufacturing operation. Thermal history depends on manufacturing strategies i.e. beam path and energy input. Energy input and beam path, are determined by either very simple models at the machine site or complex and time-consuming finite element models. This paper proposes a new thermal simulation method based on abacus to determine energy input along the trajectories. The paper presents first the method. Then, the method is validated comparing its results to finite element simulation and to built part quality.

IEEM18-P-0234

**Energy Consumption Control of One Machine Manufacturing System with Stochastic Arrivals Based on Fuzzy Logic**

Eliana TORRES DUQUE[1], Zicheng FEI[1], Junfeng WANG[1], Shiqi LI[1], Yuanfang LI [2]
[1]*Huazhong University of Science and Technology, China*
[2]*China Academy of Launch Vehicle Technology, China*

In the last decade, energy consumption has significantly risen within the manufacturing industry. This issue has not only considerably increased energy costs but has also posed an environmental concern among society. Consequently, many researchers have designed and developed methods so as to reduce energy consumption. From this vantage point, the aim of this research is to design a fuzzy controller to turn-off the machine when it tends to be idle for energy saving purposes. A one buffer one machine manufacturing system with random part arrival is considered in this paper. The decision of the controller is based on the real-time status of the machine, the upstream buffer level and the required production rate. The controller was tested through simulation experiments and it was observed that large amount of energy can be saved without affecting the throughput significantly. The warm-up energy which results from turning off and on machine is also considered.

IEEM18-P-0335

**Analysis of Product Designs for Product Recovery Using Linear Physical Programming**

Aditi D. JOSHI, Surendra M. GUPTA
*Northeastern University, United States*

Internet of Things (IoT) can help in weighing in products' designs for recovery when they are returned at their end of lives. Devices such as Radio Frequency Identification (RFID) tags and sensors can be embedded in products to store and collect information and determine their conditions at the end of their lives, which can then be used to choose a rational recovery process amongst disassembly, remanufacturing, recycling and disposal. This paper suggests an advanced system which collects device embedded products at the end of their lives to satisfy various products, components and materials requirements. The system identifies favorable design(s) for disassembly or remanufacturing based on three criteria viz., total profit, quality level and the number of disposed items. A method involving Linear Physical Programming (LPP) is used to formulate the problem. An example involving cell phones is used to illustrate the proposed methodology.

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| **Session** | Supply Chain Management 5 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom I |
| **Chairs** | Gitae KIM, *Hanbat National University*,<br>Kanagi KANAPATHY, *University of Malaya* |

IEEM18-P-0543

**Locating Facility with Multi-period and Dynamic Demand: A Case Study of Chemical Fertilizer Store in Thailand**

Natdabhorn SAPKHOKING, Arthit APICHOTTANAKUL, Komkrit PITIRUEK
*Khon Kaen University, Thailand*

This paper presents a solution for the problem in multi-period facility location of a chemical fertilizer store in Udonthani province of Thailand. The Case Study was Agricultural marketing co-operative limited (AMC). The study proposed an approach for determining facility locations with dynamic demands and multiple capacity sizes. The results showed that the proposed facility location model led to a total cost reduction of approximately 1,007,000 baht. Furthermore, scenarios were established to verify the appropriate facility locations in order to obtain the minimum total along the demand curve. Eventually, the model was proven to be an effective solution for this case and had the potential for future use in AMC.

IEEM18-P-0557

**Alignment Between Enterprise Green Supply Chain and Green Information System: An Analysis of Four Cases**

Zheng WU[1], Zhaojun YANG[1], Jun SUN[2], Yu ZOU[1]
[1]*Xidian University, China*
[2]*University of Texas Rio Grande Valley, United States*

Green innovation helps enterprises enhance economic development, organizational transformation, and market competitiveness. As an important means to implement green innovation within an enterprise, the integration of green supply chains management (GSCM) and green information systems (GIS) plays a crucial role in the sustainable development of the enterprise. This study uses the case interview method to examine the integration of GSCM and GIS by small and medium enterprises (SMEs), and its impact on organizational performance. Through the analysis of interview data collected from four sites, it is found that the overall degree of integration is still low, especially at the corporate social level. Nevertheless, the integration of GSCM and GIS indeed has a positive impact on corporate performance. The findings yield helpful insights for SMEs to enhance GSCM-GIS integration and optimize green innovation.

IEEM18-P-0580

**Decision Support System of the Single Track Railway Rescheduling with Predictive Delay**

Ahmad RUSDIANSYAH, Kurnia ISWARDANI
*Sepuluh Nopember Institute of Technology, Indonesia*

Disturbance that occurs on the train or at the station, such as a broken train engine, broken train line signals, and others, can cause delay on the train. The train operator at the station will reschedule the train schedule in the event of a delay. Currently, the train only reschedules when the delay occurs "on the spot", consequently the rescheduling determination takes a long time. This can be anticipated by taking preventive action, ie rescheduling by using predictive delay. Possible conflicts that will occur when rescheduling single track are overtaking and crossing. This research will focus on the development of rescheduling considering predictive delay. The purpose of this study is to minimize the total delay time. The output of this research is a decision support tool that can generate free-conflict timetable when delay occurs.

IEEM18-P-0597

**The Identification of Supplier Selection Criteria Within a Risk Management Framework Towards Consistent Supplier Selection**

Tumelo LESISA, Annlize MARNEWICK, Hannelie NEL
*University of Johannesburg, South Africa*

The aim of the study is to evaluate the consistency of supplier risk assessment performed during the supplier selection process. Existing literature indicates that current supplier selection processes yield inconsistent results. Consistent supplier selection cannot be accomplished without stable risk assessment performed during the process. A case study was conducted in a train manufacturer in South Africa, and document analysis, interviews and questionnaires were employed to source information and data. Triangulation and pattern matching enabled a comparative study between literature and practice from which findings were derived. The study suggests selection criteria that may be considered when performing supplier risk assessment during the selection process. The findings indicate that structured supplier risk assessment with predefined supplier selection criteria may eliminate inconsistencies in supplier assessment and selection.

IEEM18-P-0572

**Optimal Vehicle Routing for Parcel Delivery with Considering Two Time Periods**

Gitae KIM
*Hanbat National University, South Korea*

In city logistics, some group of vehicles are usually assigned a certain fixed areas so that drivers get used to the route or the customer sites. Vehicles deliver materials regularly every time period at the same area. In other words, the customer demand can be placed in the similar area each time period. Thus, we may find the optimal route for the demand of two time periods instead of finding the optimal route for the single time period. This paper proposes a mathematical programming model for the vehicle routing problem for the parcel delivery in urban transportation with considering two time periods. Since the area of delivery is the same, the integration of demand of two time periods can reduce the total transportation costs.

IEEM18-P-0212

**Revenue and Cost Sharing Mechanism for Effective Remanufacturing Supply Chain**

Tatsuya INABA
*Kanagawa Institute of Technology, Japan*

Remanufacturing has become popular as a mean to realize a sustainable society. In the remanufacturing process, two types of uncertainty reside; uncertainty of the amount of used products to be collected and that of the demand of remanufactured products. Therefore, deciding how many to collect and how many to procure is the key to success but double marginalization problem is observed if the remanufacturing process consists of two companies. To solve this problem, this study proposes a revenue and cost sharing mechanism to realize a higher expected profit as a channel and brings higher expected profits to both companies.We show its effectiveness by using numerical example. The higher expected profit brought by this proposal would make it feasible to operate remanufacturing supply chains and help accelerate the sustainable society.

IEEM18-P-0288

**The Robustness of Warranty: Wholesale Pricing Contract vs Two-part Tariff**

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

Warranty service can effectively motivate the demands of customers, especially to the risk-averse ones. However, it remains some challenging issues to be further explored, e.g., Is it robust for warranty while implementing different types of pricing contracts(i.e., wholesale pricing and two-part tariff)? How will they affect the warranty as well as the performance of supply chain? In this paper, we focus on the two scenarios: the decentralized decisions under wholesale pricing contract and two-part tariff, then we compare the results with that of the benchmark--centralized decision. The analysis shows two important findings. First, the warranty is explicitly robust and independent of the pricing contracts. Second, supply chain can be coordinated by wholesale pricing contract in a certain condition. However, It could be coordinated by two-part tariff whenever the time. These observations suggest that manufacturers could keep the warranty unchanged and gain more by implementing an appropriate pricing contract.

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| **Session** | Human Factors 2 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom II |
| **Chairs** | Manutchanok JONGPRASITHPORN, *King Mongkut's Institute of Technology Ladkrabang,* Antonio VERDU, *University Miguel Hernandez* |

IEEM18-P-0246

**Impact of Socioeconomic Factors on the Levers Influencing Households' Participation in Recycling Programs in Zambia**

Bupe G. MWANZA[1], Arnesh TELUKDARIE[2], Charles MBOHWA[2]
[1]*Cavendish University Zambia, Zambia*
[2]*University of Johannesburg, South Africa*

This research addresses recycling in developing economies for sustainable waste management and resource utilization. The purpose of the research is to assess the relationship between socioeconomic factors and the levers that influence households' participation in Plastic Solid Wastes (PSWs) recycling programs. A literature review on levers that influence households' participation in recycling programs is conducted. Based on the identified levers, a questionnaire is designed and distributed to 445 households in the city of Ndola Zambia. Factor Analysis is performed on levers that influence households' participation in recycling programs. An independent t-test analysis is conducted on socioeconomic factors and the levers. The results provide important information to plastic manufacturing and/or recycling companies, waste managers and policy makers in developing economies. The information is critical when designing and implementing waste recovery and recycling programs.

IEEM18-P-0272

**Evaluation of Physical and Motor Function in an Aging Female Population – Preliminary Results**

Marek BURES, Jana BENESOVA, Martin KABA
*University of West Bohemia, Czech Republic*

The paper is focused on age related changes regarding motor abilities and forces. The paper briefly reviews proposed methodology and measuring procedures. The fine fingers dexterity was measured by Purdue Pegboard Test and Grooved Pegboard Test. For hand dexterity the Complete Minnesota Dexterity Test was used. Hand grip strength was evaluated by Jamar dynamometer and range of motions were measured by classic goniometers. Furthermore the paper presents preliminary results of two female age groups (25-29 and 60-73) and their comparison. As expected younger group of female performed better in dexterity testing, hand grips and some range of motions. However some ranges of motions were better in older female group probably due to exercise. Some inaccuracy also might occur during measurement which will be eliminated in the future. These are just preliminary results which served for evaluation of proposed methodology. The research will carry on and will be extended in the future to other age groups and also to male population.

IEEM18-P-0178

**Age-related Differences in Work Motivations: The Case of SMEs**

Riitta FORSTEN-ASTIKAINEN[1], Susanna KULTALAHTI[2], Matti MUHOS[1]
[1]*University of Oulu, Finland*
[2]*University of Vaasa, Finland*

Human resource management practices in small and medium-sized enterprises (SMEs) are often informal and underdeveloped due to a lack of resources such as time, money, and competencies. Workforces are also becoming increasingly diverse in terms of age groups, so often three different generations are present in a single workplace. This study's primary goal was to examine whether work motivation factors substantially differ between generations. We chose to focus on motivation as it has favorable outcomes for SMEs, namely, performance, trust, and wellbeing. A sample of 4,439 employees from 93 SMEs revealed that mo-tivational factors vary significantly between generations and people of different ages. The findings further emphasize the need for age management practices in SMEs.

IEEM18-P-0619

**What Humans Act in Robotic Surgery**

Fabio FRUGGIERO[1], Marcello FERA[2], Alfredo LAMBIASE[3], Salvatore MIRANDA[3]
[1]*University of Basilicata, Italy*
[2]*University of Campania Luigi Vanvitelli, Italy*
[3]*University of Salerno, Italy*

This work discusses about variables affecting robotic assisted laparoscopic surgery using De Vinci system. A systematic review found key factors which may cause clinical errors. Key variables are identified and causal relationships, by stringing together several loops, have been recognized. Decomposition into a hierarchy of sub structures (i.e., Analytic Hierarchical Process) is performed in order to rank the role of "variables" affecting human reliability in the robotic assisted surgery. System is studied according to steady state parameters, dynamics dependences. The subjective evaluations were collected from field - managers and nurse and doctors- by the means of questionnaires and interviews. ANOVA analysis is implemented and a risk categorization is then proposed. It is resulted that breaks and rota schedule interact with physical stress. Those in turn alter (by increasing) the probability of error. Knowledge about procedures and learning about process increase fatigue limit over demand requirements. Reliability is consistently affected by the surgical experience. Collaboration in team is required whenever human reliability is at critical level. Complex tasks require smart team.

IEEM18-P-0530

**The Influence of Family on Self-reflexive and Emotional Antecedents of the Transformational Leader**

Lirios ALOS-SIMO, Antonio VERDU-JOVER, Jose Maria GOMEZ-GRAS, Marina ESTRADA-DE-LA-CRUZ
*University of Miguel Hernandez, Spain*

In the literature on organization and management, the term transformational leader is used for individuals who foster and encourage organizational and individual change. Some authors have proposed emotional intelligence as an antecedent of the transformational leader, but such leaders stimulate reflexive-cognitive processes in their followers, which makes it particularly interesting to analyze their self-reflexive capabilities. Given the family's influence on the development of emotional and self-reflexive capabilities, we propose a model in which the existence of a leader within the family could moderate the relationship of these capabilities to the transformational leader, since a leader in the family may have been a reference for the leader's vocation from an early age.

IEEM18-P-0298

**Risk Reduction Among Adult Walker Users: An Ergonomic Innovation**

Ezrha C. GODILANO, Edgardo M. BALDOVINO JR., Jeizel Abbigael D. CAHENDE, Marielle B. TERRIBLE
*Malayan Colleges Laguna, Philippines*

This study described the development of the design of an ergonomic adult walker that improved the maneuverability and stability and reduced the risk of pain and discomfort to its geriatric users. The current design of the walker was validated if it caused pain and discomfort to the different body parts of the users. Risks encountered and the factors that contributed to the discomfort of the users were also identified and analyzed. A survey was conducted using likert-based and Nordic questionnaire to assess the discomfort, pain and potential risks of certain body parts of the user. Quality Function Deployment was used to incorporate the needs of the users with regards to the features of the product. Rapid Entire Body Assessment was conducted to assess the postural risks and to identify the health risks that may develop with respect to the posture of the user. Anthropometric measurements were also determined to know the optimal dimension of the adult walker that will minimize the discomfort experienced. The proposed ergonomically designed walker successfully decreased the potential risk of having MSDs, pain, and discomfort and made it convenient to use. Cost-benefit analysis and the Failure Mode and Effect Analysis (FMEA) were also made to assess and compare the strengths, benefits, and weaknesses of the current and proposed design of the walker.

IEEM18-P-0300

**WMSD Risk Reduction Among Grocery Shoppers and Clerks by Redesigning Double Basket Shopping Carts**

Ezrha C. GODILANO, Joshua John G. ALMORO, Al John D.P. BULAHAN, Edward Kenneth Allen C. GARCIA
*Malayan Colleges Laguna, Philippines*

This study created an ergonomically designed double basket shopping cart with a purpose of reducing Work-Related Musculoskeletal Disorders (WMSD) risks to grocery shoppers and clerks. This study proved that the present design of the double basket shopping cart provides pain and discomfort to the grocery shoppers and clerks which can lead to WMSD. It also showed that incorporating ergonomic features on the proposed design of the double basket shopping cart reduce the pain and discomfort to the grocery shoppers and clerks. The study was conducted in Rey-Sal Grocery Store in Cabuyao, Laguna. Rapid Entire Body Assessment (REBA), NIOSH, Nordic Questionnaire, and surveys were used to determine the pain and discomfort that the grocery shoppers and clerks feel. Statistical Package for the Social Sciences (SPSS) was used to help in the regression analysis of the researchers. Anthropometry was used in the designing the proposed design, to develop the optimal dimensions of the double basket shopping cart for the comfort of the users. The proposed design of the double basket shopping cart effectively reduced the pain level and the discomfort of the grocery shoppers and clerks. It eliminates the need for lifting motions of the grocery shoppers due to the new design. The methods that were used were essential in reducing the risk of WMSD to grocery shoppers and clerks. Cost-benefit analysis and Failure Mode and Effect Analysis were also executed to evaluate the proposed double basket shopping cart design financially, its reliability, durability and performance.

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| **Session** | Healthcare Systems and Management 2 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Ballroom III |
| **Chairs** | Manuel De La SEN, *IIDP, EHU/UPV* ,<br>Desmond WONG, *University of Hull* |

IEEM18-P-0539

**Preoperative Analysis for Clinical Features of Unsuspected Gallbladder Cancer Based on Random Forest**

Zhen ZHANG[1], Na LI[2], Hengyi GAO[1], Zhiqiang CAI[1], Shubin SI[1], Zhimin GEMG[2]
[1]*Northwestern Polytechnical University, China*
[2]*Xi'an Jiaotong University, China*

With the incidence of unsuspected gallbladder cancer (UGC) increasing, the difference of preoperative features between unsuspected gallbladder cancer and gallbladder cancer diagnosed before operation arose doctors' attention recently. In this study, firstly, chi square test was adopted to analyze the difference of two groups and select out the difference variables. Then, the random forest was proposed to establish the classification model whose accuracy evaluated by area under curve was 0.7310. Meanwhile, the model identified the critical classification factors using variable importance, which adopted the method of mean decrease in accuracy. Finally, the results of two methods showed that clinical features of biliary calculi, cholecystolithiasis history, gallbladder polyps and family history of malignancy, serum CEA level, jaundice, cholecystitis history and abdominal pain were important factors in preoperative assessment of unsuspected gallbladder cancer. What's more, the feature of time of cholecystitis history should not be ignored for preoperative assessment of UGC patients.

IEEM18-P-0547

**Developing Customer Perception Based Organization Performance Measurement Framework for Healthcare Service**

I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN
*Indonesian Institute of Sciences, Indonesia*

We have developed a conceptual framework that can be used as customer perception based organization performance measurement framework for healthcare service. The conceptual framework consists of customer satisfaction, perceived sacrifice, and perceived service quality. This paper aims to validate the conceptual framework empirically. A survey was conducted in order to gather the data. The survey involved 123 healthcare service (HS) users in Jakarta, Indonesia. Structural Equation Modeling analysis was employed. The research result showed that the measurement model of our framework has good psychometric properties. In other words, the measurement model of our framework is valid and reliable. The research result also showed that the structural model of our framework has good goodness of fit.

IEEM18-P-0263

**Data Accessibility for Biotech and Medicine Industries: A Cross-stakeholder Perspective**

Zih-Han WANG[1], Wei JENG[2]
[1]*University of Washington, United States*
[2]*National Taiwan University, Taiwan*

There is a dilemma between data accessibility and ethical concerns in today's biotech and medicine industry (BMI) development. (BMI). Through qualitative interviews of 14 participants as different stakeholders, this study investigates and observes actual practices and obstacles that the BMI startups would encounter while acquiring data for their own products, as well as their insights for those who are eager to change and improve the current environment. Our findings reveal an inconvenient truth that the cost of data acquisition is very high, not only in terms of monetary price but also strict regulations. Interestingly, many of the BMI startups in our interviews hope that the regulations can be more transparent and well-round, rather than relaxing the regulations.

IEEM18-P-0608

**'Strategy Making', Not Re-engineering: Thinking Ahead, Again, and Across for Process Innovation in Home Care**

Desmond WONG[1], Yee Lin HIEW[2]
[1]*University of Hull, United Kingdom*
[2]*National University of Singapore, Singapore*

As a result of information asymmetry and uncertainty, home care (HC) is unamenable to conventional re-engineering. Paradoxically, patients can experience long access to care, while service providers experience low productivity. Our action research sought to adapt Neo and Chen's (2007) conceptual framework of thinking ahead, again, and across to process innovation in HC. The framework is derived from public sector innovation in Singapore, pursued amid 'black box' uncertainty. Overall, we obtained proof-of-concept by achieving desired outcomes: Patients' access to care shortened from a 7 to 90 day-range to a 1 to 3-day range, while the service provider's productivity was raised from 38% to 65%. In turn, our data and reflections suggest a fairly systematic approach to adapting thinking ahead, again, and across to process innovation in HC, with a real-world case, tables, and figures for reference. We propose a strategy making analogy as a guide for broad analyses-syntheses, surfacing options, and adapting workflow activities as the basic unit of analysis. Action research, with support from change management interventions, is likely to yield more effective process innovation in HC.

IEEM18-P-0112

**A Bi-objective Credibility-based Fuzzy Mathematical Programming Model for a Healthcare Facility Location-network Design Problem**

Reza TAVAKKOLI-MOGHADDAM, Pooya POURREZA, Ali BOZORGI-AMIRI, Nastaran OLADZAD
*University of Tehran, Iran*

This study presents a bi-objective mathematical model using credibility-based fuzzy programming for a healthcare Facility Location-Network Design Problem (FLNDP) under uncertainty. Finding the optimal location of the healthcare facility and design the underlying network is the main aim of solving this problem. To solve the problem Two well-known multi-objective meta-heuristics, namely NSGA-II and MPOSO, are applied. The results from these meta-heuristic algorithms reveal that for large sizes of the problem, NSGA-II has a better performance than MOPSO.

IEEM18-P-0037

**Implementing and Using New Information Technology in Hospital Logistics**

D. KRITCHANCHAI[1], Per ENGELSETH[2], Sirirat SRISAKUNWAN[1]
[1]*Mahidol University, Thailand*
[2]*Molde University College, Norway*

Both public and private hospitals in Tailand seek to improve and increase service sufficiency as well as opportunities in an increasingly competitive healthcare services market in Thailand. One of these strategies is to adopt new technology into various functions in the hospital. This research aims to study IT implementation in the hospital supply chain. A qualitative survey of 20 community hospitals in Thailand is conducted providing information on IT –enabled development in Information Management, Data Standardization, Inventory Management, Purchasing Process and Transportation Management. The results show that most of the hospitals with poor performance tend to lack of functions responsible for new information technology implementation. When IT is applied effectively, results show that it brings about performance gains in inventory, purchasing and transportation functions of the studied hospitals.

IEEM18-P-0432

**Design and Development of a Prototype for Measuring Range of Motion**

Manutchanok JONGPRASITHPORN[1], Nantakrit YODPIJIT[2], Thachamaporn CHANAROON[1], Thunjira PAIBOONRATTANAKORN[1], Teppakorn SITTIWANCHAI[2]
[1]*King Mongkut's Institute of Technology Ladkrabang, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*

The ability to perform range of motion can help human maintain mobility and flexibility. The transitional device for measuring range of motion is Goniometer, a manual method. This method is depended on users' experience and skill which could lead to wrong interpretation and results. The purpose of this project is to design and develop a prototype for measuring Range of Motion (ROM) by using Inertial Measurement Units (IMUs). The prototype, called ROMie, is including hardware and software. ROMie had been validated for accuracy and sensitivity at 45, 60, 90 and 180 degrees. ROMie was tested for forty times at each angle,. The results showed that ROMie has the overall accuracy greater than 95 percent. Sensitivity is equal 1 at 95 percent confidence interval and greater than 0.875 at 99 percent confidence interval.

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| **Session** | Technology and Knowledge Management 3 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Pompadour |
| **Chairs** | Chung-Huei KUAN, *National Taiwan University of Science and Technology,*<br>Amnon GONEN, *Academic Ramat Gan* |

IEEM18-P-0410

**Network Structure and Positional Relationship of the External and Internal Technology Acquisition based on the Firm Self-citation Patent Network**

Chao-Chih HSUEH
*National Pingtung University of Science and Technology/ National Taiwan University, Taiwan*

This paper will focus on how firms formulate the patent portfolio considering the technology acquisition strategy- internal technology development and external technology acquisition by using patent self-citation network analysis. The research sample is patent pool of the Monsanto Company including 5263 internal patents, 498 external acquiring ones and 860 license-out ones. In the Network Centrality analysis, the result showed that the in-degree centrality of the external acquiring patents have higher value than the internal patent development. That is mean that external technology source provided the complement knowledge for internal technology development in the knowledge creation process. Besides, internal patent have higher out degree centrality than the other two types of patent. Therefore, this study suggested that patent analysis in the firm-level should include external-acquisition technology and the results could show the real patent portfolio of the competitors.

IEEM18-P-0347

**Appropriate Technology and Management for Sustainability**

Jayshree PATNAIK, Bhaskar BHOWMICK
*Indian Institute of Technology Kharagpur, India*

Innovation in technology in the last few decades has revolutionized society's ability to solve problems. Answering the call for innovation and management, the concept of appropriate technology is discussed. Appropriate Technology is a small-scaled technology developed by community to cater their needs. The study explores the conceptualization of Appropriate Technology in the era of innovation based on empirical data from a field survey. This study attempts to redefine and relook the tenets of appropriate technology and finding out the factors of appropriateness by analyzing empirical data. The field survey is conducted through close-ended questionnaire and face-to-face interview of 193 people from NGOs (Non-Governmental Organizations), Government. Officials and students of a technical institution from a state of India. The findings of the study presented three factors of appropriateness namely designing for socio-environment sustainability, localizing design to cost solutions and exploring the market potential, which highlights the importance of positioning appropriate technology and exploiting its perspective to build it a mainstream discipline in technology management and studies.

IEEM18-P-0356

**Social Network Analysis in Lean Thinking: A Method for Improving Information Flow in Technical Integrity Management System Development**

Andika RACHMAN, R.M. Chandima RATNAYAKE
*University of Stavanger, Norway*

Due to the unstable oil price in recent years, engineering contractors and oil and gas companies have been trying to implement lean thinking to reduce the cost of developing technical integrity management system (TIMS) and improve work quality. Improving information flow becomes a critical element of lean thinking in the TIMS development process because of its multidisciplinary and knowledge-intensive nature. Process visualization is normally performed to identify the opportunities for improving information flow. However, process visualization in a knowledge-intensive process is challenging, due to its high complexity, branching information flow, and the presence of informal networks of information among personnel. This paper proposes social network analysis (SNA) as the tool for visualizing knowledge and information flow in the TIMS development process. SNA adopts a network perspective, which makes it suitable for observing complex information and knowledge flow. SNA also allows the observation of informal interactions of the actors and the regular patterns of relationship between the actors in the network. A case study is provided to demonstrate the application of SNA and to illustrate how SNA contributes to improving information flow.

IEEM18-P-0307

**Engineering Management Qualification: A Comparative Study for South African Universities**

Samuel MLANGENI, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

This study reviews a leading South African University delivering Engineering Managers in Africa, with students from South Africa, Africa and the globe. This research facilitates a review of skills development via teaching and learning for Engineering Management. This paper provides an African, Universities 21, and ASEM comparative. The current trend in industry is for engineers to be promotion to managers. Experience is a cause for succession. In this study, the modules offered at the University of Johannesburg is the baseline, with which to test/align the review of Engineering Management delivery methods offered globally. This research used a Python code as an engine to automatically gather global data. The results indicate the curriculum at the University of Johannesburg to be relevant and in line with the worlds' best Engineering Management universities.

IEEM18-P-0137

**Measuring Product Success: A Literature Study**

Trifandi LASALEWO[1], Subagyo SUBAGYO[2], Hari Agung YUNIARTO[3], Budi HARTONO[2]
[1]*Universitas Negeri Gorontalo, Indonesia*
[2]*Gadjah Mada University, Indonesia*
[3]*Universitas Gadjah Mada, Indonesia*

Previous studies of successful products have revealed three variables that directly contribute to the product success, including product characteristics, management & organizational characteristics, and marketplace characteristics. In addition, there are two variables that contribute indirectly to the product success, i.e. innovation and knowledge sharing within an organization. The objective of the current literature study is to construct a theoretical model that describes the correlation of these five variables with the product success. The model was formed through a deep literature search, which evoked all aspects (variables) contributing to the product success. The current study successfully produces a model that can be used to assess the product success, which is then tested using seven research propositions.

IEEM18-P-0337

**Determinant of Startups' Fund-raising Value: Entrepreneur and Firm Characteristic**

Pimolrat SATHAWORAWONG, Natcha THAWESAENGSKULTHAI, Kanis SAENGCHOTE
*Chulalongkorn University, Thailand*

Equity fund raising is one of the top key challenge faced by startup entrepreneur. In this stage, "how to determine the firm's value" becomes a big question. Traditional approach relies valuation process on financial information in which it is inadequate in startup context. Current studies that rely valuation on non-financial information had been perform mostly in developed countries. This study aims to identify factor effecting fund-raising value by applying empirical study using non-financial information data from startup in ASEAN. We uniquely hand-collected the data from 211 transactions in 6 ASEAN countries. 14 parameters had been preliminary identified as factor effecting fundraising value from literature review. Factor analysis reduces parameter from 14 to 7 factors and linear regression result suggested that Experience (EXP) and Education (EDU) of entrepreneur characteristic, Size (SIZE) and Team completeness (TEAM) of organization characteristic are positively impact fund raising value. To maximize fund raising value, entrepreneur should have high experience and education whereas startup company should have substantial size with full function of management in the executive team.

IEEM18-P-0426

**Configuration Lifecycle Management – Future of Product Configurators**

Anna MYRODIA[1], Thomas RANDRUP[1], Lars HVAM[2]
[1]*Configit A/S, Denmark*
[2]*Technical University of Denmark, Denmark*

The utilization of product configurators (PC) in the sales phase is a well-established solution for manufacturing companies of configurable products and it comes along with several benefits. However, there is a tendency identified currently in the industry that companies use PC to cover more lifecycle phases, such as engineering, manufacturing and service. This is described as configuration lifecycle management (CLM). Digitalization, increasing complexity and competitiveness are the main drivers of this need. This research analyses 59 case studies using PC in several lifecycle phases. The findings from the case studies confirm this tendency and the need towards a complete CLM solution is discussed.

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| **Session** | Operations Research 3 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside III |
| **Chairs** | Philipp BAUMANN, *University of Bern*,<br>Norbert TRAUTMANN, *University of Bern* |

IEEM18-P-0420

**Protecting a Sensitive Queue from Arrival Variability**

Mathieu VANDENBERGHE, Stijn DE VUYST, El-Houssaine AGHEZZAF, Herwig BRUNEEL
*Ghent University, Belgium*

Minimizing item waiting time between stages is a general focus of operations research, and of particular concern for certain industries. We propose a two-stage production system where, to minimize the waiting time before stage 2, we focus on spreading the completion times of the stage 1 machines across the available interval. We contrast this objective with a similar problem defined in a healthcare context, but that has an assumption of fixed assignment. We obtain insights in the added value that free assignment can provide, by comparing the solutions of a local search method for assignment, with those of a reference case where assignment is fixed. Computational results show that this added value is highest in cases where task means differ insufficiently to be ordered effectively, and where task distributions have low variance. For the discussed instances, significant reductions in item waiting times can be achieved while making minimal concessions on expected makespan.

IEEM18-P-0588

**Multi-criteria Mathematical Model for Partial Double Track Railway Scheduling in Urban Rail Network**

Erlangga BAYU SETYAWAN, Dida Diah DAMAYANTI, Anton Abdulbasah KAMIL
*Telkom University, Indonesia*

Train scheduling is one of the tactical planning of a railway service company. The challenge of railway scheduling is when the type of track that is passed is a partial track double track. If the scheduling is not optimal, will cause the idle time, where the train must wait for the intersection. This research purpose mathematical model for train scheduling problem in partial double track rail line to minimize idle time. We consider three criteria in developing this mathematical model: (1) Coupling / uncoupling wagon to minimize deadhead trip; (2) Fixed block signaling; (3) Rail and station capacity; (4) Meeting and passing in partial double track. To test our model, we used actual data in Indonesian Railway, especially in shout track railway, track from Bandung - Yogyakarta City. Using this mathematical model, our purposed model can minimize total idle time.

IEEM18-P-0614

**Vehicle Routing: Application of Travelling Salesman Problem in a Dairy Distributor**

Rafael PALHARES[1], Maria Creuza BORGES DE ARAUJO[2]
[1]*Universidade Federal do Rio Grande do Norte, Brazil*
[2]*Universidade Federal de Campina Grande, Brazil*

In the logistics context, the physical distribution is the responsibility of delivery of the correct products, to the exact locations and in the ideal moment, so that the expectation of the level of service is met and the transportation costs are minimized. For this, it is essential that structured routing plans are employed. Thus, this article aims to establish an efficient routing configuration for the delivery of milk and fermented dairy beverages. To create a structured routing plan, it was adopted the Traveling Salesman Problem. Due to a large number of variables analyzed, the Nearest Neighbor Algorithm was applied. Following, clusters that encompass the points closest to each other were determined and transformed into daily routes. The new plan proposed results in a reduction of approximately 3,316.2 kilometers per month. In this way, the proposed route plan will entail logistics efficiency as well as the reduction of company costs.

IEEM18-P-0078

**Enhanced Metaheuristic Algorithm for Multidimensional Optimization of Structural Engineering Problems**

Jui-Sheng CHOU[1], Ngoc-Tri NGO[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*The University of Danang - University of Science and Technology, Viet Nam*

This work develops an enhanced nature-inspired algorithm, called the metaheuristic firefly algorithm (MetaFA) for multidimensionally optimizing structural engineering design problems. Incorporating logistic and Gauss/mouse chaotic maps, adaptive inertia weight, and Levy flight into a conventional firefly algorithm (FA) significantly improves its search capability. As merits of proposed MetaFA, logistic and Gauss/mouse chaotic maps provide a highly diverse initial population and effectively tuning attractiveness parameter of the FA, respectively. Then, adaptive inertia weight controls effectively the local exploitation and the global exploration of the optima search process. Meanwhile, Levy flight accelerates the local search. A series of benchmark functions and real-world structural design problems were used to evaluate the efficacy of the proposed MetaFA. Experimental results indicated that the proposed MetaFA is efficient and effective in solving multidimensional optimization design problems of structural engineering.

IEEM18-P-0343

**A Matheuristic for a Real-world Variant of the Multiple Traveling Salesman Problem**

Philipp BAUMANN
*University of Bern, Switzerland*

Significant long-term cost savings can be achieved when labor-intensive daily operations are executed at minimal cost. We consider here a real-world planning problem that was reported to us by a real estate valuation company. The planning problem consists of scheduling on-site visits such that the total operating costs are minimized. We show that this problem represents a new variant of the multiple traveling salesman problem to which existing approaches cannot be applied directly. We formulate the problem as a mixed-binary linear program and develop a matheuristic for large-scale instances. The matheuristic employs a new strategy to construct subproblems effectively and techniques to exclude variables that are unlikely to be non-zero in an optimal solution. Our computational analysis demonstrates that the mixed-binary linear program is able to devise optimal or near-optimal solutions for instances with up to 200 visits in short running times. The matheuristic performs equally well on small and medium-sized instances and proves to be highly scalable.

IEEM18-P-0070

**Robust Periodic Vehicle Routing Problem with Service Time Uncertainty**

Mingyao QI, Wangqi XIONG, Qingte ZHOU, Shijia HUA
*Tsinghua University, China*

The periodic vehicle routing problem (PVRP) has wide applications, such as express service, elevator maintenance and urban waste collection, where customers expect fast response and small delays. The existence of uncertainty has significant influence on the cost and customer experience. Therefore, it is crucial to build routes that would be less sensitive to uncertainty. In the paper, we research on the PVRP with service time uncertainty, while no robust optimization for PVRP has been studied before. Each request for service will include an uncertain service time and a deadline for the start of service. We propose the robust model of PVRP with service time uncertainty whose objective is to minimize the overall cost including travel cost, customer's waiting cost and technician's overtime cost. Due to the complexity of the problem, we design a variable neighborhood search algorithm based on worst case to solve it. Numerical experiments prove that: 1) the robust solution has a sufficient immunity against the service time uncertainty; 2) a large uncertainty set parameters might lead to overly conservative robust solution with higher cost.

IEEM18-P-0084

**Picking Station Location in Traditional and Flying-V Aisle Warehouses for Robotic Mobile Fulfillment System**

Lijuan FENG, Xinglu LIU, Mingyao QI, Shijia HUA, Qingte ZHOU
*Tsinghua University, China*

This paper studies the optimal location of picking stations for robotic mobile fulfillment system, which is a parts-to-picker storage system with robots lifting pods directly to stationary pickers. While few previous researches focus on picking station location problem, we develop an integer programming model to determine the optimal location of picking stations to minimize the total traveling distance of robots. In addition, we compare the performance of both traditional layout and flying-V layout under random storage assignment policy. A series of numerical experiments are conducted, and the results show that flying-V designs can obtain 8-18% distance saving comparing to traditional designs. Besides, with each additional picking station, the marginal advantage of distance saving is gradually decreasing and the average saving is about 10%. These achievements can offer valuable insights to warehouse designers in practice.

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| **Session** | Big Data and Analytics 2 |
| **Date** | 18/12/2018 |
| **Time** | 11:00 - 12:45 |
| **Room** | Riverside IV |
| **Chairs** | Ruth COBOS,*Universidad Autonoma de Madrid*, Harekrishna MISHRA, *Institute of Rural Management Anand* |

IEEM18-P-0453

**Evidences of Technological Advantage Gains: The Case of Mergers and Acquisitions in the Agrichemical Industry**

Chun-Chieh WANG, Mu-Hsuan HUANG, Yu-Wei CHANG
*National Taiwan University, Taiwan*

Six agricultural giants merged into three separate companies in 2016: Dow Chemical and DuPont agreed to a merger, ChemChina purchased Sygenta's American business interests, and Bayer purchased Monsanto. These mega mergers in agrichemical industry made farmers and consumers feeling uneasy for food system controlled by these three mega-corporations. This study focuses on measuring technological advantages gains from their mergers and acquisitions activities. Through patent bibliometrics analysis based on US patents in recent ten years, we found that Dow Chemical and DuPont have higher technology similarity in Biopesticides, Organic Chemistry, Organic Macromolecular Compounds, Genetic Engineering, and New Plants fields; while Bayer and Monsanto are in Biopesticides, Genetic Engineering, and New Plants fields. We conclude that Dow Chemical and DuPont gain technology advantage through more technology similarity in five agrichemical fields; Bayer gain technology advantage through the effects of technology originality from Monsanto especially in the Genetic Engineering field.

IEEM18-P-0573

**Do Long-term Patents Have a Higher Citation Impact?**

Huei-Ru DONG[1], Dar-Zen CHEN[2], Mu-Hsuan HUANG[2]
[1]*Fu Jen Catholic University, Taiwan*
[2]*National Taiwan University, Taiwan*

Previous studies found that only a few patents are maintained for long periods of time and are considered highly valuable. This study aims to elucidate whether long-term patents contain higher citation impact, and employs patentometrics to examine all USPTO patents granted between 1996 and 2010. A total of 1,094,488 utility patents were retrieved and were classified into different groups based on their technological fields and patent terms. The patents are also divided into 4-, 8-, 12-, and 20-years term patents based on their renewal record. The result shows that long-term patents do have higher citation impact than that in short-term patents in six technological fields. It may suggest that long-term patents should be given higher weights in technology management and the evaluation of patents.

IEEM18-P-0221

**Categorization of Mergers and Acquisitions in Japan Using Corporate Databases: A Fundamental Research for Prediction**

Bohua SHAO, Kimitaka ASATANI, Ichiro SAKATA
*The University of Tokyo, Japan*

Mergers and Acquisitions (M&A) are recognized important strategy for corporate growth. In practice, M&A business consumes much energy and M&A success rate is not high. Hence, scientific M&A recommendation research is needed under such condition. This paper, focusing on M&A categorization, is a fundamental research for M&A prediction and recommendation. In this paper, we used M&A data, financial data and corporate data for M&A analysis. Based on them, we designed 13 features and used K-means clustering to separate M&A cases. The 13 features are of acquirer features, target features and their relationship features. We grouped M&A cases into 5 clusters and found different characteristics in these 5 clusters. Results in this paper show that these features will be effective for future M&A prediction and recommendation.

IEEM18-P-0249

**Distributed-based Hierarchical Clustering System for Large-scale Semiconductor Wafers**

Seungchul LEE, Daeyoung KIM
*BISTEL Inc., South Korea*

In this paper, we propose a Distributed-based Hierarchical Clustering System for Large-Scale Semiconductor Wafers (DHCSSW). By applying the big-data framework to existing hierarchical clustering algorithm, the proposed system makes it feasible to cluster large-scale wafers with up to 320,000 wafers. To verify the performance of our approach, we used simulated wafer maps. The experimental results show that our system outperformed the existing hierarchical clustering in processing large-scale wafers, suggesting that currently used hierarchical clustering is insufficient in analyzing large-scale wafer maps. In addition, some failure patterns, which the existing approach is not able to detect, can be found with the DHCSSW. We anticipate that the DHCSSW will contribute in identifying the failure patterns in large-scale semiconductor wafers.

IEEM18-P-0582

**A Learning Analytics Tool for Predictive Modeling of Dropout and Certificate Acquisition on MOOCs for Professional Learning**

Ruth COBOS, Lara OLMOS
*Universidad Autonoma de Madrid, Spain*

Massive Open Online Courses (MOOCs) appeared as a proper way to provide lifelong learning for potential learners of both professional and academic settings. Industry leaders can benefit from these courses because they foster the professional development of their employees in their industry. Despite these benefits, these online courses continue to register a high dropout rate and a vast number of their learners do not acquire the certificate provided at the completion of the course. This article proposes a predictive modeling tool with several Machine Learning algorithms (for generating Predictive Models) and feature engineering in MOOCs data integrated to contribute research to this specific issue. The proposed tool predicts two situations: which learners are likely to leave the course (dropout) and which learners are expected to pass the course (certificate acquisition). The tool was tested in fifteen deliveries of seven MOOCs. Initial results provide interesting information, for instance, that the accuracy of predicting certificate acquisition is higher than the precision of predicting dropout for all algorithms.

IEEM18-P-0287

**Study on Unbalanced Binary Classification with Unknown Misclassification Costs**

Jun GAO, Lin GONG, JinYi WANG, ZhenChong MO
*Beijing Institute of Technology, China*

With the rapid development of big data and machine learning technologies, many fields have begun to use related algorithms and methods. Classification algorithms have been widely used in the fields of financial risk identification, fault diagnosis, medical diagnosis, etc. However, the datasets are often unbalanced in these cases and the original methods fail to classify instances correctly. Many methods such as over-sampling, under-sampling and ensemble methods were raised to improve the classifier's performance, but which one to choose for a certain dataset still remains a problem. Therefore, this paper aims at a experimental conclusion on which kind of method can perform best on unbalanced classification problems generally. In detail, we evaluated the performances of 13 kinds of methods for unbalanced classification on several unbalanced datasets which have different amounts of instances and different ratios of positive instances, and finally came to a conclusion.

IEEM18-P-0519

**Data Analytics Framework for State Owned Enterprise of Bhutan**

Yadap SUBERI[1], Devi Bhakta SUBERI[2]
[1]*Druk Green Power Corporation, Bhutan*
[2]*Royal University of Bhutan, Bhutan*

With the increase in adoption of technology by the State owned Enterprises (SoE) in Bhutan, the amount of data collected has significantly increased. The data collected has significance in all aspects of the business operation including management of human resources, finance, inventory, production, process automation etc. State owned enterprises now needs to prepare towards exploring opportunities to capitalize on the Data Assets. The primary endeavor of this paper is to propose a Data Analytics framework that can be adopted by any organization, independent of the technology being implemented or the type of business operated. With time and complexity of the business, the analysis requirement will correspondingly increase demanding organizations to enhance the analytical capability. Companies need to reflect on the current capability to perform analytics, refer the framework, and assess the gap and plan for improving the organizational analytical capability.

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| **Session** | Project Management 3 |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom I |
| **Chairs** | Fan LI, *Tsinghua University*,<br>Ripon CHAKRABORTTY, *University of New South Wales, Canberra* |

IEEM18-P-0290

**Development and Evaluation of a Workshop Concept to Support Tailoring of Complex Product Development Processes**

Christoph HOLLAUER, Julia RAST, Udo LINDEMANN
*Technical University of Munich, Germany*

Product development faces a conflict of increasing complexity in products and processes as well as a need for increased flexibility and agility. While structured reference processes create a baseline, their adaptation of tailoring for particular projects is necessary. While approaches for automated tailoring have been developed in the area of software engineering, these focus on automation and collaborative, social aspects of tailoring are thus far underrepresented. To address this issue, we present a workshop-based approach, which uses input generated by structural analysis of modeled tailoring decisions. The approach has been evaluated in two industrial case studies.

IEEM18-P-0293

**Scrum Agile Project Management Methodology Application for Workflow Management: A Case Study**

Laura CARNEIRO, Ana Carolina SILVA, Luciana ALENCAR
*Universidade Federal de Pernambuco, Brazil*

The management of routine activities involves activity planning, goal alignment, and optimization of resources, in general, the same efforts needed to manage a project. In this sense, this research intended to find a methodology that could be adapted to the management of a department of a public company, aiming at continuous improvement of its performance. Within the project management field there are the traditional and the agile methodologies. Agile project management methodologies are characterized by being simple, flexible and dynamic, easily responding to changes and promoting team integration. Scrum methodology is one of the most popular because it is affordable and does not require extensive documentation. This work aimed to show how it was possible to use Scrum in the management of routines, making the necessary adaptations, and presenting the performance indicators to evaluate the improvements achieved with the use of the tool. As a result, better planning of activities, prioritization of tasks, constant monitoring of the activities, better flow of routine work, better delivery quality and greater alignment among team members were observed.

IEEM18-P-0244

**The Mediating Effect of Knowledge Internalization on the Relationship Between Dual Learning Behaviors and Technological Innovation Performance in the High-tech Enterprises**

Fangmei WANGDU, Naiding YANG, Sayed Muhammad FAWAD SHARIF
*Northwestern Polytechnical University, China*

High-tech companies promote the internalization of knowledge by inducing advanced technology from the outside and independent research. This is a tool, used by enterprises, to promote technological innovation and development as well as new product research to enhance their innovation performance. Empirical evidence from the large and medium-sized high-tech enterprises in China shows that both the exploration and the exploitation of learning activities positively affect the enterprise's technological innovation. The exploitation fits to Chinese large and medium-sized high-tech firms even better. Checking for the knowledge internalization, we found that it had a partial mediating role in the relationship between the firm's learning behaviors and technological innovation performance, hence, it is believed to improve the performance of the company's technological innovation. The results can be used as useful reference by the firms to carry out learning activities and enhance knowledge internalization in order to promote their technological innovation performance. The paper contributes to the literature on learning behavior, knowledge management and technological innovation performance and has implications for further study and research.

IEEM18-P-0286

### "I Want it That Way" and Other Aspects of the Application of Performance Reviews that Negatively Affect Project Outcomes

H.J. Christian VAN DER KRIFT, Arjan J. VAN WEELE, Josette M.P. GEVERS
*Eindhoven University of Technology, Netherlands*

Although the application of performance reviews is believed to be beneficial for projects, there is little research on the actual application of performance reviews and its effects on project outcomes. Therefore, we studied the current application of and follow-up on performance reviews in projects. Survey data were gathered among members of four different professional associations related to project and contract management. The data (n=82) show that both the application of and follow-up on performance reviews differ between companies. This heterogeneity allowed us to test the effects of performance reviews on project outcomes (i.e. relationship quality, client and contractor performance, and project performance). Indeed, the results demonstrate that performance reviews contribute positively to project outcomes. Furthermore, whereas project outcomes are positively affected by reviewing input variables, such as resources and capabilities, and output variables, such as quality and continuous improvement, it is most common that companies review process variables, i.e. in which way the project should be executed. Hence, thoughtful consideration of and a change in the application of performance reviews are needed to improve project outcomes.

IEEM18-P-0610

### Visualised Decision Support in Industrial Project Monitoring and Control

Fan LI[1], François VERNADAT[2], Ali SIADAT[3], Li ZHENG[1]
[1]*Tsinghua University, China*
[2]*University of Lorraine, France*
[3]*Arts et Métiers ParisTech, France*

Regarding the changing global competitive environment in industry, companies are forced increasingly to respond to sophisticated and diverse customer demands with efficient decisions support. Therefore, it is necessary to develop a holistic, easy-to-use and efficient performance measurement and management methodology to support sound decision making in industrial project management. For this purpose, a benefit-cost-value-risk based methodology has been developed for comprehensive performance evaluation. Based on the methodology, a visualised approach has been proposed in this paper to further ease performance evaluation and decision support in industrial project monitoring and control.

IEEM18-P-0430

### Assessing the Agility of Teams within Mechatronic Product Development

Lucia BECERRIL, Christoph HOLLAUER, Udo LINDEMANN
*Technical University of Munich, Germany*

Although agile development is increasingly being applied outside software development, the methods, tools and techniques are still new to the manufacturing industry. A major barrier is the difficulty to measure the benefits and limitations. Comparing the working practices of a team before and after implementing agile methods would provide some insights into the applicability and usefulness of concrete methods and tools in the context of mechatronic-product development. Nevertheless, existing agility assessment approaches are subjective, software centered, and/or require previous application of agile methods. The goal of this paper is to provide a holistic assessment of a team's agility independently of the methods, tools and techniques applied. For this purpose, agile, non-agile and hybrid practices provide a frame of reference to characterize how teams work across 12 project processes (e.g. project monitoring) and five levels of agility.

IEEM18-P-0398

### The Role of Participation in the Factory Planning Process

Uwe DOMBROWSKI, Alexander KARL, Christoph IMDAHL
*Technische Universität Braunschweig, Germany*

The continuous improvement of the current construction and planning processes is a relevant factor for the company's success. New and existing factories must be economical, flexible and attractive at the same time. On the basis of constantly changing or even new requirements, continuous planning adjustments are required. An increasingly important need in factory planning, in addition to the participation of internal planning stakeholders, is the participation of external actors. More and more often, inadequate project-specific involvement of these actors leads to delays or cost increases in factory planning projects. This can be caused, for example, by increasing regulatory requirements, declining technology acceptance of the population in the direct environment and growing legal capacity to appeal to residents ("Not-In-My-Backyard"). Therefore, the participation of external actors in factory planning projects has not been sufficiently considered in the relevant literature. In order to enable stakeholder acceptance, appropriate project-specific integration of relevant stakeholders into the construction project is crucial. The basis for efficient participation is the choice of the right participation features. This article addresses the current state of research in the intersecting point of factory planning and participation research and shows the need for further research.

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| **Session** | Intelligent Systems 1 |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom II |
| **Chairs** | Gai-Ge WANG, *Ocean University of China*, Benedikt MOSER, *Institute for Industrial Management at RWTH Aachen University* |

IEEM18-P-0102

**Towards a Knowledge based Support for Risk Engineering When Elaborating Offer in Response to a Customer Demand**

Rania AYACHI[1], Delphine GUILLON[2], Francois MARMIER[3], Elise VAREILLES[2], Michel ALDANONDO[2], Thierry COUDERT[2], Laurent GENESTE[2], Yvan BEAUREGARD[4]
[1]*Toulouse University – IMT Mines Albi/ INP-ENIT , France*
[2]*Université de Toulouse, France*
[3]*Toulouse University – IMT Mines Albi, France*
[4]*École de Technologie Supérieure, Canada*

This paper deals with the first ideas relevant to a knowledge based support for risk engineering when answering tenders or direct customer demands. Indeed, when an offer is defined, it becomes more and more important to analyze the possibilities of: risks occurrence, their consequences and their potential avoidance. Most of the time if it is done, this analysis is conducted manually thanks to a risk expert. In this paper, we propose to assist the expert with a risk engineering aiding tool that relies on a knowledge base and which allows to define and evaluate: (i) the risk and its probability, (ii) the main risk impacts and (iii) the interests of various corrective and preventive actions (impact and probability reductions). We first detail the problem. Then we identify risk knowledge and risk processing. This allows us proposing a knowledge model relevant to the risk engineering entities and some knowledge retrieval queries to support risk engineering.

IEEM18-P-0336

**A Cooperative Multi-agent-based Musical Scoring System for Tsugaru and Nambu Shamisen**

Juichi KOSAKAYA[1], Reiko KAWAMORITA[1], Ming-Fang HSU[2]
[1]*Hachinohe Institute of Technology, Japan*
[2]*Central Taiwan University of Science and Technology, Taiwan*

Aomori is located in the most northern pref. of main land in Japan. And it is uniquely situated within the amalgam of local instruments Tsugaru and Nambu's traditional local arts. Referring to [1, 2], the city's traditional music preservation society and schools have eagerly wished a technics to precisely score local music, especially traditional Tsugaru Shamisen. This music will be preserved as Western & Shamisen scores, which avoid relying individually on the oral education of this kind of traditional local music for trainees. In this research, "Electronic Shamisen" has been invented with pick-up microphones attached with strings and automated scoring equipment, which automatically records scores from the sound resources by cooperative agent method. Relevant researches are shown in [1-4].

IEEM18-P-0351

**Contact Coordinate Measurements of Free-form Surfaces: A FIS for Optimal Distribution of Measurement Points**

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

The coordinate measuring technique uses different measurement strategies, which may involve, e.g., the distribution of measurement points on free-form surfaces (FFSs) of products. Measurement points must be located on products' surfaces, in order to measure the quality of workpieces. The most popular method for selecting locations of measurement points on free-form surfaces is uniform distribution. This method is classified as a blind strategy and does not take into account e.g., the accuracy of a workpiece's machining process. This study focuses on the possibilities of avoiding the use of blind strategies for distributing points to measure the accuracy of FFSs with the support of fuzzy set theory. The input variables for the developed fuzzy inference system (FIS) are an area of a patch of a measured FFS and a deviation observed on a particular patch of an investigated surface (i.e. a mean deviation of a patch of a surface, calculated between a machined surface and its nominal model). The output variable of the FIS is the number of measurement points distributed on patches of FFSs.

IEEM18-P-0135

**Particle-swarm Krill Herd Algorithm**

Gai-Ge WANG[1], Wenyin GONG[2], Xiaobo LIU[2], Danyu BAI[3], Teng REN[4], Xuesong YAN[2]
[1]*Ocean University of China, China*
[2]*China University of Geosciences, China*
[3]*Nanjing Forestry University, China*
[4]*Central South University of Forestry and Technology, China*

To improve krill herd's (KH) ability for solving global optimization, by combining the advantage of KH and accelerated particle swarm optimization (APSO) method, an enhanced version of KH technique based on KH and accelerated APSO method, called particle-swarm krill herd (PKH) approach is designed. In this way, the advantage of the APSO and KH approaches are fully exploited, and the proposed PKH algorithm has the useful features originated from APSO and KH optimization techniques. The improvement includes the addition of APSO method serving as mutation operator when the krill updating for solving optimization problems. In PKH method, we used a novel type of elitism to store some best krill during the evolving stage. Eighteen standard testing problems are applied to evaluate these improvements and the results indicate that this metaheuristic method has much better performance than the original KH approach and six state-of-the-art metaheuristic algorithms. Our proposed PKH method significantly overtakes the other seven approaches. Moreover, KH is only inferior to PKH among eight methods. APSO and DE perform only worse than PKH and KH on eighteen functions. In addition, the parametric studies are also implemented to further show the robustness and generality of the proposed PKH approach in the present work.

IEEM18-P-0431

**Industrial Smart Services: Types of Smart Service Business Models in the Digitalized Agriculture**

Achim KAMPKER, Philipp JUSSEN, Benedikt MOSER
*RWTH Aachen University, Germany*

Due to lack of experience of companies with digital business models, agricultural machinery manufacturers and agricultural service companies are facing a positioning problem in their ecosystem. Smart services are getting more important for these companies and they have issues to define a matching business model for their newly developed smart services. The lack of a framework for smart service business models makes it even harder for companies to successfully develop new services. This paper contributes to a better understanding of business models for smart services and establishes a common morphological framework to define different types of business models for smart services. Six types of business models of industrial smart services were identified during the research based, which was based on a literature review and interviews with leading experts in the field of smart services. The validation of the developed types and its practical application was carried out as part of the German research project Smart-Farming-World and its four developed use cases. This paper gives a detailed description of the application of the framework on the use case nPotato.

IEEM18-P-0389

**Construction Resource Localization Based on UAV-RFID Platform Using Machine Learning Algorithm**

Daeyoun WON[1], Man-Woo PARK[2], Seokho CHI[1]
[1]*Seoul National University, South Korea*
[2]*Myongji University, South Korea*

Although location data of construction resources, such as materials, heavy machinery and workers, is one of the most critical keys to understand the context of construction site, most sites still rely on human-oriented observations to localize the resources. As one of techniques for collecting location data, RFID technology has been extensively studied. However, RFID requires multiple readers or a lot of manpower because RFID receiver is fixed or carried by human. It is infeasible in terms of time and cost in complex or large-scale construction sites. The aim of this study is to overcome the limitations of current approaches by proposing a localization method based on UAV-RFID integrated platform. With data from the platform, we applied a machine learning algorithm, k-nearest neighbors, to localize tags. Our method estimates the location of the tag with 94% accuracy. We have demonstrated the feasibility of the UAV-RFID integrated platform for construction site.

IEEM18-P-0167

**Industry 4.0 in Practice – Identification of Industry 4.0 Success Patterns**

Jörg PUCHAN[1], Alexander ZEIFANG[1], Jun-Der LEU[2]
[1]*Munich University of Applied Sciences, Germany*
[2]*National Central University, Taiwan*

This paper demonstrates the concept of a systematic methodical 'in-practice' analysis based on the Industry 4.0 maturity model, which has been developed at the Munich University of Applied Sciences. It demonstrates how Industry 4.0 knowledge of well-developed companies can be analyzed, bundled and transferred to less developed companies. The research is focused on the industrial development of small and medium sized enterprises from the manufacturing sector. Furthermore, the combination of the concept and the findings of this paper give an idea how knowledge exchange between companies in the field of digital transformation can be supported in practice.

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| **Session** | E-Business and E-Commerce |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Ballroom III |
| **Chairs** | Yue WANG, *Hang Seng Management College*, Stanislav CHANKOV, *Jacobs University Bremen* |

IEEM18-P-0318

**e-Commerce Logistics – Contemporary Literature**

Hamid JAFARI
*Jönköping University, Sweden*

This manuscript provides a general review of the contemporary literature on e-commerce logistics. The review is carried out systematically on the articles published in academic journals from 2015 up to 2018. A total of 77 manuscripts were reviewed and analyzed using this method regarding the journals, level of analysis, and scientific methods used. Moreover, coding of the findings of the papers was carried out to identify the research themes in contemporary e-commerce logistics literature. As a result, six themes were identified; namely, Distribution, Channel Design, Sustainability, Performance, Pricing, and Innovation. The results show a shift of scholarly focus over the past years.

IEEM18-P-0333

**An ERP-based Solution for the Supply Chain Planning of Medium-sized Global Manufacturing Company**

Jun-Der LEU[1], Andre KRISCHKE[2], Yi-Ping LEE[1], Larry Jung-Hsing LEE[1], Yi-Wei HUANG[1]
[1]*National Central University, Taiwan*
[2]*Munich University of Applied Sciences, Germany*

In order to achieve the integration of a supply chain with upstream and downstream manufacturers that are cross-border and cross-regional, Enterprise information systems, such as Enterprise Resource Planning (ERP) systems, have been applied to organization-wide coordination and the integration of business functions and processes. But these information systems are usually a platform for data exchanges, lacking the function of decision-making that is required in cross-border operations and planning scenarios. ERP-based Decision Support Systems (DSS) have been developed in some industries, but there are few studies of application cases. In this research, on the basis of ERP, we study the advanced planning system (APS) with theory of constraints (TOC) in decision logic design, and the system development of a master plan in a flat-panel display systems manufacturer. The results show that the case company, establishing a new system with the methods proposed in this paper, enhances planning and decision-making speed faster than the old one. The inventory level of final products and shortages of Vendor Managed Inventory (VMI) hubs are improved. This successful case offers a reference to other enterprises.

IEEM18-P-0429

**Integration of Small and Medium Enterprises for Industry 4.0 in the South African Water Services Sector: A Case Study for Johannesburg Water**

Pholo NTHUTANG, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

The need to develop a framework for Small and Medium Enterprises (SMEs) for Industry 4.0 in the water services sector presents opportunities. This work focuses on available opportunities and the role that can be played by SMEs during the implementation of Industry 4.0 for water services with specific reference to Water Conservation and Water Demand Management (WC/WDM) in the City of Johannesburg. This research highlights the role of institutions of higher learning such as the University of Johannesburg, the role of national departments and technology initiatives together with SMME's. This research presents an approach for delivering technological solutions via SME's in complex large business environments. The results include an outline methodology for successful delivery. The essential definitions and structures for successful industry 4.0 SMME incorporation are detailed.

IEEM18-P-0205

**Observational Learning in the Product Configuration Process: An Empirical Study**

Yue WANG
*Hang Seng Management College, Hong Kong SAR*

Product configurators have been acknowledged as an important enabling toolkit to realise mass customisation. Currently, some on-line configurators provide extra information on attribute variants to improve the information available to customers, such as popularity or bestseller ratings. This information is derived from the purchase behaviours of other customers. However, it is not clear how such information affects consumer decision making. Drawing on the notion of observational learning, it could be posited that customers tend to follow the choices made by others, particularly when they lack adequate prior knowledge about products. However, one of the advantages of customisation is that it enables customers to harness and reveal their own identities by configuring and purchasing a bespoke unique product that is tailored to their own desires. Thus, customers may not be willing to select the popular variants during configuration process. To solve this paradox, we empirically find that observational learning is significant in the product configuration process. Customers' abilities and motivations to process information mediate this observational learning effect.

IEEM18-P-0231

**Drone-delivery Using Autonomous Mobility: An Innovative Approach to Future Last-mile Delivery Problems**

HoJoon David YOO, Stanislav CHANKOV
*Jacobs University Bremen, Germany*

Drone-delivery is seen as a possible solution to future last-mile delivery problems. Meanwhile, autonomous mobility allows dynamic human transportation within a city, which solves future traffic complications. The purpose of this paper is to propose an innovative delivery concept called Drone-delivery using Autonomous Mobility (DDAM). DDAM combines drone-delivery with autonomous mobility, to simultaneously solve three problems of the future cities: (1) high demand of delivery (2) short delivery lead-time and (3) complex traffic congestions. Using the Design Science Research Guideline the concept is illustrated and evaluated based on interviews with experts from relevant industries. The results indicate that the DDAM concept is more feasible as an alternative delivery method in high-demand seasons. The research reveals a high-potential for utilizing autonomous mobility in last-mile delivery.

IEEM18-P-0145

**Robust Password-keeping System Using Block-chain Technology**

Daniel TSE, Kaicheng LIANG, Bin CAI, Kecong HUANG
*City University of Hong Kong, Hong Kong SAR*

Most of the cyber information systems require users to provide identity information as a way of authentication and usually the identity information is a pair of username and password. With so many information systems to access, people need to memorize hundreds of usernames and passwords. As a result, they often forget their usernames or passwords and have to go through a time-consuming and troublesome procedure to find them back. In this article, we propose a solution storing people's usernames and passwords using block-chain in an encrypted format. When the username or password for a particular website is lost, they can be accessible through the block-chain. As a result, people do not need to memorize their usernames and passwords for different websites anymore. The password stored in the block-chain would not be compromised to any cyber-attacks because block-chain is immutable.

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| **Session** | Technology and Knowledge Management 4 |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Pompadour |
| **Chairs** | Chung-Huei KUAN, *National Taiwan University of Science and Technology*,<br>Helery TASANE, *Tallinn University of Technology* |

IEEM18-P-0165

**Multiple Helix Approach in Advancing Sustainable Urban Energy Ecosystems**

Nina TURA[1], Ville OJANEN[1], Tuomas PALOVIITA[2], Sini PIIPARINEN[2]
[1]*Lappeenranta University of Technology, Finland*
[2]*Fortum Oyj, Finland*

Coping with the challenges of sustainable development requires transformation of urban energy systems. In this transition, the collaboration and knowledge transfer between actors from academia, government, industry and society has a crucial role. This study expands the current understanding of multiple helix ecosystem approach towards the design of integrated and intelligent sustainable urban energy ecosystem. The empirical results from Finnish context stresses the changing roles of different actors in moving from plan to action in the energy ecosystem.

IEEM18-P-0441

**Time Estimation for Product Configuration Systems Projects**

Katrin KRISTJANSDOTTIR, Amartya GHOSH, Loris BATTISTELLO, Lars HVAM
*Technical University of Denmark, Denmark*

Companies providing customized products increasingly apply product configuration systems (PCS) in supporting sales and design activities, thus achieving substantial benefits. While there is extensive literature on the benefits of utilizing PCS, the cost of developing and maintaining PCS has not been explored to the same extent. This makes it difficult to put the benefits into perspective. Having a more accurate method of quantifying the cost of both developing and maintaining PCS, gives a value not only to researchers but also to practitioners when making business cases and improving resource planning in PCS projects. This article shows how historical data can be used to estimate the workload for developing and maintaining new PCS by taking into consideration both cognitive complexity and integrated IT systems. The analyses in the article are conducted in collaboration with a case company that aims to improve its capabilities when estimating cost based on man-hours for new PCS projects.

IEEM18-P-0475

**Changes of Technological Knowledge Diversification within a Group of Inventors and Patent Value Corresponding to Technology Lifecycle**

Ryo TAKEMURA, Noritomo OUCHI
*Aoyama Gakuin University, Japan*

Innovation is essential for firm's survival. Managing technological diversification is a key issue in creating innovation. There are many studies analyzing the relationship between a firm's technological diversification and its performance using patent data. However, although a patent is typically held by a group of inventors, few studies consider such groups, and the impact of technological knowledge diversification within a group of inventors on patent value is unclear. In addition, while it is generally said that firms tend to fall into the "competency trap," it is uncertain whether the same phenomenon can be observed within a group of inventors. Therefore, we attempt to analyze changes of knowledge diversification within a group of inventors and patent value corresponding to the stages of technology lifecycle. Our results suggest that the competency trap can be observed within a group of inventors.

IEEM18-P-0481
**Improving Modularization in Industry by Introducing a New Model for Module Classification**
Dag RAUDBERGET, Fredrik ELGH
*Jönköping University, Sweden*
Modules are often considered the basis of product platforms by enabling a variety of product variants based on interchangeable modules. In this way, modules enable efficient utilization of resources through economies of scale. The purpose of this work is to improve the product realization process by introducing a new model for module classification that enable companies to structure their assets and formalizing them in the development system. The modules developed following this methodology contains both physical resources and non-physical resources that can be reused in a structured way, thereby improving the efficiency of the development process.

IEEM18-P-0528
**Two-dimensional Technology Profiling of Patent Portfolio**
Chung-Huei KUAN[1], Wei-Ming TU[1], Dar-Zen CHEN[2]
[1]*National Taiwan University of Science and Technology, Taiwan*
[2]*National Taiwan University, Taiwan*
Noticing that some technology content is not reflected by patents' individual classification symbols but by the co-assignment of these symbols, this study proposes to represent the technology content of a patent portfolio using a two-dimensional matrix, referred to as the profile matrix of the portfolio. The element Mij of a profile matrix M counts the co-assignment frequency of symbols Ci and Cj, and the element Mii is the individual assignment frequency of symbol Ci. The profile matrix not only covers the traditional one-dimensional patent classification analysis, but also provides a more comprehensive picture to the portfolio's technologies. The profile matrix may be applied to detect the similarity or relatedness between patent portfolios, monitor the shift of an entity's R&D direction, and discover the emergence of new, cross-disciplinary technology.

IEEM18-P-0526
**Industry 4.0 Implementation Barriers in Small and Medium Sized Enterprises: A Focus Group Study**
Guido ORZES[1], Erwin RAUCH[1], Slavomir BEDNAR[2], Robert POKLEMBA[2]
[1]*Free University of Bozen-Bolzano, Italy*
[2]*Technical University of Kosice, Slovakia (Slovak Republic)*
The attention devoted to Industry 4.0 by scholars, managers and policy makers has grown exponentially in the last few years. The goal of this paper is to empirically investigate the main barriers and difficulties faced by small and medium sized enterprises in Industry 4.0 implementation. We perform a systematic literature review on the topic and conduct some focus group studies in four countries (USA, Italy, Austria, and Thailand). We identify a set of barriers and obstacles and classified them into six categories: economic-financial, cultural, competencies/ resources, technical, legal, and implementation process. The results of the study have significant implications for both scientific research and management practice.

IEEM18-P-0266
**Channel-based Phase and Power Controllable Intelligent Wireless Power Transfer Architecture Using 4 by 4 Planar Array Antennas**
Kwonhong LEE[1], Jinhyoung KIM[2], Jinwook SEO[2], Hyunyong YU[1], Cheolung CHA[2]
[1]*Korea University, South Korea*
[2]*Korea Electronics Technology Institute, South Korea*
In this paper, channel-based phase and power controllable intelligent wireless power transfer architecture using 4x4 planar array antennas is proposed for wireless sensor network (WSN) applications. In order to obtain high power transfer efficiency, each antenna's phase and power in the arrayed transmitting antenna can be controlled. This results in a variable beam pattern and power. A phase shifted value to perform beam steering was calculated by utilizing antenna array factor. A frequency of radiated power into the air is 2.4 GHz monotone power.

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| **Session** | Decision Analysis and Methods 3 |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside III |
| **Chairs** | Kaushik NAG, *American University of the Middle East*,<br>Tatsushi NISHI, *Osaka University* |

IEEM18-P-0534
**Novel SKU Classification Approach for Autonomous Inventory Planning**
Fengyu WANG, Huey Yuen NG, Thai Ee NG
*Singapore Institute of Manufacturing Technology, Singapore*
Traditional inventory classification models divide SKUs into a few broad categories and help companies to sort inventories using a simple and intuitive way. However, these classification approaches are not able to meet the requirement of autonomous inventory performance analysis and planning in digitized supply chains. This research presents a novel classification approach, which is able to generate granular classifications based on multiple demand and performance attributes of SKUs. The performance templates of these categories can be used as learning data for supervised machine learning algorithms to perform autonomous inventory performance analysis and planning.

IEEM18-P-0593
**Fundamental Design Types of Modular Product Platforms**
Sebastian BARG, Günther SCHUH, Christian DÖLLE
*RWTH Aachen University, Germany*
Business strategies extensively focus on individualization of the product portfolio due to globalization as well as increasing competition and cost pressure. This challenge leads companies to structuring their products and technologic solutions according to the design principles of modular product platforms. In order to establish such a modular product platform successfully regarding the alignment with the company's products and targets, the choice of the conceptual design is crucial. Therefore, this paper introduces five fundamental conceptual design types of modular product platforms.

IEEM18-P-0581
**Optimal Overbooking Decision for Perishable Resources with Jointly Stochastic Booking and Show-up Requests**
Suppasit JONGCHEVEEVAT, Naragain PHUMCHUSRI, Amonsiri VILASDAECHANONT
*Chulalongkorn University, Thailand*
Overbooking is a methodology in revenue management to optimize important decision making for perishable resources or services with uncertain demand. Overbooking allows an incoming booking to be accepted in exceedance of an available capacity because it is believed that some booking will be cancelled later. It is a complicated and risky decision since the decision maker needs to minimize both outsourcing cost and opportunity-lost cost simultaneously. When there are two classes of resources, it is not necessary to always outsource the insufficient and low-priced resources. Upgrading customers to high-priced resources is possible. The objective of this research is to develop overbooking models for (1) one class of resources and (2) two classes of resources (i.e., high and low price) to minimize total cost (i.e., opportunity cost, cost of upgrading and outsource cost). The main contribution of this research is that, unlike other existing literatures, the opportunity cost considered is specifically identified in the situation where too much booking request rejection of each type of resources is present. Sensitivity analysis of our model is also shown for managerial insights.

IEEM18-P-0396

**Multicriteria Inventory Classification of Diabetes Drugs Using a Comparison of AHP and Fuzzy AHP Models**

Kaushik NAG, Magdy HELAL
*American University of the Middle East, Kuwait*

One of the most important aspects of inventory management in pharmaceutical sector is the drug categorization plan where important drugs can be separated from trivial ones. Drug categorization is undertaken on a number of selected criteria based on a particular goal. A number of multicriteria decision models can be utilized; the current paper adopting the AHP and Fuzzy AHP method for ranking diabetes drugs in a specialized diabetes clinic. Some of the unique criteria specific to the case study were identified, primarily the drug stock out implication based on availability and effectiveness of alternative drugs. Other factors considered were unit price, quantity, demand type, criticality and shelf life. The Fuzzy AHP model which can deal better with uncertainty of the decision maker's decision were able to eliminate four out of six criteria; drug criticality and stock out implication were found to be the only two important criteria.

IEEM18-P-0474

**Data-Based Identification Method for Jobshop Scheduling Problems Using Timed Petri Nets**

Tatsushi NISHI, Naoki SHIMAMURA
*Osaka University, Japan*

We address a data-based identification method of machine scheduling problems using timed Petri nets. A general machine scheduling model is represented by timed Petri nets with resource places. Given a set of machines and jobs, and their starting times and completion times of several machines, the objective is to find resource constraints of a given machine scheduling problem from input and output data. The problem is to find the connectivity of each resource place in the operational places. A mixed integer linear programming model is formulated to find an optimal connectivity of resource places to minimize the mean square error of the input and output data. An approximation algorithm is developed to apply larger instances. Numerical examples are provided to show the effectiveness of the proposed approximation algorithm.

IEEM18-P-0294

**Development of a Methodology to Design Product Portfolios in Accordance to Corporate Goals Using an Evolutionary Algorithm**

Michael RIESENER, Christian DÖLLE, Lukas SCHMITT, Merle-Hendrikje JANK
*RWTH Aachen University, Germany*

Due to diminishing product life cycles and a need to satisfy heterogeneous customer requirements, companies across all industries introduce a multitude of product variants into their portfolio. These portfolio expansions often happen unsystematically while hindering the alignment with corporate goals. However, to grow sustainably and remain competitive, it is essential for a company's product portfolio to coincide stringently with corporate goals. While current research focusses on portfolio design based on financial indicators, none of the methodologies is successful in measuring portfolio alignment along with corporate goals and deriving recommendations for actions for product managers based on key figures. This paper promotes a methodology to overcome these limitations. The method is then validated using an evolutionary algorithm.

IEEM18-P-0480

**Public Perception of the Nuclear Research Reactor in Thailand**

Sarasinee TANTITAECHOCHART[1], Naraphorn PAOPRASERT[1], Kampanart SILVA[2]
[1]*Kasetsart University, Thailand*
[2]*Thailand Institute of Nuclear Technology (Public Organization), Thailand*

This study explored perception from the public regarding the future nuclear research reactor construction in Nakhon Nayok, Thailand, using the structural equation modeling technique. Primary data were collected from the public residing within five kilometers of the proposed reactor site. Three exogenous latent variables were consisted of social status, information perception, and trust. Three endogenous variables—risk perception, benefit perception, and technology acceptance—were proposed. The results from our structure showed that trust was the main exogenous variable that affected risk and benefit perceptions and technology acceptance. Social status, on the other hand, had a very little impact on those endogenous variables. Risk and benefit perceptions also influenced the acceptance of the nuclear research reactor.

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| **Session** | Service Innovation and Management 3 |
| **Date** | 18/12/2018 |
| **Time** | 13:45 - 15:30 |
| **Room** | Riverside IV |
| **Chairs** | Markus HARTONO, *University of Surabaya*,<br>Ali SIADAT, *Arts et Metiers ParisTech* |

IEEM18-P-0241

**Multinational Enterprises R&D in China, Government Subsidy Effect: An Empirical Research Based on Simultaneous Equations**

Jian WANG, Peng GUO, Qilei LIU
*Northwestern Polytechnical University, China*

Multinational enterprises are winding their path by R&D embedding into National Innovation Systems of China. Government subsidy has been proven an effective policy instrument to encourage location of foreign capital R&D. However, few literatures take into account how government subsidy impacts innovation outputs and performance of multinational enterprises R&D in China. By collecting series data and panel data, the paper constructs lag-distribute model and simultaneous-equation model to analyze effect of government subsidy on foreign capital R&D in China.

IEEM18-P-0310

**Sustainability-oriented Innovation (SOI) in Emerging Economies: A Preliminary Investigation from Indonesia**

Budi HARSANTO, Roula MICHAELIDES, Helga DRUMMOND
*University of Liverpool, United Kingdom*

Integration of sustainability elements into firms' innovation activities, known as sustainability-oriented innovation (SOI), has received widespread attention both academically and practically, especially over the last decade [1]–[3]. Yet the results of recent systematic reviews suggest that the study of SOI centres on developed economies, with emerging economies lagging far behind, and Indonesia – which is included in major emerging economies within the BRIICS group (Brazil, Russia, India, Indonesia, China, South Africa) – has not been discussed at all. We need, therefore, to examine this research area in this specific setting. Reflecting on nine semi-structured qualitative interviews with business owners and senior managers in Indonesia, this paper reveals how participants consider this research area, identifies themes emerging related to innovation and sustainability, and provides a preliminary analysis of how firms in Indonesia are approaching SOI.

IEEM18-P-0225

**Business Logistics Optimization using Industry 4.0: Current Status and Opportunities**

Bag SURAJIT, Arnesh TELUKDARIE
*University of Johannesburg, South Africa*

In this contemporary, technological age large logistically centered business find significant beneficiation in logistical optimization. Industry 4.0 provides contemporary tools for significant supply chain opportunities with the added benefit of near real time information management. Digitalization provides further opportunities to deliver on green manufacturing, re-manufacturing and reverse logistics opportunities. The purpose of the study is to investigate the impact of Industry 4.0 on green operations under the moderating effect of Institutional pressures. The findings reveal that Industry 4.0 human enablers positively influence green manufacturing, re-manufacturing and reverse logistics optimization in the closed loop economy. The uniqueness of the study is that it provides insights on an Industry 4.0 based model, based on international best practice, delivering a new perspective on green operations optimization.

IEEM18-P-0549

**Testing and Extending P-Transqual Public Transport Service Quality Model: A Causal Approach**

I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN
*Indonesian Institute of Sciences, Indonesia*

This paper aims to propose and test an extended P-Transqual public transport (PT) passengers' perceived service quality (PSQ) model. Furthermore, this paper also investigated the contribution of each dimension of the model on overall PSQ. The research used a quantitative approach. A survey was conducted to collect data. The respondents are 177 PT passengers, which are not only paratransit passengers but also minibus passengers, bus passengers, commuter rail passengers, bus rapid transit passengers, mini-taxi with three wheels passengers, and taxi passengers. CFA, SEM, and Cronbach Alpha analysis were employed. The research results show that our proposed model has good goodness of fit, validity, and reliability. Furthermore, it is also found that personnel, tangible, and comfort significantly influence PT passengers' overall perceived service quality. Personnel dimension has the largest effect on PT passengers' overall PSQ. However, reliability does not affect PT passengers' overall PSQ significantly.

IEEM18-P-0564

**How Kano's Performance Mediates Perceived SERVQUAL Impact on Kansei**

Markus HARTONO
*University of Surabaya, Indonesia*

Through Kansei Engineering (KE) methodology in services, the perceived service quality shows a direct impact on Kansei response. In order to strengthen the KE methodology, Kano model is embedded considering the attractive [A] and one-dimensional [O] performances. However, to what extent the Kano performance brings significant impact on Kansei is questionable and has not been explored yet. It is beneficial to measure the effort spent to improve a certain service attribute, considering the Kano performance and its impact on Kansei. This study on logistics services confirms that the Kano's attractive category [A] shows the highest impact on Kansei (with loading of 0.502), followed by one-dimensional [O] and must-be [M] ones (with loadings of 0.514 and 0.507), respectively. The service provider should prioritize Kano's [A] service attributes first for improvement.

IEEM18-P-0382

**A Study Regarding the Gap Between the Industry and Academia Expectations for College Student's Employability**

Feng-Ming SUI[1], Jen-Chia CHANG[2], Hsi-Chi HSIAO[3], Su-Chang CHEN[4], Dyi-Cheng CHEN[5]
[1]*Hwa Hsia University of Technology, Taiwan*
[2]*National Taipei University of Technology, Taiwan*
[3]*Cheng Shiu University, Taiwan*
[4]*National Penghu University of Science and Technology, Taiwan*
[5]*National Changhua University of Education, Taiwan*

Cultivating the employability of students is one goal of the pursuit of higher education. In order to improve the performance of university education, the employability of graduates must be enhanced. The purpose of this study is to find the industry and academia's views on employability expected of graduates and the gap between the industry and academia in order to put forward suggestions for improvement, with the focus groups method as the research method. Research results show: The industry attaches greater importance to employability. The "specific skill and knowledge related abilities" dimension includes "computer skills (word processing, professional software application and program writing)", and "applying rules and regulations"; the "general abilities" dimension includes "working under pressure"; the "behavior/attitude qualities" dimension includes "initiative", "adaptability", "loyalty, integrity", and "tolerance, appreciation of different points of view".

IEEM18-P-0200

**Visualize Organizational Perception of Core Value in the Company: An Experiment Employing Multi-dimensional Scaling and the Competing Value Framework**

Sanetake NAGAYOSHI[1], Jun NAKAMURA[2]
[1]*Shizuoka University, Japan*
[2]*Shibaura Institute of Technology, Japan*

Organizational culture is invisible so that it hinders us organizational change. We proposed a method to visualize organizational culture, employing multi-dimensional scaling analysis with 40 terms extracted from Cameron & Quinn (2006). Applying the method to a Japanese software company, we tried to visualize their organizational culture, especially to depict their core value. The results and the interpretation of them were evaluated as good by the president in the company since they were described the cultures well. Thus it has a possibility to be an effective method to visualize organizational culture.

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| **Session** | Supply Chain Management 6 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Ballroom I |
| **Chairs** | Gitae KIM, *Hanbat National University*,<br>Aries SUSANTY, *Diponegoro University Indonesia* |

IEEM18-P-0538

**Sustainable Dynamic Pricing for Perishable Food with Stochastic Demand**

Ghada MOUSTAFA, Noha GALAL, Khaled EL-KILANY
*Arab Academy for Science, Technology & Maritime Transport, Egypt*

In current competitive environment, retailers are facing a fierce competition and are aiming to manipulate customer purchasing attitudes. Dynamic pricing strategy is a major determinant of retailer's profitability when considering perishable food. Furthermore, increasing pressure from society and international organizations calls for food security, safety and decreased food waste and losses. This paper investigates dynamic pricing strategy with the objective of maximizing revenue and minimizing food waste to ensure sustainability. A simulation model with stochastic demand based on product price and age is developed using ExtendSimTM Suite. The effect of inventory replenishment quantity on the performance measures is analyzed. Results reveal the superiority of dynamic pricing over fixed pricing strategy in terms of retailer profit and food waste.

IEEM18-P-0427

**Who Has More Incentive to Make Sustainable Investment, Supplier or Manufacturer?**

Qian YUAN, Xiutian SHI
*Nanjing University of Science and Technology, China*

Core manufacturers often require their suppliers to get involved in sustainable projects by making investment. Meanwhile, the manufacturers themselves also make sustainable investment. In this paper, we investigate the incentive and impact of the sustainable investment made by the supplier and manufacturer, respectively. Analytical results show that it is more beneficial for the environment when the supplier makes sustainable investment. In addition, the supplier has incentive to invest with profit improvement rather than the manufacturer's obligatory requirement.

IEEM18-P-0541

**Supplier Selection Model Development for Modular Product with Substitutability and Controllable Lead Time**

Yosi Agustina HIDAYAT, Tota SIMATUPANG
*Bandung Institute of Technology (ITB), Indonesia*

Modular product patterns supported by production systems should be able to cope with the high demand for product variations. In the products that have modular patterns, some components of the module compilers with the other module have the same function/use (commonality) and will be able to mutually replace one another (substitutability). On the other hand, changing in the strategic industrial environments have led to the increases of competition, changes in market structure and increases of consumer bargaining power. Changes in consumer needs are then captured by various companies which led to the concept of mass customization. In this paper we aim to develop a mathematical model that can minimize the total inventory cost to select a single supplier and determine the optimum inventory policy considering the nature of commonality and substitutability between components with controllable lead time.

IEEM18-P-0089

**Factors Affecting Sustainable Supply Chain Management: The Indian Steel Sector**

Dayal S. PRASAD, Rudra P. PRADHAN, Kunal GAURAV, Saurav DASH
*Indian Institute of Technology Kharagpur, India*

Organizational sustainability performance is highly dependent on organization's culture and work practices including sustainable supply chain management. External pressures influence organizational practices and this also reflects on the sustainability performance indicators. This study presents an analysis of their inter-relationships in the Indian steel sector. 21 measures representing dimensions of external pressure, organizational internal practices and sustainability performance were developed with reference to literature review and experts' opinion from industry. A conceptual model has been proposed which has been empirically tested by survey data collected from 145 industry practitioners through online and offline survey. Using structural equation modelling technique, the study establishes that organizational practices positively impact the sustainability performance in India's steel sector. The external pressures, though, impact organizational practices, their impact on sustainability performance is insignificant. The findings should help the practitioners, academics as well as policy makers in focusing greater attention to creating favorable conditions in the organization. This research paves the way for further work in this area.

IEEM18-P-0265

**An Incentive-based Bi-level Optimization Model for Collaborative Green Product Line Design**

Shuang MA[1], Songlin CHEN[2], Xiaotian CAI[3]
[1]*Beijing Institute of Technology, China*
[2]*Nanyang Technological University, Singapore*
[3]*Chinese Academy of Science and Technology for Development, China*

Green product design aims to improve the environmental and social quality of products and has been recognized as one of the main issues in sustainable operations. This research proposes an incentive-based bi-level joint model to optimize the green product line design in order to deal with the trade-off underlying the profit and carbon emission based on the interactive relationship in a two-tier supply chain. A case study involving one manufacturer and one supplier is developed to test the proposed optimization model. A comparison between the non-incentive-based bi-level model and the incentive-based bi-level model is presented. It is found that the developed incentive-based joint optimization model can achieve a relatively better optimal solution to minimize the amount of carbon emission and maximize the product line profit.

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| **Session** | Intelligent Systems 2 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Ballroom II |
| **Chairs** | Gai-Ge WANG, *Ocean University of China*, Benedikt MOSER, *Institute for Industrial Management at RWTH Aachen University* |

IEEM18-P-0081

**Combining IOT and Android APP System for Upper Limb Stroke Rehabilitation**

Keng-Chieh YANG[1], Chia-Hui HUANG[2], Chieh-Yow CHIANGLIN[1]
[1]*National Kaohsiung University of Science and Technology, Taiwan*
[2]*National Taipei University of Business, Taiwan*

This research constructs an experimental system for upper limb stroke ill persons. It can apply to any dwelling for patient practices. The idea of stroke rehabilitation system is applied International Classification of Functioning, Disability and Health structure and includes Barthel scale for ill person's health evaluation. These systems are designed by IOT and Android APP system to control the rehabilitation system. The findings demonstrate that it can work effectively for the patients at home. This study can collect patients' data from every day rehabilitation and send these data to medical cloud. These data can be analyzed statistically and converted to Microsoft Excel files to drop bar charts for visually display. The system reports can upload to medical institution cloud computing systems for doctors' reference. This study demonstrates the implementation of results and provides program codes for readers' reference.

IEEM18-P-0478

**Traffic Voting System to Achieve the Balance Between Privacy and Trip Chain Data Acquisition**

Wentian CHEN, Kai ZHANG, Zhiheng LI
*Tsinghua University, China*

In this era of big data, the conflict between data acquisition and privacy protection has attracted great attention. This paper proposes a Traffic Voting System (TVS) to help collect trip chain data and encourage travelers to share their information voluntarily. Travelers in the TVS will probably choose to share their travel information in exchange of less waiting time, as is proved by game theories. Trip chain data are collected by the TVS and this type of data is quite useful in traffic design and management. A comparison of TVS and other two similar systems is introduced in this paper. It is illustrated that the TVS is a traveler-centric system and is robust to deal with many complex situations in the traffic system.

IEEM18-P-0577

**A Predictive Model for Forecasting Spare Parts Demand in Military Logistics**

Hanjun LEE[1], Jaedong KIM[2]
[1]*Hannam University, South Korea*
[2]*Korea Institute for Defense Analyses, South Korea*

The proportion of the stock range that is devoted to spare parts is often considerable in industrial context. Accordingly, even small improvements in forecasting spare parts demand might lead to substantial cost savings. Time series analysis has been the most popularly applied method in the prior spare part demand forecasting models. However, these approaches need to be improved in terms of prediction accuracy. In this study, we gathered component consumption data including structured and unstructured data from a spare part management information system in military logistics. We proposed demand forecasting models based on data mining and text mining techniques. The results show that our approach can improve the prediction performance compared to that of existing approaches.

IEEM18-P-0371

**Advanced Automation for SMEs in the I4.0 Revolution: Engineering Education and Employees Training in the Smart Mini Factory Laboratory**

Luca GUALTIERI, Rafael ROJAS, Giovanni CARABIN, Ilaria PALOMBA, Erwin RAUCH, Renato VIDONI, Dominik T. MATT
*Free University of Bozen-Bolzano, Italy*

Industry 4.0 is currently changing the shop- floor of many large manufacturing companies. Small and medium-sized enterprises are also increasingly concerned with the introduction of Industry 4.0 technologies and methods. This requires a great change of employees, creating a strong demand for training and further education for existing workers. The qualification of employees of small and medium-sized enterprises as well as engineering students can take place, for example, in learning factories where a revised educational paradigm is implemented. In this paper, the experiences and results we have learnt with the implementation of specific trainings and educational activities for advanced automation in the Smart Mini Factory Laboratory of the Free University of Bolzano are explained and discussed.

IEEM18-P-0058

**A Real Time Stare in Market Strategy for Supply Chain Financing Pledge Risk Management**

Benhe GAO, Qian ZHOU, Shigang LI, Xinglu LIU
*Tsinghua University, China*

Supply Chain Financing (SCF) provides the small and medium enterprises (SMEs) with special access to loan based on supply chain, dragging numerous enterprises out of financing dilemma. At the same time, banks also have to face with risks coming with SCF. This paper mainly explores SCF pledge risk controlling taking advantage of block chain technology, which is known for information transparency and tamper proof, and proposes a strategy of Real Time Stare in Market (RTSM) to mitigate risk pressure brought by pledge of movables. Once the total value of pledge drops below the level of safety, replenishment is required. Numerical experiments results show that banks can avoid risk of pledge and even gain more from RTSM strategy.

IEEM18-P-0548

**Involving the Manufacturing System within its Planning Phase**

Matthias BARTELT, Bernd KUHLENKÖTTER
*Ruhr-Universität Bochum, Germany*

Nowadays, manufacturing systems are equipped with a huge number of digital components. Along with the increasing computing power and connectivity, they are becoming more intelligent and can make decisions on their own. Amongst others, these tasks include the self-optimization and self-configuration of the production system. In addition, such cyber-physical production systems can contribute to the planning phase of a manufacturing system, e.g. when the production process must be adapted to a new product. However, neither appropriate means nor a practical mode of operation are available yet. Hence, it is unclear how manufacturing systems can work concurrently with humans in this phase of planning. Within this paper, we present a method of concurrent engineering that enables manufacturing systems to participate in the planning of production systems.

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| **Session** | Operations Research 4 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Ballroom III |
| **Chairs** | Reza Tavakkoli-MOGHADDAM, *University of Tehran*,<br>Tatsushi NISHI, *Osaka University* |

IEEM18-P-0446

**Lease Contract with Availability Target and Price Discount**

Hennie HUSNIAH[1], Rachmawati WANGSAPUTRA[2], Bermawi P. ISKANDAR[2]
[1]*Langlangbuana University, Indonesia*
[2]*Bandung Institute of Technology, Indonesia*

A lease contract (LC) model for a fleet of dump truck with availability target is developed in this paper. Under this LC, the lessor provides a maintenance service including preventive maintenance (PM) and corrective maintenance (CM) within the contract period, and offers a price discount if the lessee leases for more than one equipment. To sustain high performance of the fleet, we proposed an availability target as performance of the LC. In addition, the lessor gives some incentive in term of a price discount if the lessee leases more dump trucks. The study is done from the lessor's viewed point and hence the decision problems of interest are to determine the tresshold between total cost and the price which is dependent on the fleet size. The optimal decisions are obtained to minimize the total cost. To illustrate the theory and optimal decisions, we provide numerical examples in the last section.

IEEM18-P-0109

**Profit Maximization in Inventory Routing Problems**

Anna ZAITSEVA[1], Lars Magnus HVATTUM[1], Sebastián URRUTIA[2]
[1]*Molde University College, Norway*
[2]*Universidade Federal de Minas Gerais, Brazil*

The inventory routing problem (IRP) deals with the transportation of one product from a producer to multiple consumers, which have given demands and inventory capacities, over a discrete time horizon. The traditional goal of the IRP is to minimize the combination of inventory and transportation costs, while avoiding stock outs at customers. This paper proposes two variations of the IRP with profit maximization. First, when the market situation allows prices to be adjusted, the problem involves finding an optimal balance of volume and margin according to a demand function. Second, when prices are fixed, unit production costs depend on the production volume, which can be adjusted to maximize the profit. Both variations lead to non-linear models, which are linearized and then tested on a selection of standard benchmark instances. Computational results show that considering profit maximization instead of cost minimization leads to different decisions, generating a larger revenue and profit.

IEEM18-P-0354

**Using Iterated Greedy with a New Population Approach for the Flexible Job-shop Scheduling Problem**

Ghiath AL AQEL[1], Xinyu LI[1], Liang GAO[1], Wenyin GONG[2], Rui WANG[3], Teng REN[4], Guohua WU[5]
[1]*Huazhong University of Science and Technology, China*
[2]*China University of Geosciences, China*
[3]*National University of Defense Technology, China*
[4]*Central South University of Forestry and Technology, China*
[5]*Central South University, China*

The flexible job-shop scheduling problem (FJSP) is known as an important problem in manufacturing systems. Many methods have been proposed to solve this problem. The iterated greedy (IG) is one of those algorithms that are widely used in simpler shop scheduling problems. This research proposes a new Telescopic Population approach (TP) to assist the IG in solving the FJSP. The use of TP approach with IG provides an effective method that is also easier to reproduce. The performance of TP with IG proves that the new population approach effectively improves the performance of IG.

IEEM18-P-0469

**Research on Overall Improvement of Production Efficiency: A Case Study Based on Value Stream Mapping Analysis in Automobile Decoration Products Manufacturing Industry**

Huang LI[1], Chunming YE[1], Zhenbin ZHOU[2], Xinyu ZHOU[2], Xiaoxue FU[2], Lingling PENG[2]
[1]*University of Shanghai for Science and Technology, China*
[2]*University of Panzhihua, China*

This article is a practical study focusing on three lean manufacturing techniques, which are value stream mapping (VSM), Kanban information system, and layout optimization of production line in Automobile decoration products manufacturing industry. Value stream mapping (VSM) is applied to focus more on the streams in the production processes, while Kanban is implemented as the main subject for just-in-time (JIT) production systems. Taken S Company F production line as an example, the application of the lean manufacturing techniques to solve the problems of F production line, such as low line balance rate, long handling route, lack of personnel utilization and unobstructed logistics and information flow, is applied to optimize its production line. As a result, the delivery time of the F production line is reduced from the original 40.24 days to 15.57 days, handling distances of the process shortened from 352.2 meters to 189 meters, the number of WIPs decreased from 166,000 to 8,300, the daily production capacity of 888 products increased from 152 to 334. It proves that using value flowchart to optimize production process is the significance of this essay.

IEEM18-P-0525

**Challenges of Digital Transformation: The Case of the Non-profit Sector**

Saeedeh SHAFIEE NAHRKHALAJI[1], Sara SHAFIEE[1], Mitra SHAFIEE NAHRKHALAJI[2], Lars HVAM[1]
[1]*Technical University of Denmark, Denmark*
[2]*Shahid Beheshti University, Iran*

Nonprofit organizations (NPOs) are critical to the quality of life in many communities not only due to the valuable services and social impact they create, but also because of the positive economic impact within local communities. However, NPOs, just as for-profits, need to innovate in response to changing customer demands and lifestyles and to capitalize on opportunities offered by technology and changing marketplaces, structures and dynamics. Digitalization is essential to fuel NPO's innovation in order to be a differentiator in the highly competitive environment. In this paper, we first develop a review to identify the challenges of digital transformation and then we examine some of the challenges that the nonprofit sector faces in undertaking digital transformation initiatives.

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| **Session** | Technology and Knowledge Management 5 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Pompadour |
| **Chairs** | Chung-Huei KUAN, *National Taiwan University of Science and Technology*,<br>Michel ALDANONDO, *Toulouse University / IMT-Mines Albi* |

IEEM18-P-0620

**Content Analysis Approach: A Review on the Extent of Science and Engineering Curriculum Meet Competency Requirements for Testing, Inspection and Certification Industry**

Fanny TANG
*The Open University of Hong Kong, Hong Kong SAR*

Testing, Inspection, and Certification (TIC) are adopted to examine if a product conforms to regulatory standards respected to safety, quality and functionality that are globally accepted. Nowadays, testing, inspection and certification applied in products aims to verify the quality of product so that consumers can make proper decision and consideration in the selection of products. Due to the importance of testing, inspection and certification, market trend, competency of practitioners engaged in TIC and the methodology to study the readiness of their engagement are discussed. This paper reviewed the market trend of the testing, inspection and certification industry, discussing competency standards for practitioners engaging in TIC industry. Three main areas are studied: testing, inspection and certification industry market trend, competency requirements and content analysis methodology.

IEEM18-P-0245

**A Conceptual Interaction Cycle Between Individual and Group Absorptive Capacity with Social Integration Mechanism and Cohesive Learning Group as Moderating Variables**

Andy Susilo LUKITO-BUDI[1], Nurul INDARTI[2]
[1]*Universitas Gadjah Mada/ Atma Jaya Catholic University of Indonesia, Indonesia*
[2]*Universitas Gadjah Mada, Indonesia*

Many researchers agree that absorptive capacity (ACAP) is a critical multilevel construct (individual to organization) for innovation success. Interestingly, little attention has been paid to this construct independently or the interaction among the levels in a full cycle. This conceptual paper aimed to visualize a proposed research model to fill in the theoretical and empirical gap in the multilevel interaction by detailing some promising moderators from the ACAP conceptual model, that is, cohesive learning groups and social integration mechanisms adopted from organizational learning (OL) 4I theory. In addition, this paper identified feed forward and feedback mechanisms, creating a cycle in the interaction process that had been identified but never tested. Some propositions were conceptualized to address this research line of work, and a research model was proposed.

IEEM18-P-0219

**The Complexity of Megaprojects in Developing Countries: A Literature Review**

Retno Wulan DAMAYANTI, Budi HARTONO, Andi Rahadiyan WIJAYA
*Gadjah Mada University, Indonesia*

Complexity becomes one of the most significant challenges in megaprojects. Studies show that the majority of megaprojects did not successfully meet deadlines, specifications and costs. Limited studies have been successfully carried out to support it. Using Systematic Literature Review and Cochrane's method stages, this study explores academic literature to find research area that should be further studied. From 24 published articles, there are four scopes for future researches that must be more explored to support the success of megaprojects in developing countries. These areas are the study that discusses the possible interrelate nature among factors of complexity, the complexity that discusses the uncertainty and change (the 'emergent complexity'), the complexity problem at each stage of megaprojects, and the development of researches that integrates the methods of quantitative and qualitative.

IEEM18-P-0334

**A Novel Concept for Solid Debris Extraction Technique from Used Lubricants for Predictive Maintenance**

Sontinan INTASONTI[1], Tadpon KULLAWONG[1], Surapol RAADNUI[2]
[1]*Pathumthani University, Thailand*
[2]*King Mongkut's University of Technology North Bangkok, Thailand*

Conventional techniques for wear debris extraction from used lubricants for predictive maintenance such as Ferrography and Filtergram can no longer be employed effectively, as per International Organization for Standardization (ISO 18436) especially in field lubricant analysis. This research aims to develop the solid debris extraction apparatus from used lubricants for predictive maintenance application.

IEEM18-P-0603

**A Method and Rules to Design Supports for Ebm Parts**

Christelle GRANDVALLET[1], Julie MAISONNEUVE[2], Frédéric VIGNAT[1]
[1]*University of Grenoble Alps, France*
[2]*G-SCOP, France*

Additive Manufacturing (AM) activities generate the development of extensive knowledge, whether from material, design or manufacturing fields. AM experts who design and build parts apply operating rules but also work by trial and error. This paper proposes an approach to validate the process of designing supports for EBM parts and capture associated rules. AM challenges are presented first, followed by the State of the Art on process rules. A case study about the design of EBM parts enables to test and update existing rules and process. AM rules are finally presented, which could be used as best practices by CAM users.

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| **Session** | Speed Talks 1 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Riverside III |
| **Chairs** | Seung Ki MOON, *Nanyang Technological University* |

IEEM18-P-1008

**An Analysis General Extended Cournot Duopoly Model with Mixture Strategic Concept**

Shih-Ting LIN, Tyrone T. LIN
*National Dong Hwa University, Taiwan*

This study explores the competitive behavior of enterprise in general extended duopoly market which based on the traditional Cournot Model. By taking two enterprises of the same production scale and produces isomorphic commodity as the main constructed the objective of competition model. Meanwhile, it assumes that when it makes decision analysis to determine its output strategy by Cournot competition and seek the maximum expected profits of the enterprise itself. Through the general extended Cournot duopoly model, the analysis of market equilibrium reveals that when the optimum production price of an enterprise is equal to the total cost of market production, and the optimal production quantity under an equivalent situation. When the production price of an enterprise is equal to the total cost of the market, this proposed model returns to the tradition Cournot duopoly model. This paper also tries to proceed to examine competitive strategy of enterprise, when it considered profit-oriented strategy and human resource strategy so as to take into account mixture strategies with each other for finding the optimal mixture strategies.

IEEM18-P-1013

**Multi-criteria Evaluation Approach to Select a Suitable Market-based Instrument for Reducing CO2 Emissions in International Shipping**

Xin Ni LEE
*National University of Singapore, Singapore*

Increasing CO2 emissions in international shipping sector has necessitated the consideration of a range of CO2 reduction measures such as Market-Based Instruments (MBIs), alternative fuels and technical and operational measures. This study focuses on MBIs and their suitability for international shipping. The analysis begins with a systems perspective of how an MBI may lead to CO2 reduction, followed by a definition of two fundamental types of MBIs' bunker levy, a form of tax on fuel, and emission trading system. Next, key criteria used to assess MBIs are consolidated from various sources. Comparing the two MBIs based on these criteria leads to the view that bunker levy is easier to implement. In view of the cumulative effect of CO2, and the time and resources required for technology change, it is argued that international shipping should adopt bunker levy in the immediate term while searching for a suitable MBI in the long term.

IEEM18-P-1033

**Development of Bio-briquette Production Equipment for Indonesia's Rural Communities**

Haryono SETIADI
*Sebelas Maret University, Indonesia*

Rural areas in Indonesia have the potential for oyster mushroom cultivation. The problem faced by these cultivators is the waste from mushroom media. After passing its productive age, the media will become a solid waste that causes environmental pollution. This waste can be applied to bio-briquettes. Bio-briquette of mushroom waste can be used as an alternative fuel source. Based on the fact, this research aims to develop the bio-briquetting producing tool that can be applied by rural communities in Indonesia. The development of the device begins with observing the habits of the village mushroom cultivators, observing waste characteristics, developing the concept design, making and testing the tool. The results of this study produced bio briquette pressing equipment with technical specifications of the UNP-100 iron frame material, manual propulsion by hand with the dimensions of 1.5m length, 0.5m width, and 2m height. Based on the testing, this device can be implemented by oyster mushroom farmers in the countryside with a production capacity of 100 kg/day. The bio-briquette has also been used as fuel for sterilisation of mushroom seeds by the farmers.

IEEM18-P-1006

**Multi-material Finite Element Analysis of 3D Printed PLA**

Enea SACCO
*Nanyang Technological University, Singapore*

Spacecraft come in many shapes and sizes and perform a huge range of missions, from GPS to space exploration. Each spacecraft is therefore customized to fit its specific mission, meaning that they are very expensive to design and build. Additive manufacturing (AM) or 3D printing allows great design freedom, which is ideal for the space industry. Many parts have already been printed, tested, and flown, and AM also allows to, for example, minimize mass or maximize thermal transmission in cooling systems. There is still a large gap in knowledge when it comes to the 3D printing process, especially predicting the properties of printed parts. Therefore, a research project is ongoing to model how different parts of objects manufactured with Fused Deposition Modeling (FDM) affect the overall mechanical properties. By considering each section of objects independently, they are simulated under tensile stress then printed using the polymer PLA and tested to confirm that the simulations are accurate. Building better models allows more complex parts and mechanisms to be built for spacecraft.

IEEM18-P-1027

**Lean Manufacturing Implementation in Management of Residues from Automotive Industry**

Mercedes Estefanía MERCEDES ESTEFANÍA
*Universidad San Francisco de Quito, Ecuador*

Lean Manufacturing is a system that improves the processes using principles and tools to reduce several types of waste. This system has been applied to a wide number of areas and activities in different companies. Having said that, still there are certain companies operating in the recycling industry, which do not consider waste processes as a problem. It is here where a controversy is born: when a recycling company treating waste from other industries, has "waste" in its processes. Lean Manufacturing Techniques tackle this problem by reducing or eliminating the waste. This is the case presented in this study, the Ecuadorian company AV. CORP., which experienced an improvement in its activities to treat waste materials coming from an automotive industry due to the application of Lean Manufacturing tools. All that has been done following the DMAIC Methodology. Many benefits were obtained, to mention a few, the reduction in occupied space in the plant, the reduction in movements of workers and the better use of trucks for transportation of materials. An improvement of seventy percent was achieved.

IEEM18-P-1047

**A Guideline for Digitalizing Visual Management as Lean Toolbox Innovation**

Koichi MURATA
*Nihon University, Japan*

This paper proposes a guideline for innovating visual management, a representative method in a lean management toolbox, in the era of digital innovation. This guideline consists of three potions. After reviewing the original purpose of visual management, the first portion clarifies scenarios to improve from conventional visual management from the following four perspectives; visual capability, temporal capability, problem-solving capability, and geographical capability. In the second portion, with discussing an approach to design digital visual management, there are proposed the approach from the improvement of an interface with people, and the approach from the development of a new data network. The third portion reveals two pitfalls, "the waste of visualization" and "the omission of visualization", hidden in the established digitalized system. The findings are useful when researchers and practitioners embody a concept of digital innovation in order to reinforce lean management activities.

IEEM18-P-1052
**Air Conditioning Load Prediction Using Recurrent Neural Network**
Sungzoon CHO
*Seoul National University, South Korea*
Predicting air conditioning load is vital for efficient operation of outdoor units in system air condition. It can be accurately obtained only in an experiment setting. Thus, in practice, it is estimated using physical models. We formulated the problem as a supervised learning. Target variables are sensible heat load and latent heat load while predictor variables include refrigerant flow rate, humidity, outdoor temperature, indoor unit capacity, air con operating status, indoor temperature, sensible heat in calories, latent heat in calories, and room volume. We obtained from a manufacturer 8 month worth of 10 minute data from 4 different outdoor sites from 2016 to 2017. A Network structure of 64-64 multi-layered GRUs with 64-64 FC layer was trained with a batch size of 32, learning rate of 0.001 with Gradient Descent Method of ADAM. We were able to obtain the practically acceptable accuracy: mean absolute test error of 0.46 for sensible heat load and 0.17 for latent heat load. We are currently working on reducing the size of the model so that it can be embedded in the hardware.

IEEM18-P-1025
**Faults Diagnosis Under Time-varying Speed Conditions with Combination of Order Tracking and Extreme Learning Machines**
Zhixin YANG
*University of Macau, Macau*
For rotation mechanical devices, vibration signals in startup and stopping stages are rich in fault information. However, the rapidly changed shaft speed under such conditions inflicts unstable features. To overcome the challenges, the time-frequency representation (TFR) is blurred by obvious frequency modulating. Order tracking could provide stable signals in angular field for traditional diagnosis. But it relies on the time consuming high accurate data resampling, which makes it unfits for online diagnosis. To utilize resampled signals, this work combines order tracking with the elegant machine learning method, extreme learning machine (ELM). It transfers the signals for classifying, and remedies the resampling error with the adaptability of ELM. For signal processing, Short-time Chirp Fourier Transform (STCFT) gained the TFR and IF which are to provide the phase information for resampling. By VMD, resampled signals turned into modes. The resulted modes were then learnt and classified by the ELM. The adoption of VMD can overcome the modulate mixing and for accelerate analysis; the ELM can effectively classify the fault features in modes, and comparisons with other methods show that the method is promising on online diagnosis.

IEEM18-P-1040
**An Optimization Model for Multiple Objective Supply Chain Master Planning**
Supachart IAMRATANAKUL
*Kasetsart University, United States*
Supply chain management is focused on the plan of product flow among factories, warehouse, and customer in the way that the total cost in the supply chain can be minimized. This research considered the master planning of a beverage company in Thailand to optimize its supply chain management process. We propose a new multi-objective mixed integer linear programming model for optimizing its aggregate planning for the beverage product business. The production cost, transportation cost, inventory cost, handling cost, and shortage cost are considered as the objective to minimize the total cost. The constraints are bounded the solutions by the production rate, production quantity, transportation quantity, inventory level, and product availability. The proposed model and solution method are validated through numerical tests. The computational results indicate that the proposed optimization model is very promising for solving the supply chain master planning.

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| **Session** | Speed Talks 2 |
| **Date** | 18/12/2018 |
| **Time** | 16:30 - 18:00 |
| **Room** | Riverside IV |
| **Chairs** | Carman Ka Man LEE, *The Hong Kong Polytechnic University* |

IEEM18-P-1012
**How Older Drivers Experience Visual Difficulties in a Real-driving Situation?**
Sang Yoon UM
*Yonsei University, South Korea*
Due to the deterioration of visual information processing ability, the risk of traffic accidents in older drivers is relatively higher than that in young drivers. Thus, it is necessary to investigate on visual challenges of older drivers in a driving context. In this study, we defined six visual difficulties of older drivers and conducted focus group interview to investigate how older drivers experienced these difficulties in real-driving situations. We analyzed the interview contents by contextual coding technique, coded corresponding visual difficulty to interview contents which is divided into phrase units and interpreted that greater number of difficulty-coded phrases indicates frequently experienced visual difficulty by older drivers. Results showed that older drivers commented about twice visual difficulties than young drivers. Furthermore, among the defined visual difficulties, difficulties of stereoscopic vision, contrast sensitivity and visual field were founded most frequently. This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIP) (No. 2017R1E1A2A01076791).

IEEM18-P-1022
**Evaluating Novelty of Patent with Graph Based Semi-supervised Learning**
Dooseob YUN
*Dongguk University, South Korea*
As competition between firms becomes deepen, importance of technology development is on the rise. Thus firms try to develop novel technology which can lead the innovation. However, novelty of technology was not considered its characteristics even the goal and purpose of technology are different. Therefore, we aim at proposing novelty features of technology and deriving novelty value of each technology with graph based semi-supervised learning and evaluating novelty of each document. For this we first derive novelty features that can explain the novelty of technology, and define the keyword that represent novelty features. And then we figure out how many novelty features are included in the patent documents which represent the technology. Finally, we evaluate novelty value of each technology by graph based semi-supervised learning. We apply our study to future safety technologies for illustration. Proposed methodology redefines novelty of technology and propose novelty feature which explain novelty of patent. In addition it is possible to calculate novelty value of each technology. Furthermore, it is useful to figure out high novelty technology and support users to prevail it.

IEEM18-P-1024
**Lean, Six Sigma and ToC Application in a Dairy Industry**
Ana Maria FLORIDO, Miriam GAVILANEZ
*Universidad San Francisco de Quito, Ecuador*
In most industries, the presence of waste is considered inherent to the system, so its reduction is a challenge. Finding a proper way to reduce it without affecting the Hazard Analysis and Critical Control Points (HACCP) is the goal. The case study presented in this article, aims to reduce waste to increase the efficiency of an important Dairy Industry. In Eculacteos, an Ecuadorian industry, the presence of waste is evident although it is already automatized. By applying synergistically Theory of Constraints, Lean and Six Sigma, bottlenecks were found. In addition, waste was reduced and defects in the pouch packing processes went down significantly. Guided by the DMAIC methodology, an improvement in the production processes was obtained. Finally, results showed a reduction of about one point of the percentage of the milk waste and material scrap in relation to the initial state of the company.

IEEM18-P-1021

**Maintenance Scheduling Optimization in Continuous Processing Plants: A Case Study in Particleboard Production Plant**

Asgele Gebrekidan KAHSAY
*Waseda University, Japan*

In today's global market, manufacturing companies are facing stiff competition at producing quality products, timely due-dates and affordable price. Efficient maintenance management is needed to achieve these objectives. Hence, the reliability of machines is always the quest of maintenance in continuous processing plants. This is because in such plants machines are connected in series configuration and breakdown of a single part causes overall plant shutdown. Sometimes this shutdown may stay for long time and causes for great lose. Therefore, the purpose of this research is to find an optimum maintenance scheduling that increases machine reliability with a minimum maintenance cost. Considering the complexity of this multiobjective problem, we used an Improved Genetic algorithm (IGA) to find Pareto-optimum solutions. A numerical analysis is performed using data collected from critical equipments in particleboard processing plant. The analysis shows that the optimum schedule found by IGA might be helpful for maintenance managers and engineers to find improvement possibilities and decision making during maintenance scheduling in continuous processing plants.

IEEM18-P-1004

**A Lower Bound Heuristic for the LNG Bunkering Facility Location in Inland Waterways**

Evrim URSAVAS
*University of Groningen, Netherlands*

The growing awareness of the environment together with the new regulations of the International Maritime Organization and the European Union has forced ship-owners to reduce pollution. Liquefied natural gas (LNG) is one of the most promising options for accomplishing this reduction for inland waterways and short sea shipping. However, the LNG infrastructure to facilitate the use of this new fuel is yet to be developed. Refuelling facilities need to be located in strategic locations allowing for alternative investment plans. To this end, we develop mathematical models that determine locations for refuelling stations where terminal-to-ship and truck-to-ship bunkering alternatives are analyzed. We take into account the characteristics of a LNG network, such as the boil-off effect (from loading and storage) when deciding on the capacities and the types of facilities. We consider cases where capacity expansion and reduction is beneficial. We develop a lower bound method based on Lagrangian relaxation technique. We perform our experiments for the waterway network in the Arnhem-Nijmegen region in the West-European river network.

IEEM18-P-1001

**Costly Information Acquisition Under Horizontal Competition**

Qi FU
*University of Macau, Macau*

Information has become a key driver for surviving and excelling in competition. In this paper, we develop a game-theoretic framework to model and analyze endogenous acquisition of costly information in a setting where two firms sell homogenous products to the same market. Prior to determining its production quantity, each firm has an opportunity to purchase a forecast, which gives a better knowledge about the market potential. There exists a correlation between the two forecasts acquired by the firms. We model the problem as a two-stage game in which the two firms first decide whether or not to acquire their respective forecasts and then decide their respective production quantities. We demonstrate that the value of information to one firm depends on the other firm's decision on information acquisition. By taking into account the value of information, we derive the equilibrium outcome regarding the information acquisition and quantity decision by the two firms and discuss the managerial insights.

IEEM18-P-1032

**The Identification of Features Influencing the Human's Perception of Similar Drugs**

Minji PARK, Jinhyung KIM, Choeun KIM, Taezoon PARK
*Soongsil University, South Korea*

This study aims to identify feature that causes confusion for healthcare professionals to handle tablets and capsules. Similar shaped drugs causes confusions to healthcare professionals who is preparing and administering them to patients. Many hospitals all over the world have reported a number of adverse events related with drug confusion, which is a serious threat to patient safety. Considering that this problem is universal, it is critical to understand how the confusion happens and to provide guidelines to pharmaceutical companies to avoid the confusion. Classifications of capsules and tablets based on the pictures revealed that the drugs could be grouped into four different large sets; white tablets, colored tablets, oval shaped tablets, and capsules. A human subject experiment conducted for comparing the human's perception with the machine image clustering, indicated that people first perceive the shape of the drug and then subdivided it with the colors. The result implied that the introduction of various tablet shape should be the first action to help distinguishing different drugs.

IEEM18-P-1054

**A New Model in Waste Management City Logistics**

Shahrooz SHAHPARVARI
*RMIT University, Australia*

This study aims to optimize the logistics network and transportation system of ISWM where the complete chain of MSW/residue is addressed in a tri-echelon ISWM logistics network with all interrelated system facilities integrated. Assuming various complexities of a real-life ISWM system, a Mixed-Integer Linear Programming (MILP) model is developed to formulate the ISWM system in the framework of the Fleet Size and Mix Vehicle Routing Problem with Time Windows. Addressing uncertainty in ratios of MSW generation, a two-stage stochastic optimization approach is proposed to effectively support the cost-effective ISWM transportation system by finding the optimal fleet size and decomposition, vehicles routes and capacity-allocation to the system components. The proposed approach successfully applied to a real-life case of ISWM in southern Teharn, Iran. The results indicate that the usefulness of the approach to minimize economic cost of the system under uncertainty and affirmed an intense effectiveness of the method when experiencing larger deviations between the estimated and actual amounts of the uncertain parameter and in cases of unplanned disruptions in the system network.

IEEM18-P-1035

**Residential Load Prediction Based on Load Data of Other Residential Communities**

Junya MATSUNAGA
*Waseda University, Japan*

In Japan, full liberalization of electricity retailing is being implemented, and retail electricity companies need to predict the residential load of contracted consumers for supply and demand adjustment in the targeted community. Particularly, if a large amount of photovoltaic power generation with unstable output is introduced in the community, it is indispensable to precisely predict the demand. In the future, it will be necessary to predict the load even for newly built houses suffering from a lack of measured data accumulation. With the above background, in this study, we propose a method for predicting the next day load of the house that has accumulated data for only several months. In the proposed method, we utilize the sufficiently compiled residential data of other communities for more than one year. As a prediction method, Just-In-Time (JIT) Modeling is used. We properly extract the load waveforms similar to that of the targeted house from the other communities for assembling the database of JIT Modeling. Some numerical examples, which demonstrate the effectiveness of the proposed method, will be reported.

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| **Session** | Posters |
| **Date** | 18/12/2018 |
| **Time** | 16:00 - 18:00 |
| **Room** | Riverside |

IEEM18-P-0020
**Managing Outsourced Logistics Service Projects as Complex Networked Resources**
Fahad AWALEH[1], Per ENGELSETH[2]
[1]*University College of Southeast Norway, Norway*
[2]*Molde University College, Norway*
A single case study of outsourced project-organized logistics services reveals particularities of managing this form of logistics operations. Focusing on features of business relationships, interaction strategy, value creation, and the interplay between these factors, organizing project management of outsourced logistics services is considered to enhance market capability. Complexity is found through the case at two levels, the supply chain structure changing albeit at a slower pace than service processes. Service management therefore supports value creation at the project's process level while also dealing with changing constraints at the project network level as a contextual factor. Furthermore, business relationships transcend the individual project organization; a third layer of investigation. This provides an analytical framework for studying strategic management of outsourced logistics services.

IEEM18-P-0094
**Location Analysis of Regional Disaster Relief Material Reserve Center: A Case Study in Sichuan Province, China**
Xuedong LIANG, Ruyun ZHANG, Canmian LIU
*Sichuan University, China*
The disaster relief material reserve center is an important strategy to deal with natural disasters. Aiming at its location problem, this paper first constructs a site selection decision evaluation system from five aspects: nature, transportation, infrastructure, social benefits and economy. Secondly, the fuzzy matter element analysis and gray TOPSIS (Technique for order preference by similarity to ideal solution) method are used to construct the disaster relief material reserve center location measurement model. Finally, an empirical analysis is carried out in Sichuan Province. The results show that the Sichuan-Central region is the best place to build a disaster relief material reserve center in Sichuan Province. This model can not only effectively locate the disaster relief reserve center, but also provide a new idea for solving the problem of multi-dimensional influencing factors.

IEEM18-P-0099
**Hospital Capacity Planning for Special Economic Zone in Thailand: A Case Study in Kanchanaburi Province**
Sao Theary AN, D. KRITCHANCHAI
*Mahidol University, Thailand*
Increasing the employment demand in a particular region has an impact on the healthcare system due to types of occupational diseases/injuries and number of workers. Kanchanaburi Province, Thailand, is one of target areas to launch special economic zone (SEZ), which will cause dramatic population growth. Thus the aim of this research is to propose hospital capacity planning in Kanchanaburi taking into account the upcoming SEZ. This study employs a two-stage approach for data collection and validation. Firstly, interview and focus group is used to gather all related healthcare logistic issues. Then hospital's capacity is forecasted based on target health provider-to-population ratios. The results show that current healthcare services in Kanchanaburi will not be sufficient to support the projected population.

IEEM18-P-0188
**Optimizing (r, Q) Decisions Considering Misplaced Items: Lost-sales and Backorder Cases**
Linda L. ZHANG[1], G. Yazgi TUTUNCU[2], Ceki FRANKO[2]
[1]*IESEG School of Management, France*
[2]*Izmir University of Economics, Turkey*
Most available (r, Q) inventory models assume that the actual inventory records are the same as these in the computer systems. With this unrealistic assumption, these models may, thus, distort the inventory decision making in practice. In this study, we develop new (r, Q) models considering the misplaced items to provide inventory managers with realistic decision-making support. In developing the new models, we characterize two cases: backorders and lost-sales. In both cases, we consider stochastic demand and introduce parameters to represent misplaced items. We also propose solution algorithms for model solving. Numerical examples are conducted to demonstrate the applicability and potential of the new (r, Q) models and solution algorithms in making realistic inventory decisions. We further obtain managerial implications.

IEEM18-P-0003
**An Integrated Scheduling Strategy in Dynamic Scheduling of Manufacturing Execution System**
Hui DU[1], Dacheng LIU[1], Chuanshen WANG[2]
[1]*Tsinghua University, China*
[2]*Zaozhuang University, China*
Currently, manufacturing execution systems (MES) are widely used in industries. Since the manufacturing execution systems is a dynamic process that comprises of production plans, machines, and resources, a scheduling strategy of great significance for rapid respond to both orders and shop floor processing variation. This paper presents developments of reactive and proactive scheduling methods on both order-oriented level and processing-oriented level. Further, an integrated scheduling strategy is devised based on the aforementioned approaches. The scheduling strategy exploits the feature of each specific strategy and complements their capabilities in order to process real-time events. The scheduling system generates a good quality schedule, which execution is performed by the triggers. A practical production case is chosen as an example to exam the proposed scheduling strategy. Results show the efficiency of the integrated scheduling strategy in production plan and real-time event processing.

IEEM18-P-0262
**Simple and Cost Effective System for Overall Equipment Efficiency Measurement**
Timo RAUTIO, Kari KUTUNIVA, Jarmo MÄKIKANGAS, Kari MÄNTYJÄRVI
*University of Oulu, Finland*
Today's business environment and intense competition drives organizations to find improved and more efficient ways to develop their production. For many manufacturers one of the key challenges is to find the bottle necks of the current production line. Overall Equipment Efficiency measurement can be used to find these, but the available solutions are usually expensive and specialized equipment. The purpose of this paper is to demonstrate how hobbyist level electronics and very cost effective solutions can successfully be used to measure Overall Equipment Efficiency. Such a system was developed and tested in a factory environment.

IEEM18-P-0411
**Solving Profit Maximization Problem in Case of the Cobb-Douglas Production Function via Weighted AG Inequality and Geometric Programming**
Vedran KOJIĆ, Zrinka LUKAČ
*University of Zagreb, Croatia (local name: Hrvatska)*
The long-run profit maximization is a standard and important problem having significant implications on a firm's competitiveness. The common approach is to consider the profit maximization problem for production function with two inputs and use calculus to solve it. However, checking the necessary and sufficient conditions in case of more than two inputs can be difficult. Geometric programming provides a way to solve that problem for any number of inputs without the use of derivatives. Hereby the results are obtained much faster and the solution procedure is more elegant then when using calculus. Liu used the technique of signomial geometric programming to solve the problem in case of the Cobb-Douglas production function with two inputs. However, he was unable to prove that the result obtained is indeed the global maximum. Therefore, in this paper we solve the problem in question by using the weighted arithmetic-geometric inequality (WAG) in case of one input and some transformations of geometric programming in case of two or more inputs and prove that the result obtained is indeed the global optimum.

IEEM18-P-0026

**Analysis of Stackelberg Leadership Model Output Behavior under the Mechanism of Expanding Market Price**

Tyrone T. LIN[1], Shu Yen HSU[1], Chiao Chen CHANG[2]
[1]*National Dong Hwa University, Taiwan*
[2]*Taipei Medical University, Taiwan*

This study explores the competitive mechanism of firms in a duopolistic market and constructs a model of duopolistic firms' optimal output and maximum profit according to the Stackelberg Leadership Model. By taking Taiwan's dairy market as an example, the paper analyzes how the leading firm, in the state of full information disclosure, makes decision analysis to determines its output strategy according to the reaction function of the follower firm. At the same time, the output strategy of the follower firm is determined according to the output strategies of the leading firm. The action of the firms has sequence, and through the dynamic cycle process to achieve the market equilibrium and to maximize the oligopolistic firm profit.

IEEM18-P-0046

**A Project Management with Allocating Advertising Budgets' Decision Analysis in Aesthetic Medicine Industry**

Hui-Tzu YEN, Tyrone T. LIN
*National Dong Hwa University, Taiwan*

This paper seeks to explore the mathematical methods of decision makers in the aesthetic medicine industry. This study uses the probability distribution model to optimize the composition of marketing campaign advertising budgets, proposes project management for optimal allocation decision analysis of advertising budgets, increases customer traffic to obtain higher operating profits, or obtains higher quality services to attract high consumers for selling high-priced medical services and products. This work presents a novel perspective for decision makers and proposes a practical and mathematical model aimed at achieving project management and industry economics with cost analysis concepts under operational research.

IEEM18-P-0086

**Research on Service Industry Network Structure based on Social Network Analysis**

Xuedong LIANG, Yangjingjing ZHANG, Yue LU, Canmian LIU
*Sichuan University, China*

The development level of service industry has gradually become an important standard to measure the degree of economic development. Accelerating the development of service industry in Sichuan province is the strategic choice to establish economic development highland of west China. Based on the statistical data of service industry in 2016, this paper regards the cities and states in Sichuan province as individuals, and takes the economic ties of the cities and states as relations. Finally, the network structure characteristics of service industry in Sichuan province are described and analyzed by using social network analysis method, which can provide reference for the rational layout of service industry structure and the sustainable and balanced development of regional service industry.

IEEM18-P-0274

**On Setting Business Goal in Corporations**

Shin-Guang CHEN
*Tungnan University/ Kaohsiung Medical University, Taiwan*

Setting business goal is a basic and important operation when running a company. Traditionally, two different perspectives are involved in such setting. On optimistic point of view, a loose business goal is usually employed by managers, who expect employees be satisfied by such tension of operations and would have good performance then. However, the employees may not respect such loose goals instead. On pessimistic point of view, a tight business goal is given by managers, who expect employees should be encouraged by such tension of operations and would have good performance then. However, the employees may be frustrated by such tight goals, and lose excitation in working. So, it is difficult to set business goal properly, and let all staffs happy. This paper proposes a novel method to set business goal in terms of the capacity of staff themselves. A numerical example is illustrated for the proposed method.

IEEM18-P-0373

**Optimal Cleaning Schedule of Photovoltaic Module**

Zhonghao WANG[1], ZhengGuo XU[2]
[1]*Zhejiang University and City University of Hong Kong, Hong Kong SAR*
[2]*Zhejiang University, China*

This paper focuses on the photovoltaic (PV) system and studies the cleaning schedule of the PV modules. An optimal cleaning schedule is proposed by dynamic optimal algorithm for the PV to maximize the profits. The algorithm jointly considers the dust change, electricity generation, cleaning cost and prediction errors. Numerical results reveal that our optimal schedule can maximize the profits online.

IEEM18-P-0570

**Text Mining-based Approach for Forecasting Spare Parts Demand of K-X Tanks**

Jaedong KIM
*Korea Institute for Defense Analyses, South Korea*

One of the critical tasks of the defense logistics is the demand forecasting of spare parts, Because low-toned accuracy can lead to substantial budget wastes, Each military used the information management system to analyze the past spare parts consumption data information and predicted the demand of each part in a time series. However, a low-toned accuracy of the demand forecasting should be improved. In our study, we gathered a large amount of spare part consumption data first and derived several features including unstructured textual data to utilize them in the discrimination of fastidious patterns in the spare part consumption data. Our approach shows improved performance in demand forecasting with higher quantitative accuracy. The result shows better prediction accuracy than the existing time series.

IEEM18-P-0576

**Minimization of Critical Infrastructure Accident Losses of Chemical Releases Impacted by Climate-Weather Change**

Magda BOGALECKA, Krzysztof KOŁOWROCKI
*Gdynia Maritime University, Poland*

The procedure based on the results of general model of critical infrastructure accident consequences and linear programming are applied to optimization of environment losses associated with chemical spill generated by ship critical infrastructure network operating at the Baltic Sea waters impacted by climate-weather change process. The optimal values of limit transient probabilities at particular states of the process of environment degradation that minimize the expected value of total environment losses for the fixed time interval are found.

IEEM18-P-0195

**Multi-scale Configuration Design Method of Reconfigurable Manufacturing System Based on Living System Theory**

Sihan HUANG, Guoxin WANG, Siming WANG, Cong ZENG, Hongwei WANG, Yan YAN
*Beijing Institute of Technology, China*

For the problem that how to design the configuration of Reconfigurable Manufacturing System(RMS) with high efficiency during the RMS reconfiguration period, a configuration design method based on Living System Theory (LST) is proposed. Firstly, a multi-scale configuration design model of RMS is constructed, which analyzes the RMS configuration design process from the scale of manufacturing system, manufacturing cell and machine tool deeply. Secondly, the LST is used to decompose and represent the RMS multi-scale configuration design model, and a universal RMS multi-scale configuration design model is built based on the 20-critical subsystem of LST. During RMS configuration design process, the universal design model is reused, through the operations of adding, deleting or replacing, to deal with the order fluctuation and improve RMS reconfigure efficiency. Finally, a case is studied to elaborate the implementation of the presented method and validate the effectiveness and practicability.

IEEM18-P-0279

**Selective Maintenance Decision for Multistate Manufacturing System Based on Extended State Task Network**

Zhaoxiang CHEN, Yihai HE, Yixiao ZHAO, Xiao HAN, Zheng HE
*Beihang University, China*

In actual production, the best maintenance operations of multistate manufacturing system cannot be implemented at intervals due to the limitation of maintenance costs. In this case, selective maintenance decisions are widely adopted. However, previous selective maintenance decisions only consider the basic reliability, which cannot fully describe the operating characteristics of multistate manufacturing system. Therefore, this paper proposes a selective maintenance decision with the goal of maximizing the mission reliability for multistate manufacturing system. Firstly, the new connotation of selective maintenance is defined to characterize the ability of a multistate manufacturing system to meet the variable task demand state. Secondly, the Extended State Task Network is proposed to characterize the operating characteristics of manufacturing system and the mission reliability model. Thirdly, under the condition of fixed maintenance cost, a selective maintenance decision method based on Particle Swarm Optimization algorithm is derived, which makes the mission reliability of next operation to be maximized. Finally, in order to verify the effectiveness of the proposed method, a case study of selective maintenance decision for a multistate cylinder head manufacturing system is given.

IEEM18-P-0296

**Introducing a Holistic Profitability Model for Additive Manufacturing: An Analysis of Laser-powder Bed Fusion**

Frank Thomas PILLER[1], Reinhart POPRAWE[2], Johannes Henrich SCHLEIFENBAUM[2], Günther SCHUH[1], Sebastian BARG[1], Christian DÖLLE[1], Christian HINKE[1], Merle-Hendrikje JANK[1], Ruth JIANG[1], Wilhelm MEINERS[2], Michael RIESENER[1], Johannes SCHRAGE[1], Stephan ZIEGLER[1]
[1]*RWTH Aachen University, Germany*
[2]*Fraunhofer Institute for Laser Technology ILT, Germany*

Nowadays, a highly volatile environment and the growing demand for customized products challenge manufacturing companies. Radically new technologies, such as Additive Manufacturing (AM) and Laser-Powder Bed Fusion (L-PBF), help companies to fulfill these needs. However, due to the novelty of these technologies, research on how to evaluate the inherent changes of Laser-Powder Bed Fusion compared to conventional manufacturing processes remains scarce. Current studies focus on either process or product innovations, not considering their respective interactions. This paper aims at developing an integrative profitability model for a holistic assessment of Laser-Powder Bed Fusion, including implications for the product architecture and customer revenue.

IEEM18-P-0375

**The Layout Optimization Problem of Automobile Engine Production Line**

Hang LI, Ran LIU, Lun SHI
*Shanghai Jiao Tong University, China*

In this paper, the layout optimization problem of an automobile engine production line is studied. First, a mixed integer programming model of the production line layout optimization problem is established. Next, the solution of production line layout is obtained by using a Variable Neighborhood Search (VNS) algorithm. Then, based on the production line layout solution obtained above, the simulation model of the production line system is established and the solution is analyzed by simulation.

IEEM18-P-0428

**Applying the Axiomatic Design with Design Constraint to Redesign of Automatic Work-piece Changer**

Tossaporn ASSAWARUNGSRI, Nattawut JANTHONG
*King Mongkut's University of Technology North Bangkok, Thailand*

This paper is aimed to propose a design of the Automatic Workpiece Changer (AWC), which will be redesigned from the existing one to reduce the time on design processes. To redesign AWC, Axiomatic design and design constraints are applied. The process composes of 2 phases, i.e., first to decompose the existing design and to represent the Design Matrix (DM) of the product and second to convert the DM to Design Structure Matrix (DSM). The first phase output is the multiple layers of DSM. Then the new task is clarified and the design constraints are considered with the design solution. Lastly, it is step of identifying the future change in the second phase. The process will help the designer to analyze the elements that affect the change, which helps him determine the propriety of the design in the economic aspect. Finally, the result of the study is the future change of AWC which can be modified to suit modules.

IEEM18-P-0143

**Research of Foreign Trade Equipment Preventive Maintenance Decision Scheme based on User Capability**

Weikang XUE, Weiwei CUI, Xiao HU, Xiaodong MA, Yao WANG
*China Academy of Launch Vehicle Technology, China*

Equipment maintenance support is a very importance and efficient method, which can maintain, restore and improve the force of Equipment. Maintenance decision scheme is the structural framework of maintenance support system, as a guiding document, which involves in maintenance resources, inventory, task, management of equipment system. This paper aimed at the preventative maintenance capability constraints of the users, this paper constructs a mathematical model to solve for a set of preventative maintenance decision scheme that lowers maintenance costs while maintaining the task sustainability probability of foreign trade Equipment. An application case is carried out for robustness check of this method.

IEEM18-P-0147

**Research on Fault Diagnosis of Rolling Bearing Based on Wavelet Packet Transform and IPSO-SVM**

Yingxiang ZHONG[1], Fan HONG-LI[1], Jiping LU[1], Lu PANG[1], Yuanfang LI[2]
[1]*Beijing Institute of Technology, China*
[2]*China Academy of Launch Vehicle Technology, China*

For the difficulties of feature extraction of fault signals of rolling bearing and the limitation of structural parameter optimization of support vector machine(SVM), this paper proposes a method of fault feature extraction and classification based on wavelet packet transform and improved particle swarm optimization(IPSO) support vector machine. First, the feature is extracted using wavelet packet transform, and the sample entropy value of each band obtained by decomposition is used as the feature vector. Secondly, the IPSO algorithm is used to optimize the tow structural parameters of SVM, penalty and Gaussian kernel coefficients. Finally, a fault classification model for rolling bearing is established. Results showed that the fault diagnosis classification model based on wavelet packet transform and IPSO-SVM has higher accuracy.

IEEM18-P-0162

**Reliability and Efficiency Optimization Assisted by Genetic Algorithm to Design a Quadratic Boost DC/DC Converter**

Giuseppe MARSALA, Antonella RAGUSA
*National Research Council of Italy, Italy*

In the last decades, the increasing use of the power electronic devices in space and military applications has led to the reliability analysis of DC-DC power converters. In this paper the design of a quadratic DC-DC converter has been performed in order to improve both reliability and efficiency. The design is performed by the minimization of objective functions using the GA heuristic algorithm, in order to identify the optimum values of the converter parameters that ensure the desired reliability. A complete reliability analysis of the quadratic converter has been done and the proposed design methodology has been demonstrated by simulation.

IEEM18-P-0179

**Degradation Modeling and Performance Monitoring of Electro-optical Detection System via Dynamic Bayesian Network**

Jinsong YU, Yiyu SHI, Diyin TANG, Hao LIU
*Beihang University, China*

This paper proposes a degradation modeling approach for Electro-Optical detection system based on dynamic Bayesian network. Modulation Transfer Function (MTF) is firstly used in each subsystem for degradation description from the perspective of energy domain, which helps the whole degradation modeling keep away from complicated description of interactions between subsystems. To enable uncertainty and time-variant description of degradation process, a dynamic Bayesian network (DBN)

constructed from MTF model is developed. Considering that parameters in DBN cannot be full recognized, Gaussian particle filtering (GPF) is applied with kernel smoothing as inference, combined with which DBN is capable of self-learning unknown model parameters based on observation data and tracking the dynamic degradation process of time-dependent variables. A case study based on simulation data is presented to show the effectiveness of the proposed method in degradation modeling and performance monitoring for Electro-Optical detection systems.

IEEM18-P-0213

**Time-dependent Reliability Modelling Method Based on Load-strength Model in the Presence of Environmental Effects**

Jian-Chun ZHANG, Yu ZHAO, Xiao-Bing MA
*Beihang University, China*

The structural performance and reliability can be affected by the strength degradation and significant repetitive load events whose occurrence rate may be different in different environments. Furthermore, in the case of the environment affecting load and strength simultaneously, the correlation analysis between load and strength should be considered. Therefore, this paper deals with the time-dependent reliability modelling problem based on the load-strength model, which incorporates the actual environmental effects into the reliability estimation in two ways: 1) the occurrence rate of the load affected by the actual environment; 2) the variable correlation between load and strength. A numerical example is given to illustrate the necessity of the environmental analysis for the time-dependent reliability modelling.

IEEM18-P-0255

**Maintenance Planning Key Process Area: Case Study at Oil & Gas Industry in Indonesia**

Rahmat NURCAHYO, Dedy DARMAWAN, Yadrifil JANNIS, Ary KURNIATI, Muhammad HABIBURRAHMAN
*Universitas Indonesia, Indonesia*

Maintenance planning contributes positively in effective maintenance activity. This research summarized 89 Key Process Area (KPA) related to maintenance planning from seven main previous research in maintenance management. Delphi method was used to identify 12 main KPA. Analytical Hierarchy Process (AHP) method was used to determine priority of each KPA. The higher value of KPA means higher criticality and contribution to successful maintenance planning. This research concluded the priority of KPA from the most critical to the less critical are shut down planning, work pack planning, job forecast and schedule, material management, e-maintenance, communication and coordination, measurement and control, preventive maintenance job plan, maintenance organization, maintenance method, maintenance budget and outsourcing.

IEEM18-P-0392

**A Multi-objective Framework for Designing Accelerated Degradation Tests Under Wiener Process Model**

Han WANG, Yu ZHAO, Xiao-Bing MA
*Beihang University, China*

In this paper, a novel multi-objective framework for designing accelerated degradation tests (ADTs) is developed under Wiener process model. The framework aims at providing aids to balance prediction accuracy and mechanism equivalence of a specific ADT. To achieve this, a new optimization criterion, named as the MV-optimization criterion, is firstly proposed by using the maximum likelihood theory. Then, under the cost constraint, a nonlinear optimization problem is constructed. Finally, a comparison is carried out between our multi-objective optimal plan and other traditional single-objective plans through the case of electrical connector. Results show that the MV-optimization plan has better properties from the perspective of improving the rationality of prediction and the robustness of test plans.

IEEM18-P-0501

**Cold-standby Redundancy Optimization for Multi-type Production Systems Using NSGA-II**

Wei WANG, Yaofeng XU, Jiqing WEI, Wei QU
*Northwest Institute of Mechanical and Electrical Engineering, China*

This paper develops a new model for investigating cold-standby redundancy allocation problem (RAP) of a multi-type production system. The system consists of several independent linearly ordered subsystems which undertaking different tasks. The system can process different types of production. Each type of production requires a unique manufacturing line: required subsystems should be turned on, while others powered off. A binary matrix is used to describe the structure of multi-type production system. Cold-standby redundancy on subsystems is considered for achieving higher reliabilities of the different manufacturing lines. The RAP for the multi-type production system is essentially multi-objective subject to resource constraints. The paper formulates the multi-objective problem and solves it by using a well-known algorithm called NSGA-II. Finally, illustrative examples are presented.

IEEM18-P-0136

**Emerging Simulation and VR for Green Innovations: A Case Study on Promoting a Zero-carbon Emission Platform in Hong Kong**

Cheuk Hang AU[1], Wai Ki YIU[2], Walter S. L. FUNG[2]
[1]*The University of Sydney, Australia*
[2]*The Hong Kong Polytechnic University, Hong Kong SAR*

Researchers are interested in applying different technologies for social innovations. Previous articles that discussed the potential role of different tasks in social and green innovation context are commonly seen. However, there are limited articles on establishing process models for technological application in the social and green innovation context. The lack of a proper process may hinder the benefits of these applications to the general public. To address the said gap for guiding the practitioners, we have chosen a case of applying VR and simulation for promoting a green deck project in Hong Kong. With references to our findings, we have established a 4-step process model for applying simulation and VR for green innovations, including planning, modelling, verifying and application.

IEEM18-P-0182

**Simulation Analysis on Energy Consumption of Multi-shuttle Automated Storage and Retrieval Systems**

Peng YANG, Wenjun XU, Shilu WANG
*Tsinghua University, China*

Multi-shuttle automated storage/retrieval systems (AS/RSs) as a high efficiency warehouse solution are applied more and more widely in the logistics industrial. Automated warehouse brings high efficiency and it also will need a lot of energy consumption. Therefore the energy consumption optimization research for multi-shuttle AS/RSs is of great significance. Based on the analysis of velocity characteristics and travel time model of multi-shuttle automated storage/retrieval systems, we make force analysis of the stacking machine and develop the energy consumption model. Through various numerical simulation experiments, we validate the model and make the sensitivity analysis considering the factors of velocity scene, number of shuttle and warehouse shape. This paper puts forward the effective and practical guidelines of reducing energy consumption in multi-shuttle automated storage/retrieval systems from the perspective of warehouse planning, operation and equipment setting.

IEEM18-P-0253

**A Study on Designing Off-grid System Using HOMER Pro - A Case Study**

Sungjun JIN[1], Hyoungtae KIM[2], Tae Hyun KIM[2], Hansol SHIN[2], Kyuhyeong KWAG[2], Wook KIM[2]
[1]*Korea Land & Housing Corporation, South Korea*
[2]*Pusan National University, South Korea*

Nowadays, grid parity has been achieved in some of countries. In accordance, the most of countries make efforts to reduce carbon emission by expanding renewable energy to the system. For example, in South Korea, they have initiated Energy Independent Island project, which pursues no fossil fuel usage to supply electricity demand in remote island. However, it needs proper economic assessment process even though renewable energy price keeps decreasing. In this paper, we model 3 arbitrary power systems by referring system data of remote islands of South Korea and perform optimization simulation using HOMER Pro to follow economic assessment process.

IEEM18-P-0275

**Integrated Cyber Physical Simulation Modelling Environment for Manufacturing 4.0**

Weidong LIN, Y.H. LOW, Y.T. CHONG, C.L. TEO
*Singapore Institute of Technology, Singapore*

This paper studied the recent development and applications of cyber physical system into manufacturing industry. It is observed in literature some models of system design and system development for Industry 4.0 but few were found specifically for manufacturing systems modelling and simulation. This paper proposed a novel system framework of Integrated Cyber Physical Simulation Modelling Environment for Manufacturing 4.0, which incorporated an architecture integrating Aggregate Cyber Space Controller (ACSC) with Physical Space Distributed Controller (PSDC). The concepts of digital twin, distributed artificial intelligence, machine learning, and distributed autonomous control are deployed in the framework with the intention to explore the future potential applications of systems modelling and simulation for manufacturing Industry 4.0 systems. The framework proposed is an extension of Cyber Physical Production System (CPPS) and provides a scenario of hybrid cyber space simulation and physical space discrete controller for manufacturing 4.0.

IEEM18-P-0442

**Multi-objective Design Space Exploration for the Integration of Advanced Analytics in Cyber-physical Production Systems**

Romuald Jupiter BAKAKEU NGASSAM[1], Jonathan FUCHS[1], Tallal JAVIED[1], Matthias BROSSOG[1], Jorg FRANKE[1], Hans-Henning KLOS[2], Werner EBERLEIN[2], Schirin TOLKSDORF[2], Joern PESHKE[2], Lars JAHN[2]
[1]*Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Germany*
[2]*Siemens AG, Germany*

The integration of advanced data analytics in manufacturing systems has shown impressive results in various fields, including fault diagnosis, predictive maintenance, energy management, and manufacturing system control. However, due to the distributed nature of analytics algorithms and the growing complexity of modern production systems, the performance and the cost of such systems highly depends on the underlying system architecture. Therefore, it is mandatory that system architects systematically explore and evaluate all architectural alternatives of the highly constrained design space defined by the systems functional and economical objectives. This paper presents a design-space-exploration method that not only generates different implementation alternatives, but also provides a formal performance analysis of the generated solutions. By analyzing the architecture of a manufacturing system as well as the data flow graph model of a data analytics algorithm, we automatically allocate, synthesize, and generate different simulatable software solutions to efficiently compute and visualize data analytics algorithms on the shop floor. This approach allows the user to evaluate different architectural implementation during the design phase, to select a solution according to its requirements and to analyze the performance of the resulting system. The applicability of this method is also demonstrated by means of a real world example.

IEEM18-P-0486

**Building Energy Conservation Strategies Evaluation and Simulation**

B-I WANG, Chien Ming LO, Min-Der LIN
*National Chung Hsing University, Taiwan*

From the view of life cycle, the energy consumption and CO2 emission of office buildings are found to mainly occur during the operation and maintenance stages and can be up to 80%. Furthermore, building design factors such as orientation, window glass types, window to wall ratio, building envelope insulation, sunshade device, air conditioner temperature, and illumination control all have significant impacts on the energy consumption of the office buildings. Therefore, the objective of this study is to investigate the efficacy of energy conservation strategies for office buildings in Taiwan. An existing office building in Taichung is used as a case study and energy conservation strategies are simulated and evaluated by EnergyPlus model. It is found that the building investigated in this study can save up to 20% annual energy consumption by implementing suitable energy conservation strategies into the existing system.

IEEM18-P-0492

**Analysis and Optimization of Bottlenecks via Simulation**

Ji'ao YUAN, Runtong ZHANG
*Beijing Jiaotong University, China*

Manufacturing enterprises in China always have a price advantage of raw material and labor force. Optimization methods are currently widely used in manufacturing system to improve the performance of their production lines and workshops. To maximum the optimization effects, simulation is increasingly applied to the optimization of manufacturing industry. Flexsim can be a useful tool to cope with this optimization made up of several highly discrete events. This article is based on the manufacturing system of company JKL's cooler. First, this paper introduces and analyzes the company's manufacturing condition including process flow and its problems in production. Second, the model will be simulated in order to find the weakness and constraints of this system. Third, we introduce a method to identify bottlenecks and offer a framework to solve bottleneck problems. Then, a model based on the statistics and processes is built. In the final section, the results are evaluated and analyzed. The simulation results show that quantity of the products and efficiency of the machines are evidently improved after optimization, which proves that the optimization is effective.

IEEM18-P-0555

**Community Detection and Growth Potential Prediction Using the Stochastic Block Model and the Long Short-term Memory from Patent Citation Networks**

Kensei NAKAI[1], Hirofumi NONAKA[1], Asahi HENTONA[1], Yuki KANAI[1], Takeshi SAKUMOTO[1], Shotaro KATAOKA[1], Elisa Claire ALEMÁN CARREÓN[1], Toru HIRAOKA[2]
[1]*Nagaoka University of Technology, Japan*
[2]*University of Nagasaki, Japan*

Scoring patent documents is very useful for technology management. However, conventional methods are based on static models and, thus, do not reflect the growth potential of the technology cluster of the patent. Because even if the cluster of a patent has no hope of growing, we recognize the patent is important if PageRank or other ranking score is high. Therefore, there arises a necessity of developing citation network clustering and prediction of future citations. In our research, clustering of patent citation networks by Stochastic Block Model was done with the aim of enabling corporate managers and investors to evaluate the scale and life cycle of technology. As a result, we confirmed nested SBM is appropriate for graph clustering of patent citation networks. Also, a high MAPE value was obtained and the direction accuracy achieved a value greater than 50% when predicting growth potential for each cluster by using LSTM.

IEEM18-P-0259

**Integrating Hierarchical Task Analysis into Model-Based System Design using Airbus XHTA and IBM Rational Rhapsody**

Jakob ROTT[1], Julian WEIXLER[1], Alexander RABL[2], Peter SANDL[2], Mario WEIß[1], Birgit VOGEL-HEUSER[1]
[1]*Technical University of Munich, Germany*
[2]*Airbus Defence & Space, Germany*

Current tools for Hierarchical Task Analysis (HTA) were designed to meet the special needs of psychologists or ergonomists, and therefore typically lack the capability to interchange data with modelling or engineering tools. As a consequence, essential information on tasks, operational processes and procedures is segregated from the development process, with the inherent risk that it is not fully taken into account. However, particularly in safety-critical systems, optimized human machine interfaces are essential to ensure safe operations, and may be decisive to guarantee a timely response. In this paper, we present our approach to bridge the gap through integrating task analysis results in a SysML model. For this, the possibility to translate a full HTA into corresponding SysML elements was investigated, and a converter tool was implemented. The converter's output is an XML-file following the OMG XMI standard containing the HTA in SysML, which is compatible with the IBM Rational Rhapsody importing interface. Integrating the HTA results in a system modeling tool offers important additional knowledge for utilization in the subsequent System Engineering process.

IEEM18-P-0448

**Comparison of Clustering Methods for Obesity Classification**

Sung Hee AHN, Cai WANG, Gee Won SHIN, Donggun PARK, Yohan KANG, Jaramier JOIBI, Myung Hwan YUN
*Seoul National University, South Korea*

Body mass index (BMI) is mostly used as a reference through its indirect measure of fat mass and can be used conveniently. Despite such reference and convenience, in accordance to previous studies done, there exist a poor degree of agreement in obesity classification when it comes to BMI and the percent body fat that was found. Together with the utility of such obesity classification which refers to predefined cut-off values of BMI was seen as controversial. This study aims to discover a new method to classify obesity by using artificial intelligence (AI) techniques and statistical methods for obesity classification with minimum number of body dimensions required for input. The performance of methods used undergo comparison in terms of accuracy and interpretability. Results have shown that fuzzy rule-based system (FRBS) to be the most appropriate method amongst the rest. FRBS showed a performance of accuracy similar to other AI algorithms and discriminant analysis (DA), also showing a more stable and consistent provision of classification rules compared to the others. Concurrently, this study is suggesting the FRBS method as an obesity classification method.

IEEM18-P-0305

**Hotel Cancellation Strategies Under Online Advanced Booking**

YIfan HE, Pingping WEN, Yongquan LAN, Zhaowei MIAO
*Xiamen University, China*

We segment heterogeneous customers that are different with each other in arriving probability into two types and study possible pricing strategies together with two types of booking cancellation policies, deadline cancellation and refund cancellation. We find that if hotel is risk neutral, the two types of cancellation contracts are the same as each other. However, for a risk-averse hotel, booking contract with refund cancellation policy is better than that with deadline cancellation policy whereas for a risk-seeking hotel, booking contract with deadline cancellation policy is better.

IEEM18-P-0444

**Agile Project Management: Successful Solutions**

ALBERTO POLZONETTI[1], Matteo SAGRATELLA[2]
[1]*ELIOS, Italy*
[2]*elios, Italy*

Traditional project management is task-driven and predictive; in other words, it assumes that circumstances affecting the project are predictable. Agile project management, on the other hand, operates well in a more fluid, more adaptive environment. Agile project management is a highly iterative and incremental process in which constant communication between the customer (end user) and the project team, which includes functions of project management and business analysis, is an inherent and critical element to success. This paper highlights an approach for adopting the agile project management frame- work, identifies key challenges to implementing agile approaches, and showcases the roles of project management and business analysis in that context

IEEM18-P-0503

**Building Material Price Forecasting Based on Multi-method in China**

Qiankun WANG [1], Tingting MEI[1], Zeng GUO[1], Lingwei KONG[2]
[1]*Wuhan University of Technology, China*
[2]*Hubei Province Engineering Consulting Co. Ltd., China*

As building material price is highly correlative to project cost, various method are utilized for price prediction. However, their accuracies and ranges of application are still in question. To increase the prediction reliability, this paper proposes a multi-method-based way and use it to predict the main building material price in Wuhan, China. Various methods, including triple exponential smoothing, grey prediction model(GM (1,1)), grey Verhulst model, polynomial fitting method, are used separately to obtain the optimum one with minimum mean square error and its prediction result is adopted as the final prediction value. The results show that: For the common C10 commercial concrete, the relative error of optimal predicted value is 0.4%; For the common hot rolled round steels, although the overall optimal method is GM (1,1), the polynomial fitting method is most accuracy at some local time points. Therefore, the results fully demonstrate the effectiveness and rationality of multi-method.

IEEM18-P-0601

**Collaborative Innovation Using Bi-processes Cross-functional Team on New Product Development**

Yueen LI[1], Jiacheng ZHANG[1], Haiyan ZHANG[2]
[1]*Shandong Jianzhu University, China*
[2]*Purdue University, United States*

Based on the traditional FFE theory, the new product innovation is used on product market decision and online analysis. Design innovation method proposed in this paper adopts the cross-method of the secondary function group to design innovation, and effectively supplements through different design information transmission processes. The new cooperative innovation model was used to develop and design the Mars Rover, and the concept of the Mars Rover is given.

IEEM18-P-0203

**Detecting Technological Recombination for Potential R&D Exploration**

Xiao ZHOU[1], Lu HUANG[2]
[1]*Xidian University, China*
[2]*Beijing institute of Technology, China*

In recent years, the research of detecting promising technological recombinative groups has been received an increasing attention. Such detection at a pre-recombination stage offers great potential value to R&D managers. In this paper, the patent network analysis-based methodology is proposed to extract technical intelligence for detecting technological recombination. Firstly, a conceptual model is specifically constructed for a target technical field, which helps to refine a reasonable search strategy and then despict the subsysmems. Then a community detection method, including an index system with network topology indicators, is proposed. In conjunction with the conceptual model, the potential technological recombination groups have been detected. Finally, an empirical study on China's artificial intelligence technologies is conducted to verify this process.

IEEM18-P-0323

**Strategy Transformation Through Cultural Tradition Innovation – A Case Study of Fenjiu Group of China Time-honored Brand**

Haibing LIU[1], Qingrui XU[1], Lihua WANG[1], Wenjing FENG[2], Li LIU[3]
[1]*Zhejiang University, China*
[2]*Xinghuacun Fenjiu Group, China*
[3]*Zhejiang Guangsha College, China*

This paper sums up the theoretical logic of cultu-ral tradition activated in China Time-honored Brand (CTHB), and constructs a SRIC loop based on strategy, resources, innovation and capability in order to explain the function mechanism of the cultural tradition innovation. Ac-cording to this research framework, it makes an exploratory case study of Shanxi Xinghua Cun Fenjiu Group(Fenjiu). The research conclusion shows: Resource Activated View (RAV) can describe the process of rebirth of Fenjiu, and a SRIC loop exists in every stage of strategic development illu-strating the relation between strategy transformation and cultural tradition innovation. The theoretical contribution of this paper is: putting forward the RAV, and the concept and process of cultural tradition innovation, and trying to con-struct the core of cultural tradition in CTHB.

IEEM18-P-0470

**Study on Incentive Mechanism of Knowledge Sharing in Supply Chain Based on Evolutionary Game Theory**

Qiankun WANG , Shi QIAO
*Wuhan University of Technology, China*

Lack of knowledge sharing is the main reason for the poor performance of supply chain management. The purpose of this study is to promote knowledge sharing between on enterprises in the supply chain. Based on the evolutionary game theory, the basic game model of knowledge sharing and the game model of incentive mechanism are established. Through analysis, after introducing incentive mechanism the evolution rule of strategic choice of enterprises is revealed. The results show that the introduction of incentive mechanism significantly improves the probability of knowledge sharing between on enterprises in the supply chain, and

the minimum incentive intensity is obtained which make the enterprises to select the sharing knowledge strategy.

IEEM18-P-0568
**An Example of Machine Learning Applied in Additive Manufacturing**
Amelina DOUARD, Christelle GRANDVALLET, Franck POURROY, Frédéric VIGNAT
*University of Grenoble Alps, France*
Artificial Intelligence has become ubiquitous in many application sectors nowadays. One field, machine learning, has proved to be promising for industries as it can solve complex problems thanks to various methods and algorithms. The present article is an example of machine learning with EBM, a recent additive manufacturing technology. Several algorithms are tested onto the manufacturing of a part in order to check which results can extrapolate at the best the deformation risks vs the quality of the part to build. In this example, a few parameters of support structures are identified and are varied to observe the algorithms validity.

IEEM18-P-0483
**Systems Analysis and Design of a Smart Traffic Service System for Predictive and Smarter Mobility and Safety in Roadway Work Zones**
Roger J. JIAO, James Y. TSUI
*Georgia Institute of Technology, United States*
Smart traffic service systems entail intelligent traffic analysis applications that enable highly functioning relationships between a range of users, including service consumers and service producers. This review paper envisions a systems architecture to empower a connected vehicle-to-X environment by integrating smart sensing and crowdsourcing technologies, large-scale cloud data analytics and computation, and predictive decision making and optimization into a coherent socio-technical configuration of people, operations and information through multimodal, real-time traffic monitoring, planning and control. Key technical challenges and research issues are discussed with respect to an illustrative case of roadway work zones.

IEEM18-P-0484
**Operating Data-driven Predictive Analytics for Tele-diagnosis of Refrigeration Systems: A Case Study**
Tianyi LU[1], Jun DU[2], Roger J. JIAO[1]
[1]*Georgia Institute of Technology, United States*
[2]*Tianjin University, China*
This paper reports a case study of applying big data analytics to tackling the problems associated with malfunctioning refrigeration systems, along with monitoring and reporting on energy use and customer experience. Predicative analytics is applied to the case of a refrigeration service provider who manufactures and maintains refrigeration control equipment for the supermarket retailers. A tele-diagnosis system is developed to provide real time support so as to facilitate the technicians on site to identify and diagnose faulty refrigeration equipment. The system exploits an iPro controller technology to collect data from refrigeration operations and communicate to cloud server for analysis.

IEEM18-P-0512
**A Serious Game for Competence Development in Internet of Things and Knowledge Sharing**
Ugyen NIMA[1], Jannicke Baalsrud HAUGE[2], Rinzin WANGDI[1]
[1]*College of Science and Technology, Bhutan*
[2]*Universität Bremen, Germany*
Internet of Things provides an ability to interact with, share the data, and expand the capabilities of the physical world in terms of computation, communication, and key control with humans through many new modalities devices in the connected network. Though the availability of the information and performance are higher at lower cost, the usage of such system becomes more complex with the advancement of technologies. The traditional ways like lecture-based and role-playing learning has developed one-sided learning and also expensive for the low-income people to acquire such knowledge. On the other hand, serious gaming has helped the users in acquiring new experiences and complex knowledge which are acquired through solving presented challenges whereby the user applies competency to solve these problems. This paper proposes serious gaming as a learning environment for gaining competence, knowledge, and experiences in IoT and knowledge sharing for the users. Moreover, the design of a serious game, effectiveness of ATMSG framework and evaluation results are also discussed.

IEEM18-P-0015
**Critical Assessment on Dangerous Goods Storage Container Yard of Port: Case Study of LPG Tank Container**
Guanquan CHU, Guangyu LYU
*China Waterborne Transport Research Institute, China*
The dangerous goods must be stored at a specific position, namely dangerous goods storage container yard of port in China. Multi-class dangerous cargo containers are stored in a storage yard, which also leads to risk overlay. Once some risk factors are uncontrolled, some accidents such as fire, explosion, leak, poisoning, etc will occur and result in group death and massive property damage. A case study is presented to evaluate critical storage of dangerous goods storage container yard of port. The event-tree technique is employed to construct and analyze probable accident scenarios based on accident prevention measures. The individual risk of a LPG tank container is calculated to pre-determinate critical storage number of LPG tank container. When individual risk and social risk of critical LPG tank containers conform to acceptable risk criteria, the initial pre-determinate number can be identified as the critical storage. To demonstrate the approach, a case study is discussed to evaluate the critical storage of dangerous goods storage container.

IEEM18-P-0499
**Critical Infrastructure Safety Indicators**
Krzysztof KOLOWROCKI, Joanna SOSZYNSKA-BUDNY
*Gdynia Maritime University, Poland*
Modelling safety of critical infrastructure (CI) free of outside impacts is presented. Safety indicators for this CI are defined and procedures of determination there model are proposed. Next, as an exemplary application, the safety of oil piping transportation system free of any outside impacts is examined. Considering this system assets' safety data received from experts, its safety is modelled, identified and predicted.

IEEM18-P-0500
**Critical Infrastructure Impacted by Operation Safety and Resilience Indicators**
Joanna SOSZYNSKA-BUDNY, Krzysztof KOLOWROCKI
*Gdynia Maritime University, Poland*
Modelling of operation process (OP) influence on safety of a critical infrastructure (CI) is presented. Particular model of safety of this CI impacted by its inside subsystems and assets dependences and by its external threats occurring in its environment of operation is created. CI safety and resilience indicators are defined and their determination procedures are proposed. Next, this model is adopted to the system composed of pipes that are used for oil transportation and which are influenced by OP. Both safety as well as resilience analysis is performed.

IEEM18-P-0210
**Inequality Structure of Global Investment: Analysis and Simulation of an M&A Network**
Kimitaka ASATANI, Hiroko YAMANO, Masanao OCHI, Ichiro SAKATA
*The University of Tokyo, Japan*
Companies considering investments should first examine the global economic structure. Despite the
world becoming flatter every day, inequalities between countries still exist. However, any discussion about the emergence and continuation of such inequality remains controversial. In this study, we use a massive dataset of global mergers and acquisitions (M&A) to analyze the unequal capital relationship between countries. We find unilateral investment between pairs of countries that do not change over decades. To identify countries where investments or returns on investment accumulate, we simulate such accumulation by the movement of money between countries through M&A relationships. We formalize the iterative movement of investment/return capital using the PageRank algorithm. The simulation result illustrates a significant difference between countries: return on investments mostly accumulate in countries with high GDP per capita. Other countries have relatively few benefits compared to accumulating investment. Consequently, we conclude

that the M&A network structure causes accumulation of returns in specific countries and results in continuous unilateral investment from rich countries to other countries.

IEEM18-P-0258
**Using Time-dependent Attractiveness to Evaluate Dynamic Place-based Accessibility**
William H. K. LAM, Bi Yu CHEN, Agachai SUMALEE
*The Hong Kong Polytechnic University, Hong Kong SAR*
This study proposes a place-based space-time accessibility measure to capture temporal variation of place-based accessibility at different times of the day. Using the space-time utility perspective, accessibility of a location is conceptualized as space-time utility offered by a set of facilities accessible from the location. A time-dependent facility attractiveness function is introduced to represent temporal variation of individuals' needs for performing activities at a certain facility. The introduced function is formulated by two components: a time-unvarying component of individuals' satisfaction derived from activity participations at the facility, and a time-varying component of individuals' intensity for performing a certain type of activities at different times of the day. To demonstrate the applicability of proposed measures, a comprehensive case study is carried out in Wuhan, China.

IEEM18-P-0115
**Product Platform Planning through Sensitivity Analysis and Improved QFD Approach**
Lei ZHANG, Hansi CHEN, Zhenlong YUAN, Xuening CHU
*Shanghai Jiao Tong University, China*
The identification of platform parameters plays a key role to keep equilibrium between the external diversity and internal commonality. The relationship between the performance parameter and the design parameter in the traditional Quality of House (QoH) was evaluated by a correlation degree rather than an influence degree. The influence degree measures the design parameter's influence on the performance parameter, and be more effective to evaluate the performance-design relationship. Hence, based on virtual orthogonal experiment, a method incorporated sensitivity analysis into the improved Quality Function Deployment (QFD) is proposed. Firstly, the virtual experiment scheme is designed through the orthogonal experiment table. Secondly, a virtual experiment environment is built by the built-in software, in which the design parameters are assigned with different values and the corresponding performances are monitored in real-time. Then the sensitivity matrix for design parameter is constructed to replace the correlation matrix in the QoH. Thereafter, the improved QFD can be used to identify the platform parameters. A case study for the smartphone of Samsung Galaxy A series is implemented to verify the effectiveness of the proposed method.

IEEM18-P-0166
**Performance Assessment of Product Modules Based on Usage Data Collected Through Embedded Sensors**
Hansi CHEN, Lei ZHANG, Xuening CHU
*Shanghai Jiao Tong University, China*
Customer needs elicitation is critical to the improvement and development of products. Due to the lack of relevant knowledge, some needs are difficult to perceive or express for ordinary customers in the traditional survey-based techniques such as interviews, questionnaires, and online reviews. Recent advances in technologies for information gathering make it possible to monitor and collect the usage data continuously during the product usage stage. In this research, a new approach is developed to assess the performance requirements of smartphones based on analysis of the operating data collected through embedded sensors. In the proposed approach, customers of the same product are first classified into different segments based on their usage patterns. Then, a data-based performance assessment method is developed to assess the performance of the product for each user considering product modules. A case study is presented to demonstrate the effectiveness of the proposed approach.

IEEM18-P-0236
**Asynchronous Multi-sensor Data Fusion with Decentralized IMM-PDAF**
Woo Jung PARK, Chang Ho KANG, Sun Young KIM, Chan Gook PARK
*Seoul National University, South Korea*
In this paper, asynchronous multi-sensor fusion with decentralized IMM-PDAF is designed. To improve the estimation performance for the maneuvering target in clutter, interacting multiple model (IMM) based probabilistic data association filter (PDAF) is utilized, and multiple sensors are assumed to be asynchronous to reflect the real multi-sensor application. To verify the tracking filter, simulations for tracking maneuvering target with asynchronous multi-sensor fusion are carried out. The simulation results show that the designed filter tracks target robustly, and fusing asynchronous multi-sensor reduces the estimation error.

IEEM18-P-0303
**Support Reuse and Maintenance of Design Information in a Development Process of Custom Engineered Product**
Morteza POORKIANY, Joel JOHANSSON, Fredrik ELGH
*Jönköping University, Sweden*
In this paper a method is introduced that supports reuse and maintenance of design information. The method allows sharing design information in different levels of details tailored for the stakeholders according to their needs. In addition, it is possible to share the information in multiple formats to suite different purposes. The results are demonstrated in an industrial partner which is a supplier of tooling for manufacturing industry.

IEEM18-P-0522
**Scoping a PIM System: A Supporting Framework**
Loris BATTISTELLO, Katrin KRISTJANSDOTTIR, Lars HVAM
*Technical University of Denmark, Denmark*
This article presents a four-step framework for supporting the scoping phase of a product information management system (PIM) and describes the results from applying the framework in an international company. The framework is based on the literature, developed in collaboration with industrial partners and tested in a multi-division and multimarket company. The framework is intended to: (1) identify the stakeholders of the PIM; (2) collect the stakeholders' requirements; (3) give an understanding of the current working process; (4) suggest a future scenario with the implementation of the software; and (5) framing a centralized product information model. The information on the PIM system is defective in the literature and no studies were found on the scoping process of this software. This study fills that gap by developing and testing a framework to support a PIM project in the scoping phase.

IEEM18-P-0594
**Reengineering of Factory Planning Processes for the Realization of Digital Factory 4.0**
Uwe DOMBROWSKI, Alexander KARL, Alexander REISWICH
*Technische Universität Braunschweig, Germany*
In order to be competitive on the market as a company, entrepreneurial processes must be constantly adapted to new requirements. An important factor for competitiveness is the targeted design of the factory. Factory planning must identify future requirements for the entire factory at an early stage and transfer them to a suitable factory structure. If this does not happen, the ability of companies to change will be restricted. In order to counter this risk, the digital factory with its digital tools and methods provides a solid basis for assisting planners with the design and realizing the required goals for the factory. Using modern digital assistance systems in factory planning, relevant planning restrictions can be identified and the planning status can be visualized and validated. It is unclear what effects the new requirements and in some cases disruptive changes will have on the classic factory planning process. This article discusses the use of business process modeling to identify, model, analyze and adapt classic factory planning processes. The goal is to generate future-proof factory planning processes. These form the basis for adapting classic tools and methods at the digital factory to the new processes. The digital factory 4.0 is created.

IEEM18-P-0150

**Systematic Selection, Adaptation and Integration of Quality Management Methods Into Quality Management Reporting**

Cosima Nadine FITZ, Guanwei HUANG
*Tongji University, China*

The aim of this study is the systematic selection, adaptation, and integration of quality methods into the quality management reporting (QMR), in order to effectively support the author of the quality reports (Q-reporter). This paper focuses on the derivation of concrete steps for the process of preparing quality reports. For this purpose, especially methods from the quality management (QM) area are analyzed with regard to their application within a phase of the QMR control loop. The present work considers one of the four fields of action of the QMR control loop to ensure the necessary detail depth. Thus, the focus is on the area of action "Collecting and Evaluating". A concrete procedure model is developed, and criteria for the assessment of analytical methods are derived from the requirements of the QMR and a method set is developed with these requirements.

IEEM18-P-0151

**A Novel Two-stage Method of Selection of Sample Points for Surface Quality Estimation of Multi-hole Workpiece**

Delin HUANG, Shichang DU, Guilong LI, Tangbin XIA
*Shanghai Jiao Tong University, China*

The analysis of surface quality has gained more and more attentions in quality control, since the functional behavior of a machined part is significantly influenced by its surface quality. Conventional sampling methods using Coordinate Measuring Machine (CMM) for surface flatness estimation mainly focus on the continuous-surface workpieces without holes. However, multi-hole workpiece appears frequently in practical production, such as engine block and valve body. Therefore, a novel two-stage method is proposed to select sample points and improve sampling accuracy for flatness estimation of multi-hole workpiece surfaces. In first stage, a new procedure for selection of initial points using Particle Swarm Optimization (PSO) algorithm is explored to search a set of initial points. In second stage, a non-uniform step-length pattern search (NUSPS) algorithm is developed to search the optimal points. The created transfer matrix is also applied in NUSPS algorithm to avoid the search into the holes and deal with points with irregular coordinate values. The results of case study show that the proposed two-stage method can be well applied in multi-hole workpiece surfaces and achieve a relatively high sampling accuracy.

IEEM18-P-0313

**One-Sided Synthetic Control Charts for Monitoring the Coefficient of Variation with Measurement Errors**

Kim Phuc TRAN[1], Huu Du NGUYEN[2], Quoc Thong NGUYEN[2], Wichai CHATTINNAWAT[3]
[1]*GEMTEX Laboratory, France*
[2]*Dong A University, Viet Nam*
[3]*Chiang Mai University, Thailand*

In this paper, we present a method to monitor the coefficient of variation (CV) squared using two one-sided synthetic control charts. The numerical results show that our design outperforms the two-sided synthetic control chart monitoring the CV. The steady-state, which is have practical meaning in many situations, is also considered. We use a Markov chain method to evaluate the statistical performance of the proposed charts. Furthermore, the effect of measurement errors on synthetic control charts monitoring the CV squared is firstly investigated.

IEEM18-P-0326

**Nonparametric Control Charts for Monitoring Linear Profile Data**

Suyi LI
*Beijing Institute of Technology, China*

Due to the fast advancing data collection technology, now it is common to obtain huge amount of quality characteristic measurement data. Profile control charts have been paid attention to by the researchers. In many situations, the quality of the process or product could be better represented by a relationship between a response variable and some explanatory variables, and such data appeared more and more in various industries. We use distribution-free model fitting technique and apply nonparametric control charts. The proposed profile control charts can be used for Phase II monitoring of linear profile data, and normality assumption is not imposed.

IEEM18-P-0330

**Quality Evaluation of Diesel Marine Engine Based on Fuzzy Analytic Hierarchy Process and Improved Close Value Method**

Yuliang ZHOU, Shenghan ZHOU, YiYong XIAO, Wenbing CHANG
*Beihang University, China*

The purpose of this paper is to evaluate diesel engine quality by applying the Fuzzy Analytic Hierarchy Process (FAHP) and the improved close value method. The fuzzy analytic hierarchy process uses two groups of experts and engineers to score, and tests their results, and then weights together to give the index weights, so that the weight determination is more credible. In addition, for the problems of positive index, reverse index, and moderate index in the diesel engine index, a more appropriate close value method was used for comprehensive evaluation. This paper improves the close value method so that it can handle multiple types of index problems. Finally, by comparing with the TOPSIS method, it was found that the combination of FAHP and the close value method can make a more accurate judgment of the quality evaluation of the diesel engine.

IEEM18-P-0053

**A Chatbot-supported Smart Wireless Interactive Healthcare System for Weight Control and Health Promotion**

Chin-Yuan HUANG[1], Ming-Chin YANG[1], Chin-Yu HUANG[2], Yu-Jui CHEN[2], Meng-Lin WU[2], Kai-Wen CHEN[2]
[1]*National Taiwan University, Taiwan*
[2]*National Tsing Hua University, Taiwan*

People who are overweight and obese have a greater risk of developing serious diseases and health conditions. A steadily increasing trend of obesity is not only limited to developed countries, but to developing nations as well. As smartphones have rapidly gained mainstream popularity, mobile applications (apps) are used in public health as intervention to keep track of diets, activity as well as weight, which is deemed more accurate than relying on user's self-report measure, for the sake of weight management. A solution called "Smart Wireless Interactive Healthcare System" (SWITCHes) is developed to facilitate objective data reception and transmission in a real-time manner. Based on the user data acquired from SWITCHes app and the auxiliary data from medical instruments, not only SWITCHes app can engage user with tailored feedback in an interactive way, in terms of artificial intelligence-powered health chatbot, but the healthcare professional can provide the more accurate medical advice to user also. This paper presents an overview of development and implementation of SWITCHes.

IEEM18-P-0183

**An Approach to Multidimensional Medical Data Analysis Based on the Skyline Operator**

Min CHE, Liya WANG, Zhibin JIANG
*Shanghai Jiao Tong University, China*

Over-treatments such as high medicine fees, repeated physical examinations, overuse of antibiotics and hormones are very common in some hospitals in China. In order to reduce these over-treatment phenomena, two multidimensional data analysis methods are used to analyze historical medical data in this paper. Then, for different situations of outpatients and inpatients, the best treatment cases for recommendation and the worst treatment cases to avoid are found out by using two algorithms based on the Skyline operator to sort multidimensional historical medical data. The results provide patients with appropriate prescriptions and provide doctors with reasonable recommendations of treatments.

IEEM18-P-0230

**Risk Identification Practice in Patient Safety Context**

Mecit Can Emre SIMSEKLER[1], Raja JAYARAMAN[2]
[1]*Khalifa University of Science & Technology, United Arab Emirates*
[2]*Khalifa University, United Arab Emirates*

Risk identification has gained an increased interest in healthcare to improve patient safety and quality within the scope of risk management. While past studies evaluated the evolvement of the risk management practice in healthcare in general, they also suggested that healthcare can learn and adapt from other safety-critical industries, such as aviation, chemical, nuclear and others. In this study, we particularly reviewed the current risk identification practice in patient safety context. Moreover, we compared healthcare with other industries to shed light on what can particularly be learned on risk identification to accelerate improvements in patient safety and enhance quality of care in healthcare delivery.

IEEM18-P-0439

**Optimizing Production and Inventory Decisions for Mixed Make-to-order/Make-to-stock Ready-made Garment Industry**

Aya Elmehanny[1], Tamer Abdelmaguid[1], Amr Eltawil[2]
[1]*American University in Cairo, New Cairo, Egypt*
[2]*Egypt-Japan University of Science and Technology (E-JUST), Egypt*

A mixed integer linear programming (MILP) model for production planning in garment industry is developed. The model considers capacity and financial planning decisions for mixed make-to-order (MTO)/make-to-stock (MTS) environment when demand exhibits predictable fluctuations. In the literature, existing models present little focus for capacity distribution between MTO and MTS products along with the effect of the cash availability on the production decisions. The developed model is applied to a real-life case study in Egypt, and the sensitivity of the results are analyzed. The model was very sensitive to the increases in the fabric prices and subcontracting costs while the overall net profits were not significantly affected by the changes in the inventory holding costs. The amount of MTS production increases with cash availability; while partitioning the capacity to 60% and 40% for MTO and MTS products respectively proved to be the best option and found to have a significant contribution on the revenues and in maintaining financial stability.

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| **Session** | Posters (Late Breaking Abstracts) |
| **Date** | 18/12/2018 |
| **Time** | 16:00 - 18:00 |
| **Room** | Riverside |

IEEM18-P-1049

**Industry 4.0 Support for Lean Production in the Semi-process Industry**

Philipp SPENHOFF
*Norwegian University of Science and Technology, Norway*

Lean production still inspires many organisations and industries beyond automotive assembly to coordinate supply and production activities to deliver at minimum costs. The semi-process industry, processing non-discrete materials in discrete batches, faces a trend of higher demand variability and volatility. Lean production and Industry 4.0 share the common objectives of enhancing the productivity and flexibility of production systems. However, the applicability of Lean production in the semi-process industry is limited due to the different planning environment characteristics, e.g. long and sequence-dependent setup times. Our empirical results show that certain Lean production practices, e.g. Heijunka, can be adapted to such planning environments. The support of Industry 4.0 and especially the advanced connectivity via Internet-of-Things and Cyber-physical systems enables a real-time flow of information from the shop floor. Industry 4.0 supports a more flexible flow of material and a more responsive production control approach. Nevertheless, a true Lean production strategy is not only the implementation of single practices. Therefore, this research investigates through case study the further potential of Industry 4.0 supported Lean production in the semi-process industry.

IEEM18-P-1020

**Printing Process Modeling and Uncertainty Quantification in Aerosol Jet Printing**

Haining ZHANG
*Nanyang Technological University, Singapore*

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 uncertainties of the process parameters such as sheath gas flow rate and carrier gas flow rate will affect the controllability on printed line resolution. In this paper, an uncertainty quantification framework is proposed to analyze and quantify the influence of the uncertainties on the printed line resolution. Considering the printed droplet diameter as output with respect to sheath gas flow rate and carrier gas flow rate, the printing process is modeled by the microfluidics and particle tracing modules. And, a sparse quadrature approach is adopted to determine the Polynomial chaos coefficients which provides a detailed representation of the stochastic model response. Then the stochastic model response is utilized to compute distributions of quantities of interest and analyze the sensitivity for uncertain parameters. The results demonstrate that the sheath gas flow rate has more impact on the printed line resolution than carrier gas flow rate.

IEEM18-P-1023

**Application of Promethee I in Projects' Selection for Public Constructions in a Small Municipality in Northeast Brazil**

Camila FAMA
*Universidade Federal de Pernambuco, Brazil*

The small cities of Brazil, especially in the Northeast, are characterized by having little investment by the government. In the Paraíba state, data from the Brazilian Institute of Geography and Statistics show that few municipalities accounted for more than half of all the wealth generated. In this way, the governors of these municipalities receive little money for investment in health, education and infrastructure. In this sense, the objective of this research was to apply a multicriteria method to direct investments in projects for public constructions in a more effective way using the preferences of the decision maker. In this case, the researcher, together with the infrastructure secretary of the Picuí municipality, located in the interior of Paraíba, applied the PROMETHEE I method to find an order in which the projects should be executed according to criteria previously established by the decision maker. The results showed that the tool was useful so that this secretary of the municipality could direct his investment in projects more clearly and with a method that justified his choice.

IEEM18-P-1031

**Is R&D Engineers' Overseas Experience Really Good for Their Creative Behaviors/attitude?**

Hideki SHIMIZU-TANAKA
*Kyoto Gakuen University, Japan*

The purpose of this study is to examine the effects of R&D engineers' overseas experiences on their creative behaviors / attitudes. In global and knowledge economy, the sources of knowledge are extended around the world, thus, R&D engineers' overseas is becoming more important. In this research, we tested the effects of overseas experience on R&D engineers' creative behavior (e.g. getting / sharing new ideas, creation of new knowledge) in Japanese context. From the results, we found that (1) if they experienced overseas activities (international conference / projects) once or more times, then they felt the significance / importance of overseas experiences as R&D engineers, also (2) R&D engineers' overseas experience had positive effects on their network and creative behaviors. Most of the Japanese R&D engineers, unfortunately, has little overseas experiences, therefore, the results of this study has more implications for management of R&D engineers' experience at Japanese company in the future.

IEEM18-P-1037

**Prediction of PV Output Transition Based on Stochastic Evaluation**

Naohiro KOURA
*Waseda University, Japan*

Photovoltaic (PV) power generation is a clean and renewable energy source and is much introduced all over the world. However, PV output depends on the weather conditions and fluctuates irregularly, which results in a negative impact on the electric power system. Therefore, it is important to precisely forecast PV output for the energy management. In our previous study, we carried out prediction interval estimation of next-day PV output with Just-In-Time Modeling. In this study, based on the behavior of measured PV outputs in the morning on the day, we predict the afternoon PV output transition in the prediction interval. The information of PV output transition is useful for the plan modification of thermal power generation on the day. In the proposed method, first, we trisect the prediction interval into three ranges. Then, we predict the range into which PV output will fall every hour with Just-In-Time Modeling. The proposed method enables us to reduce the prediction interval with keeping predictive accuracy in comparison with conventional approach. Some computational results, which demonstrate the effectiveness of the proposed method, will be reported.

IEEM18-P-1039

**Why Do Consumers Will Apply Block Chain Technology in Internet Shopping?**

Hsin-Yuan CHANG
*Takming University of Science and Technology, Taiwan*

This study applies Innovation Diffusion Theory (IDT) as our based model, and extends the characteristics of virtual currency to construct the research structure by the experts' views. This study explores the key factors in the use of virtual currency for online shopping in various payment environments. The fuzzy delphi method is applied to generalize the experts' view about use of virtual currency for online shopping in various payment environments. The results show that the main criteria for the acceptance of innovative forms of virtual currency such as Bitcoin & Ethereum (ETH) are "trialability for the users and complexity for the security". Especially, for the virtual currency to be popular in use, "Ease of Use, Market Size and Purchasing Methods" are the most important factors. The results will give the reference for the internet platform and E-Commerce.

IEEM18-P-1048

**A Human Factor Analysis for Developed Foot Rowing Type Wheelchair - Questionnaire Analysis with Elderly People -**

Naohisa HASHIMOTO[1], Yusuke TAKINAMI[1], Hiroto KAKUTA[2]
[1]*National Institute of Advanced Industrial Science and Technology, Japan*
[2]*Aguri Kogyo Corporation, Japan*

In Japan, aging population tendency is becoming, and quality of life should be improved in aging society. Especially, transportation for elderly and handicapped people is one of the most important topics for keeping the quality of life high. We developed the new type of wheelchair. The feature of the developed prototype wheelchair is foot rowing. Normally, the power of foot rowing is stronger than its of hand. We have developed the prototype considering real elderly people and finally performed experiments for evaluation. The experiments were performed with 35 elderly people. In the experiments, the differences were evaluated between the developed wheelchairs and ordinary type of wheelchair, which is turned by user's hands. The contents of questionnaire are ease of movement, comfortability of riding and getting on and off, each movement including forward, backward, braking, right and left turning, traveling on bump road, slope and slalom. Also, comments about every content and indoor and outdoor locations to use this wheelchair were gathered. From the experimental results, interesting points were found and these points are valuable for the developing.

IEEM18-P-1053

**Collaborative Network Design for Irregular Parcels in Courier Services**

Chang Seong KO
*Kyungsung University, South Korea*

Recently, rapid increase in on-line based purchase results in constant growth in courier service market. Most companies have been making a lot of efforts for expanding their delivery productivities by improving terminal activity, line-haul transportation, last mile delivery, etc. Actually, there are irregular parcel demands, which cause the delivery performance to decrease. This study proposes a collaboration model for network design of irregular parcels in courier services. 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.

IEEM18-P-1003

**Recall Data Analysis for Quality Risk Management**

Changmuk KANG
*Soongsil University, South Korea*

Whereas product development involves a variety of risks, a risk of poor quality is one of the most critical ones that may even threaten the survival of a manufacturer. Poor quality is often represented as a defect whether it is due to manufacturing or design. This study presents a method to construct a database of design and manufacturing defects to detect and prevent them early in the product development process. This database is automatically constructed by classifying and evaluating history of the product recalls, which are the most visible evidence of defects and usually open to public. This process is automated by support of some text mining techniques. Each type of defect is evaluated by its frequency, severity and undetectability adopting the form of failure mode and effect analysis. In this study, I analyzed vehicle recalls using U.S. NHTSA recall records. It is possible to design safer automobiles by avoiding repeating past mistakes.

IEEM18-P-1009

**Speed Reduction and Optimization for International Shipping to Reduce Greenhouse Gas Emission**

Jinjing HUANG
*National University of Singapore, Singapore*

International shipping plays a predominant role in the global trade that accounts for over 80% of its total volume and is still projected to expand at an annual rate of 3.2% for the next 5 years. With the vast volume of transactions, the greenhouse gas (GHG) emission will be increasing rapidly if no actions are taken. Given that bunker fuel consumption has an exponential relationship with ship speed, slowing steam may be one of the effective measures to reduce fuel consumption and thus the GHG emission. This paper will discuss the feasibility and methods of implementing speed reduction and optimizing for international shipping to reduce GHG emission. First, this paper will look at the distribution of speed profile of different categories and characteristics of ships along different trade routes for the past 10 years. To assess the feasibility of speed optimization, statistics like the efficiency of various types of ships on different routes will be analysed to determine the optimal implementation of speed reduction with the lowest GHG emission. An estimated overall reduction of GHG emission results will be provided.

IEEM18-P-1010

**Solving the Component Sequencing and Feeder Assignment Problems for a Chip Shooter Machine with an Improved Shuffled Frog-leaping Algorithm**

Hsien-Pin HSU
*National Kaohsiung University of Science and Technology, Taiwan*

The Printed Circuit Board Assembly (PCBA) is one of the most important processes in an assembly line of electronic products. However, it is also a likely bottleneck in this kind of assembly line. Thus, chip shooter machines have been widely introduced by assembly firms to expedite this process in an assembly line. How to best utilize these expensive machines has thus become one important issue of these assembly firms. Recently, Swarm Intelligence (SI)-based meta-heuristics, such as particle swarm optimization (PSO), have been increasingly used to deal with PCBA problems. However, Shuffled Frog-leaping Algorithm (SFLA) is found to have never been used to deal with the feeder assignment problem (FAP) and component sequencing problem (CSP) simultaneously for a chip shooter machine. In this paper, we have proposed an improved SFLA (I-SFLA) to deal with the two problems simultaneously. The I-SFLA allows all frogs to attend evolution and it includes some new features such as self-adaptive jump and self-adaptive variant that allow frogs to approach the optimal solution adaptively. Our experiments showed the I-SFLA had a high hit rate to the optimal solution.

IEEM18-P-1011

**Hotelling Queue Competition Models with Probabilistic Service**

Zhaotong LIAN
*University of Macau, Macau*

Offering probabilistic goods to potential buyers as additional purchase choices can help increase a firm's revenue, reduce the negative impact of demand uncertainty and the mismatch between capacity and demand. This paper studies a Hotelling queue duopoly model. The customers are assumed to be uniformly distributed in between two competition servers which are located at 0 and 1 respectively in Hotelling line. A customer has three choices: to join one of the servers, to choose a probabilistic service, or to balk from system. Three policies are considered: first come first service (FCFS), probabilistic service has high priority (PSHP) and deterministic service has high priority (DSHP). Usually, the service with higher priority will be charged a higher price. However, with the PSHP policy, the price for the deterministic service is higher than the price for the probabilistic service in a big market, but lower in a small market. With the other two queue policies (FCFS and DSHP), the firms gain lower revenues in duopoly competition than what they gain the monopoly situation.

IEEM18-P-1014

**Preliminary Study on Development of a Hand-written Text Recognition Framework for Construction Document Digitization**

Seonghyeon MOON[1], Jinwoo KIM[1], Seokho CHI[1], Duyon KIM[2], Hyunchul OH[3]
[1]*Seoul National University, South Korea*
[2]*Kyungil University, South Korea*
[3]*Daewoo E&C, South Korea*

Document digitation, converting PDF documents to TXT, is a significant process for text-mining since TXT format enables researchers to parse text into separate tokens and freely handle text data. Analyzing the text data was proved difficult, especially in the construction industry, where the data are normally recorded by hand and piled up in PDF format. Although several previous works tried to convert PDF documents to TXT, the performance was still inadequate because of less considering the domain knowledge. This research proposed a digitization framework for construction documents that focuses on hand-written text considering layout information and grammatical elements of construction reports. The research provided preliminary results of hand-written word detection, which will be input data of the Convolutional Neural Network and Recurrent Neural Network models for text recognition. When the framework is fully developed, it would contribute to facilitating text-mining analysis and automated knowledge discovery in the construction industry.

IEEM18-P-1016

**A Hybrid 3D Printing Method to Develop Embedded Smart Sensors**

Zhong Yang CHUA
*Nanyang Technological University, Singapore*

Industry 4.0 is known as the fourth industrial revolution and the current industrial trend of automation, data exchanges, cloud, cyber-physical systems, robots, Big Data, artificial intelligent, Internet of Things (IoTs), and semi-autonomous industrial techniques to realize smart industry and manufacturing goals in the intersection of people, new technologies and innovation. This allows integration of advanced control systems with an internet technology to enable communication between machines, devices, sensors and people. One of the key approach is to create smart factories which equip future products and machines with embedded smart sensors and actuators to enhance automation, communication and intelligent operation via lots. With this, Additive Manufacturing (AM) or 3D printing has been increasingly used in electronic application such as fabrication of the embedded smart sensors. This paper provides a hybrid 3D printing method to fabricate embedded sensors via an aerosol jet technology and a photopolymerisation process. The printed sensors are tested and the result are collected and analysed by a data acquisition system. Preliminary result shows that the proposed method is a promising approach to develop embedded smart sensors.

IEEM18-P-1017

**Innovation Promoter or Inhibitor? Contextualizing Innovation Investment Effect of Non-family CEOs in Family Businesses**

Cheng-Yu LEE
*Southern Taiwan University of Science and Technology, Taiwan*

As family firms are known for their conservativeness and under investment in new technologies, either scholarly interest or practical attention has been drawn to whether a non-family chief executive officer (NFC) is conducive to firm innovativeness in order to address the ever changing and dynamic markets. In a sample of Taiwanese family firms in high-tech industries, we found that the presence of a NFC has a positive but insignificant effect on the innovation investment of the focal family firm. However, family involvement in management and the percentage of outside directors yield significantly negative and positive moderating effects on the innovation investment outcome of NFCs, respectively. This study further tests that the configurational effect of two moderators on the main relationship. The result reveals that the negative moderating effect of family involvement in management outweighs the positive effect of outside directors. Overall, our findings not only echo the micro-foundation movement of strategy research but also contribute to the behavioral side of the agency theory that the risk-taking effect of NFCs is not universally happened but deliberately arranged for effect.

IEEM18-P-1018

**Intelligent Log Out Tag Out System Framework in Pipe Instrument Diagram**

Mikyeong SHIN, Woojin JO, Soohong LEE
*Yonsei University, South Korea*

According to the Marsh Report, the largest loss from 1978 to 2017 was the result of industrial disasters in the maintenance and testing of the hydrocarbon separation process. Hydrocarbons are part of the petrochemical plant engineering. Defective petrochemical plants can lead to serious industrial accidents. In 2012, there is a case in Mexico. There was a PEMEX explosion. The explosion killed 31 people and wounded 46 others. Therefore, in order to prevent industrial accidents, it is important to manage the defects of the industrial plant industry and have many research issues to date. The concept of Log out tag out, which is used for safety at the current maintenance stage, is widely used. We applied the existing log out tag out concept for research. We want to implement a device and system with dual functions by adding the sensor measurement function to the existing logout tag out safety device concept. The device performs the remote control function using the IOT function, and the system implements the overall framework based on the plant expert knowledge base.

IEEM18-P-1036

**Energy Management in PV Power Generation System with Storage Battery by Means of Next Day PV Output Prediction**

Mihoko ODA
*Waseda University, Japan*

Recently, photovoltaic (PV) power generation systems get much attention as environmentally friendly energy source, so they are actively introduced all over the world. However PV output depends on the weather conditions and is generally unstable, which results in power quality degradation in utility grid. Therefore, energy management by means of the forecast information of solar irradiance is necessary for efficiently utilizing PV power. Especially in Japan, liberalization of electricity retail sale to households and other small-scale users began in April 2016, which brought about a difficult problem with complicated trade-offs on how customers save their costs and how power suppliers and electricity retailers increase their profits under the constrain condition of CO2 emission reduction.With the above background, in this paper, we carry out multi-objective optimization of energy management in PV system with storage battery by means of prediction interval estimation of next-day PV output. The effectiveness of the developed management method will be verified through the computational simulation with a power network model of a community consisting of hundreds of residential houses with solar panels and storage batteries.

IEEM18-P-1055

**Markovian Modelling of Serial Production Systems with Rework**

George HADJINICOLA
*University of Cyprus, Cyprus*

We present a Markovian modeling framework that can describe any serial production system with rework where each production stage is represented by a state in the Markov chain. Absorbing states indicate the events of scrapping a product at a production stage or the completion of the finished product. Formulae for the final absorption probabilities are derived that represent: (1) the probability that an unfinished product is scraped at a certain production stage and (2) the yield of the system. We also derive various expected costs and quantities associated with all products ending in any absorbing state, as well as the equivalent costs and quantities for finished products. The applicability of our modeling framework is demonstrated in a real-life manufacturing environment in the food-packing industry.

## Author Index

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## Z

# Contacts

**Secretariat - Meeting Matters International Pte Ltd**
Email: info@ieem.org

| | |
|---|---|
| Teng Teng AW | HP: (65) 8198 9448 |
| Si Ying HO | HP: (65) 9025 0552 |
| Leris LEONG | HP: (65) 9647 8546 |
| Lenny SEETOH | HP: (65) 9328 8212 |

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# Transportation in Bangkok

With the Sky Trains (BTS), Mass Rapid Transit (MRT), buses & taxis, travelling in the city and suburbs can be a quick and affordable affair. These modes of transportation also make navigation around Bangkok easy. If you are adventurous, the tuk-tuks are also worth a ride.

**Skytrain (BTS)**
Sky Trains (BTS), consist of 2 lines, the Silom Line and Sukhumvit Line that are connected at Siam station. It is undoubtedly the swiftest way to get around. Fares start at 15 baht per stop and vary depending on the number of zones crossed. Tickets are bought from machines located at the stations. Payment can only be made by coins but change is given at the service desks. A one-day pass may be ideal for tourists as this pass allows unlimited travel within the duration of a single day.

**Mass Rapid Transit (MRT)**
The Mass Rapid Transit network (MRT) consists of 1 line and serves 18 stations. Trains here arrive every 5-7 minutes. Tickets are bought in the form of tokens from machines at the stations.

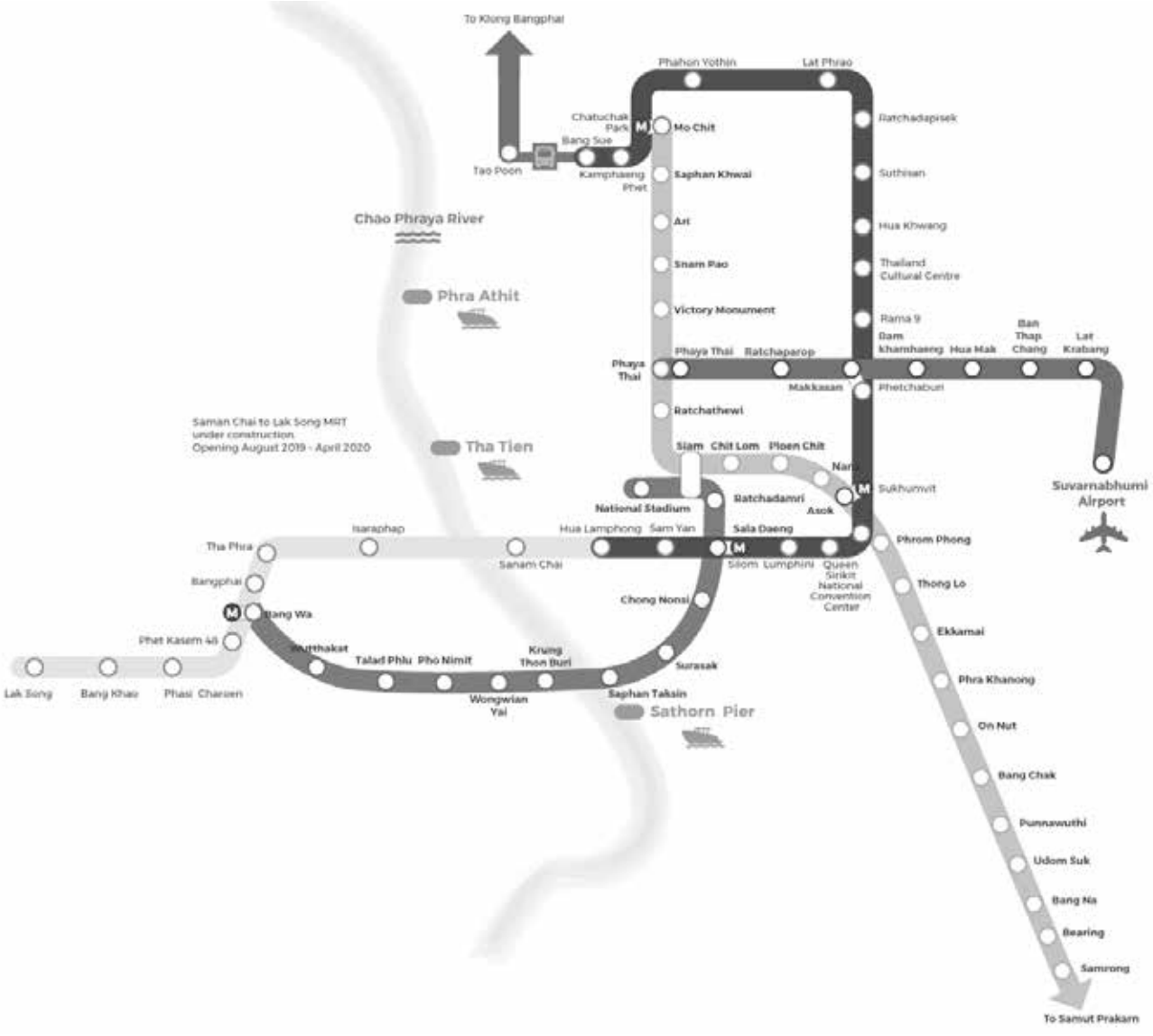
**Bus**
Bangkok buses operate daily from 05:00 to 23:00 while the night buses run 24 hours daily. Bus tickets are bought on board the bus. Buses with blue signs operate via the regular route while buses with yellow signs take the expressway and as such, do not stop at all stations.

**Taxi**
Taxis ply the island round the clock, bringing you wherever you want, anytime you want. All taxis are metered with the starting fee of 35 baht for the first 3 kilometers and then 5 baht per kilometer. You are however, responsible for any expressway toll fees. Although meter taxis are now predominate, there are occasional situations where you may have to politely ask the driver to switch on the meter. There are many taxi companies and different coloured taxis but costs and fares are the same. Taxi stands are available island-wide, as well as in hotels and shopping centres so it is not too difficult to flag one down.

Here are the hotlines for various taxi services in Bangkok, which will come in handy if you end up in a more obscure part of the island where the traffic is sparse, or if you are unable to find a taxi during peak hours or any other reason. If you're coming from an entertainment or dining venue, most concierge services will also be happy to call a taxi for you.

Bangkok Taxi Call Center Hotlines: 1681, 1661, +66 (0)2 424-2222
Airport Taxi: +66 (0)2 973-3191

# Bangkok BTS & MRT Map



# Experience Bangkok

Bangkok was founded in 1782 and is the capital city of Thailand. It is known as "Krungthep" to the locals which means the "City of Angels". Bangkok has developed rapidly over the years and is now a popular travel destination in Asia. The city is always bustling with a variety of activities, from exotic temples, to modern shopping malls, to floating markets, to street markets, including of course, Chatuchak Weekend Market, one of the world's largest markets. Be prepared to be won over by Bangkok's versatility and multiple points of interests during your visit.

**Wats and Temples**

Bangkok has no lack of majestic temples, each more elegant and impressive than the other. They are a unique part of the capital's heart and soul. A visit to Bangkok would not be complete without seeing at least two of them! The best time to visit the temples is in the early morning as it is cooler and generally less crowded. The temples ('wats') are not just tourist attractions as they also play an important part in Buddhist traditions. Do remember to dress respectfully when visiting any temple in Bangkok. One of the top temple to visit in Bangkok is the Wat Phra Kaew (Temple of Emerald Buddha)!

**Wat Phra Kaew**
Na Phra Lan Road, Phra Nakhon, Bangkok 10200, Thailand

**Street Markets**

Bangkok is home to some of the biggest and arguably best markets across South East Asia. Markets around Bangkok offer fascinating shopping experiences. You may choose to bargain your way through the crowds in the heat during the day or do so at night if you prefer the buzz and energy. Apart from excellent bargains that you can find, the markets also offer a slice of local life and opportunities to taste food not found in most restaurants. Of all the markets in Bangkok, Chatuchak Weekend Market is a must visit, while others, such as those in Patpong, Khlong Thom and Saphan Phut offer exciting night-time shopping experiences.

**Chatuchak Weekend Market**
587/10 Kamphaeng Phet 2 Rd, Chatuchak,
Bangkok 10900, Thailand

**Klongs and Canals of Bangkok**

Thonburi is Bangkok's old capital situated on the western banks of the Chao Phraya River. It has avoided much of the modern development seen elsewhere so its man-made network of khlongs, including Khlong Mon and Khlong Bangkok Noi, retain much of their ramshackle charm. For a real sense of how people in Bangkok used to live, in stilted shacks, old wooden townhouses and dilapidated lean-tos, experience Bangkok's Thonburi Khlongs first-hand.

**Floating Markets**

Visit Bangkok's popular floating market and find boats loaded with tropical fruits and vegetables, fresh, ready-to-drink coconut juice and even local food prepared directly from kitchens located right on the boat. Explore the market freely, take photographs for keepsake or hire a paddle boat along the canal to soak up the atmosphere of this legendary market. The market is over an hour outside Bangkok, and the easiest way to get there is to join a tour. Other floating markets in Bangkok are namely the Taling Chan Market, Bang Ku Wiang Market and Tha Kha Market.

**Chinatown**

Chinatown retains a large ethnic Chinese community who still continue their own traditions and religious ceremonies. Famous for its markets and numerous gold shops, the area caters largely to the local population. It also contains numerous market areas concentrated around a network of roads, alleys and small streets. Chinatown has become a popular tourist attraction and a food haven for new generation foodies who flock here to explore the vibrant street-side cuisine. The energy that oozes from this endless rows of wooden shop-houses is plain contagious and is an experience not to be missed.

**Shopping Malls**

Bangkok also has shopping malls to suit all kinds of lifestyles and budgets. From the well-known MBK, to the classy Emporium, chic Siam Discovery and Central World Plaza, or upscale Siam Paragon, Bangkok has what it takes to meet every budget and style. The latest additions to the city's 'mallscape' are the innovative Terminal 21 and Central Plaza Rama 9. Modern and air-conditioned, these malls are pleasant alternatives to the bustling hot markets, and most complexes are easily accessible via the city's modern and efficient Skytrain (BTS) system.

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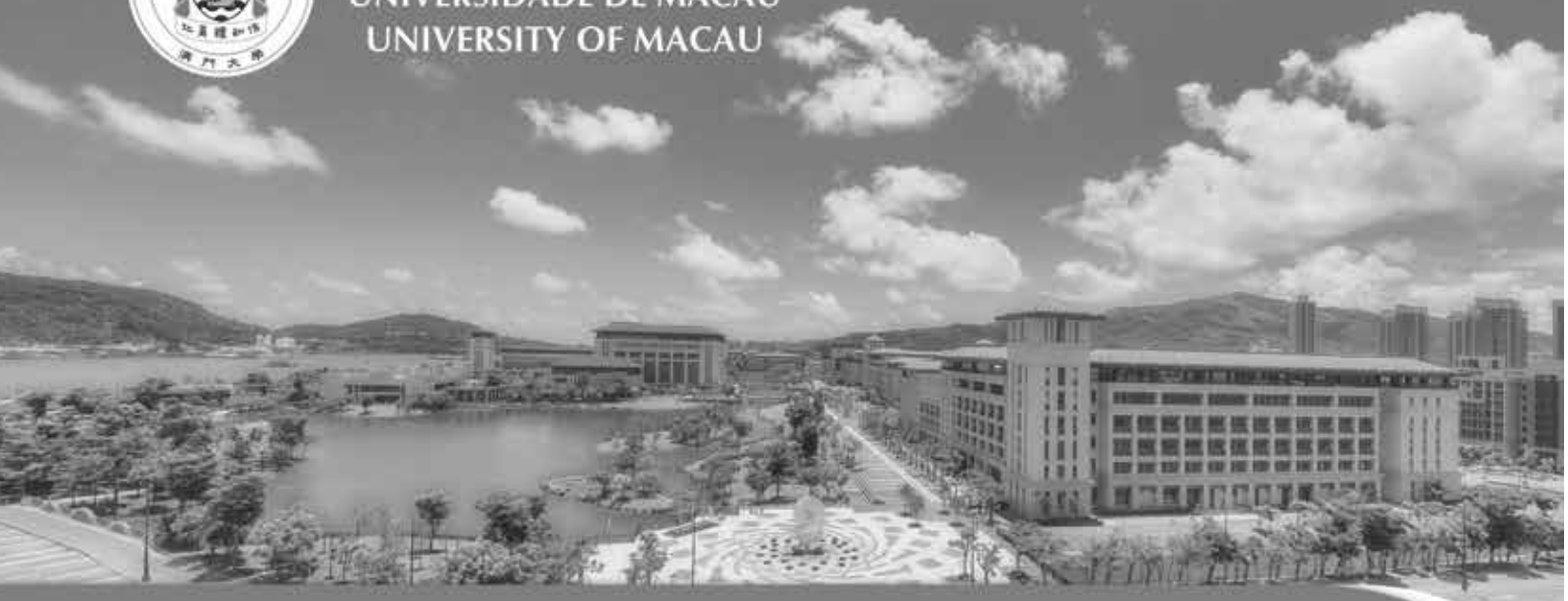

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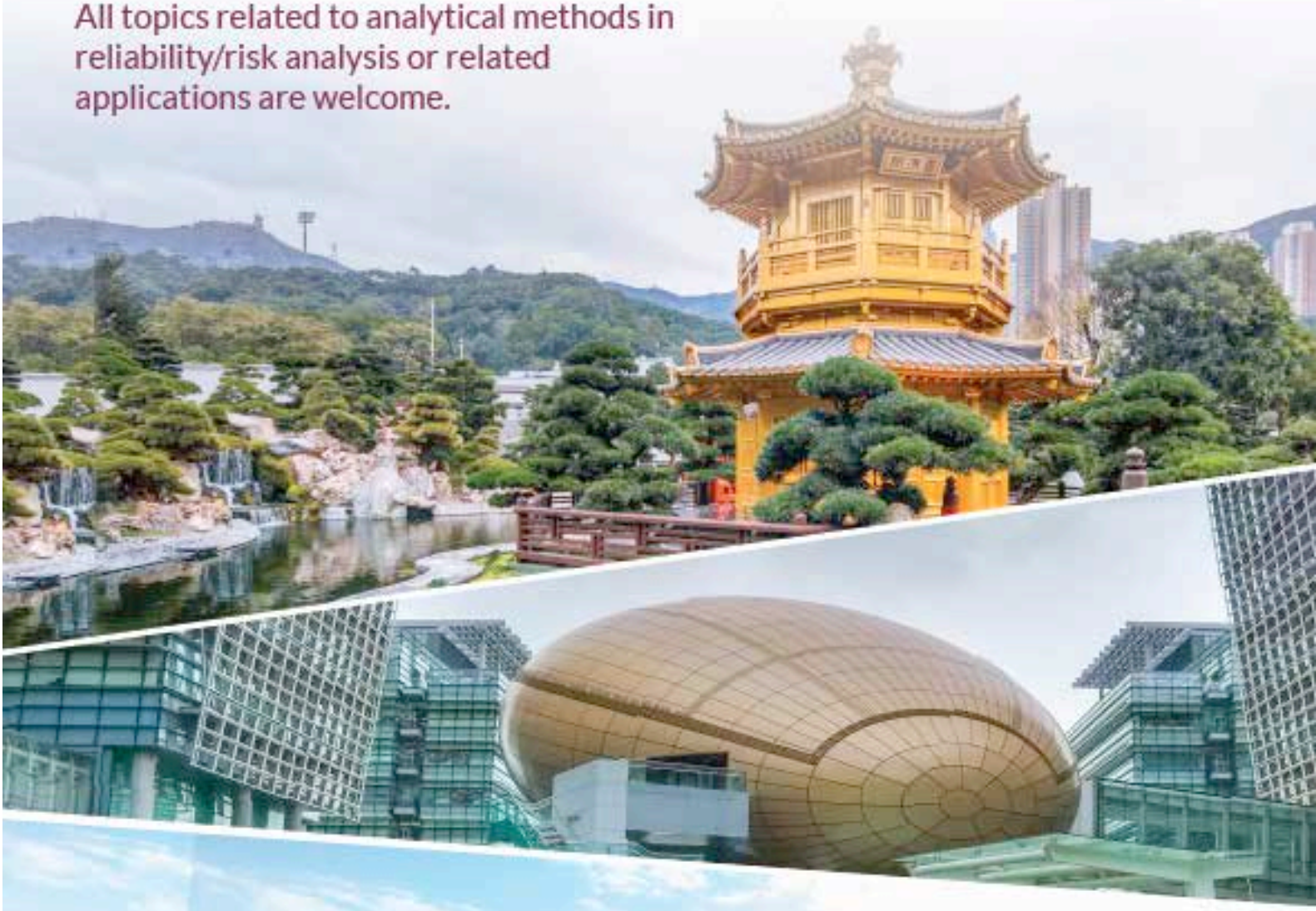



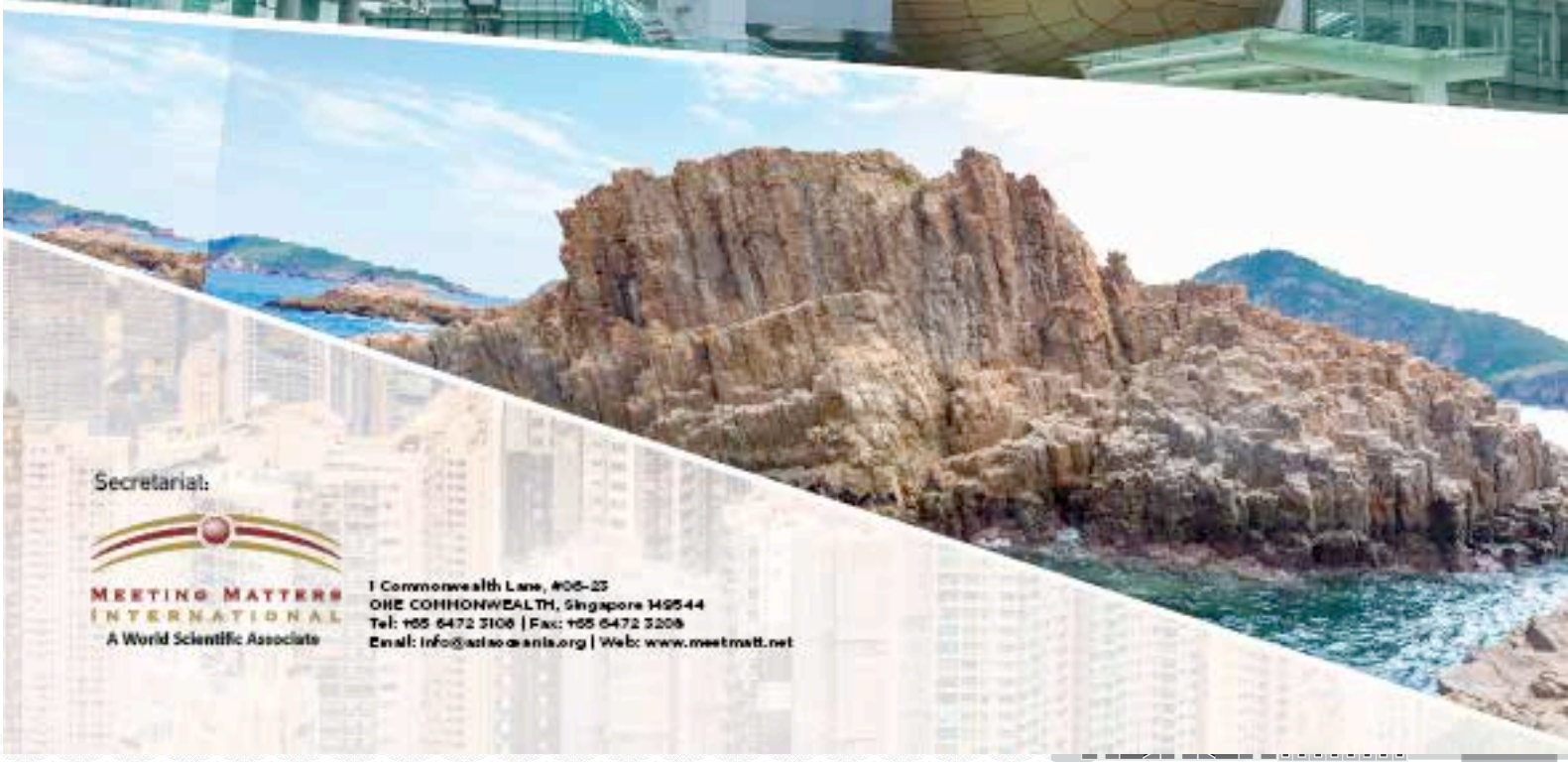

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