

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 Catalog Number: CFP18IEI-ART  
ISBN: 978-1-5386-6786-6

Copyright and Reprint Permission: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For reprint or republication permission, write to IEEE Copyrights Manager at [pubs-permissions@ieee.org](mailto:pubs-permissions@ieee.org). All rights reserved. Copyright © 2018 by IEEE.

## Table of Contents

### Supply Chain Management 1

Dedicated Agility: A New Approach for Designing Production Networks <i>Günther SCHUH, Jan-Philipp PROTE, Bastian FRÄNKEN, Julian AYS, Sven CREMER</i>	1
Contractual Barriers and Energy Efficiency in the Crude Oil Supply Chain <i>Roar ADLAND, Haiying JIA</i>	6
Carbon Footprints of Construction Industries: A Global, Supply Chain-linked Analysis <i>Parinaz TOUFANI, Murat KUCUKVAR, Nuri Cihat ONAT</i>	11
An Approach for Rolling Planning of Migration in Production Networks <i>Günther SCHUH, Jan-Philipp PROTE, Marco MOLITOR, Sven CREMER</i>	17
Lead Time Quotation Under MTO and MTS Delivery Modes with Endogenous Demand <i>Erfan ASGARI, Yannick FREIN, Ramzi HAMMAMI</i>	22
Modelling the Causal Relationship Among Variables that Influencing the Capability of Dairy Supply Chain in Indonesia <i>Aries SUSANTY, N. B. PUSPITASARI, A. BAKHTIAR, N. SUSANTO, D. KURNIA</i>	27
Building Last Mile Delivery Scenarios: A Case Study of Melbourne <i>Kolawole EWEDAIRI, Prem CHHETRI, Jago DODSON, Shams RAHMAN</i>	32

### Supply Chain Management 2

Review of Refrigerated Inventory Control System for Perishable Products <i>Dyah SATITI, Ahmad RUSDIANSYAH, Ratna Sari DEWI</i>	36
Supply Chain Configuration Modeling for Multi-product Multi-echelon <i>Sinta SULISTYO, Derana ADILIA, Nur Aini MASRUROH</i>	41
Supplier Selection Method: A Case-study on a Car Seat Manufacturer in Thailand <i>Naragain PHUMCHUSRI, Supasit TANGSIRIWATTANA, Poom LUANGJARMEKORN</i>	46
Improving Traceability System in Indonesian Coconut Oil Company <i>Ivan GUNAWAN, Iwan VANANY, Erwin WIDODO, Jaka MULYANA</i>	51
Vehicle Dispatch Problem with Precedence Constraints for Marine Container Drayage <i>Etsuko NISHIMURA, K. SHINTANI, A. IMAI</i>	56
An Impact-wave Analogy for Managing Cyber Risks in Supply Chains <i>Daniel SEPULVEDA ESTAY, Pablo GUERRA</i>	61

### Supply Chain Management 3

Redistribution Problem of Relief Supply for Post-disasters <i>Etsuko NISHIMURA, Kentaro UCHIDA</i>	66
A Green Vehicle Routing Method for the Regional Logistics Center <i>Jun-Der LEU, Andre KRISCHKE, Yi-Ping LEE, Larry Jung-Hsing LEE, Yi-Wei HUANG</i>	71
Multi-period Maximal Covering Location Problem with Modular Facilities for Locating Emergency Facilities with Back-up Services <i>Roghayyeh ALIZADEH, Tatsushi NISHI</i>	76

Intelligent Transport Systems and its Impact on Performance of Road Freight Transport in Zimbabwe <i>Wiseman MUCHAENDEPI, Charles MBOHWA, James KANYEPE</i>	80
Supply Chain Risk Mitigation Strategies in Automotive Industry: A Review <i>Ehsan DEHDAR, Amir AZIZI, Salar AGHABEIGI</i>	84
Customer Value Chain Analysis for Sustainable Reverse Logistics Implementation: Indonesian Mobile Phone Industry <i>Hesti MAHESWARI, Gatot YUDOKO, Akbar ADHIUTAMA</i>	89
<b>Safety, Security and Risk Management 1</b>	
Safety Outcomes in Small-Size and Medium-Size Metal Enterprises in Indonesia: Are They Different? <i>Nachnul ANSORI, Ari WIDYANTI, Iftikar SUTALAKSANA</i>	93
Process Safety and Performance Improvement in Oil Refineries Through Active Redundancy and Risk Assessment Method - A Case Study <i>Loganathan MADAMPATTY KRISHNASWAMY, Subhas Sarma NEOG, Sunil RAI</i>	98
Risk Assessment Among Thai and Foreign Workers in Construction Companies <i>Kosinchai PAWTHAISONG, Manutchanok JONGPRASITHPORN, Chaiporn VONGPISAL, Nantakrit YODPIJIT</i>	103
Fuzzy Risk Prioritization of the Failure Modes in Rolling Stocks <i>Behzad GHODRATI, Mohammad Javad RAHIMDEL, Amir TAGHIZADEH VAHED</i>	108
Performance Evaluation with a Z-number Data Envelopment Analysis: A Case Study of a Petrochemical Plant <i>Shohre SADEGHSA, Ali SIADAT, Reza TAVAKKOLI-MOGHADDAM, Maliheh VAEZ-ALAEI</i>	113
A Critical Review of Current Safety Assessment Method of Chemical Safety in Toys <i>Shu Lun MAK, Winnie CHIU, H. K. LAU</i>	118
Safety Barriers Against Common Cause Failure and Cascading Failure: Literature Reviews and Modeling Strategies <i>Lin XIE, Mary Ann LUNDTEIGEN, Yiliu LIU</i>	122
<b>Production Planning and Control</b>	
A SPH Simulation Approach using the Carreau Model for the Free Surface Flow of Adhesives <i>Marcus RÖHLER, Vakul KUMAR, Christoph RICHTER, Gunther REINHART</i>	128
Capacity Allocation Among Suppliers in the Presence of Spot Market <i>Tarun JAIN, Jishnu HAZRA</i>	133
A Mix Integer Programming Model for Bi-objective Single Machine with Total Weighted Tardiness and Electricity Cost Under Time-of-use Tariffs <i>Bobby KURNIAWAN, Alfian Akbar GOZALI, Wei WENG, Shigeru FUJIMURA</i>	137
An Improved Multiobjective Evolutionary Algorithm for Solving the No-wait Flow Shop Scheduling Problem <i>Tsung-Su YEH, Tsung-Che CHIANG</i>	142
Multiply-connected Neuro PID Control <i>Kun-Young HAN, Hee-Hyol LEE</i>	148
As Simple as Possible but no Simpler – An Inquiry into Approximations for a Re-order Point Inventory Control Model with Gamma-distributed Demand	153

Anders THORSTENSON

Cost-model for Energy-oriented Production Control	158
<i>Martin ROESCH, Christoph BERGER, Stefan BRAUNREUTHER, Gunther REINHART</i>	

## Human Factors 1

Barriers to Flexible Work Arrangements (FWA) in Malaysian Knowledge-based Industries	163
<i>Arnifa ASMAWI, Noor Shahaliza OTHMAN</i>	
A Study on Developing Customer Groups in Consolidated Financial Services Using Qualitative and Quantitative Analysis	168
<i>Yoonki KIM, Kyung-Jun LEE, Joong Hee LEE, Jihwan LEE, Yong Min KIM, Huamin JIN, Jaeyoon KANG, Myung Hwan YUN</i>	
Human Factors Approach for Powered Transfemoral Prostheses Conceptual Design	173
<i>Manutchanok JONGPRASITHPORN, Nantakrit YODPIJIT, Jutamat PINITLERTSAKUN, Juthamas SIRIWATSOPON, Gary GUERRA, Teppakorn SITTIVANCHAI</i>	
Evaluation of Activation Function Capability for Intent Recognition and Development of a Computerized Prosthetic Knee	178
<i>Manutchanok JONGPRASITHPORN, Nantakrit YODPIJIT, Gary GUERRA, Uttapon KHAWNUAN</i>	
Effect of Coffee Intake on Heart Rate Variability and Driving Performance in Sleep-deprived Condition	183
<i>Titis WIJAYANTO, Tasya ALMA, Bonifatius Bramantya WISNUGRAHA, Syam Rachma MARCILLIA, Galang LUFITYANTO</i>	
Dealing with Aging and Multigeneration Workforce Topics at Top Global Companies: Evidence from Public Disclosure Information	187
<i>Igancio CASTELLUCCI, Pedro AREZES, Martin LAVALIERE, Nelson COSTA, Olivia DADALT, Joseph COUGHLIN</i>	
User Experience Analysis in Industry 4.0 - The Use of Biometric Devices in Engineering Design and Manufacturing	192
<i>Yuri BORGIANNI, Erwin RAUCH, Lorenzo MACCIONI, Benedikt Gregor MARK</i>	

## Reliability and Maintenance Engineering 1

Reliability Analysis for MOSFET Based on Wiener Process	197
<i>Huiling ZHENG, Houbao XU</i>	
Lease-oriented Opportunistic Maintenance for Series-parallel Systems by Integrating Capacity Balancing	202
<i>Bowen SUN, Tangbin XIA, Ya SONG, Wenyu GUO, Lifeng XI</i>	
Improved Lease-oriented Opportunistic Maintenance for Two-machine One-buffer System under Product-service Paradigm	207
<i>Wenyu GUO, Tangbin XIA, Guojin SI, Bowen SUN, Ershun PAN</i>	
Condition-based Selective Maintenance for Multicomponent Systems Under Environmental and Energy Considerations	212
<i>Abdelhakim KHATAB, El-Houssaine AGHEZZAF, Claver DIALLO, Uday VENKATADRI</i>	
Mining System Degradation Assessment Based on Mathematical Analysis	217
<i>David VALIS, Jakub GAJEWSKI, Kamila HASILOVA, Marie FORBELSKA</i>	
System Condition Assessment Based on Mathematical Analysis	222
<i>David VALIS, Libor ZAK, Zdenek VINTR</i>	

ACO-based Parallel Machine Scheduling Considering Both Setup Time and Run-based Preventive Maintenance with Reliability Constraints	227
<i>Siqi CHEN, Liya WANG</i>	

## Reliability and Maintenance Engineering 2

Optimum Preventive Maintenance Policy for a Mechanical System Using Semi-markov Method and Golden Section Technique	232
<i>Girish KUMAR, J.P. VARGHESE</i>	
Remaining Fatigue Life Prediction of Topside Piping Using Response Surface Models	237
<i>Arvind KEPRATE, R.M. Chandima RATNAYAKE</i>	
Application of Prognostics and Health Management to Low Demand Systems: Use of Condition Data to Help Determine Function Test Interval	242
<i>Pengyu ZHU, Jayantha P. LIYANAGE</i>	
Reliability Modeling and Analysis of Nuclear Power System with Common Signal Based on Goal-oriented (GO) Method	247
<i>Yuan-Yuan YANG, Hui-Na MU, Guang-Liang CHEN, Xiao-Jian YI, Hong-Mei YAN, Chen LIU</i>	
Low Demand Safety Instrumented System: Update of Function Test Intervals with Layer of Protection Analysis in the Operational Phase	252
<i>Pengyu ZHU, Jayantha P. LIYANAGE</i>	
Decision Support Tools for Preventive Maintenance Intervals and Replacement Decisions of Engineering Assets	257
<i>Madhu MENON, Gopinath CHATTOPADHYAY, Ray BEEBE</i>	
Maintenance Planning Based on Reliability Assessment of Multi-state Multi-component System	262
<i>Niketa JAIN, Ajay Pal Singh RATHORE, Rakesh JAIN, Om Prakash YADAV</i>	

## Healthcare Systems and Management 1

Inventory Management Information System in Blood Transfusion Unit	268
<i>Fitra LESTARI, Ulfah ULFAH, Fitri ROZA APRIANIS, Suherman SUHERMAN</i>	
Modified Model of Radiographer Scheduling Problem for Sequential Optimization	273
<i>Toshiyuki MIYAMOTO, Kuniyuki HIDAKA</i>	
Women in Informatics Engineering Career: Perspective from Hofstede Cultural Dimension and Dayak Tribe's Cultural Values	278
<i>Ika WINDIARTI, Agung PRABOWO, Muhammad Haris QAMARUZZAMAN, Sam'ani SAM'ANI</i>	
On a Discrete-time Epidemic Model based on a Continuous-time SEIR Model Under Feedback Vaccination Controls	283
<i>Marta FERNANDEZ-FERNANDEZ, Santiago ALONSO-QUESADA, Manuel DE LA SEN, Aitor J. GARRIDO</i>	
Training System for the Medical Procedure of Cannulation	288
<i>Olga Katherine VERA BONILLA, Maria del Mar CHAVARRO CEBALLOS, Andres Felipe BARCO SANTA, Elise VAREILLES</i>	
Managing Product Recalls in Healthcare Supply Chain	293
<i>Raja JAYARAMAN, Fatima ALHAMMADI, Mecit Can Emre SIMSEKLER</i>	
Pareto Optimization for Hospital Alliance Reverse Referral Decision	298
<i>De TENG, Na LI</i>	

## Engineering Education and Training

The Concept of Systems Thinking Education- Moving from the Parts to the Whole <i>Sigal KORAL KORDOVA, Moti FRANK</i>	303
Using QFD to Normalize a Culture of Innovation in an Engineering SME <i>Pearse O'GORMAN, Margaret MORGAN, Rudy VAN MERKOM</i>	307
Continuous Improvement of Industrial Engineering Education Based on PDCA Method and Structural Importance <i>Yaqi GUO, Hengyi GAO, Zhiqiang CAI, Shuai ZHANG, Fangyu HU</i>	311
Effect of Needham Model Based Interactive Multimedia Material Towards Students' Achivement in Digital Logic Gates <i>M.F. LEE, S.N. MAT YUSOFF</i>	316
An Approach to Integrate Skills Development in Open Distance Learning (ODL) Environment: Part 2 <i>Tlotlollo HLALELE, Mothibeli PITA, S. SUMBANYAMBE</i>	321
Competency-based Assessment of Industrial Engineering Graduates: Basis for Enhancing Industry Driven Curriculum <i>Ryan Jeffrey CURBANO, S. G. Y. MADRID, C. T. NARVACAN, J. R. PUENTENEGR</i>	326
Training in Maintenance Engineering. Curricula Proposal <i>Miguel DIAZ-CACHO, Jorge MARCOS-ACEVEDO, Javier SANCHEZ-REAL, Salah CHIKH</i>	331

## Technology and Knowledge Management 1

Green Manufacturing's Adoption by Indonesian SMEs: A Conceptual Model <i>Ira SETYANINGSIH, Nurul INDARTI, Wakhid CIPTONO</i>	336
A Database Administration Tool to Model the Configuration Projects <i>Sara SHAFIEE, Steffan Callesen FRIIS, Lukasz LIS, Ulf HARLOU, Yves WAUTELET, Lars HVAM</i>	341
An Application of Agent-based Modeling and Simulation in Tacit Knowledge Transfer Effectiveness and Individual Performance through the Consideration of Feedback Mechanism <i>Fadillah RAMADHAN, Afrin Fauzya RIZANA, Rayinda Pramudya SOESANTO, Amelia KURNIAWATI, Iwan Inrawan WIRATMADJA</i>	346
Application of Last Planner® System in Product Concept Development Phase: Use of Lean Concepts in Academic Project Work <i>Prashanth SIVAGANESH, R.M. Chandima RATNAYAKE</i>	351
Project Success as a Function of Organizational Knowledge Management <i>Uriel ISRAELI, Amnon GONEN</i>	356
How Much "Talent" is Needed for Organizational Learning? A Study of Labor Market Entrants in an Innovation-oriented Country <i>Mait RUNGI</i>	361
Foundation of Project Interdependencies: Perspective of Organizational Theories <i>Mait RUNGI</i>	366

## Systems Modeling and Simulation 1

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	371
---	-----

*Hari Charan NANNAM, Atanu BANERJEE*

Monte Carlo Simulation Forecasting of Maritime Ferry Safety and Resilience <i>Ewa DABROWSKA, J. SOSZYŃSKA-BUDNY</i>	376
JIS: Pest Population Prognosis with Escalator Boxcar Train <i>Kin-Woon YEOW, Matthias BECKER</i>	381
Modeling the Dynamics of an Agile Scrum Team in the Development of a Single Software Project <i>Phoebe Mae CHING, Jose Edgar MUTUC</i>	386
The Stowage of Containers for Inland Shipping: A System for Maximizing Containers Allocation and Meeting Stability Requirements <i>Stefano FAZI</i>	391
Creation of Lattice Structures for Additive Manufacturing in CAD Environment <i>Dinh Son NGUYEN, Thanh Hai Tuan TRAN, Duc Kien LE, Van Than LE</i>	396
Operational Aircraft Routing Problem: Some Insights in the Capacitated Maintenance Resources <i>Miner ZHONG, Felix T.S. CHAN, S. H. CHUNG</i>	401

## Operations Research 1

Generic Framework for Stress Testing of Real-time Systems <i>Afshan NASEEM, Asad Waqar MALIK, Shoab Ahmed KHAN</i>	406
A Distributionally Robust Chance Constrained Model to Hedge Against Uncertainty in Steelmaking-continuous Casting Production Process <i>Shengsheng NIU, Shiji SONG, Jian-Ya DING</i>	411
Capacitated Assortment Optimization with Pricing under the Paired Combinatorial Logit Model <i>Daihan ZHANG, Zhenghe ZHONG, Chuning GAO, Rui CHEN</i>	417
A Lagrange Multiplier-based Regularization Algorithm for Image Super-resolution <i>Bai LI, Lixin MIAO, Canrong ZHANG, Wenming YANG</i>	422
A Genetic Algorithm for Generating Travel Itinerary Recommendation with Restaurant Selection <i>Budhi WIBOWO, Monica HANDAYANI</i>	427
A Continuous-Time Unit-Based MILP Formulation for the Resource-Constrained Project Scheduling Problem <i>Mario GNÄGI, Adrian ZIMMERMANN, Norbert TRAUTMANN</i>	432
A Rule-based Greedy Algorithm to Solve Stowage Planning Problem <i>Dalia RASHED, Mohamed GHEITH, Amr ELTAWIL</i>	437

## Operations Research 2

An MILP Model for the Internal Audit Scheduling Problem <i>Volkan YILDIRIM, M. Ebru ANGÜN, Temel ÖNCAN</i>	442
Stochastic Storage/retrieval Scheduling Considering Shuttle Failure in Multi-shuttle Automated Storage and Retrieval System <i>Jun WEN, Xinglu LIU, Peng YANG</i>	447
A Continuous-Time MILP Formulation for the Multi-Mode Resource-Constrained Project Scheduling Problem <i>Mario GNÄGI, Tom RIHM, Norbert TRAUTMANN</i>	452

Exact Method for Single Vessel and Multiple Quay Cranes to Solve Scheduling Problem at Port of Tripoli - Lebanon	457
<i>Ali SKAF, Sid LAMROUS, Zakaria HAMMOUDAN, Marie-Ange MANIER</i>	

Mathematical Modelling for a Semi-obnoxious Inverse Line Location Problem	462
<i>Mehdi GOLPAYEGANI, Haleh MORADI, Reza TAVAKKOLI-MOGHADDAM</i>	

Aggregate Production Framework for Efficiency Analysis and its Implementation by Linear Programming	467
<i>Soobin CHOI, Jaedong KIM</i>	

## **Service Innovation and Management 1**

The Effect of Owner Creativity on Organizational Creativity: Empirical Evidence from Surakarta Indonesia	473
<i>Retno INDRIARTININGTIAS, Budi HARTONO, Subagyo SUBAGYO</i>	

A Study of Continuance Intention to Adopt Cloud Services: The Moderating Effect of Users' Motivation	477
<i>Chan-Sheng KUO, Yowei KANG</i>	

Service Innovation in Retail Industry: What Can We Learn from Target?	482
<i>Rocky REYNALDO, Augustina Asih RUMANTI, Iwan Inrawan WIRATMADJA</i>	

Benefit Segmentation of Online Customer Reviews Using Random Forest	487
<i>Kenjiro TORIZUKA, H. OI, Humiaki SAITOH, Syohei ISHIZU</i>	

Government Subsidy, Industry-university-research Collaborative Innovation and Resources Allocation Efficiency	492
<i>Miao LI, Yuan HUANG</i>	

The Use of Design-science to Define Information Content Requirements for IT Service Catalogs	497
<i>Franziska SCHORR, Lars HVAM</i>	

## **Big Data and Analytics 1**

Sentiment Analysis of Airport Customer Reviews	502
<i>Arian DHINI, Dita Anggraeni KUSUMANINGRUM</i>	

Understanding Adoption of Big Data Analytics in China: From Organizational Users Perspective	507
<i>Kin Meng SAM, Chris CHATWIN</i>	

A Local-branching Heuristic for the Best Subset Selection Problem in Linear Regression	511
<i>Tamara BIGLER, Oliver STRUB</i>	

Early Detection of Events as a Decision Support in the Milk Collection Planning	516
<i>Atefe ZAKERI, Morteza SABERI, Omar KHADEER HUSSAIN, Elizabeth CHANG</i>	

Smart City Application and Analysis: Real-time Urban Drainage Monitoring by IoT Sensors: A Case Study of Hong Kong	521
<i>Kin Lok KEUNG, Carman Ka Man LEE, Kam Hung NG, Chun Kit YEUNG</i>	

Cultivating Growth and Radical Innovation Success in the Fourth Industrial Revolution with Big Data Analytics	526
<i>Magnus PENKER, Soo Beng KHOH</i>	

Clustering Subway Station Arrival Patterns Using Weighted Dynamic Time Warping	531
<i>Rui WANG, Nan CHEN, Chen ZHANG</i>	

## Service Innovation and Management 2

Event-driven Architecture for Sensor Data Integration for Logistics Services <i>Jens LEVELING, Luise WEICKHMANN, Christian NISSEN, Christopher KIRSCH</i>	536
Reaching Project Success Through Vision and Artifact and the Mediating Role of Team Spirit <i>Sayed Muhammad FAWAD SHARIF, Naiding YANG, Fouzia KANWAL, Sayed Kifayat SHAH</i>	541
A Human Centered Design Framework to Support Product-service Systems <i>Thomson Chi Shing WONG, Moon Kyoung JANG, Seung Ki MOON, Zhong Yang CHUA, Haining ZHANG, Hyung Sool OH</i>	545
Marketing Management Challenges – A Nordic Small and Medium Size Enterprises (SMEs) Perspective <i>Yonas Zewdu AYELE, Abbas BARABADI</i>	550
Consolidating Orders in a Crowdsourcing Delivery Network <i>Daniel Y. MO, Yue WANG, Nicole CHAN</i>	555
Co-creation of Value Using Social Media in the Service Industry: An Empirical Case Study of Service Innovation in a Banking and Finance Company <i>Asle FAGERSTRØM, Ravi VATRAPU, J. OTRE STØRKSEN</i>	560
Innovation Models for Public and Private Organizations: A Literature Review <i>Tariq AL HAWI, Imad ALSYOUNF, Mickael GARDONI</i>	565

## Quality Control and Management

A Comparative Study of Several Group Runs Type Control Schemes <i>Zhi Lin CHONG, Jing Yi WONG, Michael Boon Chong KHOO, Sok Li LIM, Wai Chung YEONG</i>	570
Benchmarking Quality Management Maturity in Industry <i>Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS</i>	575
Testing the ISO 9001:2015 Process Model: An Australasian Empirical Study <i>Nisansala PALLAWALA, Nihal JAYAMAHA, Nigel GRIGG</i>	580
Assessment of Quality of Service at the Main Laboratory of the LAB Aimed at Satisfying Internal Customer Needs <i>Sambil Charles MUKWAKUNGU, Eric BAKAMA, Alice Kabamba LUMBWE, Magaly Madeleine BOLIPOMBO, Dorcas NIATI, Kidoge IBRAHIMU, Jonathan Eljadael KASONGO, Charles MBOHWA</i>	586
Effects of Suggestion System on Continuous Improvement: A Case Study <i>Sorina MOICA, Cristina VERES, Liviu MARIAN</i>	592
Total Quality Management: A Framework for Quality Improvement in Indian Manufacturing Small and Medium Enterprises <i>R. KAJA BANTHA NAVAS, S. PRAKASH, A. John RAJAN, Subramaniam ARUNACHALAM</i>	597

## Project Management 1

Hybridization of Development Projects Through Process-related Combination of Agile and Plan-driven Approaches <i>Michael RIESENER, Christian DÖLLE, Johanna AYS, Julian AYS</i>	602
Risk of Quantity Increase in Vietnamese Construction Projects <i>Soo Yong KIM, Ha Duy KHANH, Van Thanh BINH</i>	607

A Literature Review on Approaches for the Retrospective Utilisation of Data in Engineering Change Management <i>Armin TALE-YAZDI, Niklas KATTNER, Lucia BECERRIL, Udo LINDEMANN</i>	612
Data Analysis in Engineering Change Management – Improving Collaboration by Assessing Organizational Dependencies Based on Past Engineering Change Information <i>Niklas KATTNER, Jan MEHLSTAEUBL, Lucia BECERRIL, Udo LINDEMANN</i>	617
Dimensioning a Product Development Project Portfolio Using a Closed Queueing Network <i>Jesper FINK ANDERSEN, Carsten LAURIDSEN, Bo Friis NIELSEN</i>	622
The Contextual Utility of Agile Project Management Maturity <i>Budi HARTONO, Dennis KUNARSITO, Citra NUDIASARI</i>	627
A BIM-based Labor Crew Moving Path Obstruction Detection Approach <i>Qiankun WANG, Zeng GUO, Qian Yao LI, Tingting MEI, Shi QIAO, Weiwei ZUO</i>	632

## Project Management 2

Decision Criteria for Contractor Selection in Construction Industry: A Literature Review <i>Maria Creuza BORGES DE ARAUJO, Luciana ALENCAR, Caroline MOTA</i>	637
A Review of Methods, Tools and Techniques Used for Risk Management in Transport Infrastructure Projects <i>Indra GUNAWAN, Tiep NGUYEN, Leonie HALLO</i>	641
The Influence of IM Use on Job Satisfaction in Cross-organizational Projects <i>Ziyue WANG, Yali ZHANG, Jun SUN, Chrissie Diane TAN, Menghua LU</i>	646
Key Influencing Factors for Cross-organizational R&D Project Stakeholder Management <i>Chrissie Diane TAN, Yali ZHANG, Jun SUN, Ziyue WANG, Ganggang ZHENG</i>	651
Robust Project Scheduling with Unreliable Resources: A Variable Neighbourhood Search Based Heuristic Approach <i>Ripon K CHAKRABORTTY, Alireza ABBASI, Michael J RYAN</i>	656

## Manufacturing Systems 1

Simultaneous Balancing and Buffer Allocation to Serial Lines with Bernoulli Stations <i>Wenchong CHEN, Hongwei LIU, Wei LIU</i>	661
Enhancement of the Design Process for Manufacturing Systems via a Multi-criteria Evaluation Method Creating a Control Loop for Guided Improvement <i>Michael FELDMETH, Egon MÜLLER</i>	666
SMED in the North American Secondary Wood Products Industry <i>Urs BUEHLMANN, Enis KUCUK</i>	671
Hybridizing MJF Based Additive Layer and CNC Supported Subtractive Manufacturing for Enhancing Productivity in PD Design Iterations <i>R.M. Chandima RATNAYAKE</i>	675
Effect of Temperature on the Quality of Welding Beads Deposited with CMT Technology <i>Pascal ROBERT, Matthieu MUSEAU, Henri PARIS</i>	680
Production Management System for Small and Medium Sized Manufacturing Enterprises <i>Lei WANG, Peng LIU, Shengqian JIANG, Yiming XUE, Kun WANG, Xiangnan LI</i>	685

## Manufacturing Systems 2

An Application of Just-in-time as a Strategy for Competitive Advantage: The Case of a Non-alcoholic Company in South Africa <i>Sambil Charles MUKWAKUNGU, Eric BAKAMA, Magaly Madeleine BOLIPOMBO, Charles MBOHWA</i>	690
Environmental Management Systems in Thai Small and Medium-Sized Manufacturing Firms <i>Pittawat UEASANGKOMSATE, Chidchanok WONGSUPATHAI</i>	695
Similarity-search and Prediction Based Process Parameter Adaptation for Quality Improvement in Interlinked Manufacturing Processes <i>Jacqueline SCHMITT, Jochen DEUSE</i>	700
An Integer Linear Programming Approach for the Combined Cell Layout Problem <i>Miguel F. ANJOS, Philipp HUNGERLAENDER, Kerstin MAIER</i>	705
Reliability Analysis for a Divisional Seru Production System with Stochastic Capacity <i>Xinzi HAN, Zhe ZHANG, Yong YIN</i>	710
Predicting the Tensile Strength of Extrusion-blown High Density Polyethylene Film Using Machine Learning Algorithms <i>Firas ALHINDAWI, Safwan ALTARAZI</i>	715
Investigation of Assessment and Maturity Stage Models for Assessing the Implementation of Industry 4.0 <i>Marco UNTERHOFER, Erwin RAUCH, Dominik T. MATT, Salinee SANTITEERAKUL</i>	720

## Engineering Economy and Cost Analysis

A Systematic Literature Review of the Implementation of Cost of Quality <i>Bheki MAKHANYA, Hannelie NEL, Jan Harm PRETORIUS</i>	726
Integrated Controlling Tool with Plan-fact Analysis <i>Zoltan SEBESTYEN, Tamas TOTH</i>	731
Decision Making on Sustainable Forest Harvest Production Using Goal Programming Approach (Case Study: Iranian Hyrcanian Forest) <i>Soma ETEMAD, Soleiman MOHAMMADI LIMAEI, Leif OLSSON, Rasoul YOUSEFPOUR</i>	736
Operational Management of the Microgrid System for the Energy-sensitive Manufacturing Plant <i>Weiwei CUI, Yujie YANG</i>	741
Analysis on Influence Factors of Enterprises' Costs for Compliance to Consumer Product Standard <i>Xia LIU, Ruan LI, Xiaolei FENG, Bisong LIU, Qian WU</i>	746
American Productivity Center Method for Measuring Productivity in Palm Oil Milling Industry <i>Fitra LESTARI, Irsan NUARI, Vera DEVANI</i>	754

## Decision Analysis and Methods 1

A Two-layer Data Envelopment Analysis Model for Sustainable Performance Evaluation <i>Willy ZALATAR, Eppie CLARK</i>	758
A Hybrid Approach Using SWOT and AHP to Prioritize the Factors for Indigenous Production of Automobiles: A Case of Pakistani Automotive Industry <i>Yasir AHMAD, Zaid BIN KHALID</i>	763

World-Class Engineering: Designing for Quality, Reliability, Maintenance, and Supply Chain Management Using the Analytic Hierarchy Process <i>Travis C. MALLETT</i>	768
A Predictive Approach to Define the Best Forecasting Method for Spare Parts: A Case Study in Business Aircrafts' Industry <i>Reza BABAJANIVALASHEDI, Armand BABOLI, Muhammad Kashif SHAHZAD, Romy TONADRE</i>	773
A New Approach to Integrate Resilience Engineering and Business Process Re-engineering Design <i>Maliheh VAEZ-ALAEI, Armand BABOLI, Reza TAVAKKOLI-MOGHADDAM</i>	778
A Methodology to Integrate Artificial Intelligence with the Design Structure Matrix Approach <i>Chuks MEDOH, Arnesh TELUKDARIE</i>	783
Prediction of Critical Infrastructure Accident Losses of Chemical Releases Impacted by Climate-weather Change <i>Magda BOGALECKA, Krzysztof KOŁOWROCKI</i>	788

## Decision Analysis and Methods 2

Data-driven Defense Strategies for an Infrastructure Network against Multiple Interdictions <i>Jing JIANG, Xiao LIU</i>	793
Solving the Bidirectional Multi-Period Full Truckload Vehicle Routing Problem with Time Windows and Split Delivery for Bulk Transportation Using a Covering Model <i>Apichit MANEENGAM, Apinanthana UDOMSAKDIGOOL</i>	798
Using Multicriteria Decision Making Methods to Manage Systems Obsolescence <i>Imen ZAABAR, Yvan BEAUREGARD, Marc PAQUET</i>	803
Assessing Information Security Risk Using Markov Chain <i>Daniel TSE, Xiaoting PAN, Yuan ZONG, Jiayi LIU, Qinyan YANG</i>	808
A Comparison of Two Location Models in Optimizing the Decision-making on the Relocation Problem of Post Offices at Narvik, Norway <i>Hao YU, Wei Deng SOLVANG</i>	814
The Effect of Decision Maker's Risk Attitude on Inventory Policy: An Empirical Studies <i>Nur Aini MASRUROH, Elok PITALOKA, Wangi PANDAN SARI</i>	819
Quantitative Assessment of Economic, Social and Environmental Impacts of Critical Infrastructure Disruptions <i>Agnieszka BLOKUS</i>	824

## Information Processing and Engineering

Latent Variable Structured Bayesian Network for Cyanobacterial Risk Pre-control <i>Peng JIANG, X. LIU, J. ZHANG, S. H. TE, K. Y. H. GIN</i>	829
Identifying and Defining Knowledge-work Waste in Product Development: A Case Study on Lean Maturity Assessment <i>Felix P SANTHIAPILLAI, R.M. Chandima RATNAYAKE</i>	834
Regional Freight Volume Forecasting with Incomplete Data of Origin/Destination Freight Volumes <i>Jiahao LIU, Guangxin OU, Zhaoxia GUO</i>	839
Application of Industry 4.0 Towards Achieving Business Sustainability <i>Megashnee MUNSAMY, Arnesh TELUKDARIE</i>	844

Enterprise Definition for Industry 4.0 <i>Arnesh TELUKDARIE, Michael SISHI</i>	849
Classification System for Egyptian Heritage Buildings <i>Mohamed MARZOUK, Noha SALEEB, M. M. ELSHARKAWY, Asmaa EID, Mohamed ALI, Mahmoud METAWIE</i>	854
Development of Halal Audit Information System (HAIS) and its Implementation Evaluation Based on Time–cost Trade–off Using Integer Linear Programming (ILP) <i>Iwan VANANY, Diesta Iva MAFTUHAH, Adi SOEPRIJANTO, Faiz Rahman ARIFIN</i>	859
<b>Supply Chain Management 4</b>	
Understanding Influential Factors in Selecting Sustainable Third-party Logistics Providers: An Interpretive Structural Modeling and MICMAC Analysis <i>Xiangce MENG, Zhaojun YANG, Jun SUN</i>	864
Scenarios in Intermodal Transportation Planning <i>Wichitsawat SUKSAWAT NA AYUDHYA</i>	869
Inventory Analysis on a Single-Echelon Supply Chain System by Considering Carbon Emissions <i>Petrus Setya MURDAPA, I. Nyoman PUJAWAN, Putu Dana KARNINGSIH, Arman Hakim NASUTION</i>	874
Application of Mathematical Model for Raw Material Storage Management <i>Chompoonoot KASEMSET, Aunchalee PETCHALALAI</i>	879
Biomass Supply Chain Design, Planning and Management: A Review of Literature <i>Fitri AGUSTINA, Iwan VANANY, Nurhadi SISWANTO</i>	884
Forecasting of Used Product Returns for Remanufacturing <i>Mohammed Woyeso GEDA, C.K. KWONG</i>	889
Supplier Integration Roles in New Product Development: The Automotive Suppliers' Perspective <i>Kanagi KANAPATHY, Kooi Onn CHU</i>	894
<b>Supply Chain Management 5</b>	
Locating Facility with Multi-period and Dynamic Demand: A Case Study of Chemical Fertilizer Store in Thailand <i>Natdabhorn SAPKHOKING, Arthit APICHOTTANAKUL, Komkrit PITIRUEK</i>	899
Alignment Between Enterprise Green Supply Chain and Green Information System: An Analysis of Four Cases <i>Zheng WU, Zhaojun YANG, Jun SUN, Yu ZOU</i>	904
Decision Support System of the Single Track Railway Rescheduling with Predictive Delay <i>Ahmad RUSDIANSYAH, Kurnia ISWARDANI</i>	909
The Identification of Supplier Selection Criteria Within a Risk Management Framework Towards Consistent Supplier Selection <i>Tumelo LESISA, Annlize MARNEWICK, Hannelie NEL</i>	913
Optimal Vehicle Routing for Parcel Delivery with Considering Two Time Periods <i>Gitae KIM</i>	918
Revenue and Cost Sharing Mechanism for Effective Remanufacturing Supply Chain <i>Tatsuya INABA</i>	923
The Robustness of Warranty: Wholesale Pricing Contract vs Two-part Tariff <i>Houping TIAN, Qingqing YAN, Changxian LIU</i>	928

### **Project Management 3**

Development and Evaluation of a Workshop Concept to Support Tailoring of Complex Product Development Processes <i>Christoph HOLLAUER, Julia RAST, Udo LINDEMANN</i>	933
Scrum Agile Project Management Methodology Application for Workflow Management: A Case Study <i>Laura CARNEIRO, Ana Carolina SILVA, Luciana ALENCAR</i>	938
The Mediating Effect of Knowledge Internalization on the Relationship Between Dual Learning Behaviors and Technological Innovation Performance in the High-tech Enterprises <i>Fangmei WANGDU, Naiding YANG, Sayed Muhammad FAWAD SHARIF</i>	943
Visualised Decision Support in Industrial Project Monitoring and Control <i>Fan LI, François VERNADAT, Ali SIADAT, Li ZHENG</i>	948
Assessing the Agility of Teams within Mechatronic Product Development <i>Lucia BECERRIL, Christoph HOLLAUER, Udo LINDEMANN</i>	952
The Role of Participation in the Factory Planning Process <i>Uwe DOMBROWSKI, Alexander KARL, Christoph IMDAHL</i>	957

### **Supply Chain Management 6**

Sustainable Dynamic Pricing for Perishable Food with Stochastic Demand <i>Ghada MOUSTAFA, Noha GALAL, Khaled EL-KILANY</i>	961
Who Has More Incentive to Make Sustainable Investment, Supplier or Manufacturer? <i>Qian YUAN, Xiutian SHI</i>	966
Supplier Selection Model Development for Modular Product with Substitutability and Controllable Lead Time <i>Yosi Agustina HIDAYAT, Tota SIMATUPANG</i>	970
Factors Affecting Sustainable Supply Chain Management: The Indian Steel Sector <i>Dayal S. PRASAD, Rudra P. PRADHAN, Kunal GAURAV, Saurav DASH</i>	976
An Incentive-based Bi-level Optimization Model for Collaborative Green Product Line Design <i>Shuang MA, Songlin CHEN, Xiaotian CAI</i>	981

### **Safety, Security and Risk Management 2**

Critical Infrastructure Impacted by Climate Change Safety and Resilience Indicators <i>Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI</i>	986
Critical Infrastructure Impacted by Operation and Climate Change Safety and Resilience Indicators <i>Krzysztof KOŁOWROCKI, Joanna SOSZYNSKA-BUDNY, Mateusz TORBICKI</i>	991
Longtime Prediction of Climate-weather Change Influence on Critical Infrastructure Safety and Resilience <i>Mateusz TORBICKI</i>	996
Information Privacy Practices in Organizations: Activities, Knowledge and Skill Requirements for Information Technology Professionals <i>Yasaman ATEFI MONFARED, Younes BENSLIMANE, Zijiang YANG</i>	1001

On Context, Issues, and Pitfalls of Expert Judgement Process in Risk Assessment of Arctic Offshore Installations and Operations <i>Masoud NASERI, Abbas BARABADI</i>	1006
Food Safety and Halal Food Risks in Indonesian Chicken Meat Products: An Exploratory Study <i>Hana Catur WAHYUNI, Iwan VANANY, Udisubakti CIPTOMULYONO</i>	1011
IMU Based Real Time Underground Soil Movement Detection System: An Illustrative Investigation <i>R. M. WEERASINGHE, D. BUDDIKA, R.M. Chandima RATNAYAKE</i>	1016

## Human Factors 2

Impact of Socioeconomic Factors on the Levers Influencing Households' Participation in Recycling Programs in Zambia <i>Bupe G. MWANZA, Arnesh TELUKDARIE, Charles MBOHWA</i>	1021
Evaluation of Physical and Motor Function in an Aging Female Population – Preliminary Results <i>Marek BURES, Jana BENESOVA, Martin KABA</i>	1026
Age-related Differences in Work Motivations: The Case of SMEs <i>Riitta FORSTEN-ASTIKAINEN, Susanna KULTALAHTI, Matti MUHOS</i>	1031
What Humans Act in Robotic Surgery <i>Fabio FRUGGIERO, Marcello FERA, Alfredo LAMBIASE, Salvatore MIRANDA</i>	1035
The Influence of Family on Self-reflexive and Emotional Antecedents of the Transformational Leader <i>Lirios ALOS-SIMO, Antonio VERDU-JOVER, Jose Maria GOMEZ-GRAS, Marina ESTRADA-DE-LA-CRUZ</i>	1041
Risk Reduction Among Adult Walker Users: An Ergonomic Innovation <i>Ezra C. GODILANO, Edgardo M. BALDOVINO JR., Jeizel Abbigael D. CAHENDE, Marielle B. TERRIBLE</i>	1046
WMSD Risk Reduction Among Grocery Shoppers and Clerks by Redesigning Double Basket Shopping Carts <i>Ezra C. GODILANO, Joshua John G. ALMORO, Al John D.P. BULAHAN, Edward Kenneth Allen C. GARCIA</i>	1051

## Intelligent Systems 1

Towards a Knowledge based Support for Risk Engineering When Elaborating Offer in Response to a Customer Demand <i>Rania AYACHI, Delphine GUILLON, Francois MARMIER, Elise VAREILLES, Michel ALDANONDO, Thierry COUDERT, Laurent GENESE, Yvan BEAUREGARD</i>	1056
A Cooperative Multi-agent-based Musical Scoring System for Tsugaru and Nambu Shamisen <i>Juichi KOSAKAYA, Reiko KAWAMORITA, Ming-Fang HSU</i>	1061
Contact Coordinate Measurements of Free-form Surfaces: A FIS for Optimal Distribution of Measurement Points <i>Marek MAGDZIAK, R.M. Chandima RATNAYAKE</i>	1068
Particle-swarm Krill Herd Algorithm <i>Gai-Ge WANG, Wenyin GONG, Xiaobo LIU, Danyu BAI, Teng REN, Xuesong YAN</i>	1073
Industrial Smart Services: Types of Smart Service Business Models in the Digitalized Agriculture <i>Achim KAMPKER, Philipp JUSSEN, Benedikt MOSER</i>	1081
Construction Resource Localization Based on UAV-RFID Platform Using Machine Learning Algorithm <i>Daeyoun WON, Man-Woo PARK, Seokho CHI</i>	1086

Industry 4.0 in Practice – Identification of Industry 4.0 Success Patterns <i>Jörg PUCHAN, Alexander ZEIFANG, Jun-Der LEU</i>	1091
--	------

## Intelligent Systems 2

Combining IOT and Android APP System for Upper Limb Stroke Rehabilitation <i>Keng-Chieh YANG, Chia-Hui HUANG, Chieh-Yow CHIANGLIN</i>	1096
Traffic Voting System to Achieve the Balance Between Privacy and Trip Chain Data Acquisition <i>Wentian CHEN, Kai ZHANG, Zhiheng LI</i>	1101
A Predictive Model for Forecasting Spare Parts Demand in Military Logistics <i>Hanjun LEE, Jaedong KIM</i>	1106
Advanced Automation for SMEs in the I4.0 Revolution: Engineering Education and Employees Training in the Smart Mini Factory Laboratory <i>Luca GUALTIERI, Rafael ROJAS, Giovanni CARABIN, Ilaria PALOMBA, Erwin RAUCH, Renato VIDONI, Dominik T. MATT</i>	1111
A Real Time Stare in Market Strategy for Supply Chain Financing Pledge Risk Management <i>Benhe GAO, Qian ZHOU, Shigang LI, Xinglu LIU</i>	1116
Involving the Manufacturing System within its Planning Phase <i>Matthias BARTELT, Bernd KUHLENKÖTTER</i>	1120

## Reliability and Maintenance Engineering 3

Environmental Sustainability in Maintenance Management of Public Transport Systems: Literature Review <i>Iyad ALAWAYSHEH, Imad ALSYOUF</i>	1125
Reliability Assessment for Multi-area Load Frequency Control Systems with Degraded Components <i>Zhiying WU, Huadong MO, Junlin XIONG</i>	1130
Spectral Graph Wavelet based Component Clustering for System Reliability Analysis <i>Ping ZHANG, Xiaoyan ZHU</i>	1135
Preparation of Preventive and Predictive Maintenance Guidelines for Emulsion Preparation and Processing Plant Using Risk Management Techniques <i>Dushan I. JAYASINGHE</i>	1140
Reliability Analysis of the Crude Oil Transfer System in the Oil Port Terminal <i>Agnieszka BLOKUS, B. KWIATUSZEWSKA-SARNECKA</i>	1145
Debugging Process Oriented Software Reliability Models and Their Goodness-of-Fit <i>Shinji INOUE, Shigeru YAMADA</i>	1150
Mixture Lognormal Cox Regression Repair Model for Prediction of the Repair Time <i>Yonas Zewdu AYELE, Abbas BARABADI, Fuqing YUAN</i>	1155

## Healthcare Systems and Management 2

Preoperative Analysis for Clinical Features of Unsuspected Gallbladder Cancer Based on Random Forest <i>Zhen ZHANG, Na LI, Hengyi GAO, Zhiqiang CAI, Shubin SI, Zhimin GEMG</i>	1160
--	------

Developing Customer Perception Based Organization Performance Measurement Framework for Healthcare Service <i>I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN</i>	1165
Data Accessibility for Biotech and Medicine Industries: A Cross-stakeholder Perspective <i>Zih-Han WANG, Wei JENG</i>	1170
‘Strategy Making’, Not Re-engineering: Thinking Ahead, Again, and Across for Process Innovation in Home Care <i>Desmond WONG, Yee Lin HIEW</i>	1175
A Bi-objective Credibility-based Fuzzy Mathematical Programming Model for a Healthcare Facility Location-network Design Problem <i>Reza TAVAKKOLI-MOGHADDAM, Pooya POURREZA, Ali BOZORGI-AMIRI, Nastaran OLADZAD</i>	1181
Implementing and Using New Information Technology in Hospital Logistics <i>D. KRITCHANCHAI, Per ENGELSETH, Sirirat SRISAKUNWAN</i>	1186
Design and Development of a Prototype for Measuring Range of Motion <i>Manutchanok JONGPRASITHPORN, Nantakrit YODPIJIT, Thachamaporn CHANAROON, Thunjira PAIBOONRATTANAKORN, Teppakorn SITTIWANCHAI</i>	1191

## **E-Business and E-Commerce**

e-Commerce Logistics – Contemporary Literature <i>Hamid JAFARI</i>	1196
An ERP-based Solution for the Supply Chain Planning of Medium-sized Global Manufacturing Company <i>Jun-Der LEU, Andre KRISCHKE, Yi-Ping LEE, Larry Jung-Hsing LEE, Yi-Wei HUANG</i>	1201
Integration of Small and Medium Enterprises for Industry 4.0 in the South African Water Services Sector: A Case Study for Johannesburg Water <i>Pholo NTHUTANG, Arnesh TELUKDARIE</i>	1206
Observational Learning in the Product Configuration Process: An Empirical Study <i>Yue WANG</i>	1211
Drone-delivery Using Autonomous Mobility: An Innovative Approach to Future Last-mile Delivery Problems <i>HoJoon David YOO, Stanislav CHANKOV</i>	1216
Robust Password-keeping System Using Block-chain Technology <i>Daniel TSE, Kaicheng LIANG, Bin CAI, Kecong HUANG</i>	1221

## **Operations Research 4**

Lease Contract with Availability Target and Price Discount <i>Hennie HUSNIAH, Rachmawati WANGSAPUTRA, Bermawi P. ISKANDAR</i>	1226
Profit Maximization in Inventory Routing Problems <i>Anna ZAITSEVA, Lars Magnus HVATTUM, Sebastián URRUTIA</i>	1230
Using Iterated Greedy with a New Population Approach for the Flexible Job-shop Scheduling Problem <i>Ghiath AL AQEL, Xinyu LI, Liang GAO, Wenyin GONG, Rui WANG, Teng REN, Guohua WU</i>	1235

Research on Overall Improvement of Production Efficiency: A Case Study Based on Value Stream Mapping Analysis in Automobile Decoration Products Manufacturing Industry <i>Huang LI, Chunming YE, Zhenbin ZHOU, Xinyu ZHOU, Xiaoxue FU, Lingling PENG</i>	1240
Challenges of Digital Transformation: The Case of the Non-profit Sector <i>Saeedeh SHAFIEE NAHRKHALAJI, Sara SHAFIEE, Mitra SHAFIEE NAHRKHALAJI, Lars HVAM</i>	1245

## Technology and Knowledge Management 2

Developing the Strategies for AI Products based on the Technology Decomposition Framework <i>Song-Kyoo KIM</i>	1250
Brain Utilization of MNCs in Japan Compared with that of Japanese Companies Overseas <i>Masayuki KONDO</i>	1255
Integration of Scenarios in Product-service System Development - Combining Scenarios, Use Cases and Requirements Traceability <i>Dominik WEIDMANN, Felix SEIBEL, Lucia BECERRIL, Niklas KATTNER, Jona LEHR, Markus MOERTL, Udo LINDEMANN</i>	1259
Integration of Scenario-based Requirements Forecast into Model-based Product-service System Planning <i>Dominik WEIDMANN, Stefan WINKLER, Markus MOERTL</i>	1264
Methodology for Digitalization – A Conceptual Model <i>Huey Yuen NG, Puay Siew TAN, Y. G. LIM</i>	1269
Value Chain from Good to Great: Multiple-case Study of Estonian Companies <i>Kadri MÄNNASOO, Mait RUNGI, Heili HEIN, Helery TASANE</i>	1274
How to Use Configuration Software in “Less Routine Design” Situations? Some Modelling Propositions <i>Abdourahim SYLLA, Delphine GUILLON, Luis GARCES MONGE, Elise VAREILLES, Michel ALDANONDO, Thierry COUDERT, Laurent GENESTE</i>	1279

## Technology and Knowledge Management 3

Network Structure and Positional Relationship of the External and Internal Technology Acquisition based on the Firm Self-citation Patent Network <i>Chao-Chih HSUEH</i>	1284
Appropriate Technology and Management for Sustainability <i>Jayshree PATNAIK, Bhaskar BHOWMICK</i>	1289
Social Network Analysis in Lean Thinking: A Method for Improving Information Flow in Technical Integrity Management System Development <i>Andika RACHMAN, R.M. Chandima RATNAYAKE</i>	1293
Engineering Management Qualification: A Comparative Study for South African Universities <i>Samuel MLANGENI, Arnesh TELUKDARIE</i>	1299
Measuring Product Success: A Literature Study <i>Trifandi LASALEWO, Subagyo SUBAGYO, Hari Agung YUNIARTO, Budi HARTONO</i>	1304
Determinant of Startups’ Fund-raising Value: Entrepreneur and Firm Characteristic <i>Pimolrat SATHAWORAWONG, Natcha THAWESAENGSKULTHAI, Kanis SAENGCHOTE</i>	1309
Configuration Lifecycle Management – Future of Product Configurators <i>Anna MYRODIA, Thomas RANDRUP, Lars HVAM</i>	1315

## Technology and Knowledge Management 4

Multiple Helix Approach in Advancing Sustainable Urban Energy Ecosystems <i>Nina TURA, Ville OJANEN, Tuomas PALOVIITA, Sini PIIPARINEN</i>	1320
Time Estimation for Product Configuration Systems Projects <i>Katrin KRISTJANSDDOTTIR, Amartya GHOSH, Loris BATTISTELLO, Lars HVAM</i>	1327
Changes of Technological Knowledge Diversification within a Group of Inventors and Patent Value Corresponding to Technology Lifecycle <i>Ryo TAKEMURA, Noritomo OUCHI</i>	1332
Improving Modularization in Industry by Introducing a New Model for Module Classification <i>Dag RAUDBERGET, Fredrik ELGH</i>	1337
Two-dimensional Technology Profiling of Patent Portfolio <i>Chung-Huei KUAN, Wei-Ming TU, Dar-Zen CHEN</i>	1342
Industry 4.0 Implementation Barriers in Small and Medium Sized Enterprises: A Focus Group Study <i>Guido ORZES, Erwin RAUCH, Slavomir BEDNAR, Robert POKLEMBIA</i>	1348
Channel-based Phase and Power Controllable Intelligent Wireless Power Transfer Architecture Using 4 by 4 Planar Array Antennas <i>Kwonhong LEE, Jinhyoung KIM, Jinwook SEO, Hyunyoung YU, Cheolung CHA</i>	1353

## Technology and Knowledge Management 5

Content Analysis Approach: A Review on the Extent of Science and Engineering Curriculum Meet Competency Requirements for Testing, Inspection and Certification Industry <i>Fanny TANG</i>	1356
A Conceptual Interaction Cycle Between Individual and Group Absorptive Capacity with Social Integration Mechanism and Cohesive Learning Group as Moderating Variables <i>Andy Susilo LUKITO-BUDI, Nurul INDARTI</i>	1361
The Complexity of Megaprojects in Developing Countries: A Literature Review <i>Retno Wulan DAMAYANTI, Budi HARTONO, Andi Rahadiyan WIJAYA</i>	1366
A Novel Concept for Solid Debris Extraction Technique from Used Lubricants for Predictive Maintenance <i>Sontinan INTASONTI, Tadpon KULLAWONG, Surapol RAADNUI</i>	1371

## Systems Modeling and Simulation 2

Simulation-based Multiple Automated Guided Vehicles Considering Charging and Collision-free Requirements in Automatic Warehouse <i>C.K.M. LEE, K.L. KEUNG, K.K.H. NG, Daniel C.P. LAI</i>	1376
Simulation and Optimization of Production Line in Em-plant based Assembly Workshop <i>Hongying SHAN, Lina LI, Yu YUAN, C. WANG</i>	1381
Lean, Simulation and Optimization: The Case of Steering Knuckle Arm Production Line <i>Hongying SHAN, Yu YUAN, Yanxiang ZHANG, Lina LI, Chuang WANG</i>	1386
Efficient Modular Product Platform Design of Mechatronic Systems <i>Günther SCHUH, Christian DÖLLE, Sebastian BARG, Maximilian KUHN, Stefan BREUNIG</i>	1391

Informational Approach to Global Optimization with Input Uncertainty for Homoscedastic Stochastic Simulation 1396  
*Haowei WANG, Jun YUAN, Szu Hui NG*

Energy Efficient Motion Planning of Dual-Armed Robots with Pickup Point Determination for Transportation Tasks 1401  
*Tatsushi NISHI, Yuki MORI*

System Dynamics Approach for the Assessment of Leanness of Organizations 1406  
*Abhijeet K. DIGALWAR, Akshay BEDEKAR, Mohit AGRAWAL*

### Operations Research 3

Protecting a Sensitive Queue from Arrival Variability 1411  
*Mathieu VANDENBERGHE, Stijn DE VUYST, El-Houssaine AGHEZZAF, Herwig BRUNEEL*

Multi-criteria Mathematical Model for Partial Double Track Railway Scheduling in Urban Rail Network 1416  
*Erlangga BAYU SETYAWAN, Dida Diah DAMAYANTI, Anton Abdulbasah KAMIL*

Vehicle Routing: Application of Travelling Salesman Problem in a Dairy Distributor 1421  
*Rafael PALHARES, Maria Creuza BORGES DE ARAUJO*

A Matheuristic for a Real-world Variant of the Multiple Traveling Salesman Problem 1426  
*Philipp BAUMANN*

Robust Periodic Vehicle Routing Problem with Service Time Uncertainty 1431  
*Mingyao QI, Wangqi XIONG, Qingte ZHOU, Shijia HUA*

Picking Station Location in Traditional and Flying-V Aisle Warehouses for Robotic Mobile Fulfillment System 1436  
*Lijuan FENG, Xinglu LIU, Mingyao QI, Shijia HUA, Qingte ZHOU*

### Decision Analysis and Methods 3

Novel SKU Classification Approach for Autonomous Inventory Planning 1441  
*Fengyu WANG, Huey Yuen NG, Thai Ee NG*

Fundamental Design Types of Modular Product Platforms 1446  
*Sebastian BARG, Günther SCHUH, Christian DÖLLE*

Optimal Overbooking Decision for Perishable Resources with Jointly Stochastic Booking and Show-up Requests 1451  
*Suppasit JONGCHEVEEVAT, Naragain PHUMCHUSRI, Amonsiri VILASDAECHANONT*

Multicriteria Inventory Classification of Diabetes Drugs Using a Comparison of AHP and Fuzzy AHP Models 1456  
*Kaushik NAG, Magdy HELAL*

Data-Based Identification Method for Jobshop Scheduling Problems Using Timed Petri Nets 1461  
*Tatsushi NISHI, Naoki SHIMAMURA*

Development of a Methodology to Design Product Portfolios in Accordance to Corporate Goals Using an Evolutionary Algorithm 1466  
*Michael RIESENER, Christian DÖLLE, Lukas SCHMITT, Merle-Hendrikje JANK*

Public Perception of the Nuclear Research Reactor in Thailand 1471  
*Sarasinee TANTITAECHOCHART, Naraphorn PAOPRASERT, Kampanart SILVA*

### Manufacturing Systems 3

A Modified MOEA/D for Energy-efficient Flexible Job Shop Scheduling Problem <i>Enda JIANG, Ling WANG</i>	1476
Radical Product Innovation in the New Zealand Food and Beverage Industry: The Effect of Company Age, Size, and Foreign Ownership <i>Julawit PITRCHART, Nihal JAYAMAHA, Allan ANDERSON</i>	1481
Integrated Simulation Optimization for Layout Problems <i>Henri PIERREVAL</i>	1486
Implementing FPGA based PID-controller for Extrusion to Reduce Raw Material Wastage <i>Samreen HUSSAIN, Muhammad ISMAEEL, Adnan WAQAR, Muhammad Ali AMJAD, Muhammad Mubeen IQBAL, Muhammad SHAUR, Rimsha ARSHAD</i>	1491
Rapid Thermal Simulation of Powder Bed Additive Manufacturing <i>Frédéric VIGNAT, Nicolas BERAUD, Francois VILLENEUVE</i>	1498
Energy Consumption Control of One Machine Manufacturing System with Stochastic Arrivals Based on Fuzzy Logic <i>Eliana TORRES DUQUE, Zicheng FEI, Junfeng WANG, Shiqi LI, Yuanfang LI</i>	1503
Analysis of Product Designs for Product Recovery Using Linear Physical Programming <i>Aditi D. JOSHI, Surendra M. GUPTA</i>	1508

### Big Data and Analytics 2

Evidences of Technological Advantage Gains: The Case of Mergers and Acquisitions in the Agrichemical Industry <i>Chun-Chieh WANG, Mu-Hsuan HUANG, Yu-Wei CHANG</i>	1513
Do Long-term Patents Have a Higher Citation Impact? <i>Huei-Ru DONG, Dar-Zen CHEN, Mu-Hsuan HUANG</i>	1518
Categorization of Mergers and Acquisitions in Japan Using Corporate Databases: A Fundamental Research for Prediction <i>Bohua SHAO, Kimitaka ASATANI, Ichiro SAKATA</i>	1523
Distributed-based Hierarchical Clustering System for Large-scale Semiconductor Wafers <i>Seungchul LEE, Daeyoung KIM</i>	1528
A Learning Analytics Tool for Predictive Modeling of Dropout and Certificate Acquisition on MOOCs for Professional Learning <i>Ruth COBOS, Lara OLMOS</i>	1533
Study on Unbalanced Binary Classification with Unknown Misclassification Costs <i>Jun GAO, Lin GONG, JinYi WANG, ZhenChong MO</i>	1538
Data Analytics Framework for State Owned Enterprise of Bhutan <i>Yadap SUBERI, Devi Bhakta SUBERI</i>	1543

### Service Innovation and Management 3

Multinational Enterprises R&D in China, Government Subsidy Effect: An Empirical Research Based on Simultaneous Equations <i>Jian WANG, Peng GUO, Qilei LIU</i>	1548
---	------

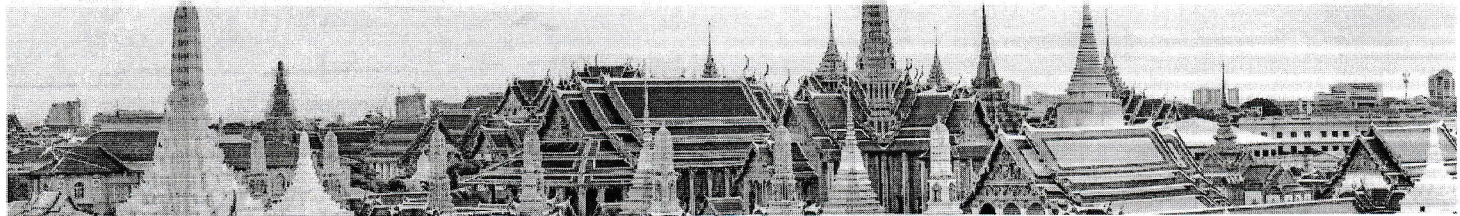
Sustainability-oriented Innovation (SOI) in Emerging Economies: A Preliminary Investigation from Indonesia <i>Budi HARSANTO, Roula MICHAELIDES, Helga DRUMMOND</i>	1553
Business Logistics Optimization using Industry 4.0: Current Status and Opportunities <i>Bag SURAJIT, Arnesh TELUKDARIE</i>	1558
Testing and Extending P-Transqual Public Transport Service Quality Model: A Causal Approach <i>I. Gede Mahatma Yuda BAKTI, Tri RAKHMAWATI, Sih DAMAYANTI, Sik SUMAEDI, Medi YARMEN</i>	1563
How Kano's Performance Mediates Perceived SERVQUAL Impact on Kansei <i>Markus HARTONO</i>	1568
A Study Regarding the Gap Between the Industry and Academia Expectations for College Student's Employability <i>Feng-Ming SUI, Jen-Chia CHANG, Hsi-Chi HSIAO, Su-Chang CHEN, Dyi-Cheng CHEN</i>	1573
Visualize Organizational Perception of Core Value in the Company: An Experiment Employing Multi-dimensional Scaling and the Competing Value Framework <i>Sanetake NAGAYOSHI, Jun NAKAMURA</i>	1578
<b>Posters</b>	
Managing Outsourced Logistics Service Projects as Complex Networked Resources <i>Fahad AWALEH, Per ENGELSETH</i>	1583
Location Analysis of Regional Disaster Relief Material Reserve Center: A Case Study in Sichuan Province, China <i>Xuedong LIANG, Ruyun ZHANG, Canmian LIU</i>	1588
Hospital Capacity Planning for Special Economic Zone in Thailand: A Case Study in Kanchanaburi Province <i>Sao Theary AN, D. KRITCHANCHAI</i>	1593
Optimizing (r, Q) Decisions Considering Misplaced Items: Lost-sales and Backorder Cases <i>Linda L. ZHANG, G. Yazgi TUTUNCU, Ceki FRANKO</i>	1598
Analysis of Stackelberg Leadership Model Output Behavior under the Mechanism of Expanding Market Price <i>Tyrone T. LIN, Shu Yen HSU, Chiao Chen CHANG</i>	1603
A Project Management with Allocating Advertising Budgets' Decision Analysis in Aesthetic Medicine Industry <i>Hui-Tzu YEN, Tyrone T. LIN</i>	1608
Research on Service Industry Network Structure based on Social Network Analysis <i>Xuedong LIANG, Yangjingjing ZHANG, Yue LU, Canmian LIU</i>	1613
Inequality Structure of Global Investment: Analysis and Simulation of an M&A Network <i>Kimitaka ASATANI, Hiroko YAMANO, Masanao OCHI, Ichiro SAKATA</i>	1618
Using Time-dependent Attractiveness to Evaluate Dynamic Place-based Accessibility <i>William H. K. LAM, Bi Yu CHEN, Agachai SUMALEE</i>	1623
On Setting Business Goal in Corporations <i>Shin-Guang CHEN</i>	1628
Hotel Cancellation Strategies Under Online Advanced Booking <i>Yifan HE, Pingping WEN, Yongquan LAN, Zhaowei MIAO</i>	1632

Optimal Cleaning Schedule of Photovoltaic Module <i>Zhonghao WANG, ZhengGuo XU</i>	1637
Systems Analysis and Design of a Smart Traffic Service System for Predictive and Smarter Mobility and Safety in Roadway Work Zones <i>Roger J. JIAO, James Y. TSUI</i>	1642
Operating Data-driven Predictive Analytics for Tele-diagnosis of Refrigeration Systems: A Case Study <i>Tianyi LU, Jun DU, Roger J. JIAO</i>	1647
Text Mining-based Approach for Forecasting Spare Parts Demand of K-X Tanks <i>Jaedong KIM</i>	1652
Minimization of Critical Infrastructure Accident Losses of Chemical Releases Impacted by Climate-Weather Change <i>Magda BOGALECKA, Krzysztof KOŁOWROCKI</i>	1657
A Novel Two-stage Method of Selection of Sample Points for Surface Quality Estimation of Multi-hole Workpiece <i>Delin HUANG, Shichang DU, Guilong LI, Tangbin XIA</i>	1662
One-Sided Synthetic Control Charts for Monitoring the Coefficient of Variation with Measurement Errors <i>Kim Phuc TRAN, Huu Du NGUYEN, Quoc Thong NGUYEN, Wichai CHATTINNAWAT</i>	1667
Quality Evaluation of Diesel Marine Engine Based on Fuzzy Analytic Hierarchy Process and Improved Close Value Method <i>Yuliang ZHOU, Shenghan ZHOU, YiYong XIAO, Wenbing CHANG</i>	1672
Research of Foreign Trade Equipment Preventive Maintenance Decision Scheme based on User Capability <i>Weikang XUE, Weiwei CUI, Xiao HU, Xiaodong MA, Yao WANG</i>	1677
Research on Fault Diagnosis of Rolling Bearing Based on Wavelet Packet Transform and IPSO-SVM <i>Yingxiang ZHONG, Fan HONG-LI, Jiping LU, Lu PANG, Yuanfang LI</i>	1682
Reliability and Efficiency Optimization Assisted by Genetic Algorithm to Design a Quadratic Boost DC/DC Converter <i>Giuseppe MARSALA, Antonella RAGUSA</i>	1687
Degradation Modeling and Performance Monitoring of Electro-optical Detection System via Dynamic Bayesian Network <i>Jinsong YU, Yiyu SHI, Diyin TANG, Hao LIU</i>	1693
Time-dependent Reliability Modelling Method Based on Load-strength Model in the Presence of Environmental Effects <i>Jian-Chun ZHANG, Yu ZHAO, Xiao-Bing MA</i>	1699
Maintenance Planning Key Process Area: Case Study at Oil & Gas Industry in Indonesia <i>Rahmat NURCAHYO, Dedy DARMAWAN, Yadrifil JANNIS, Ary KURNIATI, Muhammad HABIBURRAHMAN</i>	1704
A Multi-objective Framework for Designing Accelerated Degradation Tests Under Wiener Process Model <i>Han WANG, Yu ZHAO, Xiao-Bing MA</i>	1709
Cold-standby Redundancy Optimization for Multi-type Production Systems Using NSGA-II <i>Wei WANG, Yaofeng XU, Jiqing WEI, Wei QU</i>	1714
Multi-scale Configuration Design Method of Reconfigurable Manufacturing System Based on Living System Theory <i>Sihan HUANG, Guoxin WANG, Siming WANG, Cong ZENG, Hongwei WANG, Yan YAN</i>	1719

Selective Maintenance Decision for Multistate Manufacturing System Based on Extended State Task Network	1725
<i>Zhaoxiang CHEN, Yihai HE, Yixiao ZHAO, Xiao HAN, Zheng HE</i>	
Introducing a Holistic Profitability Model for Additive Manufacturing: An Analysis of Laser-powder Bed Fusion	1730
<i>Frank Thomas PILLER, Reinhart POPRAWA, Johannes Henrich SCHLEIFENBAUM, Günther SCHUH, Sebastian BARG, Christian DÖLLE, Christian HINKE, Merle-Hendrikje JANK, Ruth JIANG, Wilhelm MEINERS, Michael RIESENER, Johannes SCHRAGE, Stephan ZIEGLER</i>	
The Layout Optimization Problem of Automobile Engine Production Line	1736
<i>Hang LI, Ran LIU, Lun SHI</i>	
Applying the Axiomatic Design with Design Constraint to Redesign of Automatic Work-piece Changer	1741
<i>Tossaporn ASSAWARUNGSRI, Nattawut JANTHONG</i>	
An Example of Machine Learning Applied in Additive Manufacturing	1746
<i>Amelina DOUARD, Christelle GRANDVALLET, Franck POURROY, Frédéric VIGNAT</i>	
Critical Assessment on Dangerous Goods Storage Container Yard of Port: Case Study of LPG Tank Container	1751
<i>Guanquan CHU, Guangyu LYU</i>	
Risk Identification Practice in Patient Safety Context	1756
<i>Mecit Can Emre SIMSEKLER, Raja JAYARAMAN</i>	
Critical Infrastructure Safety Indicators	1761
<i>Krzysztof KOLOWROCKI, Joanna SOSZYNSKA-BUDNY</i>	
Critical Infrastructure Impacted by Operation Safety and Resilience Indicators	1765
<i>Joanna SOSZYNSKA-BUDNY, Krzysztof KOLOWROCKI</i>	
Detecting Technological Recombination for Potential R&D Exploration	1770
<i>Xiao ZHOU, Lu HUANG</i>	
Strategy Transformation Through Cultural Tradition Innovation – A Case Study of Fenjiu Group of China Time-honored Brand	1775
<i>Haibing LIU, Qingrui XU, Lihua WANG, Wenjing FENG, Li LIU</i>	
Study on Incentive Mechanism of Knowledge Sharing in Supply Chain Based on Evolutionary Game Theory	1780
<i>Qiankun WANG, Shi QIAO</i>	
A Serious Game for Competence Development in Internet of Things and Knowledge Sharing	1786
<i>Ugyen NIMA, Jannicke Baalsrud HAUGE, Rinzin WANGDI</i>	
A Chatbot-supported Smart Wireless Interactive Healthcare System for Weight Control and Health Promotion	1791
<i>Chin-Yuan HUANG, Ming-Chin YANG, Chin-Yu HUANG, Yu-Jui CHEN, Meng-Lin WU, Kai-Wen CHEN</i>	
Product Platform Planning through Sensitivity Analysis and Improved QFD Approach	1796
<i>Lei ZHANG, Hansi CHEN, Zhenlong YUAN, Xuening CHU</i>	
Performance Assessment of Product Modules Based on Usage Data Collected Through Embedded Sensors	1801
<i>Hansi CHEN, Lei ZHANG, Xuening CHU</i>	
An Approach to Multidimensional Medical Data Analysis Based on the Skyline Operator	1806
<i>Min CHE, Liya WANG, Zhibin JIANG</i>	

Asynchronous Multi-sensor Data Fusion with Decentralized IMM-PDAF <i>Woo Jung PARK, Chang Ho KANG, Sun Young KIM, Chan Gook PARK</i>	1811
Support Reuse and Maintenance of Design Information in a Development Process of Custom Engineered Product <i>Morteza POORKIANY, Joel JOHANSSON, Fredrik ELGH</i>	1816
Comparison of Clustering Methods for Obesity Classification <i>Sung Hee AHN, Cai WANG, Gee Won SHIN, Donggun PARK, Yohan KANG, Jaramier JOIBI, Myung Hwan YUN</i>	1821
Building Material Price Forecasting Based on Multi-method in China <i>Qiankun WANG, Tingting MEI, Zeng GUO, Lingwei KONG</i>	1826
Scoping a PIM System: A Supporting Framework <i>Loris BATTISTELLO, Katrin KRISTJANSDDOTTIR, Lars HVAM</i>	1831
Reengineering of Factory Planning Processes for the Realization of Digital Factory 4.0 <i>Uwe DOMBROWSKI, Alexander KARL, Alexander REISWICH</i>	1836
Emerging Simulation and VR for Green Innovations: A Case Study on Promoting a Zero-carbon Emission Platform in Hong Kong <i>Cheuk Hang AU, Wai Ki YIU, Walter S. L. FUNG</i>	1841
Simulation Analysis on Energy Consumption of Multi-shuttle Automated Storage and Retrieval Systems <i>Peng YANG, Wenjun XU, Shilu WANG</i>	1846
A Study on Designing Off-grid System Using HOMER Pro - A Case Study <i>Sungjun JIN, Hyungtae KIM, Tae Hyun KIM, Hansol SHIN, Kyuhyeong KWAG, Wook KIM</i>	1851
Integrating Hierarchical Task Analysis into Model-Based System Design using Airbus XHTA and IBM Rational Rhapsody <i>Jakob ROTT, Julian WEIXLER, Alexander RABL, Peter SANDL, Mario WEIß, Birgit VOGEL-HEUSER</i>	1856
Integrated Cyber Physical Simulation Modelling Environment for Manufacturing 4.0 <i>Weidong LIN, Y.H. LOW, Y.T. CHONG, C.L. TEO</i>	1861
Multi-objective Design Space Exploration for the Integration of Advanced Analytics in Cyber-physical Production Systems <i>Romuald Jupiter BAKAKEU NGASSAM, Jonathan FUCHS, Tallal JAVIED, Matthias BROSSOG, Jorg FRANKE, Hans-Henning KLOS, Werner EBERLEIN, Schirin TOLKSDORF, Joern PESHKE, Lars JAHN</i>	1866
Building Energy Conservation Strategies Evaluation and Simulation <i>B-I WANG, Chien Ming LO, Min-Der LIN</i>	1874
Analysis and Optimization of Bottlenecks via Simulation <i>Ji'ao YUAN, Runtong ZHANG</i>	1879
Community Detection and Growth Potential Prediction Using the Stochastic Block Model and the Long Short-term Memory from Patent Citation Networks <i>Kensei NAKAI, Hirofumi NONAKA, Asahi HENTONA, Yuki KANAI, Takeshi SAKUMOTO, Shotaro KATAOKA, Elisa Claire ALEMÁN CARREÓN, Toru HIRAOKA</i>	1884
An Integrated Scheduling Strategy in Dynamic Scheduling of Manufacturing Execution System <i>Hui DU, Dacheng LIU, Chuanshen WANG</i>	1889
Simple and Cost Effective System for Overall Equipment Efficiency Measurement <i>Timo RAUTIO, Kari KUTUNIVA, Jarmo MÄKIKANGAS, Kari MÄNTYJÄRVI</i>	1895

Solving Profit Maximization Problem in Case of the Cobb-Douglas Production Function via Weighted AG Inequality and Geometric Programming <i>Vedran KOJIĆ, Zrinka LUKAČ</i>	1900
Collaborative Innovation Using Bi-processes Cross-functional Team on New Product Development <i>Yueen LI, Jiacheng ZHANG, Haiyan ZHANG</i>	1904
Systematic Selection, Adaptation and Integration of Quality Management Methods Into Quality Management Reporting <i>Cosima Nadine FITZ, Guanwei HUANG</i>	1909
Optimizing Production and Inventory Decisions for Mixed Make-to-order/Make-to-stock Ready-made Garment Industry <i>Aya ELMEHANNY, Tamer ABDELMAGUID, Amr ELTAWIL</i>	1913
<b>Author Index</b>	<b>1914</b>



## PROOF OF ATTENDANCE

This is to certify that

**Markus Hartono**

*University of Surabaya*

has participated in the

## 2018 IEEE International Conference on Industrial Engineering and Engineering Management

held at

Royal Orchid Sheraton Hotel and Towers, Bangkok, Thailand  
during the period

16 to 19 Dec, 2018

and presented the paper(s)

***IEEM18-P-0564: How Kano's Performance Mediates Perceived SERVQUAL Impact on Kansei***

Markus HARTONO

*University of Surabaya, Indonesia*



# How Kano's Performance Mediates Perceived SERVQUAL Impact on Kansei

M. Hartono<sup>1</sup>

<sup>1</sup>Department of Industrial Engineering, University of Surabaya, Surabaya, Indonesia  
([markus@staff.ubaya.ac.id](mailto:markus@staff.ubaya.ac.id))

**Abstract** – 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.

**Keywords** - Kano, logistics services, Kansei, SERVQUAL

## I. INTRODUCTION

Nowadays, customers are increasingly more demanding. The more fulfilled, the more satisfied the customers are. Their needs consist of basic, one-dimensional, and attractive attributes, according to Kano *et al.* [1]. With regard to Kano's attractive service attributes [2], service providers and companies should listen, understand and capture carefully the voice of customer, especially the latent needs. The latent needs refer to the unspoken emotional needs [2].

Customer satisfaction only is insufficient. Due to tight business competition nowadays, to delight our customers is more critical for long-term benefits [3]. It would be more beneficial for service providers to focus more on attractive and desirable service attributes for their potential customers. Basically, something is attractive today will become a known attribute and function tomorrow, and sooner it will be used throughout the whole world.

Customer satisfaction, basically, comprises of two components, i.e., cognition and affect. Both cognitive and affective satisfactions should not be neglected. More recent studies regard emotional satisfaction as a more dominant driver for customer loyalty. Dixon *et al.* [4] doubted that customer satisfaction alone is not sufficient in predicting the customer loyalty. However, the emotion-based interaction will be attaining more customer loyalty. A recent study on affective-based service quality [5] confirmed that customer emotional satisfaction (known as

Kansei) has a significant impact on customer loyalty, and is proportionally mediating the relationship between perceived service quality and loyalty. More specifically, Kansei has been found to be equally important as cognition in a service interaction setting.

Kano model has a superior attribute to fill out the human latent needs or emotions. Those are the driver for customer satisfaction and delight. This model can promote a practical guidance for service providers in delivering the best-trade-off between resource and customer satisfaction [6]. Thus, the attractive Kano, which is called as a delighter, should be prioritized as it is deemed as a key to beat the competition in the market place [8].

Inherently, Kano's attractive and one-dimensional dimensions bring more impacts on Kansei, according to recent studies on Kansei Engineering in service quality [see [8], [9], [10]]. Recent studies on the integration of Kansei Engineering and Kano model in services show that Kano model is used to filter the performance of each service attribute regards to customer perception [see [2], [8], [9], [10]]. The identification, of which Kano's category influences Kansei the most, is still unexplored yet. The doubt lies in Kano's attractive attributes. Thus, the proof of it is highly required.

The objective of this study is to test whether the Kano's main categories, namely, attractive [A], one-dimensional [O] and must-be [M] have proportional impact on Kansei. An empirical study on logistics services has been conducted to verify the proposed hypothesis.

## II. METHODOLOGY

### A. Sample and Strategy

Data have been collected through in-depth interview and face-to-face questionnaire involving customers of a company providing logistics services. This research strategy is deemed to be powerful since it fits to the exploration and theory testing and extension [11]. As an object of this study, this company is categorized as a third-party logistics (3PL), providing delivery of documents, foods, and also ride-hailing. Those who have been using the services at least twice within a year offered by the company were targeted as participants. Data used in this study have been collected and modified from Hartono *et al.* [8]. Ten respondents were involved in the

in-depth interview, whereas, 157 subjects were valid for face-to-face questionnaire section. The unstructured in-depth-interview was used to explore the Kansei words and structure the logistics service attributes.

Purposive sampling was used as the sampling plan and strategy. It is one of non-probability sampling techniques in which a researcher chooses members of participants according to his/her judgment and considering resource saving such as time and budget.

### B. Constructs and Logistics Service Attributes

There were two constructs utilized in the study, i.e., (i) perceived service quality with Kano category, and (ii) Kansei. The measure variables of each construct were adopted and modified from the previous studies [9].

The first construct “perceived service quality with Kano category” consists of 26 logistics service attributes as the measure variables. Those questions used to measure the perception on logistics services were modified from 22 service items of Parasuraman’s SERVQUAL [12] to suit the context of logistics service. A pilot test has been conducted to reduce any wordings and perception bias. Apart from perception score, these logistics service attributes were measured in their importance and expectation levels as well [2].

The second construct “Kansei” comprises 10 measure variables, and has been measured using a five-point semantic differential scale. These variables were deemed as the representative of emotional needs for logistics services. They were as follows, helped, trusted, secured, comfortable, innovative, friendly, precise, professional, prompt, and affordable.

## III. RESULTS

### A. Hypothesis and Data Analysis

Perceived service quality has been proven as the antecedent of customer satisfaction and loyalty [2]. It also has been found to be correlated with emotions. It is confirmed that Kansei is considered to be customer emotional satisfaction which is influenced by perceived service quality and leads to loyalty [5]. According to Yang [3], Kano’s attractive attributes have a significant impact on long-term customer and provider relationship. Kano model is found to strengthen the Kansei methodology [2]. The categorization of Kano in each of perceived service attributes is of critical. It implies that Kano’s attractive performance has the greatest impact on Kansei, followed by one-dimensional and must-be performances, respectively. Thus, the identification and exploration of Kano category for each service attribute which leads to Kansei are of interest. The formulation of hypothesis is as follows [see Fig. 1].

H1. The Kano’s category mediates the perceived service quality impact on Kansei

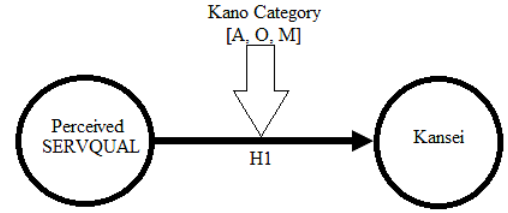


Fig. 1. Structural model of perceived SERVQUAL and Kansei

The data analysis has been performed using Microsoft Excel and Smart-Partial Least Square (Smart-PLS). Partial Least Square (PLS) is to deal with relative small sample size and promote free distributional form [13]. The proposed measurement models were tested through confirmatory factor analysis. Validity and reliability tests for each construct were done.

### B. Validity and Reliability Tests

The properties of proposed constructs “Perceived SERVQUAL” and “Kansei” were tested through confirmatory factor analysis (CFA). This is done to verify the factor structure of the observed measures [14]. A set of three tests is reported, namely, (i) convergent validity, (ii) discriminant validity, and (iii) reliability, as shown in TABLE I.

As for the convergent validity, there are three criteria applied, i.e., (i) all item factor loadings exceeds 0.6, (ii) construct reliabilities exceed 0.7, and (iii) average variance extracted (AVE) of construct should exceed 0.5. Regarding the discriminant validity, it is determined by the square root of AVE for each construct which should be greater than its corresponding inter-construct correlation coefficient. The next one is about reliability test, determined by Cronbach’s alpha of minimum 0.6. Based on the measurement of constructs as shown in TABLE I, all constructs were deemed valid and reliable for all Kano’s categories.

TABLE I  
MEASUREMENT OF CONSTRUCTS

Construct	Kano’s A			Kano’s O			Kano’s M		
	AVE*	Composite Reliability	Cronbach Alpha	AVE*	Composite Reliability	Cronbach Alpha	AVE*	Composite Reliability	Cronbach Alpha
Perceived SERVQUAL	0.51	0.84	0.79	0.62	0.87	0.79	0.56	0.91	0.87
Kansei	0.47	0.88	0.84	0.46	0.87	0.83	0.44	0.88	0.84

### C. Structural Models

This section consists of three proposed different structural models incorporating Kano’s categories (A, O, and M), as provided in Fig. 2, 3, and 4. Given the Kano category, they show that perceived SERVQUAL is significantly correlated with Kansei. In other words, perceived SERVQUAL brings significant impact on Kansei. The perceived SERVQUAL with Kano’s A category shows the greatest impact on Kansei [see the correlation measure of 0.526, as shown in Fig. 2].

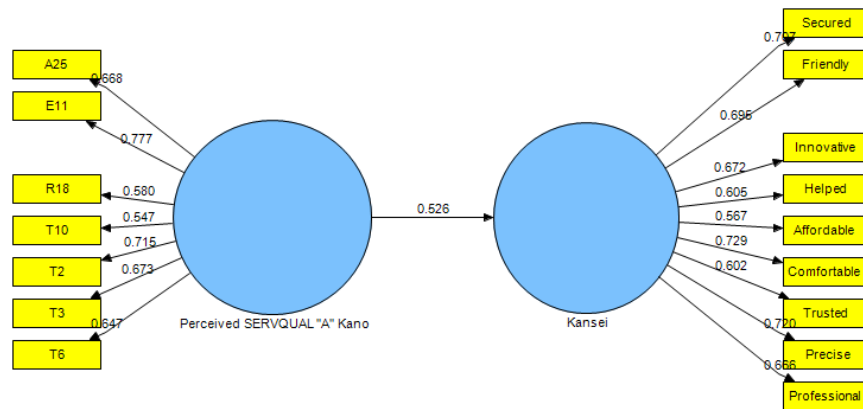


Fig. 2. Kano A and Kansei

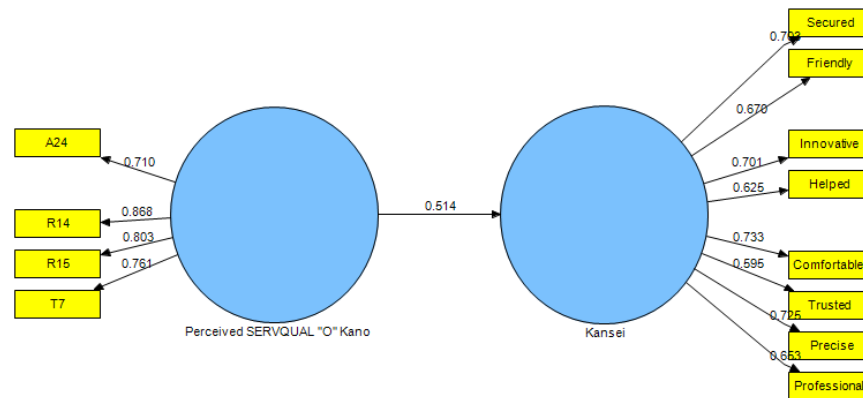


Fig. 3. Kano O and Kansei

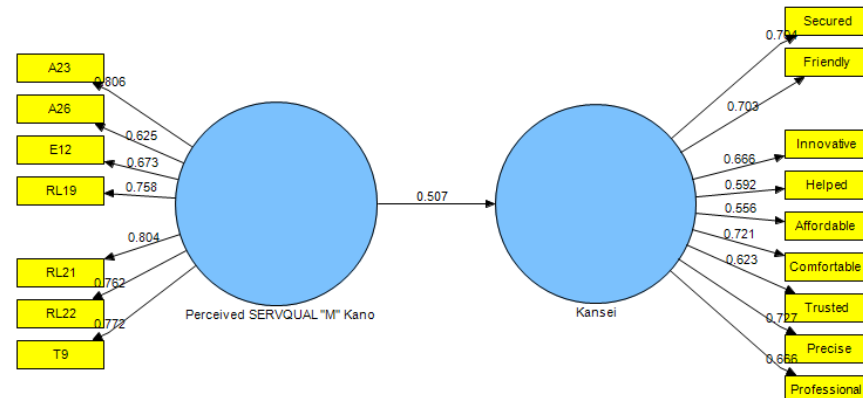


Fig. 4. Kano M and Kansei

According to the path analysis, it shows that, for Kano's A category group, there were 7 service attributes and 9 Kansei significantly representing the constructs perceived SERVQUAL and Kansei, respectively. The service attribute E11 "provision apology once any mistakes made" and Kansei "comfortable" were found to be the most critical, according to the factor loadings of 0.777 and 0.729, consecutively. Compared to first structural model, the other two structural models (i.e., (i) Kano O and Kansei, and (ii) Kano M and Kansei) show that perceived SERVQUAL has less impact on Kansei. At

the Kano's O category, the service attribute R14 "friendliness of driver" and Kansei "secured" were of critical, whereas, at the Kano's M one, the service attribute A23 "safety" and Kansei "precise" become the sensitive ones.

#### IV. DISCUSSION

The proposed hypothesis that the Kano's category mediates the perceived service quality impact on Kansei was supported by the result. This study confirms and

complements the previous studies by Ladhari [15] and Hartono and Raharjo [5]. Ladhari [15] found that emotions is critical to the relationship between perceived quality and loyalty, whereas, Hartono and Raharjo [5] showed that both affect (known as emotions or Kansei) and cognition equally mediate the relationship between perceived service quality and loyalty.

Kano attractive performance and quality [A], known as delighter or excitement attribute, performs well in delivering its impact on Kansei. The result shows that Kano's A has the greatest impact on Kansei. The Kano's A relates to the unspoken needs or hidden voice of customers. It implies that the unspoken or latent need brings truly customer emotional needs and satisfaction (Kansei). It confirms the previous study by Hartono and Tan [2]. Inherently, the attractive attributes are those unforeseen by potential customers but they can yield ultimate satisfaction. They are sometimes not verbally asked by customer, but once they are provided it may produce significant satisfaction. The absence of these attributes will create nothing serious; business will go on as usual. Hence, the beauty of Kano's attractive attributes lies on the customer imagination. It will help customer discovering the needs which they have never thought about before. Inherently, this study finding supports a study by Hartono and Tan [2] in which the perceived Kano's attractive service quality is full of Kansei, as shown in Fig.5.

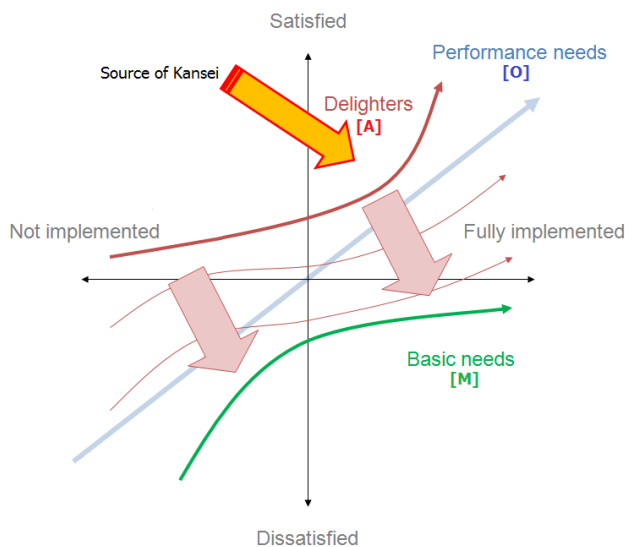


Fig. 5. Kano A and Kansei [modified from Hartono and Tan [2]]

Focusing on the improvement of service attributes with Kano's attractive category [A] will provide significant competitive advantages over a market competition. In very dynamic and diverse services offered in the market with the similar quality, the attractive attributes will act as the differentiation factor. In other words, they will produce "wow" factors in the mind of customers and boost a final confirmation for business transaction. Hence, given a very limited labor hours and budget, service providers should put their effort and focus

on the attractive service attributes in terms of continuous improvement and innovation.

## V. CONCLUSION

The purpose of this research was to test the influence of Kano's categories (especially, attractive [A], one-dimensional [O], and must-be [M]) on the impact of perceived service quality on Kansei. More specifically, the proportion impact of Kano's performance and weight on Kansei has been explored. Kansei represents the emotional needs of customer, due to service interaction and encounter. It has been found that Kano category mediates the impact of perceived service quality on Kansei. In addition, Kano's attractive [A] had the greatest effect on Kansei. Hence, given a very limited resources (e.g., budget, labor hours, and other potential resources), service providers should focus on attractive service attribute (known as delighter) for the effort of continuous improvement, breakthrough, and maintenance.

Following the attractive Kano, there were two consecutive Kano's categories, namely, one-dimensional [O] and must-be [M] to be taken note for the priority of improvement. The must-be [M] or known as basic attribute should be placed at the last for improvement effort. However, the functionality of this attribute must be guaranteed.

## VI. LIMITATION

The finding of this study is considered limited due to relatively small sample size and a single service domain, which is logistics service. Other potential methods in measuring emotional satisfaction, real-time emotion state measurement, and various service settings can be considered for future study.

## ACKNOWLEDGMENT

The authors would like to thank the anonymous reviewers, and also to the Directorate of Development and Research Enhancement, Ministry of Research, Technology and Higher Education, Republic of Indonesia for the research grant with a scheme of institutional national strategy 2018. In addition, this study has been partially supported by the Department of Industrial Engineering, University of Surabaya, Indonesia.

## REFERENCES

- [1] N. Kano, N. Seraku and F. Takahashi, "Attractive quality and must be quality", *Quality*, Vol. 14 (1984), No. 2, pp. 39-44.
- [2] M. Hartono and K.C. Tan, "How Kano model contributes to Kansei engineering in services", *Ergonomics*, Vol. 54, No. 11 (2011), pp. 987-1004.

- [3] C.-C. Yang, "Identification of customer delight for quality attributes and its applications", *Total Quality Management & Business Excellence*, Vol. 22, No. 1 (2011), pp. 83–98.
- [4] M. Dixon, K. Freeman, and N. Toman, "Stop trying to delight your customers", *Harvard Business Review*, Vol. 88, No. 7/8 (2010), pp. 116-122.
- [5] M. Hartono and H. Raharjo, "Exploring the mediating role of affective and cognitive satisfaction on the effect of service quality on loyalty", *Total Quality Management & Business Excellence*, Vol. 26 (2015), No. 9-10, pp 971 – 985.
- [6] K. Matzler and H.H. Hinterhuber, "How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment", *Technovation*, Vol. 18 (1998), pp. 25-38.
- [7] K.C. Tan and A.T. Pawitra, "Integrating SERVQUAL and Kano's model into QFD for service excellent development", *Managing Service Quality*, Vol. 11 (2001), pp. 418–430.
- [8] M. Hartono, "The extended integrated model of Kansei Engineering, Kano and TRIZ incorporating cultural differences into services", *International Journal of Technology*, No. 1 (2016), pp. 95 – 103.
- [9] M. Hartono, A. Santoso, D.N. Prayogo and Ivon "The extended framework of kansei engineering, kano and TRIZ applied to logistics services," in *Proc. of IEEE International Conference on Industrial Engineering and Engineering Management 2017*, Singapore.
- [10] M. Hartono, A. Santoso, and D.N. Prayogo, "Ergonomics-based Kansei Engineering and Kano Model for Public Services Excellence," in *Proc. of the International Conference on Industrial Engineering and Operations Management 2018 Bandung*, Indonesia.
- [11] C. Voss, N. Tsikriktsis, and M. Frohlich, "Case study research in operations management", *International Journal of Operations and Product Management*, No. 22 (2002), Vol. 2, pp. 195–219.
- [12] A. Parasuraman, L.L. Berry and V.A. Zeithaml, "SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality", *Journal of Retailing*, Vol. 64 (1988), pp. 12–40.
- [13] C.M. Ringle, S. Wende, and A. Will, *Smart PLS*. University of Hamburg, Hamburg, Germany, 2005.
- [14] D.D. Suhr, "Exploratory or confirmatory factor analysis?," in *Proc. of the 31st Annual SAS Conference (SAS Users Group International [SUGI] 31) 2006*, San Fransisco, California.
- [15] R. Ladhari, "Service quality, emotional satisfaction, and behavioral intentions: A study in the hotel industry", *Managing Service Quality*, Vol. 19 (2009), No. 3, pp. 308–331.