



IEOM Society

"Achieving and Sustaining Operational Excellence"

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IEOM Awards – 4th European Rome Conference **August 5, 2021, 5:00 – 7:00 pm, Rome Time**

IEOM Distinguished Leadership Award

- Franco Megali, VP and CEO Italy, Israel and Greece, Siemens Digital Industries Software

IEOM Distinguished Educator Award

- Dr. Tomohiko Sakao, Professor of Sustainable Product/Service Systems, Linköping University, Sweden
- Dr. Dominik Matt, Professor of Production Systems Technologies Faculty of Science and Technology, Free University of Bozen-Bolzano, Italy. Director, Research Center Fraunhofer Italia in Bolzano
- Prof. Massimo Tronci, Sapienza - University of Rome

Distinguished Industry Achievement Award

- Dr. Di Paola Galloni Jean Luc, VALEO; EXTRAC Operational Vice-Chairman, France

Distinguished Professor Award

- Dr. Dariusz Jemielniak, Professor of Management, Kozminski University, and Faculty Associate, Berkman-Klein Center for Internet and Society, Harvard University, Wikimedia Foundation Trustee
- Prof. Christoph Glock, Full professor at Technische Universität Darmstadt and head of the Institute of Production and Supply Chain Management, Germany
- Prof. dr. ing. Cristian DOICIN, Dean, Faculty of Industrial Engineering and Robotics, Universitatea POLITEHNICA din București, Romania

Outstanding Professor Award

- Dr. Joseph Sarkis, Foisie Business School, Worcester Polytechnic Institute, Worcester, MA, USA
- Dr. Fatma H. Ashour, Director of the Center for Environmental Hazard Mitigation and Environmental Research and Studies, Cairo University, Egypt
- Dr. Saurin Tarcisio Abreu, Associate Professor, Industrial Engineering Department, Universidade Federal do Rio Grande do Sul, Rio, Brazil

Outstanding Professor in Supply Chain and Logistics Award

- Professor Jose Arturo Garza-Reyes, Ph.D., Professor of Operations Management, Head of the Centre for Supply Chain Improvement, College of Business, Law and Social Sciences, University of Derby, UK
- Dr. Tom Van Woensel, Full professor of Freight Transport & Logistics, Eindhoven University of Technology, Eindhoven, North Brabant, Netherlands

Outstanding Professor in Industry 4.0 Award

- Dr. Erwin Rauch, Assistant Professor in Manufacturing Technology and Systems, Head of the Smart Mini Factory laboratory for Industry 4.0 application, Free University of Bolzano, Italy
- Professor Ramón Barber Castaño, Director of the Master in Industrial Engineering, Universidad Carlos III de Madrid, Spain
- Prof. Dr. Hab. Inż. Krzysztof Jan Kaliński, Head of the Department, Faculty of Mechanical Engineering, Gdańsk University of Technology, Poland

Outstanding Researcher Award

- Dr. Salvatore Miranda, Associate Professor Dept. of Industrial Engineering University of Salerno, Italy

IEOM Outstanding Academic Award

- Dr. Dobrica Milovanovic, Professor, Department of Energy and Process Engineering, University of Kragujevac, Serbia
- Prof. Ing. Peter Trebuňa, PhD., Director, Institute of Management, Industrial and Digital Engineering, Faculty of Mechanical Engineering, Technickej Univerzity v Košiciach, Košice, Slovakia
- Dr. Edin Jahic, Acting Dean of Faculty of Engineering and Natural Sciences, International University of Sarajevo, Iliđza, Bosnia & Herzegovina

Innovation and Entrepreneurship Award

IEOM Society Awards – 4th European Rome Conference, August 2-5, 2021

- Elena V. Gurina, Associate Professor, Head of the Department, Economy and Management of Research, Design and Production, Belarusian National Technical University, Belarus

IEOM Woman in Industry and Academia Award

- Prof. Mara Lombardi, Department of Chemical Engineering Materials Environment (DICMA), Faculty of Civil and Industrial Engineering, Sapienza-University of Rome, Rome, Italy
- Professor Grazia Speranza, Professor, Department of Quantitative Methods, University of Brescia, Italy

Diversity and Inclusion Award

- Dr. Sara Shafiee, Researcher/Assistant Professor, Department of Mechanical Engineering, Engineering Design and Product Development, Technical University of Denmark, Lyngby, Denmark

IEOM Global Education Award

- Iryna Shvets, Dr. Prof., Vice-Rector for International Relations, Donetsk National Technical University, Shybankova square 2, Pokrovsk, 85300 Ukraine
- Dr. Wim Van Petegem, Professor, KU Leuven, Leuven, Flemish, Belgium
- Denis Lemaitre, Training Laboratory and Professional Learning, ENSTA Brittany, Brest, France

IEOM Industry 4.0 Award

- FH-Prof. DI Dr. Erich Markl, Head of Faculty, Industrial Engineering, Fachhochschule Technikum Wien, Austria
- Jo Wessel Strandhagen, Department of Mechanical and Industrial Engineering, Norwegian University of Science and Technology, Trondheim, Norway

Industry Solutions Award

- Bruno Alves, Lead Manufacturing Engineer ADAS ECU, Aptiv, Braga, Portugal
- Prof. Dr. Markus Bambach, Dep. of Mechanical and Process Eng., ETH Zürich, Zürich, Switzerland

Teaching Excellence Award – IE & OM

- Dr. Susana Duarte, Assistant Professor, Universidade Nova de Lisboa, Lisbon, Portugal
- Prof. PhD Plamen Bratanov, Head of the Department of Industrial Design, Mechanical Engineering Faculty, Technical University of Varna, Varna, Bulgaria
- Dr. Tamas Szecsi, Associate Professor, School of Mechanical & Manufacturing Engineering, Dublin City University, Dublin, Ireland

OM Teaching Excellence Award

- Dr. ARCHETTI Claudia, Associate Professor, Department of Information Systems, Decision Sciences and Statistics, ESSEC Business School, Paris, France -
- Dr. Tamás Koltai, professor of production and operations management at the Department of Management and Business Economics, Budapest University of Technology and Economics, Magyar tudósok körútja 2, H-1117 Budapest
- Prof. Dr. Sabine Baumann, Professor of Management and Business Administration, Jade University of Applied Sciences, Wilhelmshaven, Germany

IEOM Distinguished Service Award

- Dr. Mario Fagnoli, Technical Director, Italian Ministry of Agriculture and University of Rome "La Sapienza" and Contact Professor at Sapienza-University of Rome (Chairman of the Committee)
- Prof. Francesco Costantino, Sapienza - University of Rome
- Prof. Giulio Di Gravio, Sapienza - University of Rome
- Dr. Riccardo Patriarca, Sapienza - University of Rome
- Dr. Patrick Dallasega, Free University of Bozen-Bolzano
- Dr. Matteo Mario Savino, University of Sannio

IEOM Outstanding Service Award

- Dr. Ahm Shamsuzzoha, Tenure Track Professor, School of Technology and Innovations, Digital Economy Platform, University of Vaasa, Finland

IEOM Society Awards

- Dr. Maria Grazia Gnoni, Associate Professor, Department of Innovation Engineering, Università del Salento, Lecce, Italy
- Professor Linda Zhang, Full Professor of Operations Management, Department of Management, IESEG School of Management, Paris, France
- Dr. Zied Hajej, Laboratory of Industrial Engineering, Production and Maintenance LGIPM, Université de Lorraine, Metz, France
- Dr. Leonardo Frizziero, Associate Professor, DIN - Department of Industrial Engineering, ALMA MATER STUDIORUM University of Bologna, Bologna – Italy
- Dr. Jiri Tupa, Associate Professor, Department of Technologies & Measurement, Vice Dean for Faculty Development, Faculty of Electrical Engineering, University of West Bohemia in Pilsen, Plzen-City, Czech Republic
- Dr. M. Affan Badar, PhD, CPEM, Professor and Former Chair, Department of Applied Engineering and Technology Management, Indiana State University, Terre Haute, Indiana, USA

Outstanding Conference Service Award

- Felix Shulze, PostDoc Researcher, Univ. of Bolzano (Italy)
- Andrea Falegnami, PostDoc Researcher, Adjunct Professor, Sapienza Univ. of Rome

IEOM Outstanding Student Leadership Award

- Silvia Colabianchi, PhD Student, Sapienza Univ. of Rome

- Elena Quatrini, PhD Student, Sapienza University of Rome
- Francesco Simone, Research Assistant, Sapienza Univ. of Rome
- Antonio Nakhal, PhD Student, Sapienza Univ. of Rome
- Margherita Bernabei, Research Assistant, Sapienza Univ. of Rome
- Rosanna Coccia, PhD Student, Sapienza Univ. of Rome
- Mohamed Gamal, PhD Student, Nahda University (Egypt)
- Alessio Moricca, MD Student, Sapienza Univ. of Rome
- Marta Galuppi, MD Student, Sapienza Univ. of Rome
- Marialuisa Menanno, PhD Student, Sannio University

Completion Awards

Undergraduate Student Paper Competition Sponsored by SIEMENS

First Place Winner

ID 334 How Industrial Internet of Things Enables Engineers to Work Remotely

Christopher Striff, John Takiff, Brandon Drury, Jimmy Algeo, Moummar Nawafleh and Mohamed Awwad

Department of Industrial and Manufacturing Engineering, California Polytechnic State University, San Luis Obispo, CA 93407, USA

2nd Place Winner

ID 309 Inefficiencies of the COVID-19 Vaccine Distribution in California

Jared McMullen, Matt Akins, Matt Grywczynski, Jack Rocca, Carter Bergquist and Mohamed Awwad

Department of Industrial and Manufacturing Engineering

California Polytechnic State University, San Luis Obispo, CA 93407, USA

3rd Place Winner

ID 557 A Math-Heuristic Approach for Two-Echelon Vendor Managed Inventory Routing Problem

Utku Yavuz, Mehmet Can Aydın, Alp Orhan Özver, Yarkın Akçıl, Aslı Erol, Çağla Deniz Özmen, Buse Küçükbükcü

Mehmet Can Aydın, Utku Yavuz, Yarkın Akçıl, Alp Orhan Özver, Çağla Deniz Özmen, Aslı Erol

Industrial Engineering Department, Faculty of Engineering,

Özyeğin University, Çekmeköy/ Istanbul, 34794, Turkey

4th Place Winner

ID 710 The Effect of ESG Rating on Credit Rating

Farhan Aulia Rahman and Yunieta Anny Nainggolan

School of Business and Management

Bandung Institute of Technology, Bandung, Indonesia

5th Place Winner

ID 2 Reducing Inventory for a Mexican Convenience Store Network by Reducing the Order Cycle Time

Mireya Elizondo, Mariana Villarreal, Vanessa Ocañas and Bernardo Villarreal, Department of Industrial Engineering

Universidad de Monterrey, San Pedro Garza Garcia, N.L. Mexico

Undergraduate Research Competition

First Place Winner

ID 382 Using Aspen Plus to Simulate Pharmaceutical Processes –An Aspirin Case Study

Alisa Douglas, Integrated Biomedical Engineering, McMaster University, Hamilton, ON L8S 4L8, Canada

Ali Elkamel, Department of Chemical Engineering, University of Waterloo, Waterloo, ON, N2L 3G1, Canada

2nd Place Winner

ID 388 Preferences and Opinions of the University of Jeddah Students Towards Electronic Exams

Ziyad Ahmed Alghamdi, Ali Yahya Albaheth, Mohammad Talal Himidah, Sultan Jamal Alqahtani, Murad Bazar Andejany, Department of Industrial and Systems Engineering

College of Engineering, University of Jeddah, UAE

3rd Place Winner

ID 766 Stringency Index and Stock Market Return Amidst COVID-19 Pandemic: Evidence from Emerging Stock Market Countries

Muhammad Ilham Gunawan and Yunieta Anny Nainggolan, A. School of Business and Management, Management Department, Bandung Institute of

Technology, Bandung, 40132, Indonesia

4th Place Winner

ID 611 Improving the Purchasing Order Process Of Model Auto And Equipment Supplies Inc. Using An Enterprise Resource Planning (ERP) Software

Jan Erica D.C. Aquino, Karlo Gabbriel D. Batto, Bonifacio A. De Jesus Iv, Aiden Lemuel T. Lumibao, Lex Marco Paolo A. Miranda, Mikka Rosella C.

Villarica and Grace Lorraine D. Intal

School of Information Technology

Mapua University, Philippines

5th Place Winner

ID 556 Sustainable Echo Absorption Material with Recycled Plastic

Komalpreet Kaur Takhar, Undergraduate student, Department of Civil Engineering, British Applied College, Umm Al Quwain, UAE

Dr. Saleema Panda, Assistant Professor, Department of Civil Engineering, British Applied College, Umm Al Quwain, UAE

Sr. Design Project Competition Sponsored by Tooling Tech Group

IEOM Society Awards – 4th European Rome Conference, August 2-5, 2021

First Place Winner

ID 559 Techno-Economic Analysis of Electrochemical Recovery of Metals from Waste Printed Circuit Boards (PCBs)
Matthew Lam, Aidan O’Gorman, Ryan Schleeahn, and Ali Elkamel, University of Waterloo
Waterloo, ON N2L 3G1, Canada

2ndPlace Winner

ID 448 Material Feeder Systems for Manufacturing Operations
Paul Ilovan and Tim Powell, Department of Electrical and Computer Engineering, Lawrence Technological University, Southfield, MI 48075, USA
George Pappas, Department of Electrical and Computer Engineering, Lawrence Technological University, Southfield, MI 48075, USA

3rdPlace Winner

ID 531 No-Hands Health Helper
Laura Silverman, Rachel Kristian, Angeliki Dimopulos, and Katie Cyster, Department of Electrical & Computer Engineering Lawrence Technological University, Southfield, MI 48075, USA
George Pappas, Department of Electrical, Computer Engineering and Embedded Software Engineering, Lawrence Technological University Southfield, MI, USA

High School STEM Competition

First Place Winner

ID 345 Ergonomic Design of Computer Workstation for College Students Studying at Home
Randolf Cabugawan, Homer Laguador, and Kelly Albert Lim, Young Innovators Research Center, Mapúa University,, Philippines
Ma. Janice J. Gumasing, School of Industrial and Engineering Management, Mapúa University, Manila, Philippines

2ndPlace Winner

ID 326 Sequential Pattern Mining of Electronic Health Record for Early Diagnosis of Amyotrophic Lateral Sclerosis
Cindy Liang, Texas Academy of Mathematics and Science, Denton, TX, USA
Lily Sun, Stanford Online High School, Redwood City, CA 94063, USA
William Jin, Community Middle School Plainsboro, NJ 08536, USA

3rdPlace Winner

ID 349 BalletNetTrainer: An Automatic Correctional Feedback Instructor for Ballet via Feature Angle Extraction and Machine Learning Techniques
Jiayao (Emily) Li, ARQuest SSERN International, Irvine, CA, USA
Haridhar Pulivarthy, ARQuest SSERN International, Kirkland, WA, USA

4thPlace Winner

ID 790 Logic, Gambling, and Games
Samuel Feldman
Stanford Online High School
Redwood City, CA 94063, USA

5thPlace Winner

ID 717 Interest in STEM in Bay Area High School Students
Nicole Serrano
Stanford Online High School
Redwood City, CA 94063 5th

Graduate Student Paper Competition Sponsored by EATON Corporation

First Place Winner

ID 438 Design for Additive Manufacturing of a horizontal axis wind turbine
Simone Cantarelli, Daniela Francia, Alfredo Liverani, Leonardo Frizziero, Department of Industrial Engineering
Alma Mater Studiorum University of Bologna, Bologna, Italy

2ndPlace Winner

ID 565 Technology Acceptance and Digital Divide as Correlates of Performance Among Engineering Students and Teachers: Inputs to Educational Technology Acquisition and Adaptation Model
RomalynL. Galingan, Technological Institute of the Philippines; Pamantasanng Lungsodng Marikina, Cubao, Quezon City, Philippines; SSS Village, Marikina City Philippines

3rdPlace Winner

ID 408 Porter’s Five Generic Strategies: A Case Study from Indonesia Automotive Industry Against Covid-19
Wirawan Pratama Suwardi, T C Kusuma, Bagas Muhamad Kartiko, Department of Industrial Engineering, Faculty of Engineering
Universitas Indonesia, Kampus UI Depok, 16424, Indonesia

4thPlace Winner

ID 612Design of Warehouse Management System using Mobile Application for Shoe Manufacturing Industry
Robimarl B. Torres, Marvis B. Halili, Donilyn D. Salazar, Grace Lorraine D. Intal
School of Information Technology
Mapúa University 658 Muralla St., Intramuros, Manila 1002, Philippines

Master Thesis Competition

First Place Winner

ID 292 Analysis and Improvement of Product Management Processes –a Case Study

IEOM Society Awards – 4th European Rome Conference, August 2-5, 2021

Francisco Leite (1) and José Faria (1, 2) and Américo Azevedo (1, 2)

(1) Faculty of Engineering, University of Porto, Portugal

(2) INESC TEC, Rua Dr. Roberto Frias, Campus da FEUP, Porto, Portugal

Ivo Pereira, Polytechnic of Porto, Engineering Institute, Porto, Portugal

2ndPlace Winner

ID 458 Inventory Management Sourcing Policy Selection: A Focus on Wastewater Infrastructure

Mohammed Maharoo and Dr. Laoucine Kerbache

Engineering Management & Decision Sciences

College of Science and Engineering

Hamad Bin Khalifa University (HBKU), Education City, Qatar

ID 533 EMV& Biometric for Secure Online Purchases

Youness Ridani

SEDCO Technologies

Ifrane Fes-Meknes Region Morocco

3rdPlace Winner

ID 460 Impact of Aircraft Model and Delay Duration on the Air Traffic Flow Management

Abdelhamid Boujarif, Industrial Engineering Laboratory, Paris-SaclayUniversity, CentraleSupélec, 91190, Gif-sur-Yvette, France

Sadeque Hamdan, College of Business and Economics, UAE University, Al Ain, United Arab Emirates

Oualid Jouini, Industrial Engineering Laboratory, Paris-Saclay University, Centrale Supélec, 91190, Gif-sur-Yvette, France

Doctoral Dissertation Competition

First Place Winner

ID 370 Data-driven throughput bottleneck analysis in production systems

Mukund Subramaniyan

Department of Industrial and Materials Science

Chalmers University of Technology

Sweden

2ndPlace Winner

ID 562 Optimization of consumable consumption in hypermarkets during the Coronavirus pandemic period

Kamilia Filali, Systems Engineering Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco

Zoubida Benmamoun, GS laboratory ENSA, Kenitra, morocco

Hanaa Hachimi, Systems Engineering Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco

Human Factors and Ergonomics Competition

First Place Winner

ID 537 Perceived Effect of Factors on Workers' Task Performance in a Cold Storage Warehouse Facility

CyntharaB. Leonardo and Marvin I. Noroña, School of Industrial Engineering and Service Engineering Management, Mapúa University, Intramuros, 1002

Metro Manila, Philippines

2nd Place Winner

ID 306 Retrofitting agricultural tractors with aftermarket weather cabins: safety issues for manufacturers and users

Gattamelata Davide, Puri Daniele, and Vita Leonardo, Department of technological innovations and safety of plants, products and anthropic settlements,

National Institute for Insurance against Accidents at Work (Inail), Italy

Mario Fargnoli and Mara Lombardi, Department of Chemical Engineering Materials Environment (DICMA), Sapienza -University of Rome, Italy

3rd Place Winner

ID 335 Development and Initial Testing of Lumbar Support for Traffic Police Motorcycle Seat With Built-In Massager System: A Preliminary Study In The

View of Ergonomics

Nur Athirah Diyana Mohammad Yusof, Karmegam Karuppiah, Putri Anis Syahira Mohamad Jamil, Irniza Rasdi, Vivien How, Sivasankar Sambasivam,

Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

Kulanthayan KC Mani, Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

Lean Six Sigma Competition Sponsored by Tooling Tech Group

First Place Winner

ID 366 Develop JMP 16_Based STEAMS and Six Sigma DMAIC Training Curriculum for Data Scientist

Mason Chen, Stanford Online High School, San Jose, CA 95131

Charles Chen, Morrill Learning Center, San Jose, CA 95131

2ndPlace Winner

ID 554 The Use of Lean Six Sigma Tools in a South African Multinational Organization

Bheki Makhanyaand Hannelie Nel

Department of Engineering Management

University of Johannesburg, Johannesburg, South Africa

3rdPlace Winner

ID 418 Applications of Lean Manufacturing in a manufacturing company in South Africa

Mpho Karen Masemola, Bheki Makhanya and Hannelie Nel

Department of Engineering Management

University of Johannesburg, South Africa

Simulation Competition

First Place Winner

ID 391FDM-sourced Shinbone Cutting Guide in Polylacticacid-based Polymers: Heat Sterilization Effects on Part Quality
Christian Leon-Cardenas, Patrich Ferretti, MerveSali, Gian Maria Santi, Francesco Gianese, Nicola Crescentini, Leonardo Frizziero, Giampiero Donnici and Alfredo Liverani, Department of Industrial Engineering, Alma Mater Studiorum University of Bologna, Viale Risorgimento, 2 –40136, Bologna, Italy
Giovanni Trisolino, Paola Zarantonello, Stefano Stallone and Giovanni Luigi Di Gennaro, IRCCS–IOR –Rizzoli OrthopaedicInstitute, Pediatric Orthopaedics and Traumatology, 40136 Bologna, Italy

ID 553CAD-Aided Preoperative Simulation in Pediatric Orthopedics: The Case Study of Ollier's Disease

Leonardo Frizziero, Alfredo Liverani, Gian MariaSanti, Paola Papaleo, Francesca Napolitano and Curzio Pagliari, Department of Industrial Engineering Alma Mater Studiorum University of Bologna, Bologna, Italy
Giovanni Trisolino, Giovanni Luigi Di Gennaro, and Paola Zarantonello
IRCSS –IOR—Rizzoli OrthopaedicInstitute
Pediatric Orthopaedics and Traumatology, Bologna Italy

2ndPlace Winner

ID 673 An Integrated Simulation Model for Water Purification and Distribution
Francesco Simone
Department of Mechanical and Aerospace Engineering
Sapienza University of Rome, Italy

ID 784 Efficient Optimization Model for Buffer Size Problem in Production Line with Rework Path

Hisham Alkhalefah, Mustufa Haider Abidi and Usama Umer
Advanced Manufacturing Institute, King Saud University, Riyadh, Saudi Arabia
Ahmed Elkaseer
Department of Production Engineering and Mechanical Design, Faculty of Engineering, Port Said University, Port Fuad, Egypt, Institute for Automation and Applied Informatics, Karlsruhe Institute of Technology, Karlsruhe, Germany

Supply Chain and Logistics Competition

First Place Winner

ID 630 Deadlock and Collision Prevention Algorithms for Mobile Robots in Automated Warehouses
Ecem Eroglu Turhanlar and Banu Yetkin Ekren
Department of Industrial Engineering
Yasar University, Izmir, Turkey

2ndPlace Winner

ID 469 The Role Of Regulatory Resilience In Supply Chain Optimization: A Case Study
Saloua SAID and Hafida BOULOIZ, Systems engineering and decision support laboratory, ENSA, Agadir, Morocco
Maryam GALLAB, MIS -LISTD Laboratory, Department of Computer Science, ENSMR, Rabat, Morocco
Supply Chain and Logistics Competition

3rdPlace Winner

ID 305 Applications of Augmented Reality to Reduce Risk in Supply Chain Management
Angela Colabella, Collette Lee, Lane Pledger, Monique Cendejas, Vikrant Mannemela and Mohamed Awwad
Industrial and Manufacturing Engineering Department
California Polytechnic State University, San Luis Obispo, CA 93407, USA

Poster Competition

First Place Winner

ID 535 Demand Forecasting with Real Case Analysis for Effective Retail Decision-Making
SafikaThasin, Caroline Zeidan, Muhammad Ishtiaq, Mentors: Dr. Dua Weraikat, Dr Adolf Acquaye
Mechanical & Industrial Engineering Department
Rochester Institute of Technology, Dubai

2ndPlace Winner

ID 653 A Model-Based Assessment of Cyber-Resilience Evaluation for Water Purification Plants with Societal Impact
Francesco Simone, Department of Mechanical and Aerospace Engineering, Sapienza University of Rome, Italy

3rdPlace Winner

ID 615 Improving the Packaging Unit at AEC
Abdulaziz Alsalamah, Abdullah Alnooh, Nawaf Alsalman, Abdulaziz Alhammadi and Sobhi Mejjaouli,
Department of Industrial Engineering, College Engineering
Alfaisal University, Riyadh, Saudi Arabia