Partners and Sponsors

Organized by

Faculty of Engineering
Sebelas Maret University

Supported by

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

IEOM Society
Achieving and Sustaining Operational Excellence
www.ieomsociety.org

Curtin University

AIP|Publishing

Scopus®
Welcome Message from Chairman

On behalf Organizing Committee, it is my privilege to welcome you to the Fifth Industrial, Mechanical, Electrical, and Chemical Engineering (5th ICIMECE 2018). The ICIMECE 2019 is organized by Faculty of Engineering - Sebelas Maret University. The ICIMECE was formerly known as IMECE which was first held on November 2015. Paper in former conference has successfully been published in the conference proceedings, which is indexed by Scopus.

This event will include the participation of renowned keynote speakers, oral presentations, and technical conferences related to the topics dealt with in the Program. This year, the ICIMECE conference are going to be broad, widely provide opportunities for the different areas to exchange new ideas and also experiences, as well as to establish business or research relations and to find global partnership for future collaboration in the fields of Engineering. The conference is expected to be an effective platform for the three axis of triple helix (Academic– Business–Government) forum, to share ideas and to present the works of scientists, engineers, educators and students.

Speakers from Indonesia, Japan, Malaysia, Vietnam, Singapore, Brunei Darussalam, USA, Iran and Kenya submitted the articles to this conference. Finally, it was our great honour and pleasure to accept the responsibilities and challenges as a Conference General Chair. We hope that the conference will be stimulating, informative, enjoyable and fulfilling experience for all who attend it.

Dr. Wahyudi Sutopo, S.T., M.Si.
Chairman, ICIMECE 2019
Faculty of Engineering, Sebelas Maret University
**Table of Content**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners and Sponsors</td>
<td>1</td>
</tr>
<tr>
<td>Welcome Message</td>
<td>2</td>
</tr>
<tr>
<td>Table of Content</td>
<td>3</td>
</tr>
<tr>
<td>About ICIMECE 2019</td>
<td>4</td>
</tr>
<tr>
<td>Committee</td>
<td>6</td>
</tr>
<tr>
<td>Venue</td>
<td>10</td>
</tr>
<tr>
<td>Maps</td>
<td>11</td>
</tr>
<tr>
<td>Keynote Speakers</td>
<td>12</td>
</tr>
<tr>
<td>Invited Speakers</td>
<td>23</td>
</tr>
<tr>
<td>Conference Program</td>
<td>31</td>
</tr>
<tr>
<td>Abstract List</td>
<td>35</td>
</tr>
<tr>
<td>Paper Abstracts</td>
<td>84</td>
</tr>
<tr>
<td>Note</td>
<td>374</td>
</tr>
</tbody>
</table>
About ICIMECE 2019

International Conference on Industrial, Mechanical, Electrical and Chemical Engineering (ICIMECE) is an annual international conference organized by Sebelas Maret University. This conference was formerly known as International Conference on Industrial, Mechanical, Electrical and Chemical Engineering (IMEC-E) which was first held on November 2015. The 1st International Conference on IMEC-E was joint conference with The 3rd International Conference on Electrical Vehicular Technology (The 3rd ICEVT - 2015). The 2nd ICIMECE was held on 6 - 7 October 2016 in Yogyakarta which was joint conference with Annual Conference on Industrial and System Engineering (ACISE). The 3rd ICIMECE was held on September 13\textsuperscript{th} – 14\textsuperscript{th} 2017 in Surakarta. The 4th ICIMECE was held on October 9\textsuperscript{th}-11\textsuperscript{th} 2018 and organized by Sebelas Maret University and Tidar University. In this year, the 5th ICIMECE will be held on September 17\textsuperscript{th}-18\textsuperscript{th} 2019 in Surakarta, Indonesia.

The conference theme is “Development and Commercialization of Green Technology”. The conference will address the practical engineering application (mechanicals, electrical, energy and power engineering, industrial engineering and chemical engineering. This conference provides opportunities for the delegates to exchange new ideas face to face, to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of engineering, science and technology. The conference program will consist of plenary/keynote speeches, invited sessions as well as oral sessions. We hope that the conference results will lead to significant contributions to the knowledge in these up-to-date scientific fields.

The aims of the conference are to provide opportunities for the different areas delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration in the fields of Industrial, Mechanical, Electrical, Chemical Engineering and Interdisciplinary Engineering & Sciences. The conference is expected
to be an effective platform for the three axis of triple helix forum, to share ideas and to present the works of scientists, engineers, educators and students.
Committee

International Advisory Board
Prof. Josaphat Tetuko Sri Sumantyo, Ph.D. Chiba University, Japan
Assoc. Prof. Dr. Nafarizal Bin Nayan Khon Kaen University, Thailand
Prof. Nonglak Meethong, Ph.D Khon Kaen University, Thailand
Assoc. Prof. Chao-Min Wu National Central University, Taiwan

Steering Committee
Dr. Techn. Ir. Sholihin As’ad, M.T. Universitas Sebelas Maret, Indonesia
Dody Ariawan, S.T., M.T., Ph.D. Universitas Sebelas Maret, Indonesia
Feri Adriyanto, Ph.D. Universitas Sebelas Maret, Indonesia

International Technical Program
Associate Professor Dr. Ahad Ali Industrial Engineering Program, Lawrence Technological University, Michigan, USA
Prof. Ir. Dr. Ing. Eko Supriyanto Universiti Teknologi Malaysia, Malaysia
Ir. Tumiran, M. Eng., Ph.D

Prof. Dr. Nurul Taufiqu Rochman, M.Eng, Ph.D

Assoc. Prof. Ir. Dr. Edwin Jong Nyon Tchan

Dr. Robert de Souza PhD, MSc, BSc Hons

Prof. Minoru Sasaki

Indonesian National Energy Council

Research Center for Physics, Indonesian Institute of Sciences, Indonesia

Curtin University Malaysia

National University of Singapore

Gifu University, Japan

Conference Chair
Dr. Wahyudi Sutopo, S.T.,M.Si

Universitas Sebelas Maret, Indonesia

Conference Co - Chair
Dr. Miftahul Anwar S.Si., M.Eng.

Dr. Muh. Hisjam, S.T.P.,M.T.

Universitas Sebelas Maret, Indonesia

Secretory
Agus Ramelan, S.Pd., M.T.

Universitas Sebelas Maret, Indonesia
Treasure
Chico Hermanu Brillianto Apribowo S.T., M.Eng. Universitas Sebelas Maret, Indonesia
Subuh Pramono S.T., M.T. Universitas Sebelas Maret, Indonesia

Technical Program Chair
Hari Maghfiroh S.T., M.Eng. Universitas Sebelas Maret, Indonesia
Dr. Ari Diana Susanti, S.T., M.T. Universitas Sebelas Maret, Indonesia

Journal and Publication Chair
Muhammad Hamka Ibrahim ST., M.Eng. Universitas Sebelas Maret, Indonesia

Corporate Partnership Chair
Fakhirina Fahma, S.TP., M.T. Universitas Sebelas Maret, Indonesia

Accomodation
Joko Slamet Saputro, S.Pd., M.T. Universitas Sebelas Maret, Indonesia

Consumption
Inayati, S.T., M.T., Ph.D. Universitas Sebelas Maret, Indonesia
Rahmaniyah Dwi Astuti, S.T., M.T. Universitas Sebelas Maret, Indonesia
Transportation
Jaka Sulistya Budi, S.T.  
Universitas Sebelas Maret, Indonesia

Webmaster and Publicity
Sutrisno, S.T., M.Sc, Ph.D  
Universitas Sebelas Maret, Indonesia
Venue

The Alana
HOTEL & CONVENTION CENTER - SURAKARTA
BY ASTON

1st Floor
- ICIMECE’S ROOMS
- EMERGENCY EXIT

Venue Map:
- BERYL
- EMERALD (EE)
- SAPPHIRE (CE)
- OPAL (ME1)
- TOPAZ (IE)
- CRYSTAL (ME2)
- GARNET
- ACARDIA 1 (MAIN HALL)
- ACARDIA 2
- ACARDIA 3
Maps
Keynote Speakers

Keynote Speaker 1
Prof. Ir. Dr.-Ing. Eko Supriyanto
Universiti Teknologi Malaysia, Malaysia

Subject Area
Engineering, Computer Science, Chemical Engineering, Medicine, Physics and Astronomy, Mathematics, Materials Science, Biochemistry, Genetics and Molecular Biology, Multidisciplinary, Chemistry, Agricultural and Biological Sciences

Biography
Prof. Dr. -Ing. Eko Supriyanto is the Head of Advanced Diagnostics and Progressive Human Care Research Group at Universiti Teknologi Malaysia. He is also the Director of Centre for Study of South East Asia Development. He has obtained his Doctor of Engineering from University of Federal Armed Forces Germany in Hamburg. His research interest is application of engineering and smart management in health and industry. He has published more than 280 papers and books, registered more than 40 patents and copyrights, and obtained more than 30 international awards. In the last 10 years, he has consulted for various ministries such as Ministry of Health Malaysia and Indonesia, Ministry of Research, Technology and Higher Education, Ministry of Communication and Information, and Ministry of Finance, as well as companies such as Petronas, Toyota, National Heart Institute and National Electric Company. He has delivered more than 40 invited talks worldwide. Currently, he is an adjunct professor at Limenau University of Technology Germany and a visiting Professor at University of Indonesia.
Latest Publication

- Predicting Down syndrome and neural tube defects using basic risk factors (2019)
- Segment-Specific EASI Coefficients for Improving Accuracy of Derived 12-Lead Electrocardiography (2018)
- Personalized Clinical Pathway for Heart Failure Management (2018)
- Computer Guided Hospital Accreditation Management System (2018)
- Optimal Power and Signal Cables Arrangement for Minimizing Electromagnetic Interference in Oil and Gas Industry (2018)

Keynote Speaker 2

Heru Setiawan, MBA
Director of Investment Planning and Risk Management, PT Pertamina (Persero), Indonesia

Biography

Heru Setiawan serves as Investment Planning and Risk Management Director of PT Pertamina (Persero) based on SOE Minister Decree no. 242/MBU/09/2018, issued on 13 September 2018, on Dismissal and Appointment of Members. Member of the Board of Directors of PT Pertamina. Heru Setiawan hold a MBA in Energy Management from Montreal Canada, Mechanical Engineering from Bandung Institute of Technology Bandung. He was Refinery and Petrochemical Megaproject Director before being assigned as Investment Planning and Risk Management Director.
Keynote Speaker 3
Ir. Tumiran, M. Eng., Ph. D*)
Indonesian National Energy Council

Subject Area

Biography
Dr. Ir. Tumiran, M.Eng is a member of The National Energy Board or Dewan Energi Nasional in Indonesia since 2004. Dr Tumiran obtained a PhD in Production and Information Sciences from Saitama University, Japan in 1996. He was the Chief Committee of National Energy Policy in 2011 – 2014, responsible for preparing the blueprint of energy strategy in Indonesia. He is also a member of Indonesian Electric Car research Team. Besides his activity at The National Energy Board, Dr Tumiran is also a lecturer at Department of electrical Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia.

In his role as Chief Committee of National Energy Policy, Dr. Tumiran proposed a strategy for energy independence and security in Indonesia, with an emphasis on efficient energy utilisation in all sector. This policy is supported by Indonesian laws and regulations, including the Indonesian Basic Constitution 1945.

Latest Publication

- Fault location estimation in LCC HVDC transmission lines using k-nearest neighbors (2019)
- Composite reliability analysis of 500 kV Jawa-Bali system related to the northern Jawa generation and transmission expansion plan (2017)
• Composite reliability evaluation of existing 500 kV Jawa Bali power system (2017)
• Harmonics reduction using LLCL filter on residential loads 450 VA and 900 VA in Central Java-Indonesia (2016)
• Using the UPFC and GUPFC controllers to maximize available transfer capability (ATC) (2014)
• Teaching the large synchronous generator dynamic model under unbalanced steady-state operation (2013)

Keynote Speaker 4
Prof. Dr. Nurul Taufiqu Rochman, M.Eng, Ph.D
Research Center for Physics, Indonesian Institute of Sciences, Indonesia

Subject Area
Engineering, Physics and Astronomy, Materials Science, Arts and Humanities, Nursing, Social Sciences

Biography
Dr. Nurul Taufiqu Rochman is a scientist who is passionate about things moving at the smallest matter where possibilities are endless. Something that is strange and unfamiliar to most people, nanotechnology has always been Dr. Nurul’s obsession in life. At the age of 40, he owns over 10 patents and copyright both here in Indonesia and in Japan, has won 17 awards, including The Best Innovation and The Best Idea in Business Award from SWA magazine in 2005 and The Best Young Scientists from the Indonesian Institute of Sciences (LIPI) in 2004, wrote 62 research papers for international publications, and he is currently the Chairman of the Indonesian Society for Nano since 2005. After years being in Japan for working and doing undergraduate, graduate, and PhD
studies on material science and production engineering, Dr. Nurul felt the calling of returning to his home country and contribute to Indonesia’s development while holding the belief that nanotechnology is the key to unlocking Indonesia’s rich treasure and bright future. Passion for innovation-driven national development and strong faith in Indonesia become the driving force for his continued research, practices, and dissemination of knowledge in the field of nanotechnology.

**Latest Publication**

- Synthesis And Sinterability Of Hydroxyapatite From Fishery By-Products (2018)
- Characterization Of Sumbawa Manganese Ore And Recovery Of Manganese Sulfate As Leaching Products (2018)
- Fabrication And Characterization Of Zinc Oxide (Zno) Nanoparticle By Sol-Gel Method (2017)
Biography

Ir. Dr. Edwin joined Curtin University, Sarawak Campus in 2014 as Adjunct Professor with the Department of Mechanical Engineering, School of Engineering and Science. Ir. Dr. Edwin Jong is a registered Professional Engineer of Malaysia with Board of Engineers Malaysia and also a Chartered Engineer of Engineering Council, United Kingdom. Presently, he is a Fellow Member of the following professional institutions: Institution of Engineers Malaysia (IEM); Institute of Materials, Mineral and Mining (IOM3) UK; Institute of Materials Malaysia (IMM). In addition, he is one of the Past Branch Chairmen of IEM Miri Branch. Presently, he is the IMM Welding Committee Chairman and the Chairman for the IMM Miri Regional Chapter. And, he is also an authorized assessor to conduct Professional Review Interviews and act as a Professional Scrutineer/Mentor on behalf of IOM3, UK.

Ir. Dr. Edwin Jong has graduated with a Doctorate Degree in Materials Engineering from Imperial College of Science, Technology and Medicine, Royal School of Mines, University of London, England, United Kingdom. His doctorate research project is “particulates reinforced titanium matrix composites” mainly aimed for aerospace applications. He has seven-year working experiences as a Research Scientist with ICI Advanced Materials Research in UK. During his 21 years working for Sarawak Shell Berhad/Sabah Shell Petroleum Company, he has gained his full working experiences in the Upstream and Downstream Sectors of Oil and Gas Industry in the following
aspects. Sixteen (17) years as the Principal Materials and Corrosion Engineer cum Technical Authority in the maintenance and operations for the shallow water sector dealing with materials and corrosion engineering, welding technology, inspection techniques and risk-based inspection (RBI) assessments and four (4) years in Shell Malaysia Deepwater Engineering Design Project Office as a Team Lead/Senior Materials and Welding Engineer and a Technical Authority, focusing on materials selection, corrosion engineering, welding technology and inspection techniques mainly for deepwater engineering applications including advanced automatic welding processes and automated ultrasonic testing (AUT) system for quality weld control. After his retirement in April 2012, he joins as a General Manager of Jurutera Perunding Akal S/B, which is a subsidiary and the technical and engineering design arm of a renowned Oil and Gas Operator in Malaysia, known as Petra Energy Berhad. His main tasks within the Company are dealing with engineering design consultancy and implementation of welding technology for the fabrication of piping, broilers and pressure vessels within the upstream sector of the O&G industry.

Latest Publication

- The influence of PWHT precipitation on DSS weld overlay towards pitting corrosion (2018)
- The Effects of Heat Treatment on Microstructures and Dilution of SMAW DSS Weld Overlay (2018)
- The Effect of Mechanical Properties by Preheating and Interpass Cleaning on Aluminum 5083 (2017)
- Effect of Using Type 310 Stainless Steel Material in High Temperature Operations (2017)
- Welding Qualification Test for a thin-walled Super Duplex Stainless Steel Pipev(2016)
- Interfacial Reaction Kinetics in α- and β-Titanium Based Metal Matrix Composites (1991)

Keynote Speaker 6

Kiwi Aliwarga
CEO and Founder of UMG, Vietnam

Biography
Harry Kasuma (Kiwi) Aliwarga is chief executive officer and co-owner of UMG Myanmar, one of the country’s leading business conglomerates. Born in Jakarta, Indonesia, Mr. Aliwarga graduated from the Institute of Technology of Indonesia (ITI) in 1992 with a degree in industrial engineering and later received a master’s degree in civil engineering at the Asia Institute of Technology in Thailand. Kiwi Aliwarga began his professional career in the business development division at Astra International, one of Indonesia’s largest traded companies, where he worked from 1992 to 1995. He went on to become business development manager at United Tractors–Indonesia (UT) before founding UMG Myanmar in 1998 with his partner MarLar Win. Mr. Aliwarga has set the ambitious goal of making UMG a billion-dollar company by 2020, by relying on three essential pillars: people, leadership, and the relentless pursuit of excellence.
Keynote Speaker 7

Dr. Robert de Souza PhD, MSc, BSc Hons
National University of Singapore

Subject Area
Engineering, Computer Science, (Business, Management And Accounting), Decision Sciences, Mathematics, Social Sciences, Physics and Astronomy, (Economics, Econometrics and Finance), Energy, Immunology and Microbiology, Chemical Engineering

Latest Publication

- Simulation Model And Simulation-Based Serious Gaming In Humanitarian Logistics (2019)
- Embedding Mixed Reality In Humanitarian Logistics Gaming (2019)
- Utilizing Excess Capacity In Last Mile Using 4th Party Milk Run (2018)
- A Heterogeneous Fleet Two-Echelon Capacitated Location-Routing Model For Joint Delivery Arising In City Logistics (2018)
- Thinklog: Interactive Learning For Supply Chain Management (2018)
Keynote Speaker 8

Prof. Minoru Sasaki  
Gifu University, Japan

Subject Area
Engineering, Computer Science, (Business, Management And Accounting), Medicine, Mathematics, Social Sciences, Physics and Astronomy, Biochemistry, Genetics and Molecular Biology, Energy, Materials Science, Chemical Engineering

Biography
He received M. Eng. and D. Eng. Degrees in mechanical engineering from Tohoku University in 1983 and 1985, respectively. He was a research associate at Tohoku University in 1985 and a lecturer at Miyagi National College of Technology, and a visiting professor at the University of California, Los Angeles. Since 1991, he has been with the Faculty of Engineering, Gifu University and is currently a professor.

Latest Publication

- Gain Tuning For High-Speed Vibration Control Of A Multilink Flexible Manipulator Using Artificial Neural Network (2019)
- The Use Of Two Fingers To Control Virtual Keyboards With Leap Motion Sensor (2018)
Combination Of Flex Sensor And Electromyography For Hybrid Control Robot (2018)
Real Time Control Of Virtual Menu Based On EMG Signal From Jaw (2018)
Two-Degree-Of-Freedom Control Of A Multilink Flexible Manipulator Using Filtered Inverse Feedforward Controller And Strain Feedback Controller (2018)
Invited Speaker 1
Professor Shigeyuki Uemiya
Dept. of Chemistry and Biomolecular Science, Gifu University, Japan

Subject Area
Chemical Engineering, Transfer Operation, Environmental Science, Catalyst, Energy

Biography
Professor Shigeyuki Uemiya current research topics include preparation and characterization of hydrogen separation membranes and hydrogen production catalysts. Among separation processes, membrane separation can be recognized as one of the most feasible energy-saving techniques without phase transformation, and furthermore, it makes possible continuous operation, process miniaturization and cheaper cost process. And, the idea of coupling catalytic reaction and membrane separation gives novel reaction environment because there are so many merits caused by reaction product separation due to the Le Chatelier’s law. The reason why this novel integrated reaction system is so attractive is that one-pass conversion and reaction selectivity will be improved compared with existing industrial reaction processes. Hydrogen-separating type reactors incorporated with hydrogen permselective membrane with thermal durability is now applied to a lot of hydrogen productions via the steam reforming of various hydrocarbons and alcohols, and via decomposition and dehydrogenation of hydrogen delivery and storage compounds.
Latest Publication

- Effect of Si/Al Ratio And Amount Of Deposited MFI-Type Seed Crystals On The Separation Performance Of Silicalite-1 Membranes For Ethanol/Water Mixtures In The Presence Of Succinic Acid (2018)
- Fabrication Of High-Performance Silicalite-1 Membrane By A Novel Seeding Method Using Zeolite-Dispersed Polymer Film (2018)
Invited Speaker 2

Associate Prof. Dr. Agus Saptoro
Dept. of Chemical Engineering, Faculty of Engineering and Science, Curtin University

Latest Publication

- Method for suppressing superheating behaviour during microwave assisted nanoparticle formation by ethylene glycol addition, Chemical Engineering & Processing (2018)
- Chemical reaction behavior in liquid-liquid system under non-contact microwave irradiation (2018)
- Bubble formation in water with magnetite nanoparticles during microwave irradiation (2017)
- In-Situ Observation of Nanoparticle Formation Under Different Power of Microwave Irradiation (2017)
- Comparison of Turbulence Models for Single Sphere Simulation Study under Supercritical Fluid Condition (2017)
- Surface tension profiles of nanofluid containing surfactant during microwave irradiation (2017)
• Promotion of nucleation for nano-particle formation by two-stage microwave irradiation (2017)

Invited Speaker 3

Assoc. Prof. Kojiro Matsushita
Department of Mechanical Engineering, Gifu University, Japan

Biography
Kojiro Matsushita received the B.S. and Ph.D. degrees. He graduated from the Department of Engineering, Tokyo University of Science, Tokyo, Japan, in 2000 and from the Graduate School of Engineering, the University of Tokyo, Tokyo, in 2007. He was a Postdoctoral Fellow in the Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, in 2008. He was a Specially Appointed Assistant Professor at the Department of Neurosurgery, Osaka University Medical School, Osaka, Japan, in 2009.
Invited Speaker 4

Dr. Eng. Bentang Arief Budiman
National Center for Sustainable Transportation Technology, Indonesia

Invited Speaker 5

Dr. Fethma M Nor
Department of Mechanical Engineering, Curtin University, Malaysia

Biography

Dr. Fethma is currently as a lecturer in the Department of Mechanical Engineering, Curtin University, Sarawak Malaysia. Previously, she was a Senior Lecturer with Universiti Tun Hussein Onn Malaysia. She obtained her D.Eng. from Dongguk University,
Korea, M.Eng. from Universiti Teknologi Malaysia, Malaysia, and B.Eng. from Universiti Tun Hussein Onn Malaysia, Malaysia.

Invited Speaker 6

Dr. Denni Kurniawan

Department of Mechanical Engineering, Universiti Teknologi Brunei, Brunei Darussalam

Invited Speaker 7

Dr. Jafri Bin Mohd Rohani

Universiti Teknologi Malaysia, Malaysia
Invited Speaker 8
Dr. Norizah Bt Hj Redzuan, PhD
Universiti Teknologi Malaysia, Malaysia

Invited Speaker 9
Sarjiya, S.T., MT., Ph.D.
Chairman of Forum Pendidikan Tinggi Teknik Elektro Indonesia (FORTEI)

Invited Speaker 10
Budi Hartono, ST, MPM, Ph.D
Associate Professor in Systems Engineering & Project Management, Universitas Gadjah Mada
Invited Speaker 11

Dr. Ratna Purwaningsih, ST, MT
Universitas Diponegoro

Invited Speaker 12

Nilda Tri Putri, ST, MT, Ph.D, IPM
Department of Industrial Engineering, Universitas Andalas

Invited Speaker 13

Dr. Eng Budi Prawara
Research Center for Electric Car and Mechatronics, Indonesian Institute of Science
# Conference Program

## Day 1, Tuesday, September 17, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.00 - 09.00</td>
<td>Registration</td>
</tr>
<tr>
<td>09.00 - 09.45</td>
<td>Opening Ceremony</td>
</tr>
<tr>
<td>09.45 - 10.00</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>10.00 - 12.00</td>
<td>Plenary Session I</td>
</tr>
<tr>
<td></td>
<td>Plenary Session I</td>
</tr>
<tr>
<td></td>
<td>Moderator: Dr. Eng. Aditya Rio Prabowo, S.T., M.T., M.Eng.</td>
</tr>
<tr>
<td></td>
<td>Prof. Ir. Dr.-Ing. Eko Supriyanto</td>
</tr>
<tr>
<td></td>
<td>Prof. Dr. Nurul Taufiqu Rochman, M.Eng, Ph.D</td>
</tr>
<tr>
<td></td>
<td>Harry Kasuma (Kiwi) Aliwarga</td>
</tr>
<tr>
<td></td>
<td>Prof. Minoru Sasaki</td>
</tr>
<tr>
<td>12.00 - 13.00</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>13.00 - 15.10</td>
<td>Parallel Session I</td>
</tr>
</tbody>
</table>

### Emerald (EE)

- **Moderator:** Sutrisno, ST., M.Sc. PhD.
- **13.00 - 13.20**
  - Invited - 1
  - Dr. Eng Budi Prawara
- **13.20 - 13.40**
  - Invited - 6
  - Sarjiya, S.T., M.T., Ph.D
- **13.40 - 14.10**
  - EE-010, EE-231
  - EE-246
- **14.10 - 14.40**
  - EE-139, EE-142
  - EE-157

### Beryl (ME)

- **Moderator:** Dharu Feby Smaradhana, ST., M.Sc.
- **13.00 - 13.20**
  - Invited - 2
  - Assoc. Prof. Kojiro Matsushita
- **13.20 - 13.40**
  - Invited - 7
  - Dr. Denni Kurniawan
- **13.40 - 14.10**
  - ME-007, ME-084
  - ME-109
- **14.10 - 14.40**
  - ME-196, ME-229
  - ME-248
<table>
<thead>
<tr>
<th>Time</th>
<th>Topaz (CE)</th>
<th>Opal (IE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderator: Mujtahid Kaavessina, S.T., M.T., PhD.</td>
<td>Moderator: Yusuf Priyandari, S.T., M.T.</td>
</tr>
<tr>
<td>13.00</td>
<td>Invited - 3 Assoc. Prof. Dr. Agus Saptoro</td>
<td>Invited - 4 Dr. Evizal Abdul Kadir, S.T., M.Eng.</td>
</tr>
<tr>
<td>13.20</td>
<td>Invited - 8 Prof. Shigeyuki Uemiya</td>
<td>Invited - 9 Dr. Eng. Bentang Arief Budiman</td>
</tr>
<tr>
<td>13.40</td>
<td>CE-004, CE-052</td>
<td>IE-032, IE-033</td>
</tr>
<tr>
<td>14.10</td>
<td>CE-056</td>
<td>IE-053</td>
</tr>
<tr>
<td>14.10</td>
<td>CE-127, CE-136</td>
<td>IE-063, IE-085</td>
</tr>
<tr>
<td>14.40</td>
<td>CE-193</td>
<td>IE-090</td>
</tr>
<tr>
<td>14.40</td>
<td>CE-014, CE-086</td>
<td>IE-114, IE-115</td>
</tr>
<tr>
<td>15.10</td>
<td>CE-202</td>
<td>IE-116</td>
</tr>
</tbody>
</table>

**Saphire (IE2)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Moderator: Yuniaristanto, S.T., M.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.00</td>
<td>Invited - 5 Budi Hartono, ST, MPM, Ph.D.</td>
</tr>
<tr>
<td>13.20</td>
<td>Invited - 10 Dr. Jafri Bin Mohd Rohani</td>
</tr>
</tbody>
</table>

**Moderator:**
- Mujtahid Kaavessina, S.T., M.T., PhD.
- Yusuf Priyandari, S.T., M.T.
- Yuniaristanto, S.T., M.T.
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Room</th>
<th>Moderator</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.10 - 15.25</td>
<td></td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opal (IE)</td>
<td>Moderator: Yusuf, Priyandari, S.T., M.T.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Saphire (IE2)

<table>
<thead>
<tr>
<th>Time</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15.55 - 16.25</td>
</tr>
<tr>
<td></td>
<td>16.25 - 16.55</td>
</tr>
</tbody>
</table>

### 19.00 - 21.00

Gala Dinner

---

**Day 2, Wednesday, September 18, 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.00 - 09.00</td>
<td>Registration</td>
</tr>
<tr>
<td>09.00 - 10.20</td>
<td>Plenary Session II</td>
</tr>
<tr>
<td></td>
<td>Moderator: Dr. Muh. Hisjam, S.T.P., M.T.</td>
</tr>
<tr>
<td></td>
<td>Assoc. Prof. Ir. Dr. Edwin Jong Nyon Tchan</td>
</tr>
<tr>
<td></td>
<td>Dr. Robert de Souza PhD, MSc, BSc Hons</td>
</tr>
<tr>
<td>10.20 - 10.35</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>10.35 - 11.55</td>
<td>Parallel Session I</td>
</tr>
<tr>
<td></td>
<td><strong>Emerald (EE)</strong></td>
</tr>
<tr>
<td></td>
<td>Moderator: Joko Slamet Saputro, S.Pd., M.T.</td>
</tr>
<tr>
<td>10.35 - 10.55</td>
<td>Invited - 11</td>
</tr>
<tr>
<td></td>
<td>Dr. Ratna Purwaningsih, S.T., M.T.</td>
</tr>
<tr>
<td>10.55 - 11.25</td>
<td>EE-076, EE-243</td>
</tr>
<tr>
<td></td>
<td><strong>Beryl (ME)</strong></td>
</tr>
<tr>
<td></td>
<td>Moderator: Fitrian Imaduddin, S.T., M.Sc., Ph.D.</td>
</tr>
<tr>
<td>10.35 - 10.55</td>
<td>Invited - 12</td>
</tr>
<tr>
<td></td>
<td>Dr. Fethma M Nor</td>
</tr>
<tr>
<td>10.55 - 11.25</td>
<td>ME-140, ME-017</td>
</tr>
<tr>
<td></td>
<td>EE-280</td>
</tr>
<tr>
<td></td>
<td>ME-107</td>
</tr>
<tr>
<td>Time</td>
<td>Session 1</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>11.25</td>
<td>CS-210, CS-244</td>
</tr>
<tr>
<td>11.55</td>
<td>CS-216</td>
</tr>
</tbody>
</table>

**Topaz (CE)**

Moderator: Anatta Wahyu Budiman, S.T., Ph.D.

- 10.35 – 10.55
  - Invited -13
  - Dr. Norizah Bt Hj Redzuan, Ph.D.

- 10.55 – 11.25
  - CE-247, CE-264
  - CE-027

- 11.25 – 11.55
  - CE-036, CE-037
  - CE-054

**Opal (IE)**

Moderator: Dr. Eko Pujiyanto, S.Si., M.T.

- 10.35 – 11.05
  - IE-080, IE-093
  - IE-100

- 11.05 – 11.35
  - IE-152, IE-170
  - IE-171

- 11.35 – 12.00
  - IE-189, IE-190
  - IE-197

**Saphire (IE2)**

Moderator: Wakhid Ahmad Jauhari, S.T., M.T.

- 10.35 – 11.05
  - IE-186, IE-241
  - IE-263

- 11.05 – 11.35
  - IE-262, IE-138
  - IE-160

- 11.35 – 12.00
  - IE-163, IE-164
  - IE-175

**11.55 - 13.00**

Lunch
<table>
<thead>
<tr>
<th>Time</th>
<th>Parallel Session II</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.00 - 14.30</td>
<td><strong>Emerald (EE)</strong></td>
</tr>
<tr>
<td>13.00 – 13.30</td>
<td>CS-261, CS-012</td>
</tr>
<tr>
<td></td>
<td>CS-212</td>
</tr>
<tr>
<td>13.30 – 14.00</td>
<td>EE-009, EE-057</td>
</tr>
<tr>
<td></td>
<td>EE-062</td>
</tr>
<tr>
<td>14.00 – 14.30</td>
<td>EE-066, EE-081</td>
</tr>
<tr>
<td></td>
<td>CS-227</td>
</tr>
<tr>
<td><strong>Topaz (CE)</strong></td>
<td><strong>Opal (IE)</strong></td>
</tr>
<tr>
<td>Moderator: Anatta Wahyu Budiman, S.T., Ph.D.</td>
<td>Moderator: Dr. Eko Pujiyanto, S.Si., M.T.</td>
</tr>
<tr>
<td>13.00 – 13.30</td>
<td>CE-223, CE-230</td>
</tr>
<tr>
<td></td>
<td>OTS</td>
</tr>
<tr>
<td>13.30 – 14.00</td>
<td>OTS</td>
</tr>
<tr>
<td></td>
<td>OTS</td>
</tr>
<tr>
<td>14.00 – 14.30</td>
<td>OTS</td>
</tr>
<tr>
<td></td>
<td>IE-275</td>
</tr>
<tr>
<td><strong>Saphire (IE2)</strong></td>
<td></td>
</tr>
<tr>
<td>Moderator: Wakhid Ahmad Jauhari, S.T., M.T.</td>
<td></td>
</tr>
<tr>
<td>13.00 – 13.30</td>
<td>IE-046, IE-055</td>
</tr>
<tr>
<td>Time</td>
<td>Emerald (EE)</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>13.00 - 14.30</td>
<td>IE-073, IE-074</td>
</tr>
<tr>
<td></td>
<td>IE-126, IE-191</td>
</tr>
<tr>
<td>14.30 – 15.00</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>15.00 - 15.30</td>
<td>Emerald (EE)</td>
</tr>
<tr>
<td>Moderator</td>
<td>Joko Slamet Saputro, S.Pd.,</td>
</tr>
<tr>
<td></td>
<td>S.Pd., M.T.</td>
</tr>
<tr>
<td>15.00 -</td>
<td>EE-290, EE-291</td>
</tr>
<tr>
<td>15.30 -</td>
<td>EE-292</td>
</tr>
<tr>
<td>15.30 - 16.00</td>
<td>OTS</td>
</tr>
<tr>
<td>16.00 -</td>
<td>OTS</td>
</tr>
<tr>
<td>16.30 -</td>
<td>OTS</td>
</tr>
<tr>
<td>17.00 -</td>
<td>OTS</td>
</tr>
<tr>
<td>15.00 - 15.30</td>
<td>Topaz (CE)</td>
</tr>
<tr>
<td>Moderator</td>
<td>Anatta Wahyu Budiman, S.T.,</td>
</tr>
<tr>
<td></td>
<td>S.T., Ph.D.</td>
</tr>
<tr>
<td>15.00 - 15.30</td>
<td>OTS</td>
</tr>
<tr>
<td>15.30 - 16.00</td>
<td>OTS</td>
</tr>
<tr>
<td>16.00 - 16.30</td>
<td>OTS</td>
</tr>
<tr>
<td>16.30 - 17.00</td>
<td>OTS</td>
</tr>
<tr>
<td>Time</td>
<td>Session 1</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>16.00 - 16.30</td>
<td>OTS</td>
</tr>
<tr>
<td>16.30 - 17.00</td>
<td>OTS</td>
</tr>
<tr>
<td>15.00 - 17.00</td>
<td>Saphire (IE2)&lt;br&gt;Moderator: Wakhid Ahmad Jauhari, S.T., M.T.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*OTS: On The Spot Registration*
<table>
<thead>
<tr>
<th>ID Paper</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-011</td>
<td>Problem Analysis of Solar Water Pump Installations in Indonesia</td>
<td>Danar Agus Susanto, Utari Ayuningtyas, Hermawan Febriansyah and Meilinda Ayundyahrini</td>
</tr>
<tr>
<td>IE-013</td>
<td>A Particle Swarm Optimization Algorithm for Optimizing Vehicle Routing Problem with Time Windows (VRPTW) : Books Distribution Case Study</td>
<td>Fairuz Yasmin', Yuniaristanto, and Muh Hisjam</td>
</tr>
<tr>
<td>IE-019</td>
<td>Clustering of the Water Characteristics of the Cirata Reservoir Using the K-means Clustering Method</td>
<td>Isma Masrofah and Bramantiyo Eko Putro</td>
</tr>
<tr>
<td>IE-021</td>
<td>Labor Realocation in PT. XYZ Assembly Machine using Simulation Approach</td>
<td>Leonard Leymena, Cucuk Nur Rosyidi, and Wakhid Ahmad Jauhari</td>
</tr>
<tr>
<td>IE-025</td>
<td>A Three-Echelon Inventory Model for Deteriorated and Imperfect Items with Energy Usage and Carbon Emissions</td>
<td>Aldy Fajrianto, Wakhid Ahmad Jauhari and Cucuk Nur Rosyidi</td>
</tr>
</tbody>
</table>
| IE-028 | A Closed-Loop Supply Chain Model for Manufacturer-Retailer-Collcgor with Rework, Waste Disposal, and Carbon Emission  
Author: Niimas Ayu Frensilia Putri Adam, Wakhid Ahmad Jauhari, and Cucuk Nur Rosyidi |
| IE-029 | Analysis of Working Posture on Muscular Skeleton Disorders of Vocational Garment Student’s in Garment Assembly Operations Practice  
Author: Irham Aribowo and Bambang Suhardi |
| IE-032 | An Integrated Inventory Model with Deteriorating and Imperfect Quality Items Considering Carbon Emission under Inflationary Environment  
Author: Dewi Sri Utami, Wakhid Akhmad Jauhari and Cucuk Nur Rosyidi |
| IE-033 | The Effects of Carbon Cap Limitations on Inventory and Land Multimodal Transportation  
Author: Thina Ardliana, I Nyoman Pujawan and Nurhadi Siswanto |
| IE-038 | Recent Developments In City Logistics Research: A literature Review  
Author: Silvi Istiqomah, Yuniaristanto, and Wahyudi Sutopo |
| IE-039 | Risk Perception Through Construction Safety Risk Assessment And Quantification  
Author: Alusine Barrie, Jafri Mohd Rohani, and Norizah Redzuan |
<p>| IE-041 | Supply Chain Risk Management: A Literature Review and Research Trends |</p>
<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-042</td>
<td>Optimization Model For Determining Economic Production Quantity and Process Mean by Considering Internal and External Quality Loss</td>
<td>Yuniarisanto and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-045</td>
<td>A Framework of Stand Up Motorized Wheelchair as Universal Design Product to Help Mobility of The Disability</td>
<td>Zufar Asyraf Fadhlurrahman, Yuniaristanto, Muhammad Hisjam and Roni Zakaria</td>
</tr>
<tr>
<td>IE-050</td>
<td>Multi Compartment Vehicle Routing Problem to Find the Alternative Distribution Route of Petroleum Product Delivery</td>
<td>Izatul Fitria Febriandini, Yuniaristanto and Wahyudi Sutopo</td>
</tr>
</tbody>
</table>
| IE-055 | Development of Food Safety Design for SMEs Yogurt Using HACCP  
Author: Endi Hari Purwanto, and Ajun Tri Setyoko, and Auraga Dewantoro |
| IE-060 | Analysis of Three-Echelon Closed-Loop Supply Chain System with Environmental Investigations  
Author: Wakhid Ahmad Jauhari, Rendy Dwi Septian, Pringgo Widyo Laksono and Anindya Rachma Dwicahyani |
| IE-061 | Simulation Based-Daily Coal Inventory Planning And Control Through Replenishment Postponement Option Under Continuous Demand And Supply : A Case Of Cement Industry  
Author: Dicky Fatrias, Nilda Tri Putri and Ilham Kurniawan Batubara |
| IE-063 | Pricing For Product-Service System Under Dual-Channel Supply Chain Structure  
Author: E Widodo, I N A Shabir and B Syairudin |
| IE-064 | Identifying Factors for Assessing Regional Readiness Level to Manage Natural Disaster in Emergency Response Periods  
Naniek Utami Handayani, Diana Puspita Sari, and Adi Setyo Nugroho |
| IE-065 | A Data Envelopment Analysis Approach for Assessing the Efficiency of Sub-sectors of Creative Industry |
| IE-068 | Optimization of Senja Utama Courier Service Schedule with Vehicle Routing Problem-Simultaneously Pick-up and Delivery  
Author : I W Saputra, Yuniaristanto and M Hisjam |
| IE-070 | Power Generation and Transmission System Analysis by Using Cooperative Game Theory (Case Study: Electricity in Kalimantan)  
Author : Erwin Widodo and Wiwit Marta Pangesty Putri |
Author : Devi Putri Rahmawati, Fakhrina Fahma, Wahyudi Sutopo, and Risang Pamungkas Anurogo |
| IE-073 | Defining the Role of Quality Function Deployment to Improve the Usability of Prosthetic Hand  
Author : Novie Susanto, Manik Mahachandra, Ratna Purwaningsih and Wiwik Budiawan |
| IE-074 | Repetitive Tasks Analysis in Cutting Tofu Process Using Assessment of Repetitive Tasks Tool  
Author : Rahmaniayah Dwi Astuti, Anindya Ratna Lakhsita, and Bambang Suhardi |
| IE-075 | Quality Assessment Of CoC (Code of Conduct) by Servqual Method And IPA Model (Case Study: Employee of PT. PLN Central Java and D.I.Yogyakarta Distrbution)  
Author : Widhiyaningrum and Novie Susanto |
| IE-077 | Working Analysis of Temporary Storage Operators and Tofu Cutting Operators Using RULA Method  
*Author: Rahmaniyah Dwi Astuti, Shofitri Dhia Hanifah, and Wakhid Ahmad Jauhari* |
| IE-078 | Ergonomic Intervention in Finishing Carton Process to Increase Productivity And Efficiency of PT. XYZ  
*Author: Lamto Widodo* |
| IE-079 | Customer Switching Behavior Factors Analysis In Airline Industry Of Low Cost Carrier And Full Service Carrier  
*Author: Aries Susanty, Nia Budi Puspitasari, and Bariqi Rahadyan Putera* |
| IE-080 | Modelling The Best Route And Truck Capacity For Delivering Ice Cream Product : Vehicle Routing Problem Approach  
*Author: Heryati Ika Puspitasari and Aries Susanty* |
| IE-082 | A Conceptual Framework on The Design of Intelligent Supply Chain for Natural Fibre Agroindustry  
*Author: Nunung Nurhasanah, Machfud, Djumali Mangunwidjaja, and Muhammad Romli* |
| IE-085 | The Current Status of Functional Food Regulation in Indonesia  
*Author: Ellia Kristiningrum, Danar Agus Susanto, Putty Anggraeni, and Muhammad Haekal Habibie* |
<p>| IE-088 | Ergonomics Principles in Traffic Signs Comprehension: A Literature Review |</p>
<table>
<thead>
<tr>
<th>Session Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-090</td>
<td>Implementation of Life Cycle Assessment (ISO 14040) On SME Fish Nugget Producer In Bandung</td>
<td>Author: Farid Ishartomo, Bambang Suhardi and Jafri Mohd Rohani</td>
</tr>
<tr>
<td>IE-091</td>
<td>Designing to Improvements of Posture and The Working Environment of Employees</td>
<td>Author: Ajun Tri Setyoko, and Ellia Kristiningrum</td>
</tr>
<tr>
<td>IE-092</td>
<td>Consumer Behaviour Analysis Towards Conventional Car Shifting To Electric Car Vehicle</td>
<td>Author: Abel Kristanto Widodo, and Singgih Saptadi</td>
</tr>
<tr>
<td>IE-093</td>
<td>Technology Assessment of Treatment of Liquid Waste in Rubber Factory Using Analytical Hierarchy Process and Promethee Methods</td>
<td>Author: Aulia Ishak and Vina Akmaliah</td>
</tr>
<tr>
<td>IE-094</td>
<td>Human Error Analysis Using SHERPA and HEART Methods in the Implementation of the Colon in Loop in the Radiology Installation of the RSUD Karanganyar</td>
<td>Author: Lusiana Putri Setyowati, Irwan Iftadi, and Rahmaniyah Dwi Astuti</td>
</tr>
</tbody>
</table>
| IE-097 | Lot-Sizing Decisions in Manufacturer-Retailer Inventory System under Carbon Emissions Reduction  
*Author: Wakhid Ahmad Jauhari* |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
*Author: Maria Nindy Alif Jodinesa, Wahyudi Sutopo and Roni Zakaria* |
| IE-100 | Literature Review of City Logistics: Classification of Studies and Dominant Factors in Developing Countries  
*Author: A Arvianto, A M S Asih, B M Sopha and M A Imron* |
| IE-101 | Supply Chain Performance Analysis With Data Envelopment Analysis in TBBM PT. Pertamina Boyolali  
*Author: Zulhendra Hanif, Kristy Permata, Martha Widhi Dela Utami, Yuniaristanto Yuniaristanto and Wahyudi Sutopo* |
| IE-102 | Framework for developing electric wheelchair standards for people with disabilities  
*Author: Syifa Luthfiana Asnan, Fakhirna Fahma, Wahyudi Sutopo and Meilinda Ayundyahrini* |
*Author: Lintang Rainamaya Nursanti1,a), Eko Pujiyanto1,b), and I Wayan Suletra1,c)* |
| IE-104 | Analysis of Indonesian Tea Competitiveness in The International Market  
Author: Yessica Nugrahaningrum, Roni Zakaria and Fakhrina Fahma |
|--------|---------------------------------------------------------------------|
| IE-106 | Comparison Analysis of Performance Measurement Between PT KALOG and PT ROSALIA EXPRESS Using the Logistics Scorecard Method  
Author: Avia Bilqis Viana, Anida Norma Cahyati, Yuniaristanto, Wahyudi Sutopo and Sofi Desi Susanti |
| IE-108 | Qualitative Comparative Analysis (QCA): A Qualitative-Quantitative Approach for Multi-Variables and Small Samples Research (Case Study: Indonesia's Megaprojects)  
Author: R.W. Damayanti, Budi Hartono, and Andi Rahadiyan Wijaya |
| IE-110 | The Impact of Critical Success Factor of Lean Six Sigma Implementation towards the Improvement of Business Performance on Low-Cost Hotel Industry: A Literature Review  
Author: Alima Shofia, Arfan Bakhtiar, and Heru Prastawa |
| IE-114 | A consignment policy for a supplier-retailer inventory system with periodic review policy  
Author: Yuka Sato, Wakhid Ahmad Jauhari, and Cucuk Nur Rosyidi |
| IE-115 | Role of Rapid Manufacturing Technology in Wearable Customized Assistive Technology for Modern Industry |
| IE-116 | Application of Quality Function Deployment for Diversification of Souvenirs of Goyor Weaving Fabrics for Foreign Tourist Needs (Case Study: Sragen Regency)  
*Author*: Ilham Priadythama, Lobes Herdiman and Susy Susmartini |
| IE-117 | Sustainable Economic Production Quantity Model with Rework and Return Policy  
*Author*: Navy Salem, Eko Liquiddanu, I Wayan Suletra and Murman Budijanto |
| IE-119 | Improvement of Work Processes and Methods to Achieve Production Targets Using VA-NVA Analysis, ECRS, and Line Balancing  
*Author*: Ilham Nur Fadlil and Cucuk Nur Rosyidi |
| IE-121 | Enhancement Quality of Sand Casting Manufacturing Product Using Taguchi Method  
*Author*: Salman Alfarisi and Wahyudi Sutopo |
| IE-122 | Mapping of Heat Exposure in Production Room of PT. Pilar Kekar Plasindo Using Surfer Software  
*Author*: Fuky Prima Pradana, Bambang Suhardi, Rahmaniyah Dwi Astuti |
| IE-123 | Integrated Economic and Environmental Model for Vendor-Buyer Inventory System with Carbon Cap and Trade Policy  
*Author*: Euis Nurlathifah, Meidiana Farras Isnafitri and Wakhid Ahmad Jauhari |
| IE-124 | Implementation of the Halal Assurance System for Small and Medium Manufacturing Industries at UNSQUA  
Author: Chaidir Akbar, Fakhrina Fahma, and Roni Zakaria |
|-------|--------------------------------------------------------------------------------------------------|
| IE-125 | Redesign Production Layout Using Dedicated Storage Method: Study Case PT. Solo Grafika Utama  
Author: Cornelius Dianto, Fachry Widiandoko, Diah Rahmasari, Wahyudi Sutopo, and Yuniaristanto |
Author: Farid Ishartomo, Sulistiono, Isna Nugraha, Aisyah Itsnaini Sholichah, and Bambang Suhardi |
| IE-128 | Determination of Route of BBM Distribution from Pertamina Oil Fuel Terminal (TBBM) Boyolali to Gas Station in Surakarta City with Clarke and Wright Savings Algorithm  
Author: Nurina Sharfina, Yosua Arinto Wicaksono, Iqbal Irsyad Muhammad, Yuniaristanto and Wahyudi Sutopo |
| IE-129 | Six Sigma Application to Minimize Castor 5 Inch Scrap Material in EOP Warehouse PT. Mega Andalan Kalasan  
Author: Aldy Fajrianto, Muhammad Habib Isna Nur Asnan, Nida An Khoﬁyah, Wahyudi Sutopo and Yuniaristanto |
| IE-130 | Redesign Determination of Plate Raw Material Supplier with Analytic Hierarchy Process (AHP) Approach |
| IE-131 | Selection of Supplier Using TOPSIS Method in PT. Trijaya Plastik Utama  
Author: Sulvi Fitriani, Syifa Luthfiana Asnan, Nida An Khofiyah, and Wahyudi Sutopo |
|--------|----------------------------------------------------------------------------------------------------------------------------------|
| IE-132 | Determination of Fuel Distribution Routes to Determine Optimal Pathways by Vehicle Routing Problem Method in Boyolali Fuel Terminal  
Author: Maulana Ichwan Anshory, Aprilia Dityarini, Yuniaristanto, Wahyudi Sutopo, and Brahmastya Artanto |
| IE-133 | Design of Electric Guitar 8 Strings with Combination of Smartphone Devices as a Virtual Guitar Effect Using Reverse Engineering Method  
Author: Sulistiono, Bambang Suhardi, and Susy Susmartini |
| IE-135 | Measurement Model of Halal Practice Readiness among Food Manufacturing Small Medium Enterprises  
Author: Ida Giyanti, Anita Indrasari, Wahyudi Sutopo, Eko Liquiddanu |
| IE-137 | Organic Vegetables Planting Model to Reduce Pesticide Using  
Author: Puji Handayani Kasih and Ahmad Rusdiansyah |
<p>| IE-138 | Application of Quality Function Deployment (QFD) Level 2 for the Development of Traditional Textile Motifs (Case Study: The |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-141</td>
<td>Design of the Civil Servant in Sragen for the production in Sukoharjo)</td>
<td>Author : Arga Setia Asmara Sakti, Eko Liquiddanu, and I Wayan Suletra</td>
</tr>
<tr>
<td>IE-141</td>
<td>Early Warning of Food Security In East Java Indonesia Using A System Dynamics Model</td>
<td>Author : Vina Vahlevi Al Juned, Iwan Vanany and Diesta Iva Maftuhah</td>
</tr>
<tr>
<td>IE-150</td>
<td>Aggregate Planning Method as Production Quantity Planning and Control to Minimizing Cost</td>
<td>Author : Isna Nugraha, Muh. Hisjam and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-151</td>
<td>The Dynamic Simulation Model for Fulfilling Soybean Logistics to Support the Soybean Price Stabilization</td>
<td>Author : Isna Nugraha, Wahyudi Sutopo, Muh. Hisjam and Nancy Oktyajati</td>
</tr>
<tr>
<td>IE-152</td>
<td>Assessment of Tourism Destination Sustainability Status using Rap-tourism case of natural based tourism</td>
<td>Author : Ratna Purwaningsih, Herdiana Nur Annisa and Aries Susanty</td>
</tr>
<tr>
<td>Title</td>
<td>Author</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Strategic Planning In Procurement Of Raw Materials Based On Kraljic’s Purchasing Portofolio Model (Case Study: CV. ABC)</td>
<td>Hery Suliantoro, Selvina Kharisma Putri, and Darminto Pujotomo</td>
<td></td>
</tr>
<tr>
<td>Analysis of Teaching Methods Using 3D Printing on Motivation and Student Learning Outcomes</td>
<td>Poppy Nandasari and Herianto</td>
<td></td>
</tr>
<tr>
<td>Green Industry Award in Increasing Manufacturing Industry Competitiveness in Indonesia</td>
<td>Suryo Hadiyono and Rahmat Nurcahyo</td>
<td></td>
</tr>
<tr>
<td>Performance Design of Cacao Agroindustry Supply Chain to Increase Farmers 'Welfare and Indonesian Cocoa Sustainability</td>
<td>Iphov Kumala Sriwana</td>
<td></td>
</tr>
</tbody>
</table>
*Author*: Latifatul Luluah, Nurruddin Baidowi, and Wakhid Ahmad Jauhari |
| IE-164 | Application of Anticipatory FMEA Model for Preventing Failures in Humanitarian Response Operation  
*Author*: Agung Sutrisno |
| IE-166 | Optimal Lot Sizing Decision in a Closed-Loop Supply Chain Considering Investment in Returned Items Collection and Product Design  
*Author*: Anindya Rachma Dwicahyani and Wakhid Ahmad Jauhari |
| IE-168 | Analysis Techno-Economy of Lithium-Ion Batteries for Truck or Heavy Duty Development  
*Author*: Aisyah Itsnaini Sholichah, Muhammad Hisjam, and Wahyudi Sutopo |
| IE-170 | Future and Challenge of 3D Printed Bone External Fixator : Statics Stress Simulations of Polycarbonate Taylor Spatial Frame Ring  
*Author*: Ilham Priadythama, Lobes Herdiman and Taufiq Rochman |
| IE-171 | Creating Motifs Using Silver Electrolyte Gel in Electroplating Technique  
*Author*: Kurnia, Dr. Paryana Puspaputra and Dr. Taufiq Immawan |
<p>| IE-173 | Optimization of Sawn Timber Production by Considering Main Order And Side Order Using |</p>
<table>
<thead>
<tr>
<th>Paper ID</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-175</td>
<td>Linear Programming Methods (Case Study: KBM IK Brumbung)</td>
<td>Octavia Riskadayanti, Muhammad Hisjam and Yuniaristanto</td>
</tr>
<tr>
<td>IE-175</td>
<td>Fault Tree and Decision Making Trial and Evaluation Laboratory Model for Formulating Risk Mitigation Strategies at Water Production Process of PDAM Baubau</td>
<td>Widya Spalanzani, Udisubakti, Ciptomulyono, Mokhammad Suef, Asmuddin Mpd and Salwiah Mpd</td>
</tr>
<tr>
<td>IE-176</td>
<td>The Selection of Lithium Battery Raw Materials by Environment, Economic, and Social Sustainability</td>
<td>Aisyah Itsnaini Sholichah, Muhammad Hisjam, and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-178</td>
<td>Evaluation Business of Battery Swap for Electric Vehicle</td>
<td>Aisyah Itsnaini Sholichah and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-180</td>
<td>A Literature Review : Preparation Electric Motorcycle Conversion in Indonesia</td>
<td>Achmad Habibie and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-185</td>
<td>Supplier Management Using Vendor Managed Inventory in Perishable Product For Health Care Organization</td>
<td>Agus Mansur, Ardi Permana, and Imam Rosyadi</td>
</tr>
<tr>
<td>IE-186</td>
<td>Analysis of Risk Factor Non Productive Time on Geothermal Drilling in Indonesia</td>
<td>Mokh Kandari, Gatot Yulianto and Singgih Saptadi</td>
</tr>
</tbody>
</table>
| IE-187 | Inventory Management of Raw Material in SMEs Using Periodic Review System and Continuous Review System  
Author: Agus Mansur and Muhamad Sabit |
|--------|----------------------------------------------------------------------------------------------------------------------------------|
| IE-189 | Parallel Injection Molding Machine Scheduling by Considering Parameter Process Conservation  
Author: R.B. Seno Wulung and Midarto Dwi Wibowo |
| IE-190 | Optimum Pipe Network Of Tahu Tempe Wastewater Distribution Using Multiple Sources Single Sink Network Flow Model  
Author: I Wayan Suletra, Yusuf Priyandari, Eko Liquiddanu |
| IE-191 | A Manufacturing Workplace Design Selection Framework to Increase Productivity Using Virtual Reality  
Author: Benazir Imam Arif Muttaqin, Wahyu Andy Prastyabudi, and Rizqa Amelia Zunaidi |
| IE-197 | Selecting the Synthetic Leather and Out sole Supplier for Shoe Production in Small Medium Enterprise  
Author: Suhartini Suhartini and Hastawati Chrisna Suroso |
| IE-198 | Modbus HMI Bluetooth for outseal PLC  
Author: Djoko Untoro |
| IE-199 | Sustainable Resources Planning and Implementation in Teaching and Research Laboratory  
Author: Norizah Redzuan, Khidzir Zakaria, Rozlina M. Sirat, Rozaimi M. Saad, and Roslin Yasak |
| IE-205 | Defect Analysis In Shoes Production Process Using Statistical Process Control and Failure Mode Effect Analysis Method  
*Author: Dimyati, Afni Khadijah, and Ellia Kristinigrum* |
| IE-209 | Developing Green Manufacturing Indicators For The Decorative Paint Industry: A Case Study Of Indonesia  
*Author: Gun Nanda Tian PurnamaDimyati, Sawarni Hasibuan and Zulfa Fitri Ikatrinasari* |
| IE-219 | Technology Selection of Solid Waste Processing Using Analytical Network Process (ANP) and Fuzzy Topsis Case Study in Jepara Indonesia  
*Author: Dyah Ika Rinawati, Srijanto and Muhammad Erwin Ferdianto* |
| IE-222 | Development of Workers Transportation Scheduling and Routing Model Using Metaheuristic Approach  
*Author: Ari Pranata Primisa Purba; Nurhadi Siswanto S.T., MSIE.,Ph.D and Dr.Eng.Ir. Ahmad Rusdiansyah, M.Eng.,CSCP, CLTD* |
| IE-226 | Quality Improvement of Woods Product using the Quality Function Deployment (QFD) Method at PT. X  
*Author: Rosnani Ginting, Eka Periana Pane, and Alfin Fauzi Malik* |
| IE-233 | An Agent Based Simulation Model For Retailers Price Promotion Strategies  
*Author: N I Arvitrida and A C Kurniawan* |
| IE-234 | Macroergonomics Approach To Analyze The Quality Of Public Bike-Sharing Transportation Services (Case Study:MIGO E-bike Surabaya)  
Author : Adithya Sudiarno and Shofa Aulia Aldhama |
| IE-235 | Natural Lighting In Workplace; The Availability And The Occupants Adaptive Behavior  
Author : Silfia Mona Aryani and Arif Kusumawanto |
| IE-241 | Integration of Quality Function Deployment (QFD) and Value Engineering in Improving the Quality of Product : A Literature Review  
Author : Aulia Ishak, Rosnani Ginting and Alfin Fauzi Malik |
| IE-242 | Product Development and Design with a Combination of Design for Manufacturing or Assembly and Quality Function Deployment: A Literature Review  
Author : Rosnani Ginting, Aulia Ishak and Alfin Fauzi Malik |
| IE-245 | Assessment of Technology Readiness Level And Manufacturing Readiness Level in PT. ABC (Case Study: Technology On Hospital Bed Products)  
Author : Fadli Syamsuddin, Yusuf Priyandari, Susanto Sudiro |
| IE-253 | Analysis Strategies with External Factors of Developing Testing Laboratories becomes a Conformity Assessment in UNS  
Author : Anita Arya Rosanti, Roni Zakaria, and Fakhrina Fahma |
| IE-254 | Development of Independent Energy Villages Based on Micro-Hydro Power Plant in Indonesia  
Author: Lilies Setiartiiti and Muhammad Hisjam |
|--------|----------------------------------------------------------------------------------------------------------------------------------|
| IE-256 | Strategy for Development of Internal Laboratory Readiness to be A Conformity Assessment Institution (Case Study : Universitas Sebelas Maret)  
Author: Kristy Permatasari, Fakhirina Fahma, and Roni Zakaria |
| IE-260 | Predictive Maintenance Model for Pumps Under Improper Maintenance Conditions  
Author: Nazmee Hashim, Adnan Hassan and Mohd Foad Abdul Hamid |
| IE-262 | The Dynamic of the Incineration Waste-to-Energy Power Plant Policy in Indonesia  
Author: Agusniar Rizka Luthfia, Albertus Sentot Sudarwanto and Eka Nada Shofa Alkhajar |
| IE-263 | Current Research on City Logistics and Possible Adoption in Developing Countries  
Author: Kuncoro Harto Widodo, Yandra Rahadian Perdana, Russell G. Thompson, Hengki Purwoto, Dwi Ardianta Kurniawan and Joewono Soemardjito |
| IE-265 | Modeling A Closed Loop Supply Chain Network With Product Return Incentives Under Carbon Emission Regulations  
Author: Fareeduddin Mohammed, Adnan Hassan and Shokri Z. Selim |
<p>| IE-266 | Implementation of Indonesian National Standards for Small and Medium Enterprises in Pandono Abstract Batik |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-273</td>
<td>Agricultural Mechanization and Rice Production in Indonesia</td>
<td>Author: Kurnia Tri Atmojo, Fakhrina Fahma and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-274</td>
<td>A Proposed Policy Of Medical Inventory System In Pharmacy Installation (Case Study in Semen Padang Hospital)</td>
<td>Author: Ernoiz Antriandarti</td>
</tr>
<tr>
<td>IE-275</td>
<td>Reducing Defect In Furniture Product Using A Lean Six Sigma Approach</td>
<td>Author: Asmuliardi Muluk, Jonrinaldi and Fadhita Maisa Asri</td>
</tr>
<tr>
<td>IE-277</td>
<td>Age and Gender Effects on Driver Distraction Caused By Passenger Presence in Simulated Driving Study</td>
<td>Author: Manik Mahachandra and Muhammad Ragil Suryoputro</td>
</tr>
<tr>
<td>IE-278</td>
<td>Municipal Solid Waste Logistics Management: a Study on Reverse Logistics</td>
<td>Author: Annie Purwani, Muhammad Hisjam and Wahyudi Sutopo Sutopo</td>
</tr>
<tr>
<td>IE-293</td>
<td>Movement Flexibility of Autistic Children during Individual Therapy using ABA Lovaas Table Modification with Foldable Table Top</td>
<td>Author: Dwi Candra Purnamasari, Sinta Sari M, and Lulu Purwaningrum</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IE-295</td>
<td>Municipal Solid Waste Logistics Management: a Study on Reverse Logistics</td>
<td>Annie Purwani, Muhammad Hisjam, and Wahyudi Sutopo</td>
</tr>
<tr>
<td>IE-296</td>
<td>Implementation of Lean Manufacturing in an Electronic Assembly Company</td>
<td>Celine Koh Xian Lin, Syed Ahmad Helmi, Muhammad Hisjam, and Ahad Ali</td>
</tr>
<tr>
<td>IE-297</td>
<td>Ergonomic Improvement in a Manufacturing Company</td>
<td>Tuan Ahmad Farhan Hakimi, Syed Ahmad Helmi 1, Muhammad Hisjam, and Ahad Ali</td>
</tr>
<tr>
<td>ME-005</td>
<td>Feasibility of Esterification Process for Producing Biodiesel from Waste Cooking Oils</td>
<td>Suyitno, Mohamad Muqoffa, Syamsul Hadi and Evi Gravitiani</td>
</tr>
<tr>
<td>ME-006</td>
<td>The Effect of Adhesive Concentration Variation on the Characteristics of Briquettes</td>
<td>Rany Puspita Dewi</td>
</tr>
<tr>
<td>ME-007</td>
<td>Simulation Study on a Torsional Stiffness Test Apparatus for Space Tube Frame Chassis</td>
<td>Rafli Alnursyah, Ubaidilla, Hashfi Hazimi, Hanna Nursya’bani</td>
</tr>
<tr>
<td>ME-008</td>
<td>Numerical Study of Effect of Blade Number and Inlet Blade Angle on Propeller Turbine Performance Using Computational Fluid Dynamic</td>
<td>Hasan Bisri, DDD Prija Tjahjana, Dwi Aries Himawanto</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>ME-017</td>
<td>An Experimental Study of a Car Maintenance Workshop Layout Optimization</td>
<td>Agung Premo, Matheus Victor P, and Himawan Hadi Sutrisno</td>
</tr>
<tr>
<td>ME-048</td>
<td>Design of Mussel Peeler Machine Ergonomic</td>
<td>Unggul Prabowo, Agung Prakoso Wicaksono, Renanda Herlian, Yosua Heru Irawan</td>
</tr>
<tr>
<td>ME-081</td>
<td>Evaluation the performance of low-frequency vibration calibrator</td>
<td>Fajar Budi Utomo, Bondan Dwisetyo, Chery Chaen Putri and Maharani Ratna Palupi</td>
</tr>
<tr>
<td>ME-083</td>
<td>The Effect of Pressure and Temperature on Biodiesel Production using Castol Oil</td>
<td>Dandun Mahesa Prabowoputra, Agus Sartomo, Suyitno</td>
</tr>
<tr>
<td>ME-084</td>
<td>Factorial Design of the Effect of Reaction Time and Reaction Temperature on Biodiesel Production</td>
<td>Agus Sartomo, Suyitno, Dandun Mahesa Prabowoputra</td>
</tr>
</tbody>
</table>
| ME-107 | Extraction and Characterization of Nanocrystalline Cellulose (NCC) from Ramie Fiber by Sulphuric Acid Hydrolysis  
*Author*: R. Faiz Listyanda, Kusmono, Muhammad Waziz Wildan, and Mochammad Noer Ilman |
| --- | --- |
| ME-109 | Savonius Turbine Performance with Slotted Blades  
*Author*: Catur Harsito and Dominicus Danardono Dwi Prija Tjahjana and Budi Kristiawan |
| ME-112 | Innovation on Increasing Savonius Wind Turbine Efficiency with Circural Cylinder as a Bluff Body in front of Its Returning Blade  
*Author*: Ikhsanudin Zaini, Okky Renaldy and Bagas Ramadhan Ananto |
| ME-118 | Effects of Processing Parameters on The Tensile Strength of Injection Moulding Unidirectional Glass Fiber Reinforced Polypropylene Composite  
*Author*: MuhammadAleks Ad, Heru Santoso Budi Rochardjo and Cahyo Budiyan |
<table>
<thead>
<tr>
<th>Paper ID</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-143</td>
<td>Effect of the Post Weld Heat Treatment on the Physics and Mechanics Properties of the Underwater Wet Welded Low Carbon Steel</td>
<td>Suryo H. Sumar, Fawwaz M. Wijdan, Wijaya A. Yogi, Saputro E.W, Harto</td>
</tr>
<tr>
<td>ME-147</td>
<td>Effect of Electrospinning Distance Between Needle Tip and Collector to Fabricate ZnO Nanofiber as Photoanode of Dye-Sensitized Solar Cells</td>
<td>Syaukaty Yasinta, Nurul Muhayat, Y.C.N. Saputro and Triyono</td>
</tr>
<tr>
<td>ME-148</td>
<td>The Influence of Electrospinning Flow Rate Parameter on ZnO Nanofiber as Photoanode of Dye-Sensitized Solar Cells</td>
<td>Zainal Arifin, Syamsul Hadi, Hanung Nugroho Jati, Singgih Dwi Prasetyo, and Suyitno Suyitno</td>
</tr>
<tr>
<td>ME-149</td>
<td>Mechanical Properties of Pouch Battery Constituents</td>
<td>Putri Nur Halimah, Bentang Arief Budiman, and Poetro Lebdo Sambegoro</td>
</tr>
<tr>
<td>ME-156</td>
<td>The Effect of Slotted Blade on The Performance of Savonius Wind Turbine</td>
<td>Agung Dwi Nugroho, Dominicus Danardono Dwi Prija Tjahjana, Budi Kristiawan</td>
</tr>
<tr>
<td>ME-159</td>
<td>Experimental Study on The Effect of Number of Archimedes Turbine Blades in Closed Flow</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Author</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Material Selection of Continuous Stirred Tank Reactor for Biogas Conversion from Palm Oil Mill Effluent</td>
<td>Ihsan Pratama Rushadiawan and Dwi Aries Himawanto</td>
<td></td>
</tr>
<tr>
<td>Future and Challenge of 3D Printed Bone External Fixator: Statics Stress Simulations of Polycarbonate Taylor Spatial Frame Ring</td>
<td>W Wulandari, R Dwimansyah, H N Anindita, R Hanafi, B A Firmandoko and H Hermawan</td>
<td></td>
</tr>
<tr>
<td>Drilling of AISI 316L Stainless Steel: Effect of Coolant Condition on Surface Roughness and Tool Wear</td>
<td>Ilham Priadythama, Lobes Herdiman and Taufiq Rochman</td>
<td></td>
</tr>
<tr>
<td>Experimental Study of the Influence Inlet Blade Geometry on Performance Propeller Turbine for Pipe Inline Installation</td>
<td>Hasan Bisri, D D D Prija Tjahyana, Dwi Aries Himawanto</td>
<td></td>
</tr>
<tr>
<td>Experimental Study of the Effect of Blade Angle on Pico Tubular Bulb Turbine Performance in Horizontal Flow</td>
<td>Akhmad Nurdin, Syamsul Hadi, Dwi Aries Himawanto</td>
<td></td>
</tr>
</tbody>
</table>
| ME-201 | Characteristics of Mechanical Properties of Coconut Fiber and Natural Rubber with Different Fraction Weight  
*Author*: Sigit Arrohman, Kuncoro Diharjo, and Dody Ariawan |
| ME-203 | Wind Powered Low Speed Centrifugal Reaction Pump for Very Low Head Water Lifting  
*Author*: YB. Lukiyanto, Budi Setyahandana, Rines |
| ME-207 | Finite Element Analysis of Needle Penetration on Skin: Effect of Needle Tip Shape  
*Author*: Lau Yunn Yang, Fethma M Nor, and Denni Kurniawan |
| ME-211 | Effect of Environment on the Defects of Welded Aluminum AA 1100  
*Author*: Rafael Simanjuntak, Aditya Rio Prabowo, Y.C.N. Saputro and Triyono |
| ME-218 | A Novel Blind Chessboard Support System Featuring Magnetorheological Elastomer Sensor  
*Author*: Dimas Adiputra, Ardiansyah Al Farouq, Ubaidillah, Rumi Iqbal Doewes |
| ME-221 | Two and Four Blades Windmill Characteristics of Traditional Salt Farmers from Demak Region  
*Author*: S. Dio Zevalukito, YB. Lukiyanto, Dimas P. Utomo |
<p>| ME-229 | The influence of Magnesium Oxide and Montmorillonite on the Flame Retardant an Flexural Strength of Fiber Glass- Unsaturated Polyester Composites |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-236</td>
<td>Computational Study of Biogas-Air Mixing Homogeneity in The Mixer of Dual Fuel Conversion Kit</td>
<td>Ojo Kurdi, Djoeli Satrijo, Ismoyo Hartanto, Mohd Shukri Yob, Novi Riyantiarn</td>
</tr>
<tr>
<td>ME-237</td>
<td>Swirling Number Effect on the Mixing Quality of Air-CNG Mixture in the Intake Manifold of CNGDiesel Dual Fuel Engine</td>
<td>Nazaruddin Sinaga, Maizirwan Mel, Qoriatul Fitriyah, Dinesh Dhande, and Bagus Suryasa</td>
</tr>
<tr>
<td>ME-239</td>
<td>Effect of Temperature Process to Aluminium Lattice Strain (Dislocation Density)</td>
<td>Aminnudin Aminnudin</td>
</tr>
<tr>
<td>ME-243</td>
<td>Construction Design of Multistage Axial Field BLDC Motor</td>
<td>Fahrul, Rusdhianto Effendi, Mochammad Rameli</td>
</tr>
<tr>
<td>ME-246</td>
<td>The Prototype of Automated Guided Vehicle Based on Autonomous Navigation Technology</td>
<td>Hoedi Prasetyo, Laras Prasetyo Adhi</td>
</tr>
</tbody>
</table>
| ME-248   | Experimental Investigation of Blades Number of Savonius Water Turbine on Performance Characteristic  
| Author: Dwiseno Wihadi and Stefan Mardiku |
| ME-250   | Design and Aerodynamics Analysis of Rear Wing Formula Student Car Using 3 Dimension CFD (Computational Fluid Dynamics)  
| Author: Mohammad Arief Dharmawan, Dominicus Tjahjana, Budi Kristiawan, Sarah Pertiwi |
| ME-257   | The Effect of Vegetable Oil Pressure on The Mist Cooling Mist on The Steel Surface Roughness that is Processed ith A Milling Machine  
| Author: Mahfud Ihsan, Aminnudin Aminnudin and Yanuar Rohmat Aji Pradana |
| ME-259   | The Effectiveness of Minimum Quantity Lubrication (MQL) SiO₂ Nanoparticle Enriched Cutting Fluids in Milling Process of Hardened Steel  
| Author: SukmajI Indro Cahyono |
| ME-267   | Characteristics of Successive Droplets Impacting The Aluminum Hot Surface around The Nucleate Boiling Region  
| Author: Arif Widyatama, Akmal Irfan Majid, Teguh Wibowo, Deendarlianto and Samsul Kamal |
| ME-268   | Analysis of The Effect of Magnesium Addition in All-Si Alloy using Steer Casting Method on Physical and Mechanical Properties  
| Author: Teguh Triyono, Eko Surojo, and Vicky Tri Utomo |
| ME-271       | The Augmentation Techniques of Savonius Wind Turbine Rotor using CFD: review  
Author: Cahyono, SI. Danar Dono DPT |
| ME-272       | The Performance Evaluation of Horizontal Twin Screw Conveyors for Grain Collector Machine Application  
Author: Cahyono, SI. TT |
| ME-280       | The influence of discharge current to temperature distribution of Lithium ion cells  
Author: Sunarto Kaleg, Abdul Hapid, Miftahul Anwar, Feri Adiyyanto, Hillga R. Radhita, Sukmaji I. Cahyono, and Kuncoro Diharjo |
| ME-284       | Analysis of Microstructure and Chemical Composition in Hexagonal Bold in Brake Lining Aircraft Cessna Caravan 208B  
Author: Indreswari Suroso and Muhammad Nur Rizqi |
| EE-009       | Analysis Curve of Maximum Power and Torque Turbine Generated by Vertical Axis Wind Turbine Based on Number of Blades  
Author: Langlang Gumilar, Muhammad Afnan Habibi, Dwi Prihanto, Hendro Wicaksono, Jade Rosida Larasati, Achmad Gunawan |
| EE-010       | Optimalization Harmonic Shunt Passive Filter Using Detuned Reactor and Capacitor Bank to Improvement Power Quality in Hybrid Power Plant  
Author: Langlang Gumilar, Denis Eka Cahyani, Arif Nur Afandi, Dezetty Monika, Stieven Netanel Rumokoy |
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE-012</td>
<td>Challenges for Standardization: Hyperspectral Technology to Support Indonesian Food Security</td>
<td>Meilinda Ayundyahrini, Endi Hari Purwanto, Reza Lukiawan, and Ajun Tri Setyoko</td>
</tr>
<tr>
<td>EE-057</td>
<td>Preliminary Research of Surface Electromyogram (sEMG) Signal Analysis for Robotic Arm Control</td>
<td>Pringgo Widyo Laksono, Minoru Sasaki, Kojiro Matsushita, Muhammad Syaiful Amri bin Suhaimi, and Joseph Muguro</td>
</tr>
<tr>
<td>EE-067</td>
<td>Analysis of Load Flow and Continuous Power Flow Method with Static VAR Compensator (SVC) for Static Voltage Stability Analysis A Case Study of 500 KV Java-Bali Electrical Power System</td>
<td>Chico Hermanu Brillianto Apribowo, Oktavian Listiyanto, Muhammad Hamka Ibrahim</td>
</tr>
<tr>
<td>EE-069</td>
<td>Simulation Single Fuzzy Logic Controller in Maximum Power Point Tracking</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EE-071</td>
<td>Automated Guided Vehicle Implementation as Urine Volume Monitoring and Waster Based Internet of Things</td>
<td>Fajar Budi Utomo</td>
</tr>
<tr>
<td>EE-076</td>
<td>Utilization of Bluetooth Wireless for SOFC Test Rigs with Android Smartphone Device</td>
<td>Daniel Aquino Purba, Muhamad Iqbal Zidny, Muhammad Hamka Ibrahim</td>
</tr>
<tr>
<td>EE-081</td>
<td>Evaluation the performance of low-frequency vibration calibrator.</td>
<td>Fajar Budi, Bondan, Chery Chaen, Maharani Ratna</td>
</tr>
<tr>
<td>EE-095</td>
<td>Optimal Energy Control of DC Motor using Fuzzy Logic Controller to Supervise PID Control</td>
<td>Hari Maghfiroh, Hamka Ibrahim and Ryoki Maftuadi</td>
</tr>
<tr>
<td>EE-105</td>
<td>Analytical Study of Temperature Effect on Current and Voltage of Battery at Charging and Discharging Condition on Electric Vehicle</td>
<td>Sifa’Us Wulaning A, Miftahul Anwar, Ferdiansyah Ashil F, Jusuf Abimas P, Irwan Iftadi,</td>
</tr>
</tbody>
</table>
| EE-111 | Desain and Simulation Linear Quadratic Gaussian (LQG) for Pan-Tilt Face Tracking Camera Servos  
*Author: Agus Ramelan, Joko Slamet Saputro, Chico Hermanu Brillianto Apribowo, Muhammad Hamka Ibrahim and Subuh Pramono* |
| EE-113 | Design and Development of Realtime and Portable Water Quality Monitoring System for Agriculture Irrigation  
*Author: Yuana Ayub Sunarya, Muhammad Hamka Ibrahim, Chico Hermanu, Subuh Pramono and Meiyanto Eko Sulistyo* |
| EE-139 | Identification Of Existing Dormitory Building Potential To Become Green Building In Efficiency And Energy Conservation Aspect  
*Author: Anis Rahmawati, Taufiq Lilo Adi Sucipto, Muhammad Kunta Biddinika and Rosi Marta Da Huba* |
| EE-142 | Design of A Telemedicine Robot using Behavior-Based Control Architecture  
*Author: Nanda Ferdana, Andi Adriansyah, Setiyo Budiyanto, Julpri Andika* |
| EE-144 | Chord Recognition using Segment Averaging and Subsampling Feature Extraction  
*Author: Linggo Sumarno* |
<p>| EE-153 | Design and Development of PC-based Photovoltaic Test and Measurement Device for Photovoltaic Quality Inspection |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE-157</td>
<td>Public Street Lighting Control and Monitoring System using Internet of Things</td>
<td>Author: Andi Adriansyah, Setiyo Budiyanto, Julpri Andika, Arif Romadlan, Nurdin Nurdin</td>
</tr>
<tr>
<td>EE-172</td>
<td>People Detection and Tracking Methods for Intelligent Surveillance System</td>
<td>Author: Wahyu Kurniawa and Sutrisno Ibrahim</td>
</tr>
<tr>
<td>EE-184</td>
<td>A User-Friendly Fuel Cell System Simulator for an Electric Vehicle Application</td>
<td>Author: Inayati Inayati</td>
</tr>
<tr>
<td>EE-188</td>
<td>Performance Analysis of MMSE based Interference Suppression in MU MIMO System</td>
<td>Author: Subuh Pramono, Agus Ramelan, Chico Hermanu BA, Muhammad Hamka I, Eddy Triyono and Budi Basuki</td>
</tr>
<tr>
<td>EE-198</td>
<td>Modbus HMI Bluetooth for outseal PLC</td>
<td>Author: Djoko Untoro</td>
</tr>
<tr>
<td>EE-200</td>
<td>Performance Evaluation of VPPM Visible Light Communication Demodulator Using Analog Comparator Front End</td>
<td>Author: Muhammad Hamka Ibrahim, Miftahuddin Irfani, Annisa Hanifa and Subuh Pramono</td>
</tr>
<tr>
<td>EE-204</td>
<td>Placement Multi Flexible Alternating Current Transmission System (Facts): Static VAR Compensator (SVC) and Static Synchronous Compensator (STATCOM) for Improving</td>
<td>Author: Kharis Akbar Baharizky, Muhammad Hamka Ibrahim and Muhammad Nizam</td>
</tr>
<tr>
<td>Course Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EE-206</td>
<td>Voltage Stability of 500 KV Java-Bali Electrical Power System</td>
<td>Chico Hermanu Brillianto Apribowo, Meiyanto Eko Sulistyo, Muhammad Hamka Ibrahim, Subuh Pramono, Oktavian Listiyanto, Agus Ramelan, and Joko Slamet Saputro</td>
</tr>
<tr>
<td>EE-206</td>
<td>Design and Development of PC-based Smart Programmable Power Supply for Battery Charging System</td>
<td>Muhammad Hamka Ibrahim, Rizal Abdulrozaq Rosadi, Chico Hermanu Brillianto Apribowo, Meiyanto Eko Sulistyo and Agus Ramelan</td>
</tr>
<tr>
<td>EE-208</td>
<td>The Design of Automatic Syringe Shaker as the Supporting Device for Method of Dissolved Gas Analysis Transformer Oil in PT.PLN APP Karawang</td>
<td>Ratih Rachmatika, Augustinus Sujono, and Chico Hermanu B.A.</td>
</tr>
<tr>
<td>EE-215</td>
<td>Design and Implementation of the Alcohol Sensor Monitoring System Based on Internet of Things</td>
<td>Muhammad Nizar Aldy, Jihan Nabillah, Muhammad Raihan Hafiz, and Feri Adriyanto</td>
</tr>
</tbody>
</table>
| EE-217 | Simulation and Modelling of Smart Inverter Performance for Grid Connected Photovoltaic Systems  
*Author: Salman Al Farisi, Attar Al Mufashal Rasyid, Berlianne Shanaza Andriany, and Feri Adiyanto* |
| EE-220 | Comparative Study of Electric Vehicles in Urban Areas in Indonesia  
*Author: Muhammad Nizam* |
| EE-224 | Energy Optimal Control of DC-drive Conveyor using LQR Method  
*Author: Hari Maghfiroh, Miftahul Anwar, and Muhammad Gunawan* |
| EE-225 | Active Power and Reactive Power Control using Fuzzy-PID Compensator for grid-connected Inverter  
*Author: Bagus Fatkharrozi and Hery Teguh Setiawan* |
| EE-228 | Plug-in Hybrid Electric Vehicle Mode Selection Strategy for Full Battery Consumption and Known Road Slope Condition  
*Author: Muhammad Hamka Ibrahim, Hari Maghfiroh and Muhammad Nizam* |
| EE-231 | The Need For National Standar Of X-Band Radar Technology To Detect Rainfall And Disaster Mitigation  
*Author: Ajun Tri Setyoko, Endi Hari Purwanto, Reza Lukiwason and Meilinda Ayundyahrini* |
<p>| EE-240 | Design of Battery Management System (BMS) For Lithium Ion Battery |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE-243</td>
<td>Construction Design of Multistage Axial Field BLDC Motor</td>
<td>Muhammad Nizam, Hari Maghfiroh and Kirana Dyah Utari Kusumaputri</td>
</tr>
<tr>
<td>EE-246</td>
<td>The Prototype of Automated Guided Vehicle Based on Autonomous Navigation Technology</td>
<td>Fahrul, Rusdhianto Effendi, Mochammad Rameli</td>
</tr>
<tr>
<td>EE-269</td>
<td>An Implementation of Linear Quadratic Regulator (LQR) for Skid-Steer Mobile Robot Movement</td>
<td>Joko Slamet Saputro, Agus Ramelan, and Hari Maghfiroh, Yoga S Satriawan</td>
</tr>
<tr>
<td>EE-280</td>
<td>The influence of discharge current to temperature distribution of Lithium ion cells</td>
<td>Sunarto Kaleg, Abdul Hapid, Miftahul Anwar, Feri Adriyanto, Hillga R. Radhita, Sukmaji I. Cahyono, and Kuncoro Diharjo</td>
</tr>
<tr>
<td>EE-282</td>
<td>Current-Voltage Monitoring of Plasma Arc Discharge Submerged in Water for Nanoparticles Fabrication</td>
<td>Lia Anjarwati, Miftahul Anwar, Yan Mahardhika, Ramanda Fadhillah, Chico Hermanu Brillianto Apribowo, Teguh Endah Saraswati and Yuana Ayub</td>
</tr>
</tbody>
</table>
| EE-283 | Mobile, Fast Response, and Interactive Measurement Tool of Psychological Disorders under Android Based Smartphone  

**Author:** Wahyul A. Syafei, A. Ediati, D. V. S. Kaloeti, J. Ariati, Subuh Pramono, M. A. Virzawan, and A. B. Prasetijo |
| EE-285 | A Novel Low PAPR Preamble for Very High Throughput WLAN IEEE 802.11ac 80MHz System  

**Author:** Wahyul A. Syafei, Achmad Hidayatno, Ajub A. Zahra and Subuh Pramono |

**Author:** Chico Hermanu Brillianto Apribowo, Luthfy Makhmudy, Oktavian Listiyanto |
| EE-287 | Experimental Method for Improving Efficiency on Photovoltaic Cell with Using Floating Installation Method  

**Author:** Chico Hermanu Brillianto Apribowo, Abyan Habibie, Zainal Arifin, Feri Adriyanto |
| EE-288 | Design and Economic Analysis Of Floating PV-wind Turbine Plant For Renewable Energy Supply In Indonesia  

**Author:** Chico Hermanu Brillianto Apribowo, Muhammad Ramadhan Bagas Purnomo, Muhammad Hamka Ibrahim |
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE-289</td>
<td>Design And Implementation Of Closed-Loop Controls For Smart Charging Lithium Ion Battery Uns Using Switching Technique Boost Converter</td>
<td>Chico Hermanu Brillianto Apribowo, Muhammad Akmal</td>
</tr>
<tr>
<td>EE-290</td>
<td>Optimization of 4G LTE (Long Term Evolution) Network Coverage Area in Sub Urban</td>
<td>Subuh Pramono, Lia Alvionita, Mustofa Danang Ariyanto, Meiyanto Eko Sulistyo</td>
</tr>
<tr>
<td>EE-291</td>
<td>Analysis and Optimization of 4G Long Term Evolution (LTE) Network in Urban Area Technique on 1800 MHz and 2100 MHz Frequencies</td>
<td>Subuh Pramono, Mustofa Danang Ariyanto, Lia Alvionita, and Meiyanto Eko Sulistyo</td>
</tr>
<tr>
<td>EE-292</td>
<td>Design of a Hydroponic Monitoring System with Deep Flow Technique (DFT)</td>
<td>Subuh Pramono, Arif Nuruddin, and Hamka Ibrahim 1</td>
</tr>
<tr>
<td>CS-002</td>
<td>Internet Reactor Laboratory Application Design on Android Client Devices</td>
<td>Adi Abimanyu, Damasus Riko Prijono, Agus Arif, and Muhtadan Muhtadan</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CS-012</td>
<td>Challenges for Standardization: Hyperspektral Technology to Supports</td>
<td>Meilinda Ayundyahrini, Endi Hari Purwanto, Reza Lukiawan, and Ajun Tri</td>
</tr>
<tr>
<td></td>
<td>Indonesian Food Security</td>
<td>Setyoko</td>
</tr>
<tr>
<td>CS-016</td>
<td>Performance Comparison in Simulation of Mandelbrot Set Fractals Using</td>
<td>Gilbert Gutabag, Gahizi Emmanuel, and Pranowo Pranowo</td>
</tr>
<tr>
<td></td>
<td>Numba</td>
<td></td>
</tr>
<tr>
<td>CS-018</td>
<td>Numba Acceleration of Image Steganography using Mandelbrot Set</td>
<td>Gilbert Gutabag, Gahizi Emmanuel, and Pranowo Pranowo</td>
</tr>
<tr>
<td></td>
<td>Fractals</td>
<td></td>
</tr>
<tr>
<td>CS-022</td>
<td>Deep Learning for the Recognition of Javanese Batik Patterns</td>
<td>Danis Aditya Mardani, Pranowo, and Albertus Joko Santoso</td>
</tr>
<tr>
<td>CS-023</td>
<td>Emotion Recognition Based On Deep Learning With Autoencoder</td>
<td>I Made Nomo Wiranata, Pranowo and Albertus Joko Santoso</td>
</tr>
<tr>
<td>CS-024</td>
<td>Classification of Indonesian Coffee Types with Deep Learning</td>
<td>I Alfan Rivalto, Pranowo and Albertus Joko Santoso</td>
</tr>
<tr>
<td>CS-144</td>
<td>Chord Recognition using Segment Averaging and Subsampling Feature</td>
<td>Linggo Sumarno</td>
</tr>
<tr>
<td></td>
<td>Extraction</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Title</td>
<td>Author(s)</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CS-165</td>
<td>Investigation of Time Domain Features for EEG-based Emotion Recognition With Naïve Bayes Classifier</td>
<td>Nur Yusuf Oktavia</td>
</tr>
<tr>
<td>CS-167</td>
<td>Soil Moisture Clustering using the K-Means Clustering method in the UNS's Agricultural Laboratory at Jumantono</td>
<td>Yusuf Budi Kurniawan, Winarno and Wiranto</td>
</tr>
<tr>
<td>CS-174</td>
<td>Detection of Forest Fire Used Multi Sensors System for Peatland Area in Riau Province</td>
<td>Evizal Abdul Kadir, Sri Listia Rosa, and Rizdqi Akbar Ramadhan</td>
</tr>
<tr>
<td>CS-181</td>
<td>Application of Demand Responsive Bus Priority Traffic Signal Control at One-Way System with Contra Flow under Mixed Traffic Conditions</td>
<td>Budi Yulianto and Setiono Setiono</td>
</tr>
<tr>
<td>CS-183</td>
<td>Android-based application of dispensation licensing system for urban freight transport</td>
<td>Budi Yulianto and Setiono Setiono</td>
</tr>
<tr>
<td>CS-210</td>
<td>Parallel Simulation of Pattern formation in a reaction-diffusion system of Fitzhugh-Nagumo Using GPU CUDA</td>
<td>Alfredo Gormantara, and Pranowo</td>
</tr>
<tr>
<td>CS-212</td>
<td>Sentiment Analysis of the 2019 Indonesian Presidential Election on Twitter with Lexicon-Based and Support Vector Machine (SVM)</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CS-214</td>
<td>The Line Segmentation Algorithm of Indonesian Electronic Identity Card (KTP-el) for Data Digitization</td>
<td>Fredericus Dwi Nugraha Putra, Pranowo, and Djoko Budiyanto Setyohadi</td>
</tr>
<tr>
<td>CS-216</td>
<td>Big Data &amp; Early Alert (Anomaly) Detection in Paiton Coal-Fired Power</td>
<td>Yasmine Afifah, Augustinus Sujono, and Chico Hermanu Brillianto Apribowo</td>
</tr>
<tr>
<td>CS-227</td>
<td>Framework of Low Cost IOT System to Monitor Coal Mining Wastewater Quality</td>
<td>Abdi Suryadinata Telaga and Radix Rascalia</td>
</tr>
<tr>
<td>CS-244</td>
<td>Camera Distance Effect For Smart Detection Littering</td>
<td>Dedy Ariyanto, Yusuf Ari Bahtiar, Muhammad Taufik, and Trie Handayani</td>
</tr>
<tr>
<td>CS-251</td>
<td>Android-based parking violation reporting application</td>
<td>Budi Yulianto and Setiono Setiono</td>
</tr>
</tbody>
</table>
| CE-004 | Photodegradation of Batik Waste with Graphitic Carbon Nitride using UV - BLB  
*Author: Bagas Cahyadi, Leony Inatsan Pertiwi, Anatta Wahyu Budiman and Queenta Perdania Putri* |
| CE-014 | Bontang LNG Plant Operational Strategy to Manage Ethane Refrigerant Inventory During Low NGL Extraction  
*Author: Rendra Prasetiyo* |
| CE-020 | Production Of LiNi0,6Mn0,2Co0,2O2 via Fast Oxalate Precipitation for Li-Ion Batteries  
*Author: Arif Jumari, Khikmah Nur Rikhy S., Refarmita Nur Halimah, Agus Purwanto, Luthfiatul Azizah Aini, Mintarsih Rahmawati* |
| CE-027 | Synthesis of Co/Ni – hydroxyapatite by Electrochemical Method  
*Author: Adrian Nur, Anatta Budiman, Arif Jumari, Fauziatul Fajaroh, Nazriati, M. Novalianto Sangadji, and Hanifah Ayu Pratiwi* |
| CE-030 | Reprocessing Through Coprecipitation of NCA Cathode Scrap Waste for Cathode Material of Li-Ion Battery  
*Author: Arif Jumari, Enni Apriliyani, Agus Purwanto, Adrian Nur, Soraya Ulf Muzayanha* |
| CE-035 | The Sintering Time of LiFePO4 Synthesis by The Co-Precipitation Method  
*Author: Adrian Nur, Agus Purwanto, Tika Paramitha, Muhammad Nizam, Luthfi Mufidatul Hasanah, Agnolla Emely Gupitasari and Della Intania Putri Nizi* |
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-036</td>
<td>Study The Effect Of UV-B Mutation On Biodiesel Microalgae Botryococcus braunii Using Esterification, Transesterification And Combination EsterificationTransesterification</td>
<td>Widjaja, Arief, Prashantyo, Muhammad Hafizh and Ramadhanri, Anggia Putri</td>
</tr>
<tr>
<td>CE-037</td>
<td>Mechanical Properties of Films from Carboxy Methyl Glucomannan and Carrageenan with Glycerol as Plasticizer</td>
<td>Fadilah, Ari Diana Susanti, Sperisa Distantina, Dea Putri Purnamasari, and Jihan Fahrizal Ahmad</td>
</tr>
<tr>
<td>CE-040</td>
<td>Synthesis of Lithium Nickel Manganese Cobalt As Cathode Material for Li-Ion Battery Using Difference Precipitant Agent by Coprecipitation Method</td>
<td>Hendri Widiyandari, Riki Ardiansah, Anisa Surya Wijareni, Mohtar Yunianto and Agus Purwanto</td>
</tr>
<tr>
<td>CE-043</td>
<td>A Brief and Rapid Method of Synthesizing LiFePO4/C for Lithium Ion Battery</td>
<td>Atika Aulia Novita Sari, Diajeng Putri Suciutami, Luthfi Mufidatul Hasanah, Agus Purwanto</td>
</tr>
<tr>
<td>CE-047</td>
<td>SEPARATION PROCESS DESIGN OF HEAVY LUBE OIL AND LIGHT LUBE OIL IN WASTE LUBE OIL WITH VACUUM DISTILLATION TO ACQUIRE MINIMUM TOTAL ANNUAL COST (TAC)</td>
<td>Renanto Handogo, Karunia Cita Desti, Venna Maurizka, Juwari Juwari and Rendra Panca Anugraha</td>
</tr>
</tbody>
</table>
| CE-049 | Light Fraction Separation Process Design Using PreFlash Drum Continued To Vacuum Distillation To Determine Minimum Total Annual Cost (TAC)  
*Author*: Renanto Handogo, Alfin Nur Rofiq, Vira Ferdi Murdabahari and Juwari Juwari |
| CE-052 | Kinetics of Hydrothermal Decomposition of Glucose in Ethanol-Water Solutions  
*Author*: Bregas Siswahjono Tatag Sembodo, Dwi Ardiana Setyawardhani, Anisa Darma Briliant and Kintan Marchika Putri |
| CE-054 | Kesambi Oil Extraction Using the Solvent Extraction Method  
*Author*: Yunita Merlin Tamara, Wahyu Nur Hidayat, Nur Asma Azizah, Dwi Ardiana S. |
| CE-056 | Bio-CSTR for Biogas Production from POME treatment – Technology & Design Analysis  
*Author*: Joni Prasetyo, Semuel Senda, Winda Wulandari and Nabila Anindita |
| CE-086 | Preliminary Study of Activated Carbon as Support Catalyst For Low Cost Methanol Production from Biomass Syngas  
| CE-127 | Dye Sensitized Solar Cell (DSSC) with Immersion Time Variation of Working Electrode |
| CE-136 | The Effect of Variation In The Type Of Contact Between Electrodes And Dye On Dye Sensitized Solar Cell Efficiency  
*Author: Riski Kusumawati, Fahru Nurosyid and Agus Supriyanto* |
| CE-146 | Preliminary Study of Lithium Nickel Cobalt Aluminum Oxide Synthesized by Flame Assisted Spray Pyrolysis  
*Author: Tika Paramitha, Hendri Widiyandari, Agus Purwanto, Cornelius Satria Yudha, Adi Prasetya, Muhammad Al Dhiyaul Haqqi Azmi* |
| CE-179 | Influence of Different Types of Filler on The Properties of Polymer Gel Electrolyte Membranes for Li-Ion Battery Applications  
*Author: Endah Retno Dyartanti, Agus Purwanto, I Nyoman Widiyas and Heru Susanto* |
| CE-192 | The Urea Release Rate of Bead Gel Based on Kappa Carrageenan, Pectin, and Glucomannan  
*Author: Sperisa Distantina, Scila Ardanari Santoso, and Melia Citrawati* |
| CE-193 | Biodiesel Production from Waste Cooking Oil By using Zirconia Catalyst |
*Author*: Diah Ayu Almaas Salwa, Khoirun Nisa, Alfi Hasanah, and Widayat |
| CE-223 | Studies of Geothermal Silica as Rubbers Compounds Reinforcing Filler  
*Author*: Muh. Wahyu Sya’bani, Yuli Suwarno, Mertza Fitra Agustian, Indra Perdana, and Rochmadi |
| CE-230 | Investigation on Fluid Mechanics Performances in Packed Bed Catalyst using Computational Fluid Dynamic (CFD)  
*Author*: Ari Diana Susanti\(^1\) and Yazid Bindar\(^2,b)\) |
| CE-238 | Polylactic Acid/Graphite Biocomposite: Morphology and Electrical Conductivity  
*Author*: Esa Nur Shohih, Henry Alvin Sebastian Lomy, Betha Putri Pratiwi, Mughtahid Kaavessina |
| CE-247 | Characterization of Secondary Metabolite Isolated from Ethyl Acetit Fraction of Petrosia alfiani Sponge from Barrang Lompo Island  
*Author*: Rahmayanti |
<p>| CE-249 | Catalytic pyrolysis of plastic waste over zeolite MOR catalyst |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-252</td>
<td>Kinetic of Steam Reforming of Toluene Over Ni/Zeolite MOR Catalyst</td>
<td>Author: Joko Waluyo, Jenny Rizkiana, I.G.B.N Makertihartha and Herri Susanto</td>
</tr>
<tr>
<td>CE-258</td>
<td>Effect of Na-Citrate on instant rice processing to lower the glycemic index</td>
<td>Author: Joko Waluyo, Yusi Prasetyaningsih, Ida Maya Sari and Fenny Tri Ariyani</td>
</tr>
<tr>
<td>CE-264</td>
<td>Synthesis of Biodiesel from Kapok (Ceiba pentandra L.) Seed Oil through Ultrasound-Enhanced Transesterification Reaction</td>
<td>Author: Ratna Dewi Kusumaningtyas, Muhammad Yasir Adhi Utomo, Pipit Risky Nurjanah, Dwi Widjanarko</td>
</tr>
<tr>
<td>CE-270</td>
<td>Synthesis of Green Diesel Through Hydrodeoxygenation Reactions of Used Cooking Oil over NiMo/Al2O3 catalyst</td>
<td>Author: Sd Sumbogo Murti, Fusia Mirda Yanti and Atti Sholihah</td>
</tr>
<tr>
<td>CE-276</td>
<td>Performance of Amberlyst 35 Wet as Solid Catalyst for Glycerol Esterification with Oleic Acid</td>
<td>Author: Diana and Nur Indah Fajar Mukti</td>
</tr>
<tr>
<td>CE-279</td>
<td>Improvement of Efficiency of Dye-Sensitizer Solar Cells (DSSC) Transparent by Optimizing</td>
<td></td>
</tr>
</tbody>
</table>
of Anthocyanin Dyes Hybrid Dyenamo Yellow (DN-F01)

Author: N E-H Diyanahesa, A Supriyanto, and A H Ramelan
IE-011

Problem Analysis of Solar Water Pump Installations in Indonesia

Danar A. Susanto, Utari Ayuningtyas, Hermawan Febriansyah and Meilinda Ayundyahrini
Center for Research and Human Resources Development, National Standardization Agency of Indonesia
BPPT 1 Building, Jl. M.H.Thamrin No 8, Kebon Sirih, Jakarta Pusat 10340, DKI Jakarta, Indonesia
e-mail: danar@bsn.go.id

Solar Water Pumps (SWP) have been installed in Indonesia to pump and drain water to meet people's basic needs for water availability. The installation of SWP in Indonesia is largely a government project to help reduce the water crisis that often occurs in remote areas with limited electricity and difficult fuel oil. The purpose of this research is to analysis and find out the problems of installing SWP in Indonesia. This study uses a qualitative descriptive research method to describe and explain the problem of installing SWP in Indonesia systematically. The problems with installing SWP in Indonesia mostly occur in the photovoltaic installation section. Incorrect installation and lack of maintenance of the PV system will cause shading problems resulting in a hot spot area, which is permanent damage and requires calls. The use and installation of inverter/controller components, pumps and installation accessories are good and there are no problems which means that already using standardized components and installation does not require special methods and specifications. The improper use, installation and maintenance of components or parts in the SWP system will cause the SWP to not perform optimally.

Keywords: Solar Water Pumps, problems of installing SWP, photovoltaic, inverter/controller, water pump
A Particle Swarm Optimization Algorithm for Optimizing Vehicle Routing Problem with Time Windows (VRPTW): Books Distribution Case Study

Fairuz Yasmine¹,a), Yuniaristanto¹,b), and Muh Hisjam¹,c)
¹Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia
Email: ¹fairuzyasmine29@gmail.com, ²yuniaristanto@ft.uns.ac.id, ³hisjam@uns.ac.id

Vehicle Routing Problem with Time Windows (VRPTW) is one of the problems in a series for vehicles have to distribute some goods from one or several depots to each costumers who spread in various location which has the aim to minimize the number of mileage by considering time windows. In this study, Particle Swarm Optimization algorithm is used for solving the Vehicle Routing Problem Time Windows to determine the optimal route for book distribution company whose delivers book's demand to outlets that needed to be fulfill everyday in Jabodetabekar area. The data processing in this research by running PSO for VRPTW using software MATLAB. The results shown the optimal route for 10 proposed clusters that can be implemented. The total mileage of the initial total distance is 3512 km and after the proposed route is implemented to be 1190.05 km. Therefore, an average reduction for all distribution activities that occurs is 2402.95 km or 68.42%.

Keywords: Vehicle Routing Problem, Time Windows, Particle Swarm Optimization
Clustering of the Water Characteristics of the Cirata Reservoir Using the K-means Clustering Method

Isma Masrofah¹,a) and Bramantiyo Eko Putro²,b)

¹Department of Industrial Engineering, Suryakancana University, Indonesia
²Department of Industrial Engineering, Suryakancana University, Indonesia

Email: a)isma.masrofah@ unsur.ac.id, b)bramantiyo@unsur.ac.id

Pollution prevention must be carried out in the upstream, middle and downstream parts. One of the Citarum watersheds located in the middle part is the Cirata reservoir. Pollution in the Cirata reservoir does not only originate from the reservoir environment, but also from rivers that flow into the Cirata reservoir. Cirata Reservoir besides being a Hydroelectric Power Plant (PLTA) unit, this reservoir is also used by the community for fish farming in the Floating Net Pool (FNP) technique. This study aims to knows the water characteristics Cirata reservoir. Through data on the content of water entering the Cirata reservoir, the characteristics of water at each point can be identified. The research data was obtained by obtaining clean water quality testing data from several estuary points of the river flow towards the Cirata reservoir and 4 centers of the Cirata reservoir. Data acquisition is done by taking primary data as well as secondary data related to water quality. Data processing techniques are carried out using Data Mining K-Means Clustering. This study obtained three groups of clusters, namely clusters. The dominant cluster of minerals that tends to be dominated by the presence of content of rock and soil minerals. Clusters of organic compounds are dominated by the presence of organic compounds such as compounds that contain nitrogen. Medium middle mineral cluster which is characterized by a high enough mineral from dissolved rock into the river flow.

Keywords: Citarum Watershed, Cirata Pollution, Water Quality, Clustering of Water Characteristics
PT. XYZ is a company engaged in the automotive industry that produces motorbikes. PT. XYZ covers motorcycle manufacturing, assembly and distribution activities. This company uses the make to stock system in carrying out its production process. PT. XYZ is divided into several sections, one of which is the section of the Assembly Engine that assembles engine components into the main engine on a motorcycle. In the Assembly Engine section there are two assembly lines with different production outputs, namely Assembly Line A and Assembly Line B. This research focuses on Assembly Line A, which covers 41 stages of the machining process. To meet the set production targets, companies must increase their productivity by reducing the bottleneck. The purpose of this paper is to improve the balance of assembly lines so that it can increase utility and production output. To fulfill this goal, a proposed model experiment was carried out with a simulation approach using ProModel software. The selection of the best proposed model uses the Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) method. The proposed model is the proposed first scenario model which has the greatest relative closeness value from the proposed other scenario with Si* value of 0.308, S'i for 0.1790, and Ci* of 0.1808.

**Keywords:** Line Balancing, Simulation Approach, TOPSIS
A Three-Echelon Inventory Model for Deteriorated and Imperfect Items with Energy Usage and Carbon Emissions

Aldy Fajrianto¹,a) Wakhid Ahmad Jauhari², b) Cucuk Nur Rosyidi³, c) 
¹Department of Industrial Engineering Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia 
²,³Production System Laboratory, Department of Industrial Engineering Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia 
Email: a) fajriontoaldy@gmail.com, b) wachid_aj@yahoo.com, c) cucuk@uns.ac.id

This research develops an integrated inventory model for deteriorated products consisting of a supplier, a 3PL and buyers. Carbon emissions are generated by the production, storage, disposal of deteriorated products and transportation activities. The production process is assumed to be imperfect, thus producing a proportion of defective items that needs to be reworked by the supplier before being sent to 3PL. The objective function of the model is to minimize joint total cost of supply chain by simultaneously determining the optimal delivery interval, and the frequency of delivery. An iterative procedure is proposed to find the decision variables. A numerical example is given as illustrations of the model. The result from numerical example shows that the optimal 3PL’s delivery interval (Tb) and 3PL’s delivery frequency (n) are 0.0598 years and 3, respectively with the joint total cost is $548,158.97.

Keywords: Deteriorated Products, Carbon Emissions, Energy Usage, Imperfect Production, Three-Echelon
Assembly Line Balancing Base Frame and Sub Assembly Excava 200 in PT X Using Genetic Algorithm Methods

Bung Ayuning Syarifah¹, Dida Diah Damayanti², and Widia Juliani³
¹,²,³Industrial Bachelor Program, School of Industrial and System Engineering, Telkom University.
Email: ¹) bungayuning@gmail.com, ²)didadiah@telkomuniversity.com, ³)widiajuliani@telkomuniversity.ac.id

Based on the time each station has an inconsistency or no balance, so it can cause idle time. This occurs due to the allocation of workloads between work stations uneven so that there is unemployment in the operator and result in the buildup of WIP caused by a bottleneck on a workstation with a time station significant work between other workstations. Therefore, the assembly line balancing is done by doing the minimization of the workstation and allocating the workload on the workstation. The balance in the placement of work elements and workloads on an assembly line can impact the efficiency of the line. The workstation applied is a single model. The method used is a Meta-heuristic method of the Genetic Algorithm used to balance the base frame assembly line and sub-assembly in the excava 200 assemblies because this method can produce better solutions and Fast. In this research conducted 3 calculation scenario that is the condition to fulfill the time, the condition of the utilization of existing workstations by utilizing 4 existing workstations and the condition increased demand 20%. So that the result of line efficiency in the scenario to fulfill the time at the base frame assembly of 100% of the actual condition of 60.45%, and the workstation has decreased from 4 workstations to 1 workstation, for a 100% sub-assembly line efficiency with the merging of each subassembly into 1 workstation. In the scenario utilization of existing workstation is the utilization of 4 workstations that exist line efficiency in the base frame assembly of 90.49%. In the scenario of demand increase 20% line efficiency of 100% with the number of workstations as much as 1 workstation, on the sub-assembly line to 1 station with the line efficiency of 100%.

Keywords: Assembly Line Balancing, Genetic Algorithm, A Single Model
A Closed-Loop Supply Chain Model for Manufacturer-Retailer-Collector with Rework, Waste Disposal, and Carbon Emission

Niimas Ayu Frensilia Putri Adam¹,a), Wakhid Ahmad Jauhari¹,b), and Cucuk Nur Rosyidi¹,c)
¹Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia
Email: a) nfrensilia@gmail.com, b) wakhidjauhari@gmail.com, c) cucuk@uns.ac.id

The importance of an industrial system that is both economically and environmentally sustainable has gained considerable attention in this last decade. In this paper, we address a closed-loop supply chain in which the manufacturer produces the brand-new product and the retailer sells it through the market. A collector will collects the used product from the consumer and sends it to the manufacturer to be remanufactured or refurbished. The used items which have not passed the acceptable quality level of the collector will be considered as a waste and need to be disposed. The defective item produced through the manufacturing system will be reworked. In order to restrict carbon emissions generated by the production phases in this system, trade regulation, carbon cap, and green technology investment are used. The proposed model simultaneously optimizes the quality level of the product that should be produced by the manufacturer, the pricing decision of the retailer, and the green technology level that should be applied by the manufacturer to reduce the carbon emissions. A numerical example is taken to illustrate the proposed model and also to perform sensitivity analysis. The result shows the benefit of the supply chain integration in terms of total gain profit of the supply chain.

Keywords: Closed-Loop Supply Chain, Manufacturing, Remanufacturing, Refurbishing, Carbon Emission
Analysis of Working Posture on Muscular Skeleton Disorders of Vocational Garment Student’s in Garment Assembly Operations Practice

Irham Aribowo¹,a), Bambang Suhardi²,b) and Eko Pujiyanto³
¹ Master Program of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia
² Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia
Email: a) irhamaribowo@yahoo.co.id, b) bambangsuhardi@staff.uns.ac.id

Garment assembly operation practice is one of the course in garment study program. It is a process of learning to sew components into apparel use single needle sewing machine. The existing sewing machine have fix height at table and chair that does not count the ergonomic aspects especially on working posture. Inappropriateness of working posture will lead the student to obtain a variety of muscle and bone disorders. In this study, the suitability of work postures is measured by RULA scores, while the fatigue level was measured use Nordic Body Map Questionnarie among 11 students. The results showed that 6 students are complained of pain in back and buttocks, 5 students in waist and nape of the neck. The RULA scores for 2 students are 7 and 9 students are 5. It is indicate that the working posture in garment assembly operation practice need to be changes soon.

Keywords: Muscular Skeleton Disorders, RULA, Nordic Body Map
An Integrated Inventory Model with Deteriorating and Imperfect Quality Items Considering Carbon Emission under Inflationary Environment

Dewi Sri Utami1,a) Wakhid Akhmad Jauhari2,b) Cucuk Nur Rosyidi1,c)

1,2,3 Department of Industrial Engineering, Sebelas Maret University, Jl. Ir Sutami 36 A, Surakarta 57126, Indonesia

Email: a) dsriutami24@gmail.com, b) wachid_aj@yahoo.com, c) cucuk@uns.ac.id

Recent integrated inventory management seeks to consider environmental responsibility but does not reduce profits. This study presents an integrated single-vendor single-buyer inventory model for deteriorating items with the imperfect quality considering carbon emission under inflationary environment. Carbon emission is the result of transporting, warehousing, and keeping the deteriorated items. Emission due to transportation depends on the fuel consumption of the vehicle, the fuel emission, and the distance traveled. Warehouse emission depends on the total inventory and the warehouse energy consumption per unit item. Emission due to deteriorating items is related to its disposal. A cap-and-trade policy offers its own advantages in that emissions allowances can be allocated so as to minimize the policy’s negative effects on competitiveness and prevent emissions leakage. During storage, inventory has a value of time and investment period so that inflation influences decision-making in inventory management. The purpose of this model is to provide policy-makers insights to collectively decide on the frequency and quantity of product delivery as well as the inventory level to minimize both the total inventory and carbon emission costs. This paper proposes a solution procedure and provides a numerical example to illustrate the theory. Sensitivity analysis is given to illustrate the validity of the model.

Keywords: Inventory, Deterioration, Carbon Emission, Inflation
The Effects of Carbon Cap Limitations on Inventory and Land Multimodal Transportation

Thina Ardliana¹,a), I Nyoman Pujawan²,b), and Nurhadi Siswanto³,c)
¹Shipbuilding Institute of Polytechnic Surabaya, Doctoral Student at Industrial Engineering Department, Sepuluh Nopember Institute of Technology Surabaya, Indonesia
²,³Industrial Engineering Department, Sepuluh Nopember Institute of Technology Surabaya, Indonesia
Email: a) ardlianathina@gmail.com, thina.ardliana@ppns.ac.id, b) pujawan@gmail.com, c) siswanto@ie.its.ac.id

Countries in the world need the right steps to maintain the sustainability of this world. This is because the effects of global warming, as a result of greenhouse gas emissions, have threatened the balance of the Earth's ecosystem. One of the joint commitments that has been made is related to reduce carbon emissions. Practically, this commitment is intended to determine the carbon capacity limitation for each country or company, which is defined as a carbon cap. With this limit, we hope to find the best solution to reduce the amount of carbon emissions while minimizing the total transportation costs and inventory costs. In this study, we developed an inventory management model that integrates land multimodal transportation from one supplier to several customers by considering carbon emission limitation. The two land multimodal transportation used are (a) trucks which transport a product from several suppliers to stations and from stations to customers and (b) trains from departure stations to arrival stations for long distance shipments. The purpose of this study is to find an optimal solution that considers total costs and carbon emissions. The decision variables of this study are inventories at the supplier and at each station, as well as the quantities and frequencies of product deliveries. Numerical experiment results show that carbon cap affects total emissions and total costs for each supply chain activity. We also carried out a sensitivity analysis to find the relationship between decision variables and carbon cap scenarios. By changing the carbon emission limit values, the amount of inventories at the departure station and at the arrival station shows different patterns.

Keywords: Carbon Cap, Multimodal Land Transportation, Inventory
Recent Developments In City Logistics Research: A literature review

Silvi Istiqomah¹,a), Yuniaristanto¹, and Wahyudi Sutopo¹
¹Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia
Email: a) silviistiqomah23@gmail.com, b) yuniaristanto@ft.uns.ac.id, c) wahyudisutopo@staff.uns.ac.id

City logistics is an important part of modern urban logistics system. In this review, we can integrating economic, environmental, and social dimensions problem to analyze the relevance of urban logistic issues and to identify gaps. This problem require cooperation between several type of stakeholders. The stakeholders have different objectives and decision spaces. We identify some information and research, so this literature review can contribute to the evolution of knowledge management. The literature review can develop opportunities and challenges for understanding about development of city logistics.

Keywords: City Logistics, Literature Review, Logistics
Risk Perception Through Construction Safety Risk Assessment And Quantification

Alusine Barrie¹,a), Jafri Mohd Rohani¹,b), and Norizah Redzuan¹,c)
¹Faculty of Engineering, Universiti Teknologi Malaysia, 81310, Skudai, Johor, Malaysia
Email: a) barriecalusine@gmail.com, b) jafrimr@utm.my, c) norizah@mail.fkm.utm.my

Lack of designer’s knowledge of construction safety risks and HSE personnel’s knowledge of structural designs and means and methods of construction are major barriers to the implementation of design for construction safety. These barriers often result in poor collaboration among designers and HSE personnel to address safety issues which lead to accidents and frequent work stoppages. The study explored the perception or ability of field personnel (HSE, engineers and superintendents) to assess and quantify risk associated with construction activities of structural components (foundation, column, wall, beam and roof). The objective was to determine how consensus are risk perception among the three groups of field personnel. A questionnaire was used to evaluate risk level of severity and time of exposure for each construction activities of structural components. The results show the associated cumulative risks from the highest risk to the lowest risks are as follows: Roof (2.8), Beam (2.4), Foundation (2.15), Wall (2.14) and Column (2.1). In conclusion, roof construction carries the highest risk value followed by beam construction. This could be as a result of the work at height involved in the process. Falls are major construction accidents caused by working at height.

Keywords: Risk Assessment, Building Construction, Design for Safety, Designers Field Personnel
Supply Chain Risk Management: A Literature Review and Research Trends

Yuniaristanto\textsuperscript{1,a}) and Wahyudi Sutopo\textsuperscript{1,b})

\textsuperscript{1}Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia

Email: a) yuniaristanto@ft.uns.ac.id, b) wahyudisutopo@staff.uns.ac.id

Supply chain risk management has become a growing area of research recently. It is necessary to classify different types of research and examine general trends in this research area. There are many papers that have been published with different focus and approaches over the past decade. This paper aims to review literature based on papers that have been published in the range of 2010-2019. We identify the literature based on research methods, risk characteristics and supply chain risk management phases. The literature review will be able to provide an outline regarding future research in this research area.

**Keywords:** Supply Chain Risk Management, Literature Review, Research Trends
Optimization Model For Determining Economic Production Quantity and Process Mean by Considering Internal and External Quality Loss

Muhammad Habib Isna Nur Asnan\textsuperscript{1}(a) Cucuk Nur Rosyidi\textsuperscript{2}(b) Eko Pujiyanto\textsuperscript{3}(c)

\textsuperscript{1}Department of Industrial Engineering Sebelas Maret University, Ir. Sutami 36 A Street, Surakarta, Indonesia
\textsuperscript{2}Production System Laboratory, Department of Industrial Engineering Sebelas Maret University, Ir. Sutami 36 A Street, Surakarta, Indonesia
\textsuperscript{3}Quality System Laboratory, Department of Industrial Engineering Sebelas Maret University, Ir. Sutami 36 A Street, Surakarta, Indonesia

Email: \textsuperscript{a)habibasnan88@gmail.com, \textsuperscript{b)cucuk@uns.ac.id, \textsuperscript{c)ekopujiyanto@ft.uns.ac.id}

The economic production quantity (EPQ) model is an inventory control model that can be used by a company to determine a number of certain product to minimize the total cost. One of the way to minimize the total cost incurred by a company is to determine optimal production quantity and process mean. This paper proposes a modified economic production quantity model with deteriorating production process. The purpose of this paper is to develop an optimization model for determining economic production quantity and process mean by considering internal and external quality loss. The optimal production quantity (Q) and process mean (\(\mu\)) are jointly determined by minimizing the total expected cost of product per unit time including the total average quality loss, the total average material cost, the total average setup cost, the total average inventory holding cost, the total average adjustment cost, and the total average maintenance cost, per unit of time. The optimal values of Q is 200 and \(\mu\) is 7.56 with the total expected cost per unit time is $ 324,486.

**Keywords:** Economic Production Quantity, Process Mean, Quality Loss, Deteriorating Production Process
IE-044

Supply Chain Performance Analysis Using Hybrid Overall Equipment Effectiveness and Discrete Event Simulation (Case Study: Futura Energy Nusantara)

Zufar Asyraf Fadhlurrahman¹, Yuniaristanto¹,a), Muhammad Hisjam¹
¹Industrial Engineering Department Universitas Sebelas Maret, Surakarta 57126, Indonesia
Email:  a) yuniaristanto@gmail.com

Productivity is one of the most fundamental and important determinants of system production. Productivity measurement help identify the problems and find solutions to improve system performance. OEE (Overall Equipment Effectiveness) is one method used to effective time manufacturing system related to the existence of equipment in production system. The Element of OEE is Availability Rate (A), Performance Efficiency (P), and Quality Rate (Q). The study aims to test through simulation production system in Lithium Ion Batteries (LIB), by considering factor OEE, with discrete event system. As a result, this study is a model to applicable, for company to improve productivity.

Keywords: Overall Equipment Effectiveness, Discrete Event Simulation, Production System, Lithium Ion Batteries
A Framework of Stand Up Motorized Wheelchair as Universal Design Product to Help Mobility of The Disability

B.Bambang Sulistiyawan\textsuperscript{1,a)}, Susy Susmartini\textsuperscript{2,b)}, and Lobes Herdiman\textsuperscript{2,c)}

\textsuperscript{1} Master program of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Sutami No. 36A, Keningan, Surakarta, 57126, Indonesia

\textsuperscript{2} Departement of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Sutami No. 36A, Kentingan, Surakarta, 57126, Indonesia

Email: \textsuperscript{a}) bbambang.sulistiyawan@gmail.com, \textsuperscript{b}) susysus2011@gmail.com, \textsuperscript{c}) lobesh@gmail.com

Research in assistive devices for disability in developing countries is low and expensive. This is interesting for researchers to make a breakthrough in conducting cheaper research for disability. Limited income and money from technical sources are important issues that must be considered for persons with disabilities to buy and use tools to carry out their daily activities. Stand up Wheelchair is one of the assistive technologies that aim to help people be more mobile, healthier, and more productive in their disability status. The standing wheelchair with universal design as a result of combining electric motor drivers from existing electric wheelchairs and three actuators in a special purpose of mechanical structures to support disabled people is easier in mobility and activity. This paper aims to describe the relationship of the universal design concept to the development of motorized wheelchairs.

\textbf{Keywords}: Disability; Assistive Devices; Stand Up Motorized Wheelchair.
IE-046

Ergonomic Evaluation in Manual Garment Pattern Workshop in Textile and Garment School, Indonesia

Abdul Rohman Heryadi1,a), Susy Susmartini1 and Lobesh Herdiman1
1Universitas Sebelas Maret Surakarta, Jl. Sutami No. 36A, Kentingan, Surakarta, 57126, Indonesia
Email: a) abdulrohmanheryadi@yahoo.com

Manual garment pattern workshop is one of the major workshops where students learn drawing skills in garment patterns with manual technic in Textile and Garment School, Indonesia. The observation shows that the drawing table is the main facility in the workshop because of almost 6 hours a day in 2-3 weeks, students do activities in there for 3 semesters. The aim of this study is to conduct an ergonomic evaluation of the table facilities for making the manual garment patterns in the workshop. This is necessary because students often sit hunched up and reach beyond the reach of their hands. Bad learning positions for a long time and repeatedly can cause injury to students. The methods used in this study are the Nordic Body Map questionnaire to assess the respondent's pain, anthropometric to check the facilities dimensional, and garment size standards based on the Indonesian National Standard (SNI) to check the suitability of a wide area of the facilities. To the best of our knowledge, in Indonesia, there are no published studies specific about evaluated the manual pattern garment workshop, so it the reasons for presenting in this research.

Keywords: Ergonomic Evaluation, Risk of Injury, Garment Pattern
IE-050

Multi Compartment Vehicle Routing Problem to Find the Alternative Distribution Route of Petroleum Product Delivery

Izatul Fitria Febriandini¹,a), Yuniaristanto²,b) Wahyudi Sutopo³,c)

¹ Laboratory Assistant Logistics Systems and Business, Industrial Engineering Department, Universitas Sebelas Maret, Indonesia.
²,³ Research Group of Industrial Engineering and Techno Economic, Industrial Engineering Department, Universitas Sebelas Maret, Indonesia
Email: a) izatulfitria23@gmail.com, b) yuniaristanto@ft.uns.ac.id, c) wahyudisutopo@staff.uns.ac.id

Distribution is an activity that firm have to do to deliver their product to the customers. This paper focuses to solve the planning distribution problem on petrol product delivery or Petrol Station Replenishment Problem. Vehicle Routing Problem (VRP) is used to find the optimal distribution route, especially Multi-Compartment Vehicle Routing Problem (MC-VRP) that consider demand of the petrol product, tank-truck capacity, distribution cost and number of compartment. In this work, mathematical formulation for MC-VRP is developed in the Mixed Integer Linear Programming (MILP) model. Using Tabu Search Algorithm to solve this distribution problem with the minimum total distribution cost.

Keywords: Petrol Station Replenishment Problem, Multi Compartment VRP, Multi Product Delivery
IE-053

Relationship of Basic Principles in ISO 14001, ISO 50001, Green Building and Zero Emision Building (ZEB)

Endi Hari Purwanto¹,a) and Ajun Tri Setyoko¹, Auraga Dewantoro¹
¹Center for research and Human Resources Development, National Standardization Agency of, Jakarta, Indonesia
Email: a) endi@bsn.go.id

The number of standards issued by ISO with more distribution makes its application at the producer level inefficient. The standards issued together with almost the same are ISO 14001, ISO 50001, Green Building and Zero Emision Building (ZEB). These four standards have the same objectives with the same environmental background arranged in different standards, so these 4 standards become very inefficient in increasing environmental-based companies seeking more benefits for these 4 standards so that they need 4 types of standard certification. This matter is surely not efficient. To get more benefits from the application, the author wants to ask for the implementation of the 4 standard implementation by simplifying and simplifying the principles of the 4 standards so that a clear position is obtained. The results show that there are 9 distinguishing factors, namely: standard standards, types of standards, commitment, number of commitments, technology design, changes in objects, main keywords, final objectives and the amount of investment needed.

Keywords: Basic Principles, ISO 14001, ISO 50001, Green Building and ZEB.
Development of Food Safety Design for SMEs Yogurt Using HACCP

Ellia Kristiningrum¹,a), Ike Permatasari¹)
¹ National Standardization Agency for Indonesia (BSN) Building 1 BPPT Jl. MH Thamrin 8 Kebon Sirih, Central Jakarta 10340
Email: a) afisqya@gmail.com

Milk has good nutrition and energy for most microorganisms which are used as raw material for making yogurt. The yogurt fermentation process involves bacteria contained in the yogurt starter / culture. Unhygienic food causes an increasing number of harmful bacteria in the intestine. Food safety becomes major concern of the food industry. Having the HACCP system is a way to identify hazards and provide preventive measures to eliminate the hazards. A study was conducted at the yogurt SMEs scale company by implementing the guidelines for preparing the HACCP plan by following the 7 principles of the HACCP system as in the SNI CAC / RCP 1: 2011. The study results a set of 8 CCPs in raw materials and production processes, indicating the selection of suppliers, control of temperature and time of storage process, process of giving seeds, sanitation of equipment, calibration of equipment, supervision of performance and enumeration is very important for the company. Monitoring and verification is fundamental to measure the effectiveness of the application of HACCP System. The study also recommends complying 4 aspects as the prerequisite regulations including construction, product labeling, sanitation and maintenance, and documentation.

Keywords: SNI, HACCP, Yogurt, Implementation, Food Safety
Analysis of Three-Echelon Closed-Loop Supply Chain System with Environmental Investigations

Wakhid Ahmad Jauhari, Rendy Dwi Septian, Pringgo Widyo Laksono and Anindya Rachma Dwicahyani

1Department of Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia
2Department of Electrical Engineering, Dedan Kimanthi University of Technology, Nyeri, Kenya

Email: a) WachidAj@yahoo.com, b) pringgo@ft.uns.ac.id, c) anindyard94@gmail.com

This study presents a mathematical inventory model in the system of Closed-loop Supply Chain (CLSC). We investigate a CLSC system that consists of a retailer, a manufacturer and a 3rd party collection dealer. The model aims to minimize the annual joint total inventory cost for the three parties and determine several decision variables including number of shipments between parties, manufacturer shipment lot size and number of remanufacturing generations. The number of remanufacturing generations is one of our concerns since we consider a type of product that could not be remanufactured in an unlimited number of times. Thus, how many times the product should be remanufactured becomes important. In this study, we also investigate the environmental impacts in term of carbon emissions, energy usage, as well as annual disposed items. The model can guide companies in the related industry to plan a system of CLSC inventory management with environmental considerations.

Keywords: Remanufacturing, Remanufacturing Generation, Carbon Emissions, Energy Effects
Simulation Based-Daily Coal Inventory Planning And Control Through Replenishment Postponement Option Under Continuous Demand And Supply: A Case Of Cement Industry

Dicky Fatrias¹, Nilda Tri Putri¹, Ilham Kurniawan Batubara¹
¹Industrial Engineering, Andalas University
Email: a) dickyf@eng.unand.ac.id

When suppliers agree to supply the buyer's material requirement for a cycle period of n days during which daily consumption and multiple supply continuously take place, the buyer's inventory planning and control decision should be designed appropriately to avoid a massive overstock/understock problem. Associated with that problem, this study proposes to manage daily coal inventory planning and control problem which is held during a cycle whose stock is continuously consumed for cement production and, at the same time, replenished by multiple batch supply from several suppliers in an arbitrary days interval. The problem is noteworthy in that we apply a widely used max-min method and introduce an option for the decision maker to decide and control the timing of supply. Taking into account that both demand and supply are stochastic in nature, the objective is to find the optimal coal inventory setting that minimize the average amount of inventory and to maximize the potential saving to be earned by postponing replenishment shipment. We develop simulation based solution technique to achieve the goal and perform sensitivity analysis in terms of: 1) a decrease of quantity of coal supply, and 2) an increase of the probability of supplier not replenish the daily stock. It is found that the proposed inventory decision are only profitable for both cases when the deviation reaches 20%, where 10% increase in the latter case outperforms the others in terms of potential saving from postponing the replenishment shipment.

Keywords: Coal Inventory, Max-Min Method, Continuous Demand And Supply, Replenishment Postponement, Simulation Technique
Pricing For Product-Service System Under Dual-Channel Supply Chain

E Widodo\(^{1, a)}\), I N A Shabir\(^{2, b)}\), B Syairudin\(^{3, c)}\)

\(^{1}\)Department of Industrial Engineering, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia
\(^{2}\)Department of Industrial Engineering, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia
\(^{3}\)Department of Industrial Engineering, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

Email: \(^{a)}\) erwin@ie.its.ac.id, \(^{b)}\) ismi.nuradhashabir@gmail.com, \(^{c)}\) bambangsyaairudin@gmail.com

The rapid development of the internet and information technology has made consumer purchasing behavior changes to shopping online. In order to widen the market range, respond the customers’ behavior change, and increase supply chain profitability, manufacturers start combining both online & offline channel as a new structure, is known as dual-channel supply chain (DCSC). In the DCSC introduction, some research focuses only on the product without further consideration of complementary service-related. An advanced idea to sell a bundle of product and its related services are known as a product-service system (PSS).

To the development of PSS, previous research only discussed PSS in one sales channel both offline and online. There was no one that integrates these two channels. This research attempts to study the pricing strategy for product & service bundle under the PSS concept. This bundle is offered to the customer under the DCSC structure. Such a combination may yield better financial performance under proper DCSC and PSS setting. To observe this hypothesis, a mathematical model represents pricing decision and managerial behavior in PSS practice is developed. The model that has been built will represent two scenarios of game theory namely Stackelberg Leadership and Bertrand. By using an analytical approach, optimum prices for all scenarios and all players under the DCSC-PSS structure could be proposed, so managers have theoretical knowledge to operate their tactical or operational activities.

**Keywords:** Dual Channel Supply Chain, Product-Service System, Pricing, Game Theory
Identifying Factors for Assessing Regional Readiness Level to Manage Natural Disaster in Emergency Response Periods

Naniek Utami Handayani¹, Diana Puspita Sari¹, Adi Setyo Nugroho¹
¹Department of Industrial Engineering, Faculty of Engineering, Diponegoro University, Jl. Prof. Soedarto, SH, tembalang, Semarang 50275, Indonesia
Email: a) naniekh@ft.undip.ac.id

Disaster preparedness is an effective, realistic and coordinated planning program with risk reduction measures, reducing the impact of disasters, saving lives optimally, and returning the community to normal conditions in the shortest possible time. Sleman Regency has a volcanic eruption of Mount Merapi potensial. The agency of the emergency response should manage the emergency response period effectively and efficiently both concerning victim handling, and disaster logistics management. This study aims to identify factors for assessing regional readiness in disaster management. The analytic hierarchy process was employed to accomplish the objective of this research. There are 11 factors for assessing regional readiness in natural disaster management, namely: strengthening the legal framework for disaster management, mainstreaming disaster risk reduction in development, implementing Good Governance in disaster management, increasing the effectiveness of disaster prevention and mitigation, improving preparedness and handling disaster emergencies, increasing disaster recovery capacity, understanding disaster risk, strengthening risk governance, DRR investment for resilience, and improving risk management.

Keywords: Regional Readiness Level, Disaster Management, Assessment Factors, Identify
A Data Envelopment Analysis Approach for Assessing the Efficiency of Sub-sectors of Creative Industry

Naniek Utami Handayani¹, Diana Puspita Sari¹, M. Muiya Ulkhaq¹, Risa Candra Ayu Fitriani¹

¹Department of Industrial Engineering, Faculty of Engineering, Diponegoro University, Jl. Prof. Soedarto, SH, Tembalang, Semarang 50275, Indonesia
Email: a) naniekh@ft.undip.ac.id

The creative industry (CI) is considered to promote human development while promoting the economic growth. It maintains and protects historical and cultural heritage, improve cultural capital, and foster communities as well as individual creativity. Although there is widespread classification of the CI, the Ministry of Tourism of Indonesia has classified CI into 16 sub-sectors, i.e., (1) advertising, (2) architecture, (3) interior design, (4) product design, (5) craft, (6) visual communication design, (7) fashion, (8) film, animation, and video (9) photography, (10) application and game developers, (11) music, (12) performing arts, (13) publishing, (14) fine arts (15) TV and radio (broadcasting), and (16) gastronomy/culinary. The creative industry is an industry that originates from the use of creativity, skills and individual talents to create prosperity and employment by generating and exploiting the individual's creative and creative power. Batik industry is one of Creative Industry in Indonesia which plays an important role in the economic development. However, the Batik are facing difficulties in many areas, especially in spending their scarce resources efficiently. A case study to assess the efficiency of the Batik enterprises has been conducted by applying the data envelopment analysis in Semarang, Indonesia. The results show that from ten assigned Batik enterprises, there are nine enterprises’ that are considered efficient, while the rest are regarded as inefficient. This research is expected to give some advantages to the Batik enterprises’ regarding how to use their limited resources in an efficient way.

Keywords: Efficiency, Creative Industry, Data Envelopment Analysis, Batik Enterprises
Optimization of Senja Utama Courier Service Schedule with Vehicle Routing Problem-Simultaneously Pick-up and Delivery

I W Saputra¹,a), Yuniaristanto¹, M Hisjam¹

¹Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami No. 5 Surakarta 57126, Central Java, Indonesia
Email: a) iqbalwahyusaputra@gmail.com

Nowadays online shopping activities in Indonesia are increasing rapidly. Freight companies experience an increase in shipping demand which then requires companies to evaluate existing systems in order to be able to meet their existing demand, especially companies with fixed schedule service providers such as train-based shipping services. This article use Senja Utama Courier Service as study case, which have Vehicle Routing Problem - Simultaneously Pick Up and Delivery that going to be solved by CPLEX software, the objective of this article is to find the most efficient pick-up and delivery schedule for each customer with the lowest total cost. The result shows the most efficient schedule to pick up and deliver the items are the schedule which have lowest dispatching cost and total traveling cost.

Keywords: Optimization, Vehicle Routing Problem, Simultaneously Pick-Up and Delivery
Power Generation and Transmission System Analysis by Using Cooperative Game Theory (Case Study: Electricity in Kalimantan)

Erwin Widodo¹,a) and Wiwit Marta Pangesty Putri¹,b)

¹Industrial Engineering Department, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, 60111, Surabaya, Indonesia
Email: a) erwin_widodo@yahoo.com, b) wiwit.marta@gmail.com

Electricity is a part of national infrastructure that indeed has a role in developing economy. Being economic driving force of a country, the electricity supply must be adequate in accommodating the demand. In fact, electricity supply in Indonesia is not adequate enough to meet the demand. According to RUPTL (long term corporate planning) of PLN (state-owned electricity company) for 2017-2026, the demand in Indonesia has not been satisfied especially in Kalimantan island. The statistic shows there exists 9.7% gap growth between electricity sales and generator capacity. Government has made some programs to overcome electricity problem and one of them is a 35,000 MW electricity development program. With the abundant potential primary energy, Kalimantan Island is considering to build thermal and hydro power plant with 275 kV or 500 kV transmission voltage systems. This research aims to develop a model to seek the lowest cost in electricity generation and transmission system among some alternatives. This model supposes be able to support PLN in making decision on which alternative to invest. Such model represents two alternatives of scenario namely regional balance and interconnectivity. Cooperative game theory is used to solve this problem since coordination (coalition) among players is important to reduce the costs. The result shows that the best alternative is area 1 and area 2 interconnectivity alternative. This alternative produces total cost of 123,5 trillion rupiahs. One way and two way sensitivity analysis are conducted to enrich the decision. The current decision will be shifted to regional balance alternative if the coal price is reduced 50% from its initial value or more.

Keywords: Economic Dispatch, Game Theory, Generation, Transmission
Technical Feasibility for Technology Commercialization of Manual Wheelchair Testing Laboratory

Devi Putri Rahmawati¹,a), Fakhrina Fahma¹,b), Wahyudi Sutopo¹,c), and Risang Pamungkas Anurogo²,d)

¹Sebelas Maret University, Surakarta 57126, Indonesia
²PT. Mega Andalan Kalasan, Indonesia

Email: a) deviputrirahma97@gmail.com, b) fakhrina09@gmail.com, c) wahyudisutopo@gmail.com, d) r_pamungkas_a@yahoo.com

Wheelchair is a tool used to improve the mobility activity for people with disability, especially for diffable, elderly and people who have physical limitations in doing activities. The government is pushed to develop and adopt the wheelchair standard to ensure the level of wheelchair quality. In Indonesia, there is an SNI about wheelchair of SNI 09-4663-1998 which was established since 1998 and has been used for 20 years without any renewal. SNI 09-4663-1998 has not been able to become a reference for wheelchair manufacturers, because the reference of ISO 6440-1985 already obsolete due to this standard has been withdrawn, and replaced by ISO 7176. So the SNI about wheelchair need to be reviewed. In the research of Pratiwi, et al (2018), from the result of the review resulted eight main parameters to be regulated in wheelchair SNI. As an effort of the application of SNI, it was needed a research laboratory. Nowadays, PT. Mega Andalan Kalasan has a manual wheelchair laboratory research and is developing a testing laboratory of manual wheelchair based on reviewed result test parameter. To increase profits, PT MAK will commercialize those testing technology as spin-off company from PT. MAK. In doing commercialization, the manual wheelchair testing laboratory should meet the requirements in various aspects, one of them is the technical aspect. Then in this study a technical feasibility study was conducted on the commercialization of manual wheelchair testing laboratories based on the commercialization model of goldsmith. And to assessing the readiness of the laboratory conducted an assessment that refers to Putri’s research et al (2018). From this research it was found that the manual wheelchair testing laboratory at PT. MAK has fulfilled the technical aspects of the Goldsmith commercialization model and the laboratory is said to be ready according to ISO / IEC 17025: 2017.

Keywords: Technical Feasibility, Manual Wheelchair Testing Laboratory, Goldsmith Commercialization Model, IS0/IEC 17025:2017
Defining the Role of Quality Function Deployment to Improve the Usability of Prosthetic Hand

Novie Susanto\textsuperscript{1,2,a)}, Manik Mahachandra\textsuperscript{1,2)}, Ratna Purwaningsih\textsuperscript{1)}, Wiwik Budiawan\textsuperscript{1)}} and Ahmad Sahal Afhami\textsuperscript{1))

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Diponegoro University

\textsuperscript{2}Center for Biomechanical, Biomaterial, Biomechatronics and Biosignal (CBIOM3S), Central Laboratory Building, Diponegoro University

Email: \textsuperscript{a)} novie.susanto@ft.undip.ac.id

This paper aims at establishing improvement process of prosthetic hand product design using Quality Function Deployment (QDF). Since the prototype of the well-functioned prosthetic hand is launched, the early life cycle checking of the product design is undefined. Brainstorming and QFD are utilized to gain improvements of the product usability. Besides, usability test is designed both qualitative and quantitative test to assess the usability concept of a custom product. The research finding show the improvement of product based on easiness factors while Voice of Customer calculate the highest absolute value for technical responses is regulation of the motion mechanism (53.4%).

\textbf{Keywords:} Usability, QFD, Prosthetic Hand
Repetitive Tasks Analysis in Cutting Tofu Process Using Assessment of Repetitive Tasks Tool

Rahmaniyah Dwi Astuti\textsuperscript{1,a)}, Anindya Ratna Lakhsita\textsuperscript{1,b)}, and Bambang Suhardi\textsuperscript{1}

\textsuperscript{1}Sebelas Maret University, Surakarta 57126, Indonesia
Email: \textsuperscript{a) Niyah22@gmail.com, \textsuperscript{b) anindyratnnao@gmail.com}

The increasing consumption of tofu in Indonesia is causing the high production of tofu. Sari Murni tofu industry, one of the tofu producers in Surakarta. The first process is using soybean as a main ingredient is initiated with deep soaking. After the deep soaking process is done, the tofu is moved to washing process tofu, filtering process, grinding process, boiling process, cooking process, pressing process. Lastly, the tofu is cut, and kept in final storage. Cutting process, one of the process, produces repetitive tasks. The cutting knife and a wooden ruler are used in cutting process. It can produce 18 times repetitive movements to cut 1 tofu pan. Meanwhile, the daily production capacity is 250 pans. There are two operators in cutting process. According to the condition, one day it can produce 2,250 times repetitive movements done by two operators to cut tofu with upper limb (arms and hands) being involved in repetitive task. The observation was run by several methods for risk assessment on repetitive tasks but this observation using Assessment of Repetitive Tasks (ART) tool to assess the risk of repetitive tasks carried out by cutting operators. This tool was developed by Health and Safety Executive (HSE) in 2010. The ART tool is used to identify risk factors for repetitive tasks that have the potential to cause injury to the upper limbs (hands and arms). The results of ART shows in the cutting process, which are found on right hand and left hand, with a medium risk level (further investigation required). The most important risk factors are pressure, arm posture, and hand grip posture. The second important risk factors are repetition, arm movement, and work pace. Both of these risk factors are concerned for further intervention.

Keywords: Repetitive Task, Assessment of Repetitive Tasks Tool (ART Tool), Cutting Tofu Process
Quality Assessment Of CoC (Code of Conduct) by Servqual Method And IPA Model (Case Study: Employee of PT. PLN Central Java and D.I.Yogyakarta Distribution)

Widhiyaningrum¹,a) and Novie Susanto¹,b)
¹Universitas Diponegoro, Semarang, Central Java, Indonesia
Email: a) ningrumwidhiya@yahoo.com, b) nophie.susanto@gmail.com

Technology and knowledge development in globalization era are influence to all aspect through society life. A technology implementation which been applied in society such as education, government, transportation, communication, and others. On the other side, a modern technology is can not able to improve performance quality in every sector or instance. The important thing which can influence performance quality is about availability of human resources. Humans have more sophisticated abilities and flexibility to conduct performance evaluations. An example of human resources duties is COC (Code of Conduct) activity in PT. PLN. Its address to job evaluation, work evaluation, and solve the problems in company. Therefore, researcher conduct research through quality assessment of COC (Code of Conduct) activity by using SERVQUAL method and integrated to IPA diagram. On the other side, researcher give suggestion of improvement through the instrument of IPA diagram has lower scale which are not suitable to employees expectation. Researcher distributed thirty questionnaire to all employees. The questionnaire is fulfillment by using likert scale 1 to 5.

Keywords: SERVQUAL, IPA, Performance, COC, Employees
Working Analysis of Temporary Storage Operators and Tofu Cutting Operators Using RULA Method

Rahmaniyah Dwi Astuti1,a), Shofitri Dhia Hanifah1,b), and Wakhid Ahmad Jauhari1,c)

1Sebelas Maret University, Surakarta 57126, Indonesia
Email: a) niyah22@gmail.com, b) shofitridhia@gmail.com, c) wachid_aj@yahoo.com

Tofu is one of Indonesian traditional food that often being used as side dishes. Sari Murni Small Medium Enterprise (SME) produces 250 tofu pans every day. The processes of making tofu consists of ten processes. The first process is soybeans soaking. After the soybean soaking is done, the next processes are soybeans washing, soybeans grinding, and ground soybean boiling. Then, the mixture of boiled ground soybean is filtered to remove soybean dregs. The next processes are adding vinegar and pressing the mixture using tofu pressing tool to form tofu then moving the formed tofu to temporary storage. After keeping the formed tofu for a while, the tofu texture become hard and ready to be cut. The last process is kept the cut tofu in final storage. Almost all of the processes are done manually and traditionally, among these processes there are activities that require working method analysis, such as material transportation activites which oblige temporary storage operators to travel 5,000 m and also oblige tofu cutting operators to travel 2,500 m every day to move tofu pans. In addition, there are no table that specifically used for tofu cutting process, the absence of this facility causes the tofu cutting operators to do their work on any surface that can support tofu pan during cutting process. The height of the supports vary between 38 cm to 71 cm. This arises to a problems called worker musculoskeletal disorders (WMSDs) due to awkward posture. Nordic Body Map (NBM) was used to identify operators’ body parts that experience pain. Quick Exposure Checklist (QEC) was used to assess risk level of back, shoulder/arm, wrist/hand, and neck during work. Rapid Upper Limb Assessment (RULA) was used to evaluate working posture of tofu cutting operators to find the specific problem. The result of NBM shows that one of temporary storage operators experiences pain in body parts that have high risk level in QEC assessment, those are back and shoulder/arm. Other than that, the result of NBM also shows that all tofu cutting operators experience pain in body parts that have high risk level in QEC assessment, those are back, shoulder/arm, and neck. Evaluation of tofu cutting operators’ working posture using RULA shows that the posture score is 7 which means that the risk level of exposure to WSMDs is very high and it needs implement change now.

Keywords: Working Method Analysis, MSDs, NBM, QEC, RULA
Packaging of a product is needed to protect the product from damage. One of the materials used is a carton. Another function of the packaging is to improve the appearance of the product to increase customer attention. The production process at a packaging company, PT. XYZ, is done manually without the use of machines or tools. As a result, there is inefficiency, because it requires more work time and greater worker energy. This also has the potential to cause more fatigue and accidents at work. This paper is the result of ergonomic research that aims to understand the sequence of work, physical complaints of workers, evaluation of work posture and standard work time. Next is a design of a tool to overcome the problem. Physical complaints of workers were measured by the Nordic Body Map (NBM) questionnaire. Workloads are measured by the Rapid Entire Body Assessment (REBA) Analysis, the Ovako Working Analysis System (OWAS), and the Muscle Fatigue Assessment (MFA). Next, right and left hand charts are made, calculating cycle time, normal time and standard time. Work tool was designed according to the analysis of complaints, causes, and solutions expectations of workers interpreted in terms of design tools. The specifications of the workers' needs and the concept classification tree were made to get as many as 8 concepts. These alternatives were selected using the Pugh concept selection. REBA analysis results for body posture in existing conditions in the activity of lowering the product under the floor, pressing the product, folding the product, and raising the product on the table are 10, 8, 9 and 11 respectively. After implementation, there was a decrease in the REBA score for press and fold activities with each score 3. As for the activity of lowering and raising the product, it is eliminated, because the presence of work aids does not need to be done by workers. While the REBA score for activities in the finishing process decreased from 9 to 7. OWAS scores for each activity before implementation ranged from 2131 to 4211. After implementation the OWAS values decreased to 1171 to 312. While the MFA values before implementation are categorized as L, VH and H, and after implementation all belong to the L category. The results of work time measurements before implementation are cycle time is 320.23 seconds, normal time is 336.24 seconds and the standard time is 437.11 seconds. After implementation the cycle time is 275 seconds, the normal time is 299.75 seconds and the standard time is 374.69 seconds. There is a decrease percentage for cycle time of 28.13%, normal time is 25.93% and standard time is 28.57%. Total production of cardboard packaging after use press tools increased from 25 pcs to 30 pcs in one production.

**Keywords:** Ergonomics, Nordic Body Map, REBA, OWAS, MFA
This research investigates the variables that are important to influence the migration of customers from the segment of low cost carrier to the segment of full service carrier airlines or vice versa by looking at the push-pull-mooring and demographic factors. This research used the primary data which were collected through closed questionnaires with 1-5 Likert scale. A sample of this research was 200 respondents; 100 respondents from low cost carrier segment and 100 respondent from full service carrier segment. The research used Analysis of Variance (ANOVA) and Structural Equation Modelling (SEM)-Partial Least Square (PLS) to process the collected data. The results of this research showed that mooring factor is not different for male and female and also for income less than 5,000,000 IDR or more than 5,000,000 IDR. The result of this research also showed that push and pull factors have positive and significant effect on switching behaviour from both segment (low cost carrier and full service carrier segment); whereas, mooring factors only have negative and significant effect on switching behaviour of full services carrier. The role of mooring factors as moderating effect only proved for the relationship between pull factor and switching intention.

**Keywords:** Low Cost Carrier, Full Service Carrier, Push Factor, Pull Factor, Mooring Factor
Currently, the order processing of the studied company involves uploading the ice cream product into the truck and distributing it to various depots and stores after collected the orders. There were two problems faced by the studied company. The first problem was the mismatch of the truck capacity with the number of ice cream products should be delivered to the various depots and stores. The second problem was the length of time needed to upload the ice cream product to the trucks that caused the inability of the trucks to distribute the product during the regular business hours. The remaining product that cannot be delivered in regular hours, will be sent by overtime or will be postponed for the next day. Hence, based on this condition, the aims of this study is to find the optimal combination of the number of trucks related with their capacity and also to find a set of delivery regions and routes that satisfying some requirements or constraints and giving minimal total cost. As ice cream is a unique product that requires temperature -180C, in order to minimize the transportation cost, this study prefer to find the optimal combination of the number of trucks rather than minimize the travel distance. Frequent opening of a truck door will cause sudden temperature increases, so the number of delivery locations for each truck cannot exceed three to prevent the products from melting. This research uses a Vehicle Routing Problem (VRP) approach to consider the distribution scenario where a truck with specific capacity depart from the company, upload the ice cream products, and deliver them to a specific depot and store. This research also uses sensitivity analysis to see the impact of possible route failures on variable decisions, estimated costs and route reliability. Last, the research will use the Estimating Expected Interruption Cost) (ECOST) method to estimate disruption cost that occurs in the distribution system. This research use secondary data collected from the studied company, i.e. time needed for distribution activity, distance and route from company to various depots and stores, the number of depots and stores, the number of demand in each depot and store, the number of truck needed for distribution activity, and the number of employees involved in distribution activity. The result of extensive computational secondary data will provide the best route of delivery from studied company to the various depot and stores that are done using trucks with a certain capacity, so the minimum cost is obtained.

**Keywords:** Truck Capacity, Routes, Depot, Store, VRP
A Conceptual Framework on The Design of Intelligent Supply Chain for Natural Fibre Agroindustry

Nunung Nurhasanah\textsuperscript{1,a)}, Machfud\textsuperscript{2,b)}, Djumali Mangunwidjaja\textsuperscript{3,c)}, and Muhammad Romli\textsuperscript{4,d)}

\textsuperscript{1}Doctoral Program of Agro-industrial Engineering Department, Faculty of Agricultural Technology, IPB University, Indonesia
\textsuperscript{2,3,4}Professor of Agro-industrial Engineering Department, Faculty of Agricultural Technology, IPB University, Indonesia

Email: \textsuperscript{a)} nunung_nurhasanah@apps.ipb.ac.id, \textsuperscript{b)} machfud21@gmail.com, \textsuperscript{c)} jumalimw@hotmail.com, \textsuperscript{d)} mromli@hotmail.com

Kenaf (Hibiscus cannabinus L.) is one of fibre-producing plants that is still highly potential to develop in Indonesia. There is a gap between supply and demand of natural fibre by 90.38\% [1], meaning that it is only 9.62\% of kenaf fibre demand met by domestic processors. The main objective of this research is designing an intelligent supply chain model of natural fibre agroindustry. In order to design the main model, three sub-models would be developed to answer research questions, i.e.: (1) Developing a sub-model of collaboration among supply chain actors, (2) Designing a sub-model of integrated production and inventory planning, and (3) Developing a sub-model of improvement in supply chain performance. Some approaches that would be employed in this study are Supply chain analytics, Collaborative planning, forecasting and replenishment, Particle swarm optimization, Decision support system, and Value chain operation reference. The concept of 4.0 industry that would be developed was an implementation scheme of Internet of Things in production optimization of dried kenaf fibre through employment of sensors and image processing. Indicators of success factor for this research that were established are: (1) Enhancement in supply chain efficiency and effectivity of natural fibre agroindustry, (2) Enhancement in satisfaction level among supply chain actors, and (3) Achievement of level optimization and inventory cost minimization, as well as (4) Usefulness of a web based NFSCA application for users.

Keywords: Intelligent Supply Chain, Supply Chain Analytics, Collaborative, Performance
The Current Status of Functional Food Regulation in Indonesia

Ellia Kristiningrum\textsuperscript{1, a)}, Danar Agus Susanto\textsuperscript{1, b)}, Putty Anggraeni\textsuperscript{1, c)}, and Muhammad Haekal Habibie\textsuperscript{1, d)}

\textsuperscript{1}Pusat Riset dan Pengembangan SDM, Badan Standarisasi Nasional, Kompleks Puspiptek, Tangerang Selatan, Indonesia

Email: \textsuperscript{a)} ellia@bsn.go.id, \textsuperscript{b)} danar@bsn.go.id, \textsuperscript{c)} putty.anggraeni@bsn.go.id, \textsuperscript{d)} haekal@bsn.go.id

Indonesia has some of the richest natural resources which have potential bioactive content and can be developed into functional food sources. In its development, functional food in Indonesia is very prospective and has opportunities in the export trade. Until now there has been no universal agreement regarding the terms and definitions of functional food, including in Indonesia. The amount of research and development regarding functional food carried out by researchers from various circles in Indonesia must be supported by regulations from the Indonesian government. The stipulated regulations is regarding the process of standardization and conformity assessment for certain types of functional food. This research was carried out in a descriptive exploratory manner by reviewing the regulations on functional food in several countries in the world. The results of this research were then analyzed and used as role models for the regulation of functional food in Indonesia. The method used in the research is FACTS (Framework for Analysis, Comparison, and Testing of Standards) with the Zachman Framework approach which has been widely used. From this research, it was concluded that a national quality infrastructure that consists of standardization, conformity assessment and metrology is needed to support regulations regarding functional food in Indonesia.

\textbf{Keywords:} Functional Food, Regulation, Standardization, National Quality Infrastructure
Ergonomics Principles in Traffic Signs Comprehension: A Literature Review

Farid Ishartomo¹,a), Bambang Suhardi¹, and Jafri Mohd Rohani²
¹Graduate School of Industrial Engineering, Universitas Sebelas Maret, Surakarta 57126, Indonesia
²Department of Materials, Manufacturing, and Industrial Engineering, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia
Email: a) ishartomo@student.uns.ac.id

Traffic signs are one of the required road safety equipment and easily found throughout the world. Comprehension of traffic signs are absolutely necessary to improve aspects of road safety. This paper aims to discuss several previous studies related to drivers' comprehension of traffic signs. In addition, ergonomics principles are also considered in it. From the review, it is known that there are several evaluation methods that have been developed to test the comprehension level of traffic signs. This paper also discusses the human characteristics examined by previous researchers and defines conclusions from any characteristics that have a significant relationship with the level of drivers’ comprehension of traffic signs.

Keywords: Traffic Sign, Ergonomics, Road Safety
IE-090

Implementation of Life Cycle Assessment (ISO 14040) On Sme Fish Nugget Producer In Bandung

Ajun Tri Setyoko¹,ᵃ), and Ellia Kristiningrum¹
¹Center for research and Human Resources Development, National Standardization Agency of Indonesia, Jakarta, Indonesia
Email: ᵃ) ajun_ts@bsn.go.id

SMEs very rapidly growing in Bandung, one of which is the fish nugget product. They produced the fish nugget without any attention on number of energy used; solid, liquid and gas management; and influences environment as well. The purpose of this study is to determine the energy and material usage the released waste to environment. The reference for calculating the energy usage and other parameters was 1 kg finished product. Energy measurement was taken place at all energy used during the production such as human energy, electricity, liquid petroleum gas and gasoline. The released emissions were measured in CO2, SO2, and NOx. The result depicted that energy needed to produce 1 kg fish nugget was 339.64 MJ. The emission released was 138032 g CO2; 1.13 g SO2; and 8.68 NOx. The input given to the SMEs from the results of this study are expedition selection for product distribution and efficient use of production equipment.

Keywords: LCA, Energy, Emissions, Fish Nugget, SMEs
Designing to Improvements of Posture and The Working Environment of Employees

Abel Kristanto Widodo\textsuperscript{1,a)}, Singgih Saptadi\textsuperscript{1,b)}

\textsuperscript{1}Department of Industrial Engineering, Diponegoro University, Semarang, Indonesia

Email: \textsuperscript{a)} abelkriswidodo@gmail.com, \textsuperscript{b)} singgihs@ft.undip.ac.id

Currently, many companies pay attention to occupational safety and health (OSH) to improve productivity, especially environmental factors and work posture. A state company of Indonesia (PT PLN Main Distribution of Jateng & DIY) is one of the companies that consider Health and Safety Management to improve productivity. Employees of PT PLN Main Distribution of Jateng & DIY use computers intensively as operational in routines, so that cause some complaints to employees, such as musculoskeletal, back pain and etc. This research focuses on improving work postures and works environment PT PLN Main Distribution of Jateng & DIY with approaching with Nordic Body Map (NBM) and ergonomic checklist. There are 30 respondents who participated in this research. Only 6 major aspects experienced by employees: the upper neck, back neck, right shoulder, back, waist, and hips. To decreasing musculoskeletal, the design of equipment of employee is needed that can let down RULA score from 4 to 2 as well as the giving of micro breaks periodically. The result of this study can provide PT PLN Main Distribution of Jateng & DIY by precious insight into decreasing the chance of musculoskeletal for employees that reflect the RULA score.

Keywords: Occupational Safety and Health, Ergonomic, Musculoskeletal, RULA
Consumer Behaviour Analysis Towards Conventional Car Shifting To Electric Car Vehicle

Martha Widhi Dela Utami¹,a), Tasya Adella¹,b), and Wahyudi Sutopo¹,c)
¹Sebelas Maret University, Jl. Ir. Sutami 36A Keningan Surakarta 57126, Indonesia
Email: a) marthawidhidela@gmail.com, b) adellaatasya@gmail.com, c) wahyudisutopo@gmail.com

In 2025 Indonesia could already produce 2,200 electric or hybrid cars regarding to Presidential Regulation of Indonesia Number 22 of 2017 about General Plan for National Energy. This regulation will be applied by various other countries such as France, Britain, Norway and India. Ministry of Energy and Mineral Resources has been set a target that starting from 2040, the sale of cars with combustion engines is prohibited and people are asked to use electricbased vehicles. This effort is a step to answer two issues, the depletion of oil fuel reserves and air pollution. Regarding air pollution, Indonesia has committed to cut 29% of CO2 emissions by 2030 as the results of the Paris Climate Change Conference held in 2015. However, there are many challenges for the electric car vehicle adoption. Questionnaires were distributed in Surakarta to knowing about citizen’s awareness on electric car vehicle, first impression, psychological factor, and policy awareness involving 80 respondents who have seen and/or conducted a test drive using Toyota Prius PHEV. The answers are processed using multiple linear regression analysis test, coefficients determination test (R²), simultaneous F test, and partial t test to test the influence of several independent variables towards the dependent variable using SPSS statistical software 20. This article develops a factor analysis of consumer behavior that could reveal business opportunities in supporting the shifting of conventional car to electric car vehicle. This article will educate consumer about the importance of electric vehicle and clear government regulation suggestions to support conventional car shifting to electric car vehicle in Indonesia.

Keywords: Electric Car Vehicle, Shifting, Factor Analysis, Consumer Behavior, Regulation
Technology Assessment of Treatment of Liquid Waste in Rubber Factory Using Analytical Hierarchy Process and Promethee Methods

Aulia Ishak¹,a), Vina Akmaliah¹,b)
¹Industrial Engineering Department, Faculty of Engineering, Sumatera Utara University
Email: a) aulia.ishak@gmail.com, b) vina.akmaliah@gmail.com

Liquid waste generated from the production process of large rubber plantations reaches approximately 26.4 m³/ton dry rubber. The high liquid waste is because water is the most resource needed during the production process. This waste can cause adverse effects on the environment if not managed properly. Several liquid waste treatment technologies have been implemented in rubber plants in Indonesia, but there is no assessment of the best liquid waste treatment technology to be applied in rubber plants in order to avoid adverse environmental impacts. Therefore, in this study, conducted an assessment of liquid waste treatment technology using AHP and PROMETHEE methods. The determination of criteria and weighting is based on expert consensus using the Delphi method. Assessment of liquid waste treatment technology by providing effective solutions and criteria for liquid waste treatment technology. The results of this study indicate that the Active Sludge System with priority weight (0.4550) is superior to other liquid waste treatment technology alternatives that is Pond System (0.2995) and the phytoremediation system (0.2456). Evaluation of the assessment by the PROMETHEE method also shows that the Active Sludge System is ranked first.

Keywords: Liquid Waste, Technology Assessment, Analytical Hierarchy Process, Promethee Methods
Hospital accreditation is mandatory for the purpose to improve hospital service's quality and to protect patient's safety. Those purposes can be achieved by doing risk management. Risk management program is used to identify error, reduce injuries, and reduce risks of patient safety. The aims of this study are to identify potential errors and the impact of errors found in Colon in Loop (CIL) examinations at the radiology installation of RSUD Karanganyar and to provide proposed improvements to minimize these errors as a form of risk management that can be done. This research was carried out through 3 stages, those are identification of procedures using Hierarchical Task Analysis (HTA), identification of human error using Systematic Human Error Reduction and Prediction Analysis (SHERPA), and identification of human error probability using Human Error Assessment and Reduction Technique (HEART). The stages of SHERPA consist of task classification, identification of human errors, analysis due to errors, analysis of error recovery, analysis of probability of sequential errors, analysis of critical error level, and analysis of error repairs. While the stages of HEART consist of task classification, determine EPC, determine APOE, calculate AE, and calculate HEP. In this study, the SHERPA method found 51 tasks have occurred human error or have potential of the occurrence of human error from 136 tasks that must be performed by a radiographer to complete CIL examination. 2 of those 51 tasks were found to have high critical level. The highest critical risk occurs when the radiographer forgets to give informed consent to the patient and when the radiographer forgets not to wear a film badge on his body when carrying out the examination. Then with the HEART method the highest probability of error occurring was found, namely the task of injecting negative contrast with manual air pumping with HEP of 0.252; positioning the object in accordance with the projection with HEP of 0.198; and give informed consent to be understood and agreed to by patients with HEP of 0.104. The result of the analysis of this study can be used to determine the right proposed improvements to minimize errors that occur or possibly occur in CIL examinations by the radiology installation of the RSUD Karanganyar.

Keywords: Human Error Analysis, Colon In Loop, HTA, Sherpa Method, Heart Method
IE-096

Life Cycle Energy and Environmental Impact Assessment of CRIMSON Sand Casting on Intake Manifold Production Process

Salman Alfarisi¹,a) and Wahyudi Sutopo²,b)
¹Muria Kudus University, Indonesia
²Sebelas Maret University, Jl. Ir. Sutami 36A Kentingan, Surakarta 57126, Indonesia
Email: a) salman.alfarisi@umk.ac.id, b) wahyudisutopo@staff.uns.ac.id

The simplification of manufacturing efficiency can drive the great impact to the energy consumption. In foundry industry, CRIMSON (Constrained Rapid Induction Melting Single Shot Up-Casting) usually used to reduce the sequences of processes and energy consumption. The present paper focuses to analyse the CRIMSON sand casting stages due to its energy consumption and environmental impact. In this paper, CRIMSON sand casting process is used to produce automotive component, intake manifold. The environmental impact assessment obtained through simulation by considering material and energy consumption while in manufacturing process. It is proven that CRIMSON sand casting drive to higher energy efficiency. However, the amount of pollutant is high enough.

Keywords: CRIMSON, Life Cycle Energy, Sand Casting, Environmental Impact Assessment, Efficiency
IE-097

Lot-Sizing Decisions in Manufacturer-Retailer Inventory System under Carbon Emissions Reduction

Wakhid Ahmad Jauhari*

1Sebelas Maret University, Jl. Ir. Sutami 36A Kentingan, Surakarta 57126, Indonesia
Email: wachid_aj@yahoo.com

We develop a mathematical inventory model for single-retailer single-manufacturer under stochastic demand and carbon reduction policy. The aim of the proposed model is to find optimal decisions regarding inventory management in supply chain system by minimizing the joint total cost. The model contributes to the current stochastic joint lotsizing literature by allowing the investigation of the impact of carbon cap policy to inventory decisions. The carbon emissions mainly generated from several activities in the supply chain system, including the production, transportation and storage activities. The regulator, for example the government, uses a carbon cap policy to restrict the amount of emissions generated from the system. As we use strict carbon cap, the carbon emissions generated from the system must not exceed the carbon emission level set by regulator. An iterative procedure is proposed to find the optimal decision variables, which are ordering quantity, safety factor, number of deliveries and production rate. A numerical example is provided to show the application of the model and to investigate the impact of different levels of carbon cap on inventory decisions.

Keywords: Emissions, Lot Sizing, Environmental Investigation, Inventory, Supply Chain
IE-098

Markov Chain and Techno-Economic Analysis to Identify the Commercial Potential of New Technology: A Case Study of Electric Motorcycle Conversion in Surakarta, Indonesia

Maria Nindy Alif Jodinesa¹,a), Wahyudi Sutopo¹,b), and Roni Zakaria¹,c)
¹Sebelas Maret University, Jl. Ir. Sutami 36A Keningan, Surakarta 57126, Indonesia
Email: a) marianindy14@gmail.com, b) wahyudisutopo@staff.uns.ac.id, c) ronizakaria@staff.uns.ac.id

The motorcycles purchase rate in Indonesia reached 113,030,793 units with an annual average increase of 4%. The technology used is the internal combustion engine (ICE) or fuel combustion. This technology is related with energy crisis and global warming by motorcycles as the biggest contributions for greenhouse gas emission. Electric vehicles conversion can be solution to overcome the problems by substitute fuel with a Lithium-Ion battery kit as an energy source. This has a business opportunity in the future because it can solve problem that threaten the world: energy crisis and global warming. To assess the commercial potential for such a new technology, market share needs to be estimated as well as the techno-economic feasibility. Market share prediction were examined using population in Surakarta, and techno-economic analysis using Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) indicators were conducted in this study.

Keywords: Electric Vehicle, Markov Chain, ICE, Feasibility Study, Lithium-Ion Battery
Literature Review of City Logistics: Classification of Studies and Dominant Factors in Developing Countries

A Arvianto¹,², A M S Asih¹, B M Sopha¹ and M A Imron³
¹Industrial Engineering, Gadjah Mada University, Jl. Grafika No. 2, Kampus UGM, D. I. Yogyakarta, 55281 INDONESIA
²Departement of Industrial Engineering, Diponegoro University, Jl. Prof. Soedarto, SH, Tembalang, Semarang, Central Java, 50275 Indonesia
³Faculty of Forestry, Gadjah Mada University, Jl. Grafika No. 2, Kampus UGM, D. I. Yogyakarta, 55281 INDONESIA
Email: aryarvi@yahoo.com

Many reported cases of city logistics in literature have been dominated by developed countries, and the numbers of cases have significantly increased over time. One hand, it is argued that the city characteristics in developed countries differ from those in developing countries. Different characteristics generate different problems and also a different approach to problem-solving. This paper provides practices of city logistics in developing countries. The purpose of the present study is to identify typical city logistics problems and the dominant factors of city logistics practices in developing countries. This paper describes literature-based research that has sought to understand the practices of city logistics in developing countries. The literature review process used a bibliometric analysis and followed by a systematic literature review to organize 132 papers relating to the concept and the practice of city logistics. We identify the typical problems or subjects of city logistics that emerged in developing countries are related to transportation networks, routing, loading and unloading systems, and collaborative planning. Meanwhile, several factors that are often considered in city logistics in developing countries are transportation network, dense of the urban area, the scale of distribution, service level, and the mission of administrator.

Keywords: City Logistics, Developing Country, Urban Logistics
IE-101

Supply Chain Performance Analysis With Data Envelopment Analysis in TBBM PT. Pertamina Boyolali

Zulhendra Hanifa, Kristy Permataib, Martha Widhi Dela Utamic, Yuniaristantod, and Wahyudi Sutopoe

1Sebelas Maret University, Jl. Ir. Sutami 36A Kentingan, Email: ahendrahanif@gmail.com, bkristyprmt@gmail.com, cmarthawidhidela@gmail.com, dyuniaristanto@ft.uns.ac.id, ewahyudisutopo@staff.uns.ac.id

PT. PERTAMINA TBBM Boyolali is a supplier of fuel oil in the form of premium, pertamax and diesel. The company should distribute fuel products using tank cars with operating areas covering Boyolali, Surakarta, Karanganyar, Sukoharjo, Sragen, Klaten, Wonogiri, Ngawi, Pacitan, Magetan, Ungaran, Semarang, Salatiga, Purwodadi, and Blora. An efficient supply chain is needed to provide the right products and services, with the specifications needed, in the right place and to the right customers. This article aims to increase fuel distribution efficiency at Pertamina TBBM Boyolali. Decision Making Units (DMUs) The DMU stated in this study is the period of supply chain activities from January 2018 to November 2018 at TBBM Pertamina Boyolali, the number of DMU is 11 DMUs. Supply Chain Operation Reference (SCOR) method with responsiveness, flexibility, and reliability attributes is used to measure Supply chain performance. To analyze supply chains efficiency, this article apply Input-oriented DEA CCR (Charnes, Cooper, and Rhodes) model which considers linear relationships in its input and output. Data Envelopment Analysis (DEA) is a strong tool for measuring the efficiency of the DMUs and does not need to normalize indicator values that have different dimensions. The software used for processing data in this article is Banxia Frontier Analyst 4.2. This article provides suggestions for improving cash-to-cash cycle time, lead time, and flexibility for more efficient fuel distribution.

Keywords: Supply chain, DEA, DEA-CCR, SCOR, Distribution efficiency
IE-102

Framework for developing electric wheelchair standards for people with disabilities

Syifa Luthfiana Asnan\textsuperscript{1a}, Fakhrina Fahma\textsuperscript{1b}, Wahyudi Sutopo\textsuperscript{1c}, and Meilinda Ayundyahrini\textsuperscript{2d}

\textsuperscript{1}Department of Industrial Engineering, Sebelas Maret University, Surakarta, Indonesia
\textsuperscript{2}The National Standardization Agency (BSN), Jakarta, Indonesia
Email: \textsuperscript{a}syifafia06@gmail.com, \textsuperscript{b}fakhrina09@gmail.com, \textsuperscript{c}wahyudisutopo@gmail.com, \textsuperscript{d}meilinda.ayundyahrini@bsn.go.id

The trend of using electric wheelchairs in Indonesia has begun to appear. However, Indonesia does not yet have an official government regulation that regulates electric wheelchairs. So, it is very important to know the standard parameters needed to regulate the production of electric wheelchairs in Indonesia from the opinion of selected stakeholders. The selected stakeholders in this study were people with disabilities who had used electric wheelchairs for a certain period of time. In developing the standard framework, the FACTS (Framework for Analysis, Comparison, and Testing of Standard) approach was chosen. This approach begins with an analysis of stakeholder needs, a comparison of standards that are used as a reference, and testing of the standard framework. This method was chosen because it can consider the interests of all relevant stakeholders in developing standards. The results of this study are framework used in standard setting in Indonesia so that Indonesia National Standard (SNI) for electric wheelchairs can be developed and can be used to protect electric wheelchair products in Indonesia.

Keywords: Standardization, Indonesian National Standard, electric wheelchair, disability, FACTS, framework for analysis comparison and testing standard
Multi-Response Optimization of Woven Fabric Tensile Strength and Breaking Elongation Using Taguchi Method and Grey Relational Analysis

Lintang Rainamaya Nursanti¹,a), Eko Pujiyanto¹,b), and I Wayan Suletra¹,c)
¹Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.
Email: a) lintang.raina@gmail.com, b) ekopujiyanto@staff.uns.ac.id, c) suletra@staff.uns.ac.id

In this paper, tensile strength and breaking elongation of cotton woven fabric has been experimented in relation to certain loom parameters. In manufacturing process of fabric with plain weave structure, there are 5 parameters with 3 level each used. The sample fabrics are produced in the air jet loom machine. The parameters used as controllable factor are weft yarn count, weft density, air pressure, warp tension, and rpm. The experiments are conducted according to Taguchi’s experimental design using L18 orthogonal array, combined with Grey Relational Analysis (GRA) to optimize the four responses. Considering signal to noise ratio, using analysis of variance (ANOVA) it is found that weft yarn count and weft density have significant effects toward the tensile strength and breaking elongation of cotton woven fabric in both warp-way and weft-way directions. Meanwhile, the warp tension factor only significantly affects the warp-way breaking elongation. The experimental results show that the optimized condition is found to be Ne 30 type of weft yarn count, 70 ppi of weft density, 5 bar of air pressure, 2.0 kN of warp tension, and 450 rpm. The optimum value of the tensile strength (28.38 kg for warp-way and 24.06 kg for weft-way) and breaking elongation (18.27% for warp-way and 8.69% for weft-way) are all above the specified minimum requirements.

Keywords: Woven Fabric, Taguchi Experimental Design, Grey Relational Analysis (GRA), Optimization, Tensile strength, Breaking elongation
Analysis of Indonesian Tea Competitiveness in The International Market

Yessica Nugrahaningrum\textsuperscript{1,a)}, Roni Zakaria\textsuperscript{1,b)}, Fakhrina Fahma\textsuperscript{1,c)}
\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.

Email: \textit{a)} yessicaningrum@gmail.com, \textit{b)} 2012.ibnu@gmail.com, \textit{c)} fakhrinafatma@staff.uns.ac.id

Indonesia is one of the largest producers and exporters of tea commodities on the international market. Indonesia as a tea exporting country is also a country that imports tea. Tea is one of Indonesia’s leading agricultural export commodities on the international market. In 2013-2016 Indonesian tea exports tended to decrease by 10.05\% per year. As a result of the decline in export volume, some of the main markets of tea that have been controlled by Indonesia have been taken over by other tea producing countries. To maintain tea as the main export commodity in agriculture, precautionary measures need to be taken to maintain existing market share through increasing productivity or improving the quality of tea so that it can enter the international market as premium tea. Based on the background that has been described in general, this study aims to analyze the competitiveness of Indonesian tea on the international market. Specifically, this study aims to analyze the position of tea exports, the competitiveness of Indonesian tea and the strategy of increasing Indonesian tea exports on the international market. The method used to answer the research objectives is the Trade Specialization Index (ISP), Revealed Comparative Advantage (RCA), Constant Market Share (CMS) and Diamond Porter Theory. The data used in this study are time series secondary data from 2010-2016. Based on the results of the study showing that the position of Indonesian tea exports in the international market, the average value of Indonesian ISPs in the world market from 2010-2016 was 0.69. This value indicates that the position or stages of Indonesian tea exports are at the stage of expanding exports with indicator values (0-0.8) and tend to be exporting countries rather than importers. The competitiveness of the results of the average value of Indonesian tea RCA in the international market calculated from 2010-2016 reached 2.32 because the RCA value is greater than one, Indonesia has a strong competitiveness in tea exports in the world. For the value of Indonesian tea CMS, the average for the last six years is positive for standard growth and composition effects but is negative in terms of the effect of competitiveness.

\textbf{Keywords}: Competitiveness, CMS, export, RCA, Tea, Porter’s Diamond Theory
Comparison Analysis of Performance Measurement Between PT KALOG and PT ROSALIA EXPRESS Using the Logistics Scorecard Method

Avia Bilqis Viana\textsuperscript{1,a)}, Anida Norma Cahyati\textsuperscript{1,b)}, Yuniaristanto\textsuperscript{1,c)}, Wahyudi Sutopo\textsuperscript{1,d)} and Sofi Desi Susanti\textsuperscript{1,e)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.

Email: \textsuperscript{a)} aviabilqis@gmail.com, \textsuperscript{b)} anidanorma@student.uns.ac.id, \textsuperscript{c)} yuniaristanto@ft.uns.ac.id, \textsuperscript{d)} wahyudisutopo@staff.uns.ac.id, \textsuperscript{e)} sofidesi.solo@gmail.com

The development of freight forwarding services has led to tighter competition for logistics companies in Indonesia. Therefore, it is important to design a logistics performance measurement model that is appropriate as an evaluation tool for logistics companies in Indonesia. PT. KALOG is a logistics company owned by PT. Kereta Api Indonesia (KAI) where the company uses a train owned by PT. KAI as a mode of transportation in delivering goods to consumers. The design of the logistics performance measurement model is based on the Logistics Scorecard perspective, and is divided into two stages: identifying supply-logistics chain business strategies to obtain KPIs, and compiling a model for measuring logistics performance. There are 23 KPIs according to the five Logistics Scorecard perspectives. From the implementation of the logistics scorecard, the percentage of total results for each company is obtained, and indicators that must be improved can be identified. In this study, a comparison performance between PT. KALOG and PT. Rosalia Express as a logistics services company.

**Keywords:** Key Performance Indicator, Logistics Scorecard, Performance measurement
Qualitative Comparative Analysis (QCA): A Qualitative-Quantitative Approach for Multi-Variables and Small Samples Research (Case Study: Indonesia's Megaprojects)

R.W. Damayanti¹, Budi Hartono¹, and Andi Rahadiyan Wijaya²

¹Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.
²Industrial Engineering Study Program, Faculty of Engineering, Gadjah Mada University, Yogyakarta, Indonesia

Email: a) rwd@ft.uns.ac.id

Two approaches that have been known to analyze research, namely qualitative and quantitative. Case studies with qualitative methods have advantages of focus on in-depth analysis, not limited by the mathematical assumptions and not requiring large samples. However, the disadvantages are that it cannot be generalized, and its variables analyse limited due to fixated on the specific cases. The quantitative research, commonly known as a statistical approach, has the advantages of being able to be generalized and accommodate analysis of multi-variables, but it must meet the statistical assumptions and require a large sample. Recently, researchers have the number of specific goals but hampered in meeting the requirements of these approaches. For example, researchers want to examine many factors (multi-variables) that focused in-depth analyzed but can still be generalized even in a small sample. A method comparative analysis principal which is considering a qualitative-quantitative approach that potentially used in research with these characteristics is Qualitative Comparative Analysis (QCA). The case study in Indonesia megaproject field is used to provide descriptions of the use of this QCA approach. Based on the study analysis, QCA has an opportunity to be used as a research approach which consists of multi-variables with small sample size with in-depth analysis and potentially generalized results.

Keywords: Multi-Variables, Quantitative-Qualitative Method, Qualitative Comparative Analysis, Small Sample
The Impact of Critical Success Factor of Lean Six Sigma Implementation towards the Improvement of Business Performance on Low-Cost Hotel Industry: A Literature Review

Alima Shofia¹,a), Arfan Bakhtiari¹, and Heru Prastawa¹
¹Department Of Industrial Engineering, Diponegoro University, Indonesia
Email: ovi.shofia@gmail.com

Semarang City’s Government is aggressively developing the tourism business which is supported by adequate transportation access such as the existence of airport, stations and bus terminals. This makes it easy for foreign and local tourists to visit the city. This also opens a business opportunity for residents to open a low-cost hotel that is supported by the ease of online booking sites and cooperation with Virtual Hotel Operator (VHO), such as Airy Room, Red Doorz, etc, which help the owners to manage and promote the rooms. Lean Six Sigma as a tool proves that it can be very useful to optimize the production of products and services, but it rarely to find the hotels which implement this approach to improve their performance. Seeing this phenomenon, the author intends to examine how much the impact of the determinants of Lean Six Sigma's success in improving business performance in the hotel industry, especially low-cost hotel industry. This study will examines some papers that relate to the Critical Success Factor of Lean Six Sigma in service industry, especially hotel industry. The finding of this paper will show how those CSF influence the Lean Six Sigma to boost the business performance of the company.

Keywords: Lean Six Sigma, CSF, Business Performance Improvement, Hotel Industry
A Consignment Policy For A Supplier-Retailer Inventory System With Price-Dependent Demand

Yuka Sato¹,a), Wakhid Ahmad Jauhari²,b), and Cucuk Nur Rosyidi³,c)
¹,²,³Department of Industrial Engineering, Sebelas Maret University, Jl. Ir Sutami 36 A, Surakarta 57126, Indonesia
Email: a) yukasatuy@gmail.com, b) wachid_aj@yahoo.com, c)cucuk@uns.ac.id

In this paper, a consignment policy is proposed to manage inventories in a supply chain system involving a supplier and a retailer. The periodic review policy is adopted by both parties to control the inventory level in order to satisfy the stochastic demand coming from end customers. The mean of demand is assumed to be dependent on retailer's selling price. Two mathematical inventory models are developed and investigated, the first is the model without consignment policy and the second is the model with consignment policy. An iterative procedure is applied to search the optimal periodic review, safety stock and retailer's selling price so the joint total profit can be maximized. A numerical example is also provided to illustrate the application of the model and to show the performance of the proposed models. The result shows that the second model results a higher joint total profit compared to the first model. This concludes that the inclusion of consignment policy in inventory management gives significant benefits to supply chain.

Keywords: Inventory Model, Periodic Review, Consignment Policy, Price-Dependent Demand, Joint Total Profit
Role of Rapid Manufacturing Technology in Wearable Customized Assistive Technology for Modern Industry

Ilham Priadythama¹, Lobes Herdiman¹, and Susy Susmartini¹
¹Laboratory of Product Planning and Design, Industrial Engineering, Universitas Sebelas Maret
Email: a) priadythama@gmail.com, b) lobesh@gmail.com, c) susysus2011@gmail.com

An impact of a modern industrial system, such as in Industry 5.0, which brings customer authorization deeper into the manufacturing stream, may give pressure toward the industrial working system. Along with this system transformation, the declining trend of labor number as world demographical change created demand for higher productivity worker, which is stronger and more versatile for handling more than one working station, giving added value and personalization in fulfilling customer needs. Assistive Technology (AT) which is formerly for disabled or handicapped people, would be more widely used for everyone and working for its new purposes in producing higher individual physical capacity. A common challenge of providing a wearable AT, such as limb protheses, orthoses, or exoskeletons, is customizing their geometry to fit on user body parts. In Industrial context, this would even be more challenging since it must be provided in massive number which can overburden companies overhead. The disruptive technology of prototyping such as 3D scanning and 3D printing brings a customized prototype into a new level of accomplishment life cycle and affordability. New processing technology and material development in 3D printing eventually transform rapid prototyping into rapid manufacturing of final AT product. This paper aims to examine recent research and development of AT from AT developers and communities as well as its novel development process. The new challenges of new AT existence are discussed further in the context of working safety and product standardization and a study about its impacts towards industrial productivity are highlighted.

**Keywords:** Rapid Prototyping, Rapid Manufacturing, Assistive Technology, 3D Printing, 3D Scanning, Working Productivity
IE-116

Application of Quality Function Deployment for Diversification of Souvenirs of Goyor Weaving Fabrics for Foreign Tourist Needs (Case Study: Sragen Regency)

Navy Salem\(^1\)*, Eko Liquiddanu\(^1\), I Wayan Suletra\(^1\), Murman Budijanto\(^1\)
\(^1\)Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami 36A, Surakarta 57126, Indonesia
Email: a) iwanmelas@gmail.com

Goyor woven fabric is a traditional fabric product from the Central Java region, especially in Sragen district. However, because the process of making woven fabrics takes a long time and the income obtained from making woven fabrics is less compared to other jobs, the Sragen people prefer to work in furniture factories nearby. To revive the tradition of goyor woven fabric, a new market is needed to receive woven fabric products and so that weavers can have a steady income. One potential market is the foreign tourist market. To reach the market, it is necessary to do research to find out the desires of consumers so that products can be made according to market demand. This study uses the Quality Function Deployment (QFD) method. The results obtained in the form of the types and specifications of souvenir products desired by the foreign tourists as well as the opinions of foreign tourists on woven fabrics.

**Keywords:** Quality Function Deployment; Souvenir; Foreign Tourist; House of Quality
Sustainable Economic Production Quantity Model with Rework and Return Policy

Ilham Nur Fadli\textsuperscript{1,a)}, Ratna Novitasari\textsuperscript{1}, and Wakhid Ahmad Jauhari\textsuperscript{1}

\textsuperscript{1}Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami 36A, Surakarta 57126, Indonesia

Email: \textsuperscript{a)} ilhamnurfadli@gmail.com

This paper develops an Economic Production Quantity (EPQ) model for imperfect items by considering the number of defective products, the rework and remanufactured process, and the value of carbon emissions. In this model development, defective products come from the results of direct production and defective products returned by customers. Defective products which turned back by customers may occur because of the inspector mistakes during screening process, these mistakes include classifying items that are defective as perfect quality items or incorrectly classifying non-defective items as damaged items. The defective product will be reworked at the end of the production cycle. The proposed model also considers carbon emissions emitted during the overall production cycle. The carbon emissions referred to are the amount of energy consumption that is released during the production process until the produced items are stored in the warehouse. The results obtained from the mathematical model are in the form of optimum number of production setup in one cycle and optimum regular production period length to achieve minimum total inventory related cost per unit time.

Keywords: Economic Production Quantity, Multiple Production Setups, Carbon Emission, Defective Item, Deteriorating Items, Rework, Return Policy, Scrap Items
Improvement of Work Processes and Methods to Achieve Production Targets Using VA-NVA Analysis, ECRS, and Line Balancing

Ilham Nur Fadlil\textsuperscript{1} and Cucuk Nur Rosyidi\textsuperscript{1}
\textsuperscript{1}Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami 36A, Surakarta 57126, Indonesia
Email: a) ilhamnurfadlil@gmail.com

The production process is the reason why a company can survive. This is because the production process produces output in the form of products that have added value so the company can benefit from the sale of these products. In the production process there are several problems that often occur, one of which is not achieving the production target, where the output produced is lower than the production target. This problem will have an impact on increasing production costs due to the implementation of overtime work. This problem can be solved by improving work processes and methods, such as identifying work steps that have waste and not adding value to the product using VA/NVA analysis; eliminate, combine, reduce, and simplify work steps using the ECRS method; and minimizing production cycle times using line balancing. The results of the study show that improvements using VA-NVA analysis, ECRS, and line balancing optimization using branch and bound algorithms can increase the utility of each work station, increase balance efficiency, reduce balance delay, and reduce maximum cycle time or service time, so that production targets can be achieved.

Keywords: Work Processes Improvement, VA/NVA Analysis, ECRS, Line Balancing, Branch and Bound
Enhancement Quality of Sand Casting Manufacturing Product Using Taguchi Method

Salman Alfarisi¹,a) and Wahyudi Sutopo²,b)

¹Department of Industrial Engineering, Universitas Muria Kudus, Kudus, Indonesia
²Department of Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

Email: a) salman.alfarisi@umk.ac.id, b) wahyudisutopo@staff.uns.ac.id

Sand casting is the most widely used technique in foundry industry. In manufacturing process, there are found a number of parameters involved. The parameters should be controlled to improve the quality of sand casting product. However, a number of barriers make the casting process difficult to avoid a defect of casting. This paper aims the reduction of waste and number of defect. Taguchi method was used to evaluate the sensitivity to some parameters and optimize the parameters. Orthogonal array is used for experimental purpose. Several control parameters; such as sand particle size and pouring temperature were selected as control parameters. The analysis this study indicated a reduction of waste, number of defect and enhancement of optimal parameter value to increase the quality.

Keywords: Sand Casting, Taguchi, Foundry Industri, Defect
IE-122

Mapping of Heat Exposure in Production Room of PT. Pilar Kekar Plasindo Using Surfer Software

Fuky Prima Pradana¹,a), Bambang Suhardi¹,b), Rahmaniyyah Dwi Astuti¹,c)
¹Department of Industrial Engineering Sebelas Maret University, Ir. Sutami 36 A Street, Surakarta, Indonesia
Email: a) fuky.primaa@gmail.com, b) bambangsuhardi@staff.uns.ac.id,
c) niyah22@gmail.com

PT. Pilar Kekar Plasindo is an industry engaged in the manufacture of plastic bags. This industry has ten work stations in its production space. With the importance of the function of the production room, it is necessary to fulfill the thermal comfort aspects to support internal activities. Thermal comfort is very influential on the production process. One that affects thermal comfort is temperature. This study aims to determine the distribution of heat exposure in the production room of PT. Pilar Kekar Plasindo through mapping using surfer software and to determine the thermal comfort level of workers in accordance to Permenakertrans No. PER 13 / MEN / X / 2011. The method used in this study is direct measurement based on SNI-16-7062-2004 and ASHRAE 55, and the time of measurement based on SNI-16-7061-2004 for 6 working days. The data obtained will be processed through a software surfer. Software surfer in this study is used to map the temperature contours of each work station in the production room of PT. Pilar Kekar Plasindo, so the solution given is expected to be right on target.

Keywords: Contour Map, Surfer Software, Temperature
In this paper, we propose an integrated inventory model for vendor-buyer system with deteriorating items and carbon emission reduction policy. Discussed about government who trying to reduce carbon emission from carbon produced by companies with determine carbon emission cap, especially in terms of inventory. Carbon emission is result of burning fuel from engine. In this case, carbon emission produces by companies from result of warehouse emission for electricity and emission for transportation. Then, the purpose of this model is to minimize carbon emission generated from companies in terms of demand and distance of delivery to buyers. Also then, total cost with addition of carbon emission in warehouse is from the changes in demand and distance of delivery result in the same cost of $3487.02.

**Keywords:** Inventory, Carbon Emission, Deteriorating items, Imperfect quality, Sustainability
Implementation of the Halal Assurance System for Small and Medium Manufacturing Industries at UNSQUA

Chaidir Akbar\textsuperscript{1,a)}, Fakhrina Fahma\textsuperscript{1,b)}, and Roni Zakaria\textsuperscript{1,c)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.

Email: \textsuperscript{a)} cakbar17@gmail.com, \textsuperscript{b)} fakhrinafahma@ft.uns.ac.id, \textsuperscript{c)}2012.ibnu@gmail.com

UNSQUA is a bottled drinking water produced through the Universitas Sebelas Maret’s Drinking Water Supply Sistem (SPAM UNS). Since the launch of UNSQUA, in 2017, this product has only circulated within the internal UNS. However, until now UNSQUA has not received a positive response from various circles. In addition, UNSQUA also does not have a Halal Certificate. This research was conducted to implement the Halal Assurance System at UNSQUA. The application of the Halal Assurance System aims to obtain Halal Certificates in order to fulfill Law of Republic of Indonesia Number 33 of 2014, and gain consumer trust. The implementation of the Halal Assurance System is carried out by applying eleven criteria for the Halal Assurance System for Small and Medium Manufacturing Industry made by the LPPOM-MUI Central Java agency. This study provides recommendations to improve the documentation system in accordance with eleven criteria for the Halal Assurance System at UNSQUA.

**Keywords:** Quality Assurance, Bottled Drinking Water, Halal
Redesign Production Layout Using Dedicated Storage Method: Study Case PT. Solo Grafika Utama

Cornelius Dianto\textsuperscript{1,a)}, Fachry Widiandoko\textsuperscript{1,b)}, Diah Rahmanasari\textsuperscript{1,c)}, Wahyudi Sutopo\textsuperscript{1,d)}, and Yuniaristanto\textsuperscript{1,e)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.

Email: \texttt{a) cornelius.dianto@gmail.com, b) fachrywdndoko@gmail.com, c) diahrahmanasari@gmail.com, d) wahyudisutopo@staff.uns.ac.id, e) yuniaristanto@ft.uns.ac.id}

PT. Solo Grafika Utama is one of the companies in the field of newspaper production. The newspaper industry has strict production characteristics. Therefore, it requires a good factory layout in order to create effectiveness and production efficiency. The warehouse layout in PT Solo Grafika Utama still deficient in the application of material handling in warehouses so that it often raises problems. The problem is that the product arrangement in the warehouse is not optimal because there are still products stored in an wrong place. This article aims to provide an effective and efficient proposal to improve warehouse layout in PT Solo Grafika Utama using the dedicated storage method. Dedicated Storage is chosen to improve warehouse arrangement and minimize the distance of product displacement. After the proposed improvement, a better warehouse layout is obtained. In the proposed layout can also minimize the product displacement distance of 23\% from the initial distance. Thus it can be said that the proposed layout is better than the initial layout and can be proven to be able to facilitate the handling of materials in the warehouse so that it can make newspaper production more effective and efficient.

\textbf{Keywords}: Layout, Dedicated Storage, Material Handling, Newspaper Industry
Learning from Plastic Waste Village in Boyolali Indonesia: SMEs-based Plastic Recycling Industries

Farid Ishartomo¹,ᵃ) Sulistiono¹, Isna Nugraha¹, Aisyah Itsnaini Sholichah¹, and Bambang Suhardi¹
¹Graduate School of Industrial Engineering, Universitas Sebelas Maret, Surakarta 57126 Indonesia
Email: ᵃ) ishartomo@student.uns.ac.id

Plastic waste is an important issue in all countries. Reducing or even prohibiting the plastic usage in daily life has been carried out by several countries to help creating a better environment in the future, but recently it has not been able to significantly reduce the volume of plastic waste worldwide. Recycling is one of the solution to reduce the plastic waste. In Boyolali Indonesia, there is a place known as plastic waste village, where the local people utilize plastic waste to become a source of income for their families through the establishment of small and medium-sized enterprises (SMEs). This paper aims to study how local people run their business in recycling plastic waste. This research is expected to be able to provide an overview of community empowerment within the village scope through small and medium scale of plastic waste recycling industries.

Keywords: Plastic Waste, Recycling, Small and Medium Enterprise (SME), Environment
Determination of Route of BBM Distribution from Pertamina Oil Fuel Terminal (TBBM) Boyolali to Gas Station in Surakarta City with Clarke and Wright Savings Algorithm

Nurina Sharfina¹, Yosua Arinto Wicaksono¹, Iqbal Irsyad Muhammad¹, Yuniaristanto¹ and Wahyudi Sutopo¹

¹Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia.

Email: a) n.sharfina@hotmail.com, b) arintoyosua@gmail.com,
c) iqbalirsyadm@gmail.com, d) Yuniaristanto@ft.uns.ac.id,
e) Wahyudisutopo@staff.uns.ac.id

PT. Pertamina TBBM Boyolali distributes fuel to 8 gas stations in the city of Surakarta with tank truck transportation modes. Each tank truck performs more than one routes in a planning horizon. The research focused on 8 selected gas stations in Surakarta City with the highest demand. This research was conducted using the Clarke and Wright Saving Algorithm method to determine the optimal BBM distribution route. Based on the research results, savings can be seen from tank trucks that do not always commute from depot to gas station with an average tour time of 5.89 minutes because working hours for zone I (under 30km) on fuel distribution at PT. Pertamina TBBM Boyolali is from 9:00 - 14:00 and after that the truck must rest and other fleets must run to zone II (30km-60km) and zone III (above 60km). From the results of the study, it was found that the workload of each vehicle as a result of the calculation was actually evenly distributed because the time produced was not much different from the average completion time of the tour which was 5.89 minutes.

Keywords: BBM, TBBM, Distribution, Vehicle Route, Clarke and Wright Saving
Six Sigma Application to Minimize Castor 5 Inch Scrap Material in EOP Warehouse PT. Mega Andalan Kalasan

PT. Mega Andalan Kalasan is one of the manufacturing companies engaged in manufacturing hospital equipment that often has problems regarding the quality of materials stored in warehouses. The problem is often found in the 5 Inch castor material that becomes scrap and incurs costs so that waste occurs. Based on data from April 2018 to September 2018, the percentage of scrap material is increasing every month from 1.44% to 1.77%. Due to these problems, the purpose of this research is to minimize the 5 Inch castor material which is a scrap to avoid waste costs in the Export Oriented Product Warehouse Unit of PT. Mega Andalan Kalasan Yogyakarta. The methodology in this study uses the Six Sigma method, namely by implementing the Define, Measure, Analyze, Improve, and Control (DMAIC) stages. The results obtained are the most dominant cause of scrap castor 5 Inch material is storage of material on a rack that is not organized. Thus, it is necessary to make improvements to minimize the scrap castor 5 Inch material by conducting a routine briefing by the PIC Area Warehouse Unit Export Oriented Product before operational activities begin. So that it can reduce the cost of waste in the 5 Inch castor scrap material.

Keywords: Six Sigma, Scrap Material, Waste
Redesign Determination of Plate Raw Material Supplier with Analytic Hierarchy Process (AHP) Approach

Kartika Ari Hidayati\textsuperscript{1,a)}, Anita Arya Rosanti\textsuperscript{1,b)}, Nida An Khofiyah\textsuperscript{1,c)}, and Wahyudi Sutopo\textsuperscript{1,d)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia

Email: \textsuperscript{a)} hidayatikartika2@gmail.com, \textsuperscript{b)} anitaaryar@gmail.com, \textsuperscript{c)} khofiyah.nidaan@gmail.com, \textsuperscript{d)} wahyudisutopo@staff.uns.ac.id

PT. XYZ is a company in the newspaper industry. This study was conducted to discuss issues related to supplier selection. Data collection is done by means of interviews, questionnaires, and literature studies. Based on the results of data collection, among others, the purchase price, delivery time, maximum number of orders, the level of disability and the distance of the supplier with the company. Data processing uses one of the MCDM (Multi Decision Making Criteria) methods, namely AHP (Analytic Hierarchy Process), with the results of supplier 1 being designated as the best supplier.

Keywords: AHP, Criteria, Supplier
Selection of Supplier Using TOPSIS Method in PT. Trijaya Plastik Utama

Sulvi Fitriani\textsuperscript{1,a)}, Syifa Luthfiana Asnan\textsuperscript{1,b)}, Nida An Khofiyah\textsuperscript{1,c)}, and Wahyudi Sutopo\textsuperscript{1,d)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia

Email: \textsuperscript{a)} sulvifitriani@gmail.com, \textsuperscript{b)} syifafia06@gmail.com, \textsuperscript{c)} khofiyah.nidaan@gmail.com, \textsuperscript{d)} wahyudisutopo@staff.uns.ac.id

With the development of business competition that continues to increase, many strategies can be used to win the competition, one of which is purchasing and manufacturing. Where these two strategies become key roles in a company. Therefore choosing the right supplier is very necessary. In this study discussing the selection of the right supplier of raw materials (PVC) for PT Trijaya Plastik Utama. The study used the TOPSIS method (Techniques for Others Reference by Similarity to Ideal Solution). There are three alternative raw material suppliers and four criteria considered by the company. The calculation uses two types of normalization namely distributive normalization and ideal normalization. The results of the second calculation of normalization found that the first position was occupied by PT Royal Raplastek with a distributive index of 0.77 and an ideal index of 0.80.

\textbf{Keywords:} Procurement, Supplier, TOPSIS, Topics: Industrial
Fuel is very important in human life. Various uses of fuel are to support various sectors. The distribution of fuel certainly needs to be evaluated. Problems related to the distribution of fuel include making decisions regarding the routes distributed to gas stations. The choice of vehicle route will determine the total distance traveled by the fleet to create an optimal distribution system, route selection must be effective and efficient. This study will discuss the distribution of fuel from Boyolali Fuel Terminal to gas stations in several of the residences in Surakarta and western eastern Java. The method used is the Vehicle Routing Problem (VRP) using Python programming to get the minimum total distance from the fuel transport truck. The results of this study are the acquisition of a new pattern so that the distance of transportation decreases by about 60% than before.

**Keywords**: Fuel, Distribution, Vehicle Routing Problem
Design of Electric Guitar 8 Strings with Combination of Smartphone Devices as a Virtual Guitar Effect Using Reverse Engineering Method

Sulistiono¹,a), Bambang Suhardi¹, Susy Susmartini¹

¹Departement of Industrial Engineering, Universitas Sebelas Maret, Surakarta 57126, Indonesia

Email: a) tyonoslazh@gmail.com

Electric guitar is an instrumental instrument that is widely used in music, because with an electric guitar the music played will be more varied. That happens because of the supporting devices, namely the effect of the pedals that are used as setting the sound variations of the electric guitar being played. With the development of smartphone devices and applications on the Android and IOS platforms, the application developers made a new breakthrough by creating a virtual application of guitar effects that could be used like a pedal effect with sound results not much different from the original. then, electric guitars for now, still rely on the number of 6 strings, but some guitarists cannot reach out to the music genre that requires low and heavy tones, therefore, it is necessary to add 1 or 2 strings in order to get a low tuning sound character and increasing the number of frets on the fretboard to 30 frets, the more new tones that can be explored. From the above review, the design of electric guitar is done with a reverse engineering method approach, with the stages of product demolition to identify the anatomy and dimensions of electric guitars, the mechanism of combining electric guitar components with smartphone devices, benchmarking electric guitar products and components, defining design concepts and components and product design sketches based on several electric guitar product concepts. And finally is the manufacture of electric guitar 8 strings products with a combination of smartphone devices as a virtual effect. And it can be concluded that the electric guitar 8 strings has a low-tuning sound character with clear articulation and playability aspects that are suitable for guitarists, and easy to use in the operation of smartphones placed specifically on the guitar body, making guitarists easier to adjust sound effects on the device smartphone. Then, for the process of making electric guitars 8 string carried out by luthier wira musica, the overall workmanship is very good and neat for the scale of home industry, although there are only a few details that are not neat, but do not reduce the performance and visuals of electric guitar 8 strings which can later enhance the value of the local electric guitar creative industry.

Keywords: Reverse Engineering, Virtual Guitar Effect, Smartphone Device, Electric Guitar 8 Strings
IE-135

Measurement Model of Halal Practice Readiness among Food Manufacturing Small Medium Enterprises

Ida Giyanti1,a), Anita Indrasari2,b), Wahyudi Sutopo3,c), Eko Liquiddanu4,d)

1,2Industrial Engineering Study Program, Faculty of Engineering, Universitas Setia Budi, Surakarta, 57127, Central Java, Indonesia
3,4Industrial Engineering Department, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, 57126, Central Java, Indonesia

Email: a) idhag7181@gmail.com, b) anita.indrasari@gmail.com, c) wahyudisutopo@staff.uns.ac.id, d) ekoliquiddanu@staff.uns.ac.id

This paper aimed to develop a validated and reliable measurement model of halal practice readiness of food manufacturing Small Medium Enterprises (SMEs) in order to fulfill halal requirements as stated in HAS 23000. Based on readiness assessment, Importance Performance Analysis (IPA) was used to classify and prioritize the aspect of HAS 23000 needing urgent improvements. The measurement model was designed based on 11 criteria stated in HAS 23000 document. The measurement model was reviewed by professionals from LPPOM-MUI to ensure that the questions in the measurement model have represented the 11 criteria of HAS 23000. Based on their recommendations, adjustments were made to improve the clarity of the wording. In order to test model validity and reliability, Confirmatory Factor Analysis (CFA) was performed. To describe the applicability of the model, the measurement model was then applied to empirically assess the food manufacturing SMEs readiness through a case study. This measurement instrument can be used by food manufacturing SMEs as a self-assessment tool before and during halal practice implementation. Based on the self-assessment, the SME managers can evaluate their strength and weaknesses regarding HAS 23000 implementation in their organization.

Keywords: Halal Readiness, Food Manufacturing SMEs, Importance Performance, Analysis, Measurement Model
Organic Vegetables Planting Model to Reduce Pesticide Using

Puji Handayani Kasih\textsuperscript{1,a)} and Ahmad Rusdiansyah\textsuperscript{1,b)}
\textsuperscript{1}Institut Teknologi 10 Nopember, Surabaya, Indonesia
Email: \textsuperscript{a)} pujihandayanikasih@gmail.com, \textsuperscript{b)} arusdian@ie.its.ac.id

This paper deals with organic vegetable production planning which the farmer has to determine the harvest schedules and the quantity of each of vegetables to fulfill the demand as a contract farming so as to achieve a maximum profit. The farmer has to fulfill the demand otherwise the penalty will be charged. In the planting process do not use pesticides, it must consider the ecological constraints in which farmers must determine the crop sequence and in which plots each vegetable must be planted in firm lands in accordance with the rules of crop rotation. We propose the mixed-integer linear programming model to develop organic vegetable production. There are two decision variables in this study, the first is the time to start planting which is a binary number and the amount that must be harvested for each plant which is an integer. Based on the calculation can be known the start time for planting, the duration of planting, the location of planting and how much must be harvested to meet the demand for each vegetable.

\textbf{Keywords:} Planting Scheduling, Crop Rotation, Adjacency Constraint, Linear Programming
Application of Quality Function Deployment (QFD) Level 2 for the Development of Traditional Textile Motifs (Case Study: The Design of the Civil Servant in Sragen for the production in Sukoharjo)

Ariga Seta Asmara Sakti¹,a), Eko Liquiddanu²,b), I Wayan Suletra³,c)

¹Department of Industrial Engineering Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia
²,³Industrial System Design & Optimization Laboratory, Department of Industrial Engineering Sebelas Maret University Ir. Sutami 36 A Street, Surakarta, Indonesia

Email: a) asmarasakti27@gmail.com, b) liquiddanu@gmail.com, c) suletra@staff.uns.ac.id

The traditional motifs on the official uniforms of the Sragen District Civil Servants that have been used today are less attractive to users. The selection of uniform motifs of traditional motifs does not consider consumer preferences. This study aims to develop traditional textile motifs based on consumer preferences. Consumer preferences collected, changed to technical specifications. This technical specification data is focused on key elements, in the form of materials, production processes, and skills needed in each production process. The application of design engineering uses Quality Function Deployment (QFD) level 2 and uses the Operating Process Chart (OPC) in analyzing the production process. The results of the OPC were continued by parsing technical specifications to be applied to technical design engineering. The technical design engineering explained how to implement the technical specifications into goyor woven fabrics for official uniforms. This paper produces several key elements. Key material elements include Coloring, bleaching, and locking. Key processes elements include motive design, coloring, binding, and weaving. Key skills are drawers, color makers, motif binders, and weavers.

Keywords: Quality Function Deployment (QFD), Operating Process Chart (OPC), Technical Specification, Traditional Textile Motifs, Goyor Woven Fabrics
Early Warning of Food Security In East Java Indonesia Using A System Dynamics Model

Vina Vahlevi Al Jened$^{1}$, Iwan Vanany$^{2}$, Diesta Iva Maftuhah$^{3}$

$^{1,2,3}$Department of Industrial Engineering, Faculty of Industrial Technology Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

Email: $^{a)}$ vvahlevi@gmail.com, $^{2)}$ vanany@ie.its.ac.id, $^{3)}$ diesta@ie.its.ac.id

Rice is the main staple food in Indonesia that has the four largest population in the world. East Java is one of a rice major national producer not only supplying for its own needs but also for several other provinces. The purpose of this paper is to develop System Dynamic model for early warning of Indonesian food security. The objective of the model is to provide an early warning tool for policy-makers and better scenario policies to strengthen Indonesia's food security. Structural and behavioral pattern and statistical test were used to validate the proposed model. The results of simulation showed that the simulated outputs fit and relatively similar with the observed reality of the system. Three scenarios policies were simulated such as (scenario 1) expanding rice field area, (scenario 2) improving the intensification and there should be additional support to farmers through provision of agricultural inputs such as seeds, fertilizers and pesticides and be given sufficient training to best apply these input and (Scenario 3) increasing the amount of infrastructure in order to distribute more supply.

Keywords: Food Security, Early Warning Model, System Dynamics, Rice Stock and Demand
Evaluation of Book Editor’s Work Loads Using NASA-TLX (Case Study: PT. Tiga Serangkai Pustaka Mandiri Surakarta)

Anida Norma Cahyati\textsuperscript{1,a)}, Irwan Iftadi\textsuperscript{1,2}, and Wakhid Ahmad Jauhari\textsuperscript{1}
\textsuperscript{1}Department of Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia
\textsuperscript{2}Department of Electrical Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

Email: \textsuperscript{a)}anidanorma@student.uns.ac.id, \textsuperscript{2)}iftadi@gmail.com, \textsuperscript{3)}wakhidjauhari@gmail.com

Management of human resources is an important thing that must be considered by the company. We know that every company has its own target in the process of running its business. Likewise in the printing business, the target for each employee in a company is closely related to workload. Workload is the difference between the ability of workers and the demands of work. The workload is divided into two, namely physical workload and mental workload. In this case, a mental workload of the book script editor's will be measured at PT. Tiga Serangkai Pustaka Mandiri Surakarta using NASA-TLX method. This research is motivated by the most common problem in the Publishing department so far, that is, overtime of the book script editor. There are two divisions in the Publishing department, namely, School Book and General Book. According to the results of discussions and interviews with the two managers in the Publishing department, information was obtained that this overtime problem often occurs especially in 2018. In fact, every book script editor in each division has its own target. This study uses a questionnaire with 3 stages, they are, filling in the comparison card (weight assessment), then filling the rating sheet (scaling), then calculating the Weighted Workload (WWL). From the results of WWL calculations, the highest percentage of workload is in the dimension of Mental Demand (MD) with a value of 27%. Furthermore, Temporal Demand (TD) with a value of 23%, Own Performance (OP) of 15%, Effort (EF) of 14%, Frustration Level (FR) of 13%, and Physical Demand (PD) of 8%. Next, an analysis of the six dimensions is carried out regarding what is the main cause or root cause of the workload value in each dimension of the NASA-TLX. The results of this analysis can later be used to determine further actions such as readjusting the target of each editor which has an impact on minimizing the overtime and increasing work productivity of each editor.

Keywords: Mental Workload, Book Script Editor, Overtime, NASA-TLX method
Aggregate Planning Method as Production Quantity Planning and Control to Minimizing Cost

Isna Nugraha¹, Muh. Hisjam² and Wahyudi Sutopo³

¹Master Program of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia

²,³Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia

Email: ¹isna.nugraha13@gmail.com, ²hisjam@gmail.com, ³wahyudisutopo@gmail.com

Aggregate planning is a way to estimate the amount of output to be produced to meet demand during the planning period (3 to 18 months) going forward and adjusted to the company's production capacity. Aggregate planning enables companies to develop a way of optimally utilizing company resources in order to achieve effective and efficient capacity based on future demand forecasts. Effective which means the alignment between planning and the results obtained, while efficient means being able to produce a certain output with the available resources to a minimum. One of the food products from the business activities of PT. Bulog namely wheat flour with the trademark “Terigu Keluarga Indonesia" Terigu Kita produce and distribute by Perum BULOG along with companies that work with Perum Bulog. Based on the calculation or aggregate planning that has been done using demand and production data of the company PT. Bulog in the previous period found that the best method that can be used in the company's production process is the chase strategy method, this method is used by increasing or reducing the number of workers based on the number of consumer requests. By using a chase strategy, the costs incurred by the company are less when compared to other methods. Costs incurred based on the selection of the best method for wheat flour products amounting to IDR 258,628,000.00.

Keyword: Aggregate Plan
The Dynamic Simulation Model for Fulfilling Soybean Logistics to Support the Soybean Price Stabilization

Isna Nugraha¹,a), Wahyudi Sutopo²,b), Muh. Hisjam²,c) and Nancy Oktyajati³,d)
¹Master Program of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia
²Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 57126, Indonesia
³Department of Industrial Engineering, Universitas Islam Batik Surakarta, Jalan Agus Salim No. 10 Surakarta
Email: a) isna.nugraha13@gmail.com, b) wahyudisutopo@gmail.com, c) hisjam@gmail.com, d) oktyajati.nancy@gmail.com

Food price fluctuations always make it difficult for producers and consumers of food and for the economy as a whole, because the direction and development furthermore the final results are difficult to predict beforehand, so that economic growth is disrupted. Therefore, almost all countries in the world always try to overcome food price volatility through stabilizing food prices. The stability of soybean prices can always be maintained if there is a balance between soybean demand and supply. Badan Urusan Logistik (BULOG) Divisi Regional (DIVRE) of Central Java is one of the government agencies that is given the main task of maintaining national food availability in general and Central Java in particular. So BULOG here has a very important role in maintaining the stability of soybean prices by absorbing soybean products from farmers at prices that do not harm the farmers. We focus on examining the relationship between variables that exist in the fulfillment of soybean logistics in Central Java, namely regarding food needs (demand), total availability (supply) and soybean prices. The results of this study are to create a dynamic system model for fulfilling soybean logistics to maintain soybean price stability through several scenarios for supply and demand planning in supporting supply continuity and soybean price stability.

Keywords: Price Stabilization, Dynamic System, Simulation, Modeling, Soybeans, Supply, Demand
Assessment of Tourism Destination Sustainability Status using Rap-tourism case of natural based tourism

Ratna Purwaningsih¹, Herdiana Nur Annisa², Aries Susanty³
¹,²,³ Industrial Engineering Department, Faculty of Engineering, Diponegoro University, Jl. Prof. H. Soedarto, SH. Semarang 50275.
Email : -

This research aim to assess the sustainability status of Baturaden tourism destination based on the sustainability index values of four dimensions of sustainable development, each dimension consist of some indicators. The main reference are the regulation of tourism ministry of republic Indonesia and UNWTO regulation. A questionnaire was develop as a tool for data collection which each indicators assessed in 5 scale. Data collected by distributed the questionnaire to tourism site managers, local government, visitors and local community. Data processing uses the rap-tourism method with a multidimensional scaling (MDS) approach. The results of the MDS analysis shows that the value of the Baturraden tourism destination sustainability index is 81.92 categorize as very sustainable. The index consist of four dimensional value. The first is the environmental dimension value which reach 82.74 (very sustainable), the second is economic dimensions value which reach 88.19 (very sustainable), the third is the socio-cultural dimensions value which reach 76.43 (very sustainable), and the fourth is institutional dimensions which reach 78.85 (very sustainable). Sensitive attributes of each dimension are the attributes of eco-friendly transportation for environmental dimension, involving and supporting local business for economic dimensions, the visitor management system for socio-cultural dimensions and hazard prevention & inspection system for institutional dimensions. Some recommendation was formulated to increase the sustainability level based on sensitive variables.

Keywords: Sustainability Index; Tourism Destination; Rap-Tourism; MDS
Strategic Planning In Procurement Of Raw Materials Based On Kraljic’s Purchasing Portofolio Model (Case Study: CV. ABC)

Hery Suliantoro¹,a), Selvina Kharisma Putri²,b) and Darminto Pujotomo³,c)
¹Departemen Teknik Industri, Fakultas Teknik, Universitas Diponegoro, Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang, Indonesia 50275, Telp. (024) 7460052
Email: a)suliantoro_hery@yahoo.com, b)kharismaselvina@gmail.com, c)darminto_pujotomo@yahoo.com

Procurement strategy is purchased planning that is made to ease the achievement of the overall goals and objectives. CV. ABC is a company which focuses on producing apparel products. In procurement process, there is no special division that regulates the process. The procurement process is carried out by owners and employees who are considered capable of handling the process. The company also doesn’t have a guide in determining capable of handling the process. The company also doesn’t have a guide in determining the procurement strategy for each raw material and each different time of raw material planning, so the company uses the same procurement strategy for each raw material. This study aims to design a procurement strategy by classifying items for procurement of raw materials at CV. ABC by using kraljic’s purchasing portofolio model. Data processing in this study uses Analytical Hierarchy Process (AHP) and multidimensional scalling in Microsoft Excel to map raw material items. Mapping on kraljic’s purchasing portofolio model consists of four quadrants namely strategic, leverage, bottleneck, and noncritical. The mapping results indicate that the raw materials included in the strategic quadrant is bonding fabric, leverage quadrant are polar fabric, parasitic fabric, taslan fabric, and softshell fabric, bottleneck quadrant are label and zipper, noncritical quadrant are yarn, glue, mica, and sponge.

Keywords: Procurement Strategy, Kraljic’s Purchasing Portofolio Model, Analytical Hierarchy Process
The Economic Benefits Of The Implementation Of Batik Indonesian National Standard (SNI) By ISO Methodology - Economic Benefit Standard (EBS) Approach

Phalitatyasetri¹,a), Fakhrina Fahma¹,b), and Wahyudi Sutopo¹,c)

¹Industrial Engineering, Universitas Gadjah Mada Yogyakarta, Indonesia

Email: a) phalitatyasetri07@gmail.com, b) fakhrina09@gmail.com, c) wahyudisutopo@staff.uns.ac.id

The development of international trade in the current era of globalization has led to a free trade which can affect the export and import value of a country, as well as Indonesia. Small and Medium Enterprises (SMEs) are one of the economic pillars in our country because they can absorb enough workers, can increase people's income and contribute to GDP up to 60.34%. One of the ways to improve the performance of SMEs is through the application of standardization to increase the value of a product so that it can compete to face the free market. However, the benefits obtained by standard implementing SMEs are many that are intangible.

The purpose of this study was to determine the economic benefits of applying standardization obtained by SMEs using ISO Methodology – Economic Benefit Standard (EBS). This research was conducted on batik SMEs in Central Java, namely Mahkota Laweyan Batik, Semarang 16 Batik, Mutiara Hasta Batik, and Zie Batik. The stages in ISO methodology include: understand the value chain, analyze value drivers, identify impact of standards, and assess and consolidate results.

Keywords: Economic Benefits of Standards, Small Medium Enterprises, ISO Methodology
Analysis of Teaching Methods Using 3D Printing on Motivation and Student Learning Outcomes

Poppy Nandasari\textsuperscript{1,a) and Herianto\textsuperscript{2,b)\textsuperscript{1,2}}

\textsuperscript{1,2}Industrial Engineering, Universitas Gadjah Mada Yogyakarta, Indonesia
Email: a) poppynandasari@mail.ugm.ac.id, b) herianto@ugm.ac.id

Background: Rapid Prototyping and 3D Printing allows the creation of objects directly from 3D software-assisted design files. To design the effects of the learning model using 3D Printing based on the students’ experience and learning process design, students are creating new designs from the manufacture of pre-existing prototypes. The effectiveness of the learning model using 3D Printing as a teaching method can be measured from the achievement of student learning outcomes and motivation. Based on the things mentioned above, the effectiveness of the learning model using 3D Printing is used as a teaching method. Objective: To measure before and after learning outcomes and how students motivation who take practice using 3D Printing. Method: This research has a quasi-experimental design. There are two things that will be assessed: (1) 3D printing knowledge by pre-test and post-test questions, and (2) Motivation of student learning with a Motivated Strategy for Learning Questionnaire (MSLQ). The students were grouped into several groups randomly; The Wilcoxon Marked Rank Test Method and the Mann-Whitney Test will be used for statistical analysis. Results: The expected results of this study include (1) There are or no significant differences in student knowledge before and after following the learning process with the 3D Printing method (2) There are or no significant differences in student learning motivation before and after the learning process with use 3D Printing (3) The method of teaching using 3D Printing has an effect or does not significantly affect knowledge and learning motivation. Conclusion: Learning is more effective in increasing students' knowledge and motivation towards the topic of the basic principles of 3D printing.

\textbf{Keywords}: 3D Printing. Knowledge. Motivation to Learn. Learning Outcomes.
Halal Assurance System Implementation and Performance of Food Manufacturing SMEs: A Causal Approach

Anita Indrasari¹,a), Ida Giyanti²,b), Wahyudi Sutopo³,c), Eko Liquiddanu⁴,d)

¹,²Industrial Engineering Study Program, Faculty of Engineering, Universitas Setia Budi, Surakarta, 57127, Central Java, Indonesia
³,⁴Industrial Engineering Department, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, 57126, Central Java, Indonesia

Email: ³anita.indrasari@gmail.com, b)idhaq7181@gmail.com, c)wahyudisutopo@staff.uns.ac.id, d)ekoliquiddanu@staff.uns.ac.id

Halal guarantee has become an important parameter in the selection of consumer goods including food products. Halal is not just regulating the content in food products, but all the processes related to the food production process. This paper presents the dynamic link between halal assurance system (HAS) implementation and performance of food manufacturing SMEs. The relationship was modeled through Causal Loop Diagram (CLD) based on literature reviews. Firstly, this research was done by identifying success factors, barriers, and enablers associated with HAS implementation. Its effect on the performance of food manufacturing SMEs was also explored. Then CLD was developed in order to better understand the causal relationship. For further research, this causal model can be used as a framework to study empirically the dynamics of HAS implementation in food manufacturing SMEs.

Keywords: Halal Assurance, Performance, Food Manufacturing, SMEs, Causal Loop Diagram
IE-161

Green Industry Award in Increasing Manufacturing Industry Competitiveness in Indonesia

Suryo Hadiyono\textsuperscript{1,a) and Rahmat Nurcahyo\textsuperscript{1}}
\textsuperscript{1}Universitas Indonesia, West Java, Indonesia
Email: \textsuperscript{a)} iyoky81@gmail.com

Government efforts to campaign for the Green Industry through the Green Industry Awards are used by manufacturing companies to increase their competitiveness in Indonesia. This Green Industry Award is important to be socialized continuously because since 2010 until now it is still participatory. Manufacturing companies that get awarded this award feel the benefits of this, especially in the business process that becomes more efficient. This study aims to analyze the Green Industry Award in controlling the use of raw materials and energy, managing production and waste processes, and managing the company. Descriptive analysis method was used in this study. The results of this study indicate that Green Industry Awards can increase competitiveness through efficiency of resources in the company.

Keywords: Competitiveness, Green Industry Award, Environmental Performance
Performance Design of Cacao Agroindustry Supply Chain to Increase Farmers 'Welfare and Indonesian Cocoa Sustainability

Iphov Kumala Sriwana*
1Universitas Esa Unggul, Indonesia
Email: a) iphov.kumala@esaunggul.ac.id

Indonesia is the third largest cocoa producer worldwide, and 94.01% of the plantations was run by smallholdings farm, giving potential to cacao farmers in Indonesia in achieving high level of welfare. In fact, the aspired welfare has not been achieved as prosperity of cacao farmers is still below poverty line. This is favoured the fact that farmers converted their land to more profitable plants. This research was aimed to help enhance farmers welfare through performance improvement in cacao agroindustry supply-chain at Larompong Sub-district South Sulawesi. Methods employed included value chain analysis using SCOR performance measurement. Based on performance measurement, improvement in performance by 23.14% was gained when farmers sell the cocoa through chain 4. Strategy proposed to overcome this issue was implementation of GAP including activities of pruning, fertilization, as well as pest and plant disease control of cacao. Based on calculation using Hayami model, it was noticed that farmers potentially gained added-value by 29% when implementing GAP and selling cocoa to UPH farmer groups and Initial added-value earned by farmers from each production of 1,520 kg cacao was 473,55 IDR, and rise to 13,840,030 IDR The amount of profit earned by farmers would result in improvement in their welfare.

Keywords: Poverty of Farmers, Cacao, Supply Chain, SCOR
Spare parts are one of the important components of the production process at PT. Sari Warna Asli Textile. The production line at this company consists of dyeing, finishing, and printing. In fact, dyeing and finishing production lines often experience the absence of spare parts, while the mechanical department requires these parts. Therefore, this study discusses the improvement of inventory control of parts included in the important ABC category using a periodic review policy. The research begins with the classification of spare parts using the ABC-Fuzzy classification method followed by forecasting parts using Syntetos Boylan Approximation. Then, the research is continued with the determination of inventory levels, which are the maximum inventory amount (R) and time between orders (T). The minimum total inventory cost is obtained by investigating the impact of several service levels on total cost. The results show that the service level obtained by the proposed policy is higher than the service level determined by the company. It also show that the proposed policy performs better reducing total inventory cost compared to company policy.

Keywords: Inventory, Spare Part, ABC-Fuzzy Classification, Syntetos Boylan Approximation, Periodic Review Policy, Service Level
IE-164

Application of Anticipatory FMEA Model for Preventing Failures in Humanitarian Response Operation

Agung Sutrisno*

1 Department of Mechanical Engineering, Sam Ratulangi University, Indonesia
Email: a) agungsutrisno@unsrat.ac.id

Preventing increasing number of disaster victims is becoming priority in any humanitarian response operations. In an attempt to reap above goal, preventing errors in undertaking above operation is very important. In this paper, a new model in preventing errors in humanitarian response operation is presented by using Anticipatory FMEA. An example on using the model for illustrative purpose is presented and followed by new paths for further perusals.

Keywords: Anticipatory FMEA, Risk, Disaster, Decision Support System
Optimal Lot Sizing Decision in a Closed-Loop Supply Chain Considering Investment in Returned Items Collection and Product Design

Anindya Rachma Dwicahyani¹,a) and Wakhid Ahmad Jauhari²,b)  
¹Industrial Engineering, Adhi Tama, Institute of Technology Surabaya, Indonesia  
²Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta, 57126, Central Java, Indonesia  
Email: a) anindyard94@gmail.com, b) wachid_aj@yahoo.com

This study develops a model of pricing and lot sizing strategies of a Closed-Loop Supply Chain (CLSC) system consists of a collector, a depot, and a distributor. We develop the current literature by incorporating the investment in returned items collection along with the investment in product design. In addition, we also investigate how the optimal decision affects the environment through the Green-House-Gas (GHG) emission generated from both transportation and manufacturing processes. The objective of this study is to determine the optimal order lot size, retail price, finite number of remanufacturing generations, and the amount of investment in collection and product design that minimize the total inventory cost. An analytical approach is applied and a numerical example is provided. The result of this study gives managerial insights on making optimal decisions in the related CLSC system.

Keywords: Closed Loop Supply Chain, Inventory Model, Lot Sizing, Pricing, Investment, Carbon Emissions
Lithium-ion batteries are one of the best battery technology ratios and have relatively self-discharge when used. At present the development of Lithium-ion battery technology in Indonesia is quite rapid, one of them is like replacing a battery that is used for vehicles of cars or motorbikes. So with regard to this development, it can also be able to replace truck batteries or large vehicles today. In an effort to assess the decision to commercialize Lithium-ion batteries for large vehicles, technological developments can be reviewed from the technical aspects, market aspects, and business aspects. The purpose of this study is to analyze the feasibility of Lithium-ion batteries for large vehicles in business aspects, market aspects, and technical aspects and to have a sensitivity analysis to recommend this project. To analyze finances, this uses NPV, IRR, and PP.

**Keywords:** Lithium-Ion, Market, Financial
Future and Challenge of 3D Printed Bone External Fixator: Statics Stress Simulations of Polycarbonate Taylor Spatial Frame Ring

Ilham Priadythama\textsuperscript{1,a)}, Lobes Herdiman\textsuperscript{1,b)}, and Taufiq Rochman\textsuperscript{1,c)}

\textsuperscript{1}Laboratory of Product Planning and Design, Industrial Engineering, Sebelas Maret University

Email: \textsuperscript{a)} priadythama@gmail.com, \textsuperscript{b)} lobesh@gmail.com, \textsuperscript{c)} tofiqrochman@yahoo.com

The Bone external fixator was practically used since the late 19th centuries for fracture treatment. Over decades this device transform into various advanced ring fixations. However, their key design requirement is always the same, the distal-proximal stabilization of fracture site. To fulfill the requirement, lightweight metals such as aluminum are commonly used as their main structure. However, in recent years, high strength plastic or Carbon Fiber Reinforced Plastic (CFRP) start to be used since they can provide better strength to weight ratio over the metals. Problems that are still the same for this only one time use device, from the past until now, is affordability. Even it will be worse for the highly engineered plastics, especially if some complex geometry components included. 3D printing is a disruptive technology in producing a plastic product. Since the expiration of Fused Deposition Modeling (FDM) Technology patent in 2009, commercial 3D printer spread out around the world with various kind of plastic filament. Some of them considerable strong, durable, and comparable to lightweight metal. With the capability to produce high complexity product, 3D printing may challenge older fabrication techniques for creating more affordable bone external fixator.

However, there are some weaknesses of 3D printed plastics such as strength affected printing orientation. This research aims to show how a 3D printed polycarbonate external fixator component holds the load compares to 6061 T6 aluminum in a simulation environment. 155mm Full Ring Component of the Taylor Spatial Frame was used as the comparison case. Static stress simulations ran in Autodesk Fusion 360. Force magnification of 1.43 times was applied to represent 30\% strength decrement in Z-axis direction of printed component. As a conclusion, 3D printed polycarbonate may be an alternative due to the promising simulation results. Since there are several stronger material than polycarbonate available and there are also several process types provide better strength than FDM, this technology will have a bright future as bone external fixator fabrication process.

Keywords: 3D Printing, External Fixator, Static Stress Analysis, Taylor Spatial Frame, Polycarbonate Filament
Creating Motifs Using Silver Electrolyte Gel in Electroplating Technique

Kurnia\textsuperscript{1)}, Dr. Parya Puspaputra\textsuperscript{2)}, Dr. Taufiq Immawan\textsuperscript{3)}
\textsuperscript{1}Magister Teknik Industri, Fakultas Teknologi Industri, Universitas Islam Indonesia, Jl. Kaliurang KM 14,5 Sleman, Yogyakarta, 55584, Indonesia
Email: \textsuperscript{a})17916111@uii.ac.id, \textsuperscript{b})Parya@fti.uii.ac.id, \textsuperscript{c})Immawan16@gmail.com

Nowadays, the development of silver industry in Indonesia tends to decline from year to year. Based on data from the Central Bureau of Statistics in 2011, silver jewellery exports in Indonesia decreased by 11.67\% from 287 to 254 tons. This decline is partly due to growing market demand. For these problems, new innovations are needed in the development of metal jewellery products, one of the innovations is creative colouring in the electroplating process. Electroplating is the process of coating metals using direct current through electrolysis methods. In general, the resultant layer of electroplating will be evenly distributed throughout the surface of the workpiece. In this study it is expected that the new electroplating process can produce non-uniform layers or certain motives on the surface of the workpiece. This study will discuss the used parameters, stirrer systems, electrolyte thickening methods and the effect of electrolyte viscosity changes. Making motives with electroplating can be done by forming electrolyte liquid into a gel according to the desired shape mirror, then plated with a 2-volt voltage in 6 seconds without going through the dyeing process.

Keywords: Jewellery, Elektrolyte Gel, Creative Colouring, Electroplating
Optimization of Sawn Timber Production by Considering Main Order And Side Order Using Linear Programming Methods (Case Study: KBM IK Brumbung)

Octavia Riskadayanti¹,a), Muhammad Hisjam¹,b), and Yuniaristanto
¹Deparment of Industrial Engineering, Faculty of Engineering, Sebelas Maret University, Jl. Ir. Sutami No. 36 A Keningan, Surakarta, 5712, Indonesia
Email: a) octaviariskadayanti@gmail.com, b) hisjam@staff.uns.ac.id

The optimal number of sawn timber product combination is the key element in the sawmill process that will give an impact on the sawmill industry and the environment. The impact is the reduction of the use of raw materials that can affect inventory and procurement, and the reduction of production waste that can affect the company's income and the environmental problem. However, optimizing the number of sawn timber product combination requires good planning and many criteria must be adjusted to the sawmill process. Some of the criteria are profit, productivity, demand satisfaction, production costs, and others. This paper represents a model for maximizing profit by considering production costs, raw material costs, production machinery capacity, consumer demand as main order, as well as other sawn timber product combination as a side order to optimize the sawmill process. Problems are solved using linear programming methods. This research was conducted in KBM IK Brumbung, Indonesia. The output of this research is the optimal number of sawn timber product combinations according to the main order and the side order.

Keywords: Sawn Timber, Sawmill, Optimization, Linear Programming
Fault Tree Analysis (FTA) and Decision Making Trial and Evaluation Laboratory (DEMATEL) Models to Formulate Risk Mitigation Strategies in the Water Production Processes of Regional Water Companies (PDAM)

Widya Spalanzani, Udisubakti, Ciptomulyono, Mokhammad Suef, Asmuddin Mpd and Salwiah Mpd
1Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
2Universitas Haluoleo, Indonesia
Email: a) spalanzani.17024@mhs.its.ac.id, b) udisubakti@ie.its.ac.id, c) mokhsuef@gmail.com, d) asmuddinbani@gmail.com, e) salwiah@ymail.com

Drinking water for humanity is very important. Likewise in the remote city of researchers, namely the city of Baubau. The need for drinking water in this city is supplied by Regional-Owned Enterprises (BUMD), namely the Baubau Regional Water Company (PDAM). Raw materials for processed PDAM water are supplied directly from the Kalibalan river water to be processed in the Drinking Water Treatment Plant (IPA). However, in the operational management of natural science problems often occur that can potentially pose risks.

Operational risk is defined as risks related to the operations of a company organization that include the occurrence of risks related to organizational systems, work processes, technology, and human resources. The researcher here will process the operational risk with the help of the Fault Tree Analysis (FTA) method to find the root causes of the risk and use the Decision Making Trial and Evaluation Laboratory (DEMATEL) to find the relationship between risks and Focus Group Discussion (FGD) so that risk mitigation strategies can be proposed operations.

Based on the results of the research that has been done, there are 5 operational risks and the cause is the quality of the water source deteriorates (X1) caused by pump damage, mechanical component damage (X2) caused by turbidity meter damage, mixer damage, chemical meter damage, flow meter damage, problems electricity, no filter rate control, lower duct blocked, dosing controller not functioning, dosing pump damage, operational error (X3) caused by increased flow rates, increased turbidity, improper floc size, floc not efficiently removed, increased filtration rate, turbidity solving when filtered, filter inspection is inadequate, filters are re-used without backwashing, disinfectants are less optimum, do not report residues and locations, inadequate chlorine / chlorine residue monitoring, failure of quality control (X4) caused by non-existent supporting devices, and improper material (X5) is caused by chemicals running out, mud ball, filter not clean, loss of media.

Of the five operational risks, the 2 probability values of likelihood and consequences were obtained using FTA, respectively 0.034 (3.4%), 0.333 (33.3%), 0.446 (44.6%), 0.043 (4.3%), and 0.146 (14.6%). From these values, X3 and X2 are high risk which is obtained from likelihood which is quite frequent and consequential which can lead to large financial losses followed by X1, X4, and X5 which are Medium Risk obtained from likelihood which are rare but if consequences occur that can be caused is a large financial loss. The results of analysis of X3 and X2 which are included in high risk and X1, X4, X5 included in the risk medium of the FTA are then inputs that can affect the DEMATEL parameters which will be filled through the DEMATEL questionnaire to be processed and the relationship between operational risks is sought. The results are found that there is a relationship or relationship between X1 to X5 and then the respective operational risk mitigation strategies are proposed.

Keywords: operational risk, Fault Tree Analysis (FTA), Decision Making Trial and Evaluation Laboratory (DEMATEL), Drinking Water Treatment Plant (IPA), Regional Water Supply Company (PDAM)
The Selection of Lithium Battery Raw Materials by Environment, Economic, and Social Sustainability

Aisyah Itsnaini Sholichah¹, Muhammad Hisjam², and Wahyudi Sutopo³

¹Master Program of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 5712, Indonesia
²Departement of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 5712, Indonesia
E-mail: ¹aisyahnanik95@gmail.com, ²hisjam@staff.uns.ac.id, ³wahyudisutopo@staff.uns.ac.id

The methodology was developed to assess relevant issues from environmental, economic and social dimensions to modern sustainability concepts. This research is designed to evaluate and choose the best raw material for batteries. The predetermined approach is the assessment of the life cycle of the environment, the determination of life cycle costs, social life cycle assessment, material flow analysis, and the analysis of "critical" resources used and adjusted according to the conditions and limitations of certain applications. The assessment was applied to the use of lithium-ion batteries with nickel-manganese-cobalt (Li-NMC) cathodes, polymers (LiPo), and iron-phosphate cathodes (LiFeP) in electric vehicles, and compared with each other. This research is also to find out the life cycle of lithium batteries from being produced and after being used by customers.

Keywords: Sustainable, Lithium Batteries, Life Cycle
Evaluation Business of Battery Swap for Electric Vehicle

Aisyah Itsnaini Sholichah\textsuperscript{1,a)} and Wahyudi Sutopo\textsuperscript{1,b)}

\textsuperscript{1}Sebelas Maret University, Jl. Ir. Sutami No. 36 A Kentingan, Surakarta, 5712, Indonesia

Email: \textsuperscript{a)} aisyahnanik95@gmail.com, \textsuperscript{b)} wahyudisutopo@staff.uns.ac.id

Electric vehicles have developed rapidly in this global era. Many countries have replaced conventional vehicles into electric vehicles. Electric vehicles need a battery as an electric reservoir. The way to charge batteries for electric vehicles is only through a charge and it takes a long time, so the idea of a battery swap grows to simplify battery changes in electric vehicles. This research was conducted to find out business opportunities and competition for battery swaps on the global market.

Keywords: Business, Electric Vehicle, Batteries Swap
The number of motorcycles is very significant in Indonesia in the last 10 years, reaching 300%. Its will make carbon pollution in Indonesia increasing. Electric motorcycle is one that can be used to remove carbon pollution. The purpose of this study is to see the development of research on converting conventional motorcycles into electric motorcycle, both in the world and in Indonesia. The method used is quantitative descriptive statistics through Scopus web and Googles scholarships web. The results of this study are expected to be a reference for research in Indonesia that want to be immediately prepare for electric motorcycle conversion.

**Keywords:** Conversion, Electric Motorcycle, Literature Review
Supplier Management Using Vendor Managed Inventory in Perishable Product For Health Care Organization

Agus Mansur\textsuperscript{1,a)}, Ardi Permana\textsuperscript{1,b)}, and Imam Rosyadi\textsuperscript{1,c)}
\textsuperscript{1}Universitas Islam Indonesia, Yogyakarta, Indonesia
Email: \textsuperscript{a)} agusmansur.am@gmail.com, \textsuperscript{b)} ardindra.p@gmail.com, \textsuperscript{c)} imamarifinr@gmail.com

The main task of the hospital is to provide optimal services to the community in the health sector. One of the hospital performance indicators is the level of availability of medicine needed by patients. The challenge faced by hospital in determining drug needs is the magnitude of fluctuations in demand which result in inaccuracy of the amount ordered to the supplier. The impact of the inaccuracy of drug forecasting is the risk of shortages or outdated inventory because drugs are perishable products so this will affect the amount of inventory costs. This study aims to design the management of drug supply with the Vendor Management Inventory (VMI) approach. Vendor Managed Inventory method is collaboration between the Hospital and Vendors in inventory control. The result of this research that by using VMI method the inventory cost can be reduced significantly. The total inventory cost for three types of drugs (30 Mg Flexpen / 5 total, Novomix 30 Flexpen / 5 and Ringer Lactat) have saving 30%, 18%, and 21% , respectively.

Keywords: Vendor Managed Inventory, Perishable, Health Care, Topics: Industrial Engineering
Analysis of Risk Factor Non Productive Time on Geothermal Drilling in Indonesia

Mokh Kandari1*, Gatot Yilianto2, Singgih Saptadi3

1Sekolah Pascasarjana, Magister Energi, Universitas Diponegoro, Jalan Imam Bardjo Nomor 5, Semarang, Indonesia
2Jurusan Fisika, Universitas Diponegoro, Jalan Prof Soedarto, Semarang, Indonesia
3Jurusan Teknik Industri, Universitas Diponegoro, Jalan Prof Soedarto, Semarang, Indonesia

Email: a) kandari.djk@gmail.com

This study analyzes non-productive time (NPT) in geothermal drilling operations. In geothermal drilling operations, NPT can be caused by several factors, such as decision making factors, operational planning error factors, geological factors, and equipment failure factors. This study was conducted on a geothermal well drilling project conducted in 3 geothermal drilling wells MKD location in Indonesia. Every operation and activity that causes a downtime rig will be recorded and counted as NPT. The data then be identified as the cause of NPT in drilling operations whether caused by decision-making factors, operational planning factors, geological factors, or caused by failure factors of rig equipment. The research results in the field show that the factors that cause NPT can cause rig downtime and not cause rig downtime. Analysis in this study used excel and monte carlo. The results of the analysis get a comparison of the time between operation and NPT, probability of the factors causing NPT and the probability of the risk level of each factor causing unproductive time. The results of the analysis will be used as a reference in risk mitigation in geothermal well drilling.

Keywords: Non Productive Time, Geothermal Drilling, Downtime Rig, Operation Rig
IE-187

Inventory Management of Raw Material in SMEs Using Periodic Review System and Continuous Review System

Agus Mansur¹,a) and Muhamad Sabit¹,b)
¹Universitas Islam Indonesia, Yogyakarta, Indonesia
Email: a) agusmansur.am@gmail.com, b) 15522331@students.ui.ac.id

One of challenge have been met by SMEs was the difficulties to manage its inventory level of raw material. The company does not know the optimum level of inventory and has problem to decide the appropriate time to create order of its raw material. The purpose of this study is to assist company in managing inventory, so company can manage its suitable inventory and determine which items should be prioritized. Periodic review system and continuous review system methods will proposed to establish the level of inventory and optimum review period. The result of this research is new inventory policy that more efficient rather than the current policy.

Keywords: Inventory, SMEs, Periodic Review, Continuous Review
IE-189

Parallel Injection Molding Machine Scheduling by Considering Parameter Process Conservation

R.B. Seno Wulung¹,a) and Midarto Dwi Wibowo¹,b)
¹Politeknik ATK Yogyakarta, Ministry of Industry, Republic of Indonesia, Jl. Prof.Wirjono Prodjodikoro (Ring Road Selatan), Glugo, Panggungharjo, Sewon, Bantul, 55188
Email: wulung@kemenperin.go.id, bwulung@yahoo.com, midarto@kemenperin.go.id, midarto.dw@gmail.com

This paper proposes the efficient scheduling model in the plastic injection molding company with a parallel machine and multiple products. The variety of plastic part products are increased rapidly. The variety of the plastic part will lead the different parameter setting complexity that faced the company with multiple product and multiple machines. On the one hand, previous studies have focused on the methodology for optimizing the parameter process, while the others, and have focused on the scheduling problem. Unfortunately, there has been no effort to formulate the scheduling model for parallel injection molding machines by considering optimum parameter setting conservation to minimize setup and idle time. The setup and idle time during product changeover, are known as an important factor to arrange an optimum production schedule. Therefore, our proposed model considers the conservation of the setup parameter influences the efficiency of the machines setup. We examine the degree of parameter conservation based on product characteristic similarity. Moreover, for handling the multiple products to a parallel machine, we consider the production sequence and product changeover in machines assignment. The more similar product in the production sequence changeover, will have a higher degree of the conservation and reach the optimum setting parameter faster. In our model, we also consider the previous works are accumulated in the learning process.

Keywords: Injection Molding, Scheduling, Setup Time, Parameter Setting, Degree Of Conservation, Learning Process, Product Changeover
Optimum Pipe Network Of Tahu Tempe Wastewater Distribution Using Multiple Sources Single Sink Network Flow Model

I Wayan Suletra¹, Yusuf Priyandari², Eko Liquiddanu³
¹Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret
Email: a)suletra@staff.uns.ac.id, b) priyandari@ft.uns.ac.id, c) liquiddanu@gmail.com

The purpose of this research is to find the optimum path network to flow wastewater from multiple sources to a single facility of wastewater treatment in Mojosongo, Surakarta, Indonesia. The sources are 11 small enterprises of tahu tempe producing 1000 litres wastewater everyday on average from each location. The Local government of Surakarta wants to build a pipe network to flow the wastewater from those locations to a single facility with a minimum cost considering capacity requirement. There are several feasible paths from each node of 11 sources of wastewater to the treatment facility. We propose a multiple sources single sink network flow model to solve this problem. The construction cost to build each arch of pipe network between two nodes are the cost parameters. Capacity constraints are determined by the volume of wastewater produced by each source and the size of pipe. We introduce several dummy nodes to represent the intersection of pipe network where there is no wastewater source at the nodes. Feasible paths of pipe force to build those kind of intersection. The problem is formulated as a single objective linear integer programming model and branch-and-bound algorithms is used to solve the model.

Keywords: Integer Programming, Multiple Sources Single Sink, Network Flow, Wastewater.
A Manufacturing Workplace Design Selection Framework to Increase Productivity Using Virtual Reality

Benazir Imam Arif Muttaqin¹(a), Wahyu Andy Prastyabudi¹, and Rizqa Amelia Zunaidi¹

¹Institut Teknologi Telkom Surabaya, Surabaya, Indonesia
Email: a) benazir.imam.a.m@ittelkomsby.ac.id

Workplace is one of the important aspects related to the productivity of a worker or human. The arrangement and appearance of workplace layouts, especially in industrial applications, greatly affect the perspective and cognitive of workers, and even the production cycle time. Therefore, to reduce production operating costs and the workplace design repair costs, the design of the workplace needs to be planned and designed appropriately. To design a productive workplace, we can use the Virtual Reality (VR) technology. The main concept of VR technology is to imitate, visualize, and simulate the workplace design to the perspective of the user/operator who uses it. From the results of these simulations, then the relevant stakeholders can evaluate and assess the feasibility of each workplace layout design alternative. This paper presents a problem solving framework for the industry in choosing the best productive workplace layout by utilizing VR technology. A series of stages and procedures, as well as the application of the tools involved in the problem solving framework are presented in this paper. At the end of the paper, a discussion is presented regarding the insight, future challenges, and possible developments of this research.

**Keywords:** Productive Workplace, Virtual Reality, Workplace Design
Selecting the Synthetic Leather and Out sole Supplier for Shoe Production in Small Medium Enterprise

Suhartini Suhartini¹(a) and Hastawati Chrisna Suroso¹
¹ITATS – Surabaya, Surabaya, Indonesia
Email: a) suhartini.itats@gmail.com

CV. Dua Putra is a manufacturing company which has speciality in shoe production. The types of shoes vary, one of which is futsal shoes which consist of synthetic leather and outsole as main materials. In order to supply materials, the company has four suppliers of synthetic leather and four suppliers of outsole. The aims of this research are to find out the criteria and sub-criteria in selecting the supplier in accordance with the demand of the company. In this research, AHP and TOPSIS are chosen to reach the aims. AHP is used to obtain the weight value on criteria and sub-criteria, meanwhile TOPSIS is used to obtain the best alternatives which is close to the positive ideal solution. There are eight criteria and 27 sub-criteria in supplier selection. Eight criteria from AHP are price, quality, delivery, flexibility, guarantee and claim policy, repair service, geographical location, and technical ability. The result of this research is UD. Mega Jaya is chosen for synthetic leather supplier with the final score as much as 0,899 and UD. Bintang Terang is chosen as outsole supplier has the final score as much as 0,851.

Keywords: AHP, TOPSIS, Supplier, Synthetic Leather, Outsole, Small Medium Enterprise
Sustainable Resources Planning and Implementation in Teaching and Research Laboratory

Norizah Redzuan\textsuperscript{1,a)}, Khidzir Zakaria\textsuperscript{1}, Rozlina M. Sirat\textsuperscript{1}, Rozaimi M. Saad\textsuperscript{1,b)}, and Roslin Yasak\textsuperscript{1,c)}

\textsuperscript{1}Universiti Teknologi Malaysia, Malaysia

Email: \textsuperscript{a)} norizah@mail.fkm.utm.my, \textsuperscript{b)} rozaimi@utm.my, \textsuperscript{c)} roslinyasak@utm.my

Sustainability has become an important part of an approach either in the production of new products or anything in development process. Neither is the development or sustainability of many attempts to be applied by individuals or organizations towards sustainability. The educational organization face challenges in implementing sustainable approach of laboratories management because of many aspects need to consider. In this study, it is emphasized how sustainability approach can be applied to laboratories which involve in teaching and research.

Through basic research of sustainability development within the laboratory, it can be concluded that several approaches and important points need to be addressed such as human resources, facilities, policy, safety, budget, priority, product or sample testing methods, energy management, process planning and selection of materials used. As a beginning, after all these matters are considered, it is concluded that the sustainability approach needs to be formulated first. The essential policy should cover all these said aspects in order to implement sustainability approaches. This approach has been implemented in the Production Laboratory, School of Mechanical Engineering, UTM that can be used as a guideline to any laboratory which involve with teaching and research that can meet the current sustainability level in higher education.

Keywords: Sustainable, Teaching Laboratory, Safety, Policy
Defect Analysis In Shoes Production Process Using Statistical Process Control and Failure Mode Effect Analysis Method

Dimyati1), Afni Khadijah1), Ellia Kristinigrum2)*
1Industrial Engineering Study Program, Faculty of Engineering, University of Banten Jaya
2National Standardization Agency for Indonesia (BSN), Building I BPPT Jl. MH Thamrin 8 Kebon Sirih, Central Jakarta 10340
Email: a) afisqya@gmail.com

The purpose of this research is to find out the root causes and to reduce defect problems in the shoe during production process in the company in January-December 2017. and to provide alternative solutions to problems in the production process and system in the following in the future. This research was conducted at PT. Parkland World Indonesia, this study based on the results of the calculation, it will be concluded that the best solution is to find out the root cause. This can be seen from the results of the Defect calculation obtained from the Process Control Statistics method with the Failure Effect Mode Analysis approach. The results of the study showed that in the shoe production process there are 10 types of characteristics that cause the defect to be the key CTQ, there are bonding (21.6%), dirty (16.3%), broken stitches (15.7%), over cementing (10.4%), heel height (10.2%), under/over roughing (9.9%), long-shot of midsole (8.5%), backstay (4.2%), incorrect position/shake (2.2%), toe last not in position (1.1%). The company has a target in reducing the height of the defect. Using cause and affect diagrams, it can be found the factors that cause defects and proposed improvements to reduce process failure by using FMEA analysis, so that the improvement plan can be applied to learning references in the next shoe production process, and is expected to improve quality and achieve zero defects.

Keywords: Statistical Process Control, Seven Tool, Defect Process & Failure Mode Effect Analysis
Developing Green Manufacturing Indicators For The Decorative Paint Industry: A Case Study Of Indonesia

Gun Nanda Tian PurnamaDimyati¹, Sawarni Hasibuan², Zulfa Fitri Ikat ratinasari³

¹Master of Industrial Engineering Student Universitas Mercu Buana Jakarta, Indonesia
²Master of Industrial Engineering Program Universitas Mercu Buana Jakarta, Indonesia
³Master of Industrial Engineering Program Universitas Mercu Buana Jakarta, Indonesia

Email: sawarni02@gmail.com, sawarni@mercubuana.ac.id

The development of the paint industry in Indonesia is currently quite rapid which has a good impact on the Indonesian economy. On the other hand, the paint industry is also required to produce paint products that are increasingly environmentally friendly to reduce the adverse effects on the environment along the supply chain. Currently, Indonesia does not have guidance regarding green manufacturing in the paint industry. The purpose of this study is to develop green manufacturing indicators in the case of the Indonesian decorative paint industry. Determination of the basic indicators of green manufacturing adopted from OECD sustainable development toolkit 18 indicators. The selection of relevant indicators adopted at the decorative paint industry is done by using the method of Delphi. The experts who were involved in the selection process indicator green manufacturing decorative paint industry is a stakeholder who have competence and experience in the paint industry supply chain. The results showed that from the 18 initial indicators 12 indicators were agreed by experts with a minimum agreement value of 83%.

Keywords: Green Indicator, Paint Industry, Delphi Method
Technology Selection of Solid Waste Processing Using Analytical Network Process (ANP) and Fuzzy TOPSIS Case Study in Jepara Indonesia

Dyah Ika Rinawati¹,², Sriyanto¹, Muhammad Erwin Ferdianto¹
¹Industrial Engineering Department, Faculty of Engineering, Diponegoro University
Email: dyah.ika@gmail.com

Highly increasing in the amount of solid waste in landfills, caused decreasing of environmental quality. Several studies have designed various waste processing technologies to solve this problem, such as biodrying, fluffing, hydrothermal, pyrolysis and melting technology which have different characteristics. However, implementing all of technology in waste management is very difficult because of limitation in resources. So, operators must select which is the technology to be applied. In this research, solid waste processing technology being selected by using multi criteria decision making (MCDM) model. This study aims to select plastic waste processing technology based on criteria and subcriteria that have designed. The methods used with ANP and fuzzy TOPSIS. ANP was used to build the decision model and determine the weights of each criteria and subcriteia. Fuzzy TOPSIS was used to conduct an assessment of technology alternatif to be selected. This research conducted in Jepara, Indonesia. The results of this study showed that there were 4 criteria and 19 subcriteria that were considered in determining the plastic waste processing technology. The criteria that has the highest weight is environment and the subcriteria that has the highest weight is water and soil pollution and investment cost with a value of 0,11. The result of this research obtained the priority of plastic waste processing technology in Jepara sequentially i.e. Fluffing, Melting, Hidrotermal, Pyrolysis and Biodrying.

Keywords: Multi Criteria Decision Making, Solid Waste Processing Technology, ANP, Fuzzy TOPSIS
Development of Workers Transportation Scheduling and Routing Model Using Metaheuristic Approach

Ari Pranata Primisa Purba\textsuperscript{1,a)}, Nurhadi Siswanto S.T., MSIE.,Ph.D\textsuperscript{1,b)}, Dr.Eng.Ir. Ahmad Rusdiansyah, M.Eng.,CSCP, CLTD\textsuperscript{1,c)}

\textsuperscript{1}Industrial Engineering Department, Institut Teknologi Sepuluh Nopember, Surabaya, East Java, Indonesia

Email : \textsuperscript{a)} ariprimisapurba@gmail.com, \textsuperscript{b)} nsiswanto@gmail.com, \textsuperscript{c)} arusdianz.repository@gmail.com

A firm has intention in various ways to make workers feel safe and comfortable at work, such as a comfortable work environment, transportation, health and safety guarantees given by the firm and etc. The policy that taken by the firm is to provide buses as a facility for the workers that picked them up from several locations and drop them off at several destinations. This paper aims to implement an extension of VRP so called Vehicle Routing Problem Split Delivery with Time Windows (VRPSDTW) in a case study. Scheduling on the workers transportation bus is a NP-hard problem, which is difficult to solve using conventional methods and requires a long computation time to get an optimal solution because the case has many constraints that must be solved. The solution was generated using metaheuristic method with two scenarios. The number of start point for the buses and the location of the start point make some differences between two scenarios. Tabu Search of VRPSDTW problem is presented. The produced solution was better than the existing routing and scheduling that the company used. The solution was also capable of reducing fuel cost by 8% for scenario 1 and by 7% for scenario 2 that was obtained from shorter total distance travelled by the buses.

**Keywords**: Transportation Scheduling, Tabu Search, Optimization, Vehicle Routing Problem, Time Window
Quality Improvement of Woods Product using the Quality Function Deployment (QFD) Method at PT. X

Rosnani Ginting¹,a), Eka Periana Pane¹, and Alfin Fauzi Malik²,b)

¹Department of Industrial Engineering – Universitas Sumatera Utara, Indonesia
²Universitas Sumatera Utara, Indonesia

Email: a) Rosnani_usu@yahoo.co.id, b) alfinfm@gmail.com

PT. X is a company engaged in manufacturing Finger Joint Laminated Board (FJLB) wood. The product manufacturing process is controlled by the product quality control section. However, in the implementation, there are product defects during the production process. Based on 2018 data, the percent yield of 25% mercury pine and 20% rubberwood. From extracted material which can be processed, there are wood parts which are discarded at each stage of the process because they are not in accordance with the desired wood specifications and there are defects such as wood eyes, rot, there are skins, cracks, twists, incompatible sizes and pointed or diameter ends less. The number of defects during 2018 is 22.05%. Quality improvement is carried out by using the Quality Function Deployment (QFD) Phase II method. Determination of product critical parts by using Quality Function Deployment (QFD) Phase II was obtained from the results of calculations using the Phase Function Quality Function Deployment (QFD) method. The result of Quality Function Deployment (QFD) Phase II shows the highest critical part priority is the ability to laminate machines to have a value of difficulty level of 4 and the degree of importance is 17% and an estimated cost of 18%.

Keywords: Quality Improvements, Quality Function Deployment, Woods Product
An Agent Based Simulation Model For Retailers Price Promotion Strategies

N I Arvitrida¹,a) and A C Kurniawan¹,b)

¹Department of Industrial Engineering, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia
Email: arvitrida@gmail.com

Retailers have a vital role in the supply chain, namely as an intermediary that brings together supply and demand. So, the strategies taken by retailers will affect the supply chain as a whole. One of the strategic decisions that retailers need to take is to set price strategies. Retailers have a role related directly to consumers, then in setting price strategies retailers need to pay attention to consumer behavior. In addition, retailers also need to pay attention to competition in the market because the retail business environment is classified as an oligopoly environment or there are many competitors who sell the same products to consumers. Based on the two factors above, it is difficult to determine the best strategy for retailers when using traditional mathematical approaches because both factors made the problem more complex. This research offers a solution in the form of a simulation model that can help analyze pricing strategies through price promotion for retailers who consider consumer behavior, competition among retailers using an agent-based simulation approach. An agent-based simulation is an approach to designing the behavior of each individual then analyzing interactions between individuals based on predetermined rules (bottom-top approach). Thus, an agent-based simulation approach would be appropriate for solving complex problems that mathematical approaches cannot solve. The final result of this study is an agent-based simulation model and analysis of price promotion strategies that are in line with the dynamic retail business environment.

Keywords: Pricing Strategy, Promotion, Retailer, Agent-Based Model, Simulation
Macroergonomics Approach To Analyze The Quality Of Public Bike-Sharing Transportation Services (Case Study: MIGO E-bike Surabaya)

Adithya Sudiarno\textsuperscript{1,}(a) and Shofa Aulia Aldhama\textsuperscript{1,b)}

\textsuperscript{1}Industrial Engineering Department, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

Email: \textsuperscript{a)} adithya.sudiarno@gmail.com, \textsuperscript{b)} aldhama.sa@gmail.com

In the last few decades the increasing number of motorized vehicles has caused congestion problems and worsened air quality. Starting from the concern about the impact on the environment, the concept of transportation of Public Bike-Sharing was developed. The public bike-sharing transportation system was first introduced by MIGO E-Bike. The macroergonomics approach was adopted to evaluate the service quality of the MIGO E-bike. Referring to Socio-Technical System aspect in macroergonomics theory, Customer Relationship Management (CRM) strategic model was modified by adding Green Ergonomic Model (GEM) concept to evaluate functionality of a product service. The DEMATEL-ANP method is used to find out the relationship criteria in the system and suggest the improvement. Based on the results, Value is indicator with the greatest weight (0.4291), then E-bike (0.2558), Substation (0.1583), Rental System (0.0963), and Infrastructure (0.0605). Whereas the global weight, energy-saving and eco-friendly bicycle indicators have the highest value (0.3136) and comfortable bicycles when used are indicators with the second highest value (0.1648). The gap analysis shows that the comfort of e-bike (-0.3296) and energy-efficient e-bike (-0.6271) still do not meet user expectations.

Keywords: Macroergonomics, Socio-Technical System, Customer Relationship Management, Green Ergonomic Model, Public Bike-Sharing
IE-235

Natural Lighting In Workplace; The Availability And The Occupants Adaptive Behavior

Silfia Mona Aryani1,a) and Arif Kusumawanto1
1Universitas Sebelas Maret, Surakarta, Central Java, Indonesia
Email: a) Silfia.aryani@staff.uns.ac.id

Research on how to optimize the natural ventilation can recommend the solution to save the energy without ignore the occupants visual comfort. This article is purposed to discuss the natural lighting availability in the lecturer rooms of Magister Teknik Sistem, Universitas Gadjah Mada, Yogyakarta. The research is conducted with computer simulation using DIALux software and also field measurement in one day at three different times of measurement which are 8.00, 12.00 and 16.00. The research object is tested and measured in three window conditions; (1) without vertical blinds, (2) closed vertical blinds and (3) open vertical blinds. The research also observes the adaptive behavior of the occupants regarding to the natural lighting condition. The result of simulation and measurement show that the natural lighting of the research object has not meet the requirement as a workplace. Nevertheless, the occupants passively adjust the vertical blinds position for creating the visual comfort. They tend to do adaptive activities such as move from the sitting position when there is abundant light or turning on the artificial lighting when the room seems to be not bright enough.

Keywords: Behavior Observation, DIALux Simulation, Field Measurement, Vertical Blinds, Window
Integration of Quality Function Deployment (QFD) and Value Engineering in Improving the Quality of Product: A Literature Review

Aulia Ishak\textsuperscript{1,}\textsuperscript{a)}, Rosnani Ginting\textsuperscript{1,}\textsuperscript{b)}, and Alfin Fauzi Malik\textsuperscript{1}

\textsuperscript{1}Universitas Sumatera Utara, Indonesia

Email: \textsuperscript{a)} aulia.ishak@gmail.com, \textsuperscript{b)} rosnani_usu@yahoo.co.id

At present competition among manufacturing companies is increasing. Therefore manufacturing companies need to improve product quality and develop quality management processes to develop new product designs and product designs. The method is effective in improving the quality of the product are QFD and Value Engineering. The use of QFD will increase the likelihood of success, produce high-quality products, and cut costs. Value Engineering is a process in which a product analyzed in terms of its role and appearance. Costs related to these functions, and differences in value, in terms of the cost of the importance of the functions identified and improvement that targeted. This paper provides analysis of investigative reviews, and of combined methods from QFD and Value Engineering. Several international journal articles published in 2010-2019 have been. A thorough analysis has been performed and focused on this paper on practical use. It is expected that the paper could be utilized as a future reference for researchers and other manufacturers of QFD combined value engineering in product design.

Keywords: Quality Function Deployment (QFD), Value Engineering, Product Design, Quality
Product Development and Design with a Combination of Design for Manufacturing or Assembly and Quality Function Deployment: A Literature Review

Rosnani Ginting¹,a), Aulia Ishak²,b) and Alfin Fauzi Malik²

¹Department of Industrial Engineering, Universitas Sumatera Utara, Indonesia
²Universitas Sumatera Utara, Indonesia

Email: a) Rosnani_usu@yahoo.co.id, b) aulia.ishak@gmail.com

Changes in consumer lifestyles result in companies having to compete to be able to create new products that are more creative and varied to support their place in the market. The design that must be developed by the company is a design that is oriented towards the wants and needs of consumers. There are many methods of product development, one of which is to use a comprehensive method starting from developing ideas to finished products being marketed to the public. In addition, it can also be used Design for Manufacturing, Design for Assembly or Design for Manufacturing or Assembly to cut the number of components or parts that do not give more value to decrease production costs and production time. With the existence of QFD, it can also be found to improve the quality of service quality or product quality as well as the development and design of products according to the wants and needs of consumers. This paper tries to see the extent of the application of both by analyzing several relevant journals. This paper provides suggestions based on the results of the papers published in recent years. The authors hoping this paper can help many academics and practitioners see the benefits and constraints in applying the combination of the two methods.

Keywords: Product Design, Quality Function Deployment, Design for Manufacturing, Design for Assembly
IE-245

Assessment of Technology Readiness Level And Manufacturing Readiness Level in PT. ABC (Case Study: Technology On Hospital Bed Products)

Fadli Syamsuddin\(^1\), Yusuf Priyandari\(^2\), Susanto Sudiro\(^3\)
\(^1^{,}2\)Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret
\(^3\)Magister Mechanical Engineering, Faculty of Engineering, Universitas Pancasila Jakarta

Email: \(^a\)fadlisyamsuddinmote, \(^b\)priyandari@ft.uns.ac.id, \(^c\)susantosudiro@yahoo.co.id

Escalation on medical devices demand is one of the factors that has triggered the growth on medical equipment industry. This requires companies in this industry to give more innovations in health care products. PT. ABC is one of the company engaged in this field. Main product produced by the company is hospital beds. Currently the company is developing several new hospital bed products. At the product design stage the company also needs to prepare facilities and manufacturing capacity. This paper takes a case study on hospital bed products named as HB B. To determine the maturity of manufacturing, an assessment is needed. Manufacturing readiness level (MRL) is one method that can be used to assess the maturity of manufacturing. This MRL assessment only for quality management threads. MRL assessment requires input from technology readiness level (TRL) assessment. The assessment of manufacturing maturity is divided into three stages, first is TRL and MRL self-assessment stage, TRL assessment stage and the MRL assessment stage. Assessment result shows that the technology on HB B products has reached level 5 TRL, while level of manufacturing readiness in the quality management thread reached level 5. This paper reveals the gap between required facilities and plant capacity before starting production and actual preparation for manufacturing the product.

Keywords: Hospital Bed, Manufacturing Readiness Level (MRL), Technology Readiness Level (TRL).
Analysis Strategies with External Factors of Developing Testing Laboratories becomes a Conformity Assessment in UNS

Anita Arya Rosanti\textsuperscript{1,a)}, Roni Zakaria\textsuperscript{1,b)}, and Fakhrina Fahma\textsuperscript{1,c)}

\textsuperscript{1}Universitas Sebelas Maret, Surakarta, Central Java, Indonesia

Email: \textsuperscript{a)} anitaaryar@gmail.com, \textsuperscript{b)} 2012.ibnu@gmail.com, \textsuperscript{c)} fakhrina09@gmail.com

Product certification is a way to ensure the product fulfills existing standards. A product needs to be tested to ensure its quality before obtaining certification. Testing is carried out by a testing laboratory. The university is one of the agencies that provide testing laboratories. Therefore the laboratory functions need to be developed not only for teaching or learning laboratories, but also as testing laboratories. This research method is the Porter five forces analysis to design strategies for strengthening and developing laboratories in the UNS by considering opportunities and threats from the external environment. The results of this research are information in the form of testing standards and management strategies to be used as a reference in designing the Conformity Assessment in Universitas Sebelas Maret.

Keywords: Standardization, Strategy, Testing Laboratories
IE-254

Development of Independent Energy Villages Based on Micro-Hydro Power Plant in Indonesia

Lilies Setiartiti¹,a) and Muhammad Hisjam²,b)

¹Department of Economics, Faculty of Economics and Business, Universitas Muhammadiyah Yogyakarta, Indonesia.
²Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia.
Email: a) Setiartiti.lilies1267@gmail.com, b) hisjam@staff.uns.ac.id

The development of independent energy villages as an effort towards self-sufficiency in energy means to fulfill the energy needs of the village, without the need of energy sources from the outside village. The main objective for developing an Energy Independent Village is to reduce poverty and to substitute oil fuel. The concept of an independent energy village is felt to be in accordance with the condition of Indonesia which has high biodiversity and diverse geographical conditions. This study aims to analyze carrying capacity and feasibility in planning the development of an independent energy village based on the case of micro-hydro renewable energy in Purwoharjo Village, Kalibawang, Yogyakarta, Indonesia. We also analyzed the potential of renewable energy and the pattern of electricity consumption. The results show that in the village the average power produced by MHP was 149 kW. MHP can operate throughout the year or for 8760 hours per year by producing 1,306.64 MWh of electricity. When compared with the electricity needs in one year amounting to 1108.51 MWh, this micro-hydro power plant can fulfill all electrical energy needs in the village. Overall, this research provides some important insights for Yogyakarta to highlight possible steps for policymakers as a reference in formulating energy fulfillment policies through the development of energy independent village programs.

Keywords: Independent Energy Village, Micro-hydro Powerplant, Indonesia
Strategy for Development of Internal Laboratory Readiness to be A Conformity Assessment Institution (Case Study: Universitas Sebelas Maret)

Kristy Permatasari\textsuperscript{1,\textit{a)}, Fakhrina Fahma\textsuperscript{1,\textit{b)}, and Roni Zakaria\textsuperscript{1,c)}

\textsuperscript{1}Sebelas Maret University, Surakarta, Indonesia

Email: \textit{a)} kristyprmt@gmail.com, \textit{b)} fakhrina09@gmail.com, \textit{c)} 2012.ibnu@gmail.com

Sebelas Maret University (UNS) Surakarta is a university that has implemented a pattern of financial management of public service bodies, and will go to a Legal Entity State University (PTNBH) based on revenue generating. One of the business activities that support UNS to become PTN-BH is to establish a Conformity Assessment Institution (LPK) consisting of a Testing Laboratory and a Product Certification Institute (LSPro). Quality of laboratories needs to be improved by fulfilling standard requirements which has been stated in Indonesian National Standard (SNI) for testing laboratories, namely SNI ISO/IEC 17025 and Product Certification Institute namely SNI ISO/IEC 17065, so Conformity Assessment Institution can be used as a source of formal expenditure by the UNS. Questionnaires were used to assess laboratory readiness with Technometric methods and Management Strategy methods based on SNI ISO / IEC 17025 and SNI ISO / IEC 17065. Then this research will produce a laboratory readiness development strategy from internal factors to meet the standards of being a Testing Laboratory and Product Certification Agency. Then the university can choose the laboratory that is considered the most ready from all laboratories at UNS to become the Institute for Conformity Assessment.

Keywords: Conformity Assessment Institution, Testing Laboratory, Product Certification Institute, Management Strategies, Technometric
Predictive Maintenance Model for Pumps Under Improper Maintenance Conditions

Nazmee Hashim\textsuperscript{1}, Adnan Hassan\textsuperscript{1,a)}, and Mohd Foad Abdul Hamid\textsuperscript{1}

\textsuperscript{1}Universiti Teknologi Malaysia, Malaysia
Email: \textsuperscript{a)} adnan@mail.fkm.utm.my

The development of predictive maintenance models for maintenance cost optimisation have attracted many researchers lately. In industrial practices, system reliability can be improved by understanding the underlying root cause of system failures. Failures and maintenance activities data are normally recorded. However, proper failure cause analysis is still lagging in many industries besides automotive and petrochemical. As such, the benefits of predictive maintenance models could not be realised from many industrial equipment and facilities. This has contributed to high operational and maintenance cost and not sustainable in the long term. In this study, a methodology to develop predictive maintenance model for industrial pumps based on failure cause analysis is presented. Failure modes effects and criticality analysis (FMECA) and reliability block diagram (RBD) are used in developing the pump reliability model. The methodology developed is verified with actual failure historical data of a selected pump in an oleo chemical industry located in Johor, Malaysia. The potential benefit of the pump reliability model is illustrated in predicting suitable preventive maintenance actions at certain time interval to achieve desired pump reliability levels with optimum maintenance cost. The findings from this study should be beneficial to maintenance partitioners and researchers toward achieving sustainable operations.

\textbf{Keywords:} Predictive Maintenance, Reliability, Failure Distribution, Sustainable Operation
The Dynamic of the Incineration Waste-to-Energy Power Plant Policy in Indonesia

Agusniar Rizka Luthfia¹,ᵃ), Albertus Sentot Sudarwanto¹, and Eka Nada Shofa Alkhajar¹
¹Sebelas Maret University, Surakarta, Indonesia
Email: ᵐᵃ) agusniarrizka@gmail.com

Waste in Indonesia has emerged as a critical and serious problem faced by Indonesian government. One of the proposed solutions taken by the government is the development of Incineration Waste-to-Energy Power Plant projects. These projects have been regarded as national strategic projects. This article aims to reveal its policy dynamic at the state level and societal level and its impact for future development. The study employed qualitative research method in which data gained from documentation study. Meanwhile, qualitative content analysis used to analyze the data. The result of the study show that despite the policy gained various responses in positive and negative tones. However, the government used to use their authority to make sure that Indonesia can reduce waste significantly and gained value added from waste.

Keywords: Waste, Incineration Waste-to-Energy Power Plant, Policy
Current Research on City Logistics and Possible Adoption in Developing Countries

Kuncoro Harto Widodo\textsuperscript{1,2,a)}, Yandra Rahadian Perdana\textsuperscript{3,b)}, Russell G. Thompson\textsuperscript{4,c)}, Hengki Purwoto\textsuperscript{1,5,d)}, Dwi Ardianta Kurniawan\textsuperscript{1,e)}, Joewono Soemardjito\textsuperscript{1,f)}

\textsuperscript{1}Center for Transportation and Logistics Studies, Gadjah Mada University, Yogyakarta, Indonesia.
\textsuperscript{2}Department of Agroindustrial Technology, Gadjah Mada University, Yogyakarta, Indonesia.
\textsuperscript{3}Department of Industrial Engineering, Islamic State University of Sunan Kalijaga, Yogyakarta, Indonesia.
\textsuperscript{4}The University of Melbourne, Australia.
\textsuperscript{5}Department of Economics and Business, Gadjah Mada University, Yogyakarta, Indonesia.

Email: \textsuperscript{a)}kuncorohw@ugm.ac.id, \textsuperscript{b)}yandra.perdana@uin-suka.ac.id, \textsuperscript{c)}rgthom@unimelb.edu.au, \textsuperscript{d)}hengkipurwoto@ugm.ac.id, \textsuperscript{e)}dwiardianta@ugm.ac.id, \textsuperscript{f)}joewono_itok@ugm.ac.id

The concept of city logistics has been used to describe the process of transportation and logistics optimization as performed by companies in the scope of urban areas by considering the environment, traffic and energy consumption aspects. This research identifies the gaps in city logistics research from actors, issues, method aspects and possible adoption in developing countries. According to the literature review, it was found that research in city logistics has been developed and extended to include various issues such as infrastructure, social, performance assessment and food safety. Meanwhile, city logistics involves different actors and stakeholders with different roles. Researches in city logistics field could utilize several methods as follows, Agent-Based Models (ABM), adaptive large neighborhood search (ALNS), 2-tuple hybrid ordered weighted averaging (THOWA), Gray Relational Analysis technique (GRA), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Genetic Algorithms (GA), Supply Chain operations reference model (SCOR), service oriented architecture (SOA), and Content Analysis (Qualitative).

Keywords: City Logistics, Developing Countries, Optimization
Modeling A Closed Loop Supply Chain Network With Product Return Incentives Under Carbon Emission Regulations

Fareeduddin Mohammed1,a), Adnan Hassan1,b), and Shokri Z. Selim2
1Department of Materials, Manufacturing & Industrial Engineering, School of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.
2Systems Engineering Department, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.
Email: a) fareeduddinm@gmail.com, b) adnan@mail.fkm.utm.my

Climate change and rapid increases of greenhouse gases emissions have urged countries to implement various carbon emission regulatory mechanisms to protect the environment. One of the effective approaches to reduce environmental footprint is the adoption of closed loop supply chain (CLSC) in manufacturing industries. Performance of recovery activities in a CLSC mainly depends upon the effective and efficient collection process of used products. The used products recovery promotes environmental sustainability and maximizing the value creation of entire lifecycle of a product with best possible recovery practices. Therefore, there is a need to investigate an optimal network design to increase the quantity and quality of products returns through financial incentives. The optimal supply chain network design (SCND) is crucial for manufacturers to remain competitive. Thus, this research proposes an optimization model for a multi-period, multi-product CLSC network design with multiple recovery options and financial incentives for product returns. The impact of carbon regulatory policies namely, carbon tax and carbon trade policies were investigated. The proposed model incorporates environmental protection technologies, transportation mode selection, and capacity limits on production, distribution and storage. Numerical results show that the proposed model captures trade-offs among the supply chain design parameters and carbon emissions policies. The results suggest that carbon tax rate is linearly impact on the total cost and carbon emission. Carbon trade policy is more flexible and efficient compared to the carbon tax policy. Moreover, this policy motivates firms to emit less carbon units even when the carbon allowance is in excess. This study provide evidence that besides achieving optimal SCND, it also reduces carbon emissions significantly without increasing the total cost. This study provides guidelines for decision makers to decide which carbon policy to be chosen well in advance to minimize the total cost and carbon emissions.

Keywords: Closed-Loop Supply Chain, Multi Recovery, Return Incentive, Carbon Tax, Carbon Trade, Mathematical Modeling.
Implementation of Indonesian National Standards for Small and Medium Enterprises in Pandono Abstract Batik

Kurnia Tri Atmojo^1,a), Fakhrina Fahma^2,b) and Wahyudi Sutopo^3,c)

^1Industrial Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia

Email: ^a)kurniatria@gmail.com, ^b)fakhrina09@gmail.com, ^c)wahyudisutopo@gmail.com

One of the commodities that is the focus of the government in carrying out the empowerment of SMEs in Indonesia is Batik SMEs. In order to compete in the global market, Batik must improve quality standards. In Indonesia batik standards are regulated in SNI 8302:2016, namely SNI "Batik Tulis - Fabrics - Characteristics, quality requirements and test methods", but the level of awareness of batik producers to implement this is still very low. Some of the factors that led to the low awareness of implementation of batik were that the utilization of product certification institutions (LSPro) had not been optimized for the sake of SNI implementation which focused more on research, producers felt that the economic benefits of implementing this could not be felt, until opinion developed that SNI implementation was complicated and expensive, because of the lack of direct socialization to the Batik SMEs. This research was conducted to design workflows for the implementation of SNI for Batik Products which aimed to help the Batik community to better understand the flow of activities and documents in a business process. The making of this workflow refers to the SNI “Batik Tulis” Criteria and administrative requirements according to the scheme that have been established by the National Standardization Agency (BSN). Then, the workflow created is expected to facilitate batik SMEs to apply SNI Batik and obtain SNI Certificates on their products.

Keywords: Standard, Standardization, Batik, Implementation, SNI, SMEs, Small and Medium Enterprises
In order to achieve the goal to self-sufficiency, Indonesian government develops the agricultural mechanization for rice production. Thus, the rice farmers can increase rice productivity and efficiency; reduce post-harvest losses; and strengthen among small, medium, and large scale farming. This study aims to examine the impact of agricultural mechanization on rice production in main rice producer areas in Indonesia by using PATANAS data collected by the Indonesian Ministry of Agriculture. The PATANAS data used in this paper is 2007-2012 unbalanced panel data. Therefore, in this study, we use pooled data of rice production in the five provinces that are the main rice production areas in Indonesia. The result shows that agricultural mechanization is positively significant to the rice production at $\alpha = 1\%$. All regions use tractors to cultivate the land. Some areas, such as West Java, East Java, and South Sulawesi also use draft animal to cultivate the land. In North Sumatra, 90.7% of the farmers have been using the tractor. While in West Java, which is only 85.4% using the tractor and 5.2% still use draft animal to plow paddy fields. However, in Central Java, no respondents who use draft animal 92% claimed to use the tractor. East Java and South Sulawesi have similar results. In these areas, most farmers use tractors and several farmers use draft animal. Farmers in West Java, East Java, and South Sulawesi still use draft animal because some areas in the surveyed areas are mountain slopes that are relatively difficult to reach by tractor.

**Keywords:** Mechanization, Rice Farming, PATANAS, Tractor
A Proposed Policy Of Medical Inventory System In Pharmacy Installation (Case Study in Semen Padang Hospital)

Asmuliardi Muluk\textsuperscript{1,a)}, Jonrinaldi\textsuperscript{2,b)} and Fadhita Maisa Asri\textsuperscript{3,c)}

\textsuperscript{1,2,3}Department of Industrial Engineering, Universitas Andalas, Limau Manis, Pauh, Padang 25163, Sumatera Barat, Indonesia.

Email: \textsuperscript{a)}asmuliardi@gmail.com, \textsuperscript{b)}jonrinaldi772000@gmail.com, \textsuperscript{c)}fadhita.maisa@gmail.com

Hospital must be aware with the management in pharmacy especially on pharmacy inventory management in pharmacy installation. Semen Padang Hospital is a facilities that provides health service that has one pharmacy as the central place that is responsible for the procurement, storage and distribution of medication throughout the hospital. But in current conditions, Semen Padang Hospital could not fulfill the demand of the medicine for its patients because there are out of stocks for several medicines at the inventory and its affect to the period of getting those required medicines for the patients where most of them have a pending issue. The number of pending receipt of medicines significantly increase month-by-month and its increasing ten times greater from July until December. This condition happened because there is no policy to manage the procurement of medication in Semen Padang Hospital. To anticipate the stockout condition of medicines, the managerial implement some solutions. However, this solution gives a negative impact for its financial aspect and their quality of service. Based on the problem, a new inventory policy is needed to reduce the number of stockout medicines and to minimize the total cost of inventory that incurred by the hospital. First the medicines will be classified into three classes by using ABC analysis based on its value of investment. The proposed medical inventory policy for class A and vital medicines are solved using probabilistic inventory model (EOQ + Safety stock) and for class B and C (Non \( \Box \) vital) solved using Joint Replenishment. This models are used because of the assumptions are suitable with the actual condition in Semen Padang Hospital. By using proposed inventory policy, Semen Padang Hospital has saving money potential as much 63.27\% of the cost spend based on the current policy that applied right now in the last three months in 2018 (October - Decembe 2018).

\textbf{Keywords}: EOQ, Medical Inventory System, ABC Analysis, Joint Replenishment
Reducing Defect In Furniture Product Using A Lean Six Sigma Approach

Ermayana Megawati*

1Industrial Engineering Department, Diponegoro University, Semarang, Central Java, Indonesia
Email: ermay1802@gmail.com

Today, competition between furniture manufacture become very tight. Companies should improve their performance to win the competition. One of company performances that should concern is reducing waste. There are eight waste commonly recognized in furniture industry such as transportation, inventory, motion, waiting, overproduction, over processing, non-utilized talent and defects. The aim of this study is to improve the quality performance using lean and Six Sigma method. A six sigma DMAIC approach was used to quantify opportunities, show evidence for improvement, and potential benefits to be gained. The research phase could explain as Define-Measure-Analyze-Improve-Control (DMAIC). On define phase, pareto chart has used to identify the biggest defective symptoms. Measuring phase is used to assess the current sigma level. Then, the identification of potential causes has using tool such as brainstorming, cause and effect diagram and root causes in phase of analyze. On improving phase, we have proposed action plan which have taken such as summary change of edge banding machine parameter, improving maintenance and know how training for all persons in charge. To make stabilize the action, we also proposed control using standard operating procedure and daily process control.

The result of this research was found that the edge veneer peeled off rises as the biggest defect within 4.35 of sigma level on April 2019 then after 2 month applying DMAIC, this defect could reduce and Sigma level was increased to 5.22 on June 2019, this evidence show that Lean six sigma method have work.

**Keywords**: Lean Six Sigma, DMAIC, Furniture Industry
Distraction experienced by the driver while driving is something that can reduce the level of performance, concentration, and attention of the driver. About 30% of traffic accidents occurred due to drivers who were lack in concentration because of distraction. One factor that can distract driver performance and somehow also help to maintain the sleepiness on wheel is passenger presence. However, little was known about gender and age effect on this driver distraction. Six teenage and six adult on both gender were involved in this study as participants. Each of them participated in three laboratory experiments on a driving simulator with counterbalance arrangement, i.e. driving alone, driving with similar gender passenger, driving with different gender passenger. Driving performances were measured objectively by alertness level via electroencephalograph and Observer Drowsiness Rating. Whilst subjective measurement was conducted by Karolinska Sleepiness Scale and Prosocial and Aggressive Driving questionnaires. Results show that there were age effect on driver performance, where teenage driver exposed lower objective and subjective sleepiness level than older driver. However, the alertness between female and male drivers, with out without passenger beside them, were not significantly differ. Implication of this study to increase the safety in driving were discussed.

**Keywords:** Driving, Distraction, Passenger, Gender, Age
Municipal Solid Waste Logistics Management: a Study on Reverse Logistics

Annie Purwani¹,a), Muhammad Hisjam² and Wahyudi Sutopo Sutopo²
¹Department of Industrial Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Indonesia
²Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia

Email: a) annie.purwani@ie.uad.ac.id

Municipal solid waste problem is a complicated problem, due to its impacts in economic, social and environmental aspects. Municipal solid waste problem is a multi-discipline problem which involves many stakeholders that needs to be considered simultaneously. Many analytical approaches have been done since the collecting method, separating method, transportation, disposal and/or 3 R (reduce, reuse, recycle) and other related operations. This paper compares the implementation of the municipal waste that has been made in some countries with different characteristics and focuses on using the reverse logistics approach to solve municipal solid waste problems. The analysis gives alternatives to solve the problems that can help the stakeholders in improving the performance of managing the municipal solid waste.

Keywords: Municipal Solid Waste, Reverse Logistics, Sustainability
Prayer is an important thing for Muslim obedience, there are five times a day. Muslims need to do the prayer movement perfectly because of the relation to health condition. While it is difficult for elderly to make the prayer movements perfectly like sitting to standing. So this study is to investigate the effect of adding handrails and springs seat on elderly prayers chairs for the movement of sitting to standing. The method for this study is quantitative with 17 respondens. Experiment using 4 types of wooden chairs for prayer: AA chair (a chair without any addition); AAB chair (a chair with additional handrails); AAC chair (a chair with additional springs seat); AABC chair (chair with additional handrails and springs seat). The result showed that the handrails and spring seat affected the timing of the sitting motion to standing and the response of the participants. Therefore this study recommends the design of chairs for elderly prayers plus handrails and springs seat.

**Keywords:** Elderly, Prayer Chair, Springs Seat, Handrails, Muslim
Movement Flexibility of Autistic Children during Individual Therapy using ABA Lovaas Table Modification with Foldable Table Top

Dwi Candra Purnamasari 2,a), Sinta Sari M 3,c) and Lulu Purwaningrum 1,2b)

1Master program of art and design, Universitas Sebelas Maret, Indonesia
2Departemen of Interior Design, Universitas Sebelas Maret, Indonesia
3Pusat Layanan Autis Surakarta, Indonesia
b) Corresponding author: lulu_purwaningrum@staff.uns.ac.id
a) dwicpurnamasari@student.uns.ac.id
c) psi.sintha@gmail.com

Difficulty to sit still in autistic children during therapy causes hindrance to the therapy process. From the previous research, ABA (Applied Behavior Analysis) therapy table was tested in a short period and has resulted in a new alternative of therapy table. This study aims to investigate the effects of a permanent mat addition and removal of oval curvature on ABA therapy table to be evaluated and improved in terms of effectiveness as a means for successful therapy. The participants were 15 autistic children (12 boys, 3 girls) with Mean ± SD anthropometric data as the following: age: 8.3 ± 2.6 years; height: 128 ± 15.7 cm; weight: 29.7 ± 8.9 kg. The experiment used three types of tables, namely Table A, which is commonly used in ABA therapy, with an oval hole for the edges and without a permanent mat, and Table B, which is a table without an oval hole on the edge but with a permanent mat, and Table C, which is a table designed as a result of previous research recommendations, using a mat and a foldable curve. Observations were conducted directly during therapy sessions for 4 months. The results of the study showed the functionalization of each table so that its effectiveness in ABA therapy can be improved. The benefits of this study results can be taken as consideration for redesigning autistic therapy table. It can be concluded that among the three tables, Table C is the best table to be used during therapy, because it can help improve attention, overcome aggressive behaviour on children with autism and help train self-development.
Maintenance Strategy Selection in a Cement Company: An Integrated AHP-FAHP Approach

Masoud Rahiminezhad Galankashi\textsuperscript{1,2,a)}, Fatemeh Khorramrouz\textsuperscript{1,b)}, Mehran Esmaeilnezhad\textsuperscript{1,c)}, Farimah Mokhatab Rafiei\textsuperscript{2,d)}, Muhammad Hisjam\textsuperscript{3,e)}

\textsuperscript{1}Department of Industrial, Mechanical and Aerospace Engineering, Buein Zahra Technical University, Buein Zahra, Qazvin, Iran.
\textsuperscript{2}Department of Industrial Engineering, Tarbiat Modares University, Tehran, Iran.
\textsuperscript{3}Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia.
\textsuperscript{a)} Masoud.rahiminejad@yahoo.com
\textsuperscript{b)} f.khorramrouz1374@gmail.com
\textsuperscript{c)} mehran7396@gmail.com
\textsuperscript{d)} f.mokhatab@modares.ac.ir
\textsuperscript{e)} hisjam@staff.uns.ac.id

This study develops an integrated AHP-FAHP approach to select the best maintenance strategy for different equipment of a cement manufacturer located in Iran. Although the topic has been investigated in previous literature, it is less examined in cement manufacturers of developing countries. To fill this gap, this research has been conducted in three phases as follows. Firstly, the most important measures of maintenance strategy selection are developed and ranked using a questionnaire. Next, these measures are applied to choose the best maintenance strategy for different equipment of a case study using an Analytic Hierarchy Process (AHP). Finally, a Fuzzy AHP is developed to investigate the obtained results in an uncertain environment. The considered strategies include Corrective maintenance (CM), Reliability Centered Maintenance (RCM), Total Productive Maintenance (TPM), Preventive Maintenance (PM) and Predictive Maintenance (PDM). According to the obtained results, safety, cost, reliability and availability are the most important criteria of maintenance strategy selection. In addition, according to AHP, the PDM strategy is suggested for furnace, PM is suggested for electro filter machine and PDM is suggested for crusher. These results were comparatively investigated by FAHP and some managerial insights are suggested.
Municipal Solid Waste Logistics Management: a Study on Reverse Logistics

Annie Purwani 1,a), Muhammad Hisjam 2,b) and Wahyudi Sutopo 2,c)

1Department of Industrial Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Indonesia.
2Department of Industrial Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia.

a)Corresponding author: annie.purwani@ie.uad.ac.id
b)hisjam@staff.uns.ac.id
c)wahyudisutopo@staff.uns.ac.id

Municipal solid waste problem is a complicated problem, due to its impacts in economic, social and environmental aspects. Municipal solid waste problem is a multi-discipline problem which involves many stakeholders that needs to be considered simultaneously. Many analytical approaches have been done since the collecting method, separating method, transportation, disposal and/or 3 R (reduce, reuse, recycle) and other related operations. This paper compares the implementation of the municipal waste management that has been conducted in some countries with different characteristics and focuses on using the reverse logistics approach to solve municipal solid waste problems. The analysis gives alternatives to solve the problems that can help the stakeholders in improving the performance of managing the municipal solid waste.

Keyword: municipal solid waste, reverse logistics, sustainability.
Implementation of Lean Manufacturing in an Electronic Assembly Company

Celine Koh Xian Lin \(^{1,\text{a)}}\), Syed Ahmad Helmi \(^{1,2,\text{b)}}\), Muhammad Hisjam \(^{3,\text{c)}}\) and Ahad Ali \(^{4,\text{d)}}\)

\(^1\)School of Mechanical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
\(^2\)Center for Engineering Education, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
\(^3\)Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia.
\(^4\)Industrial Engineering Programs, Lawrence Technological University, Southfield, MI 48075, USA
\(^{\text{a)}}\)Corresponding author: celinekoh_lin@live.com
\(^{\text{b)}}\)helmi@utm.my
\(^{\text{c)}}\)hisjam@staff.uns.ac.id
\(^{\text{d)}}\)sali@ltu.edu

Lean manufacturing is a systematic method to utilize the resources and reduce wastes of the production system. In order to tackle problems in an electronic assembly company, the current value stream mapping is constructed and the solutions are proposed. In this study, the critical wastes were identified including waiting time, transportation and inventory. Hence, lean tools are applied to reduce these wastes which are elimination of unnecessary operations, layout rearrangement, and application of Kanban system. Simulation approach is used to test the performance of each proposed alternatives. Future value stream mapping is proposed to show the improvement of the production system. The proposed solution reduced the total production lead time and increased the value-added ratio by 11%.
Ergonomic Improvement in a Manufacturing Company

Tuan Ahmad Farhan Hakimi 1,a), Syed Ahmad Helmi 1,2,b), Muhammad Hisjam 3,c) and Ahad Ali 4,d)

1School of Mechanical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
2Center for Engineering Education, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
3Department of Industrial Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia.
4Industrial Engineering Programs, Lawrence Technological University, Southfield, MI 48075, USA

a)Corresponding author: tuanahmad96@gmail.com
b)helmi@utm.my
c)hisjam@staff.uns.ac.id.my
d)sali@ltu.edu

The objective of study is to identify the musculoskeletal disorders (MSDs) experienced by particular workers who perform manual tasks. Improper working techniques and substandard while working, have exposed workers to occupational health risks especially in manufacturing factory. The study focused on the production line in the metal manufacturing company. The surveys of body discomfort have been distributed among the workers in each department to identify the most critical department that has experienced MSDs. The ergonomic of risk level was analysed by using Rapid Upper Limb Assessment (RULA). The proposed improvement design was constructed by using Solidworks software. Based on result of survey it shows that most operators in deburring department have experienced 4 main MSDs which are wrist, upper back, lower back and hips due to prolonged sitting and improper handling methods during process of deburring and grinding metal plate. This study has proven that the new design proposed had improved the existent posture of workers by reducing the RULA score from 7 to 2. The application should be implemented in order to improve the work posture and reduce the exertion of excessive force while working.
Mechanical Engineering
Feasibility of Esterification Process for Producing Biodiesel from Waste Cooking Oils

Suyitno¹,a), Mohamad Muqoffa²,b), Syamsul Hadi¹,c) and Evi Gravitiani³,d)

¹Department of Mechanical Engineering, Universitas Sebelas Maret, Indonesia, suyitno@uns.ac.id
²Faculty of Engineering, Universitas Sebelas Maret, Indonesia
³Faculty of Economics and Business, Universitas Sebelas Maret, Indonesia
Email: ²)mmuqoffa@yahoo.com, ³)syamsulhadi@ft.uns.ac.id, ¹)suyitno@uns.ac.id, d)e_gravity2000@yahoo.com

Biodiesel is a renewable fuel and easily produced by various raw materials via esterification and transesterification processes. The objective of study is to investigate the feasibility of esterification and transesterification process for producing biodiesel waste cooking oils. The esterification and transesterification process were modelled by using plug flow reactor with various ratio of methanol and oils. The two order of kinetic reaction was used. The results show that esterification process and financial parameters were strongly influenced by the ratio of methanol and oils. The best ratio of MeOH/WCOs was 10. At the ratio 10, the content of ester in biodiesel is 99.6%. The IRR, NPV, PP, and B/C were 45.6%, 289 Million USD, 2.36, and 16.4, respectively.

Keywords: Esterification, Biodiesel, Cooking Oils
The depletion of fossil fuel reserves is increasingly encouraging people see to other renewable energy sources. Strategic steps that can be taken is by applying the concept of energy diversification. One of the simplest and easiest ways to diversify energy is through biomass energy utilization. Indonesia has abundant biomass energy sources, which can come from waste. Potential waste that can be used as raw material for briquettes are sawdust and coconut shell waste. The purpose of this study was to determine the effect of variations in the adhesive concentration of starch on the characteristics of charcoal briquettes which include caloric value, moisture content, and ash content. The research are done with variating of adhesive concentration 4%, 6%, and 8% with sawdust and coconut shell composition 75%:25%. The research result shows that briquettes with 4% of adhesive concentration have caloric value 6974.022 cal/g, moisture content 4.518%, and ash content 1.364%. Briquettes with 6% of adhesive concentration have caloric value 7561.582 cal/g, moisture content 4.232%, and ash content 1.762%. Briquettes with 8% of adhesive concentration have caloric value 6996.102 cal/g, moisture content 4.455%, and ash content 1.623%. The characteristics of briquette have fulfilled the value of briquette quality standard SNI 01-6235-2000. The most optimum of adhesive concentration in briquette production from the research is 6%.

Keywords: briquette, adhesive, caloric value, moisture content, ash content
Simulation Study on a Torsional Stiffness Test Apparatus for Space Tube Frame Chassis

Rafli Alnursyah, Ubaidilla*, Hashfi Hazimi, Hanna Nursya’bani

Mechanical Engineering Department, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami 36A, Kentingan, Jebres, Surakarta. 57126
Email: * ubaidillah_ft@staff.uns.ac.id

Torsional rigidity of a vehicle is a measure of how much force needed to be applied to twist the frame by one degree. An appropriate torsional rigidity improves the ride quality of a vehicle. This paper delivered the engineering design and experimental works of a test apparatus for chassis testing of a formula student car. The apparatus is a solid jig with an adjustable mount equipped with a rotational loading arm at the front axis point and a fix mount at rear axis point. Firstly, the apparatus was design using 3D engineering drawing software, then the object was analyzed its strength using finite element analysis approach. During simulation, the loading condition was set at a worse condition that was locking the arm bearing. A 1 kN was applied at the loading arm and the critical part was determined from the stress distribution. An iterative design was undertaken to improve the critical part by changing the material until reach the best material, the material for the simulation was aluminum, steel, and stainless steel. Finally, simulation having achieved a reasonable safety factor that was 1.33, and the workshop drawing was finalized for further prototyping process.

Keywords: chassis, torsional, stiffness, formula
ME-008

Numerical Study of Effect of Blade Number and Inlet Blade Angle on Propeller Turbine Performance Using Computational Fluid Dynamic

Hasan Bisri\(^1\), DDD Prija Tjahjana\(^1\), Dwi Aries Himawanto\(^1\),* 

\(^1\)Departement of Mechanical Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia
E-mail: *dwiarieshimawanto@gmail.com

Nowadays Ultra Low Head (ULH) hydropower becomes a research trend for electricity generation. One form of ULH is horizontal flow irrigation. Reaction turbine that is widely used in irrigation flows is the type of propeller turbine. Advantages of propeller turbines are such as high efficiency, simple, and low production costs. Propeller rotor employed in this research has a diameter of 83 mm and a slope of 30°. This study used addition of a bulb body to increase speed of fluid flow, the bulb ratio used in this study is 0.6. Discharge of water used is 0.02 m\(^3\)/s. Simulation is done using solid work software flow simulation to produce mesh of the flow domain of all blade variant. This study aims to determine effect of number of blades and inlet blade angle on turbine performance. Variations number of blades used in this study were 4, 5, 6, and 7. This study also analyzes effect of inlet blade angle differences on tips, which were 29°, 36°, and 46°. This research focus of data analyzed is turbine torque value. The results of this study state that the number of blades and increase value of inlet tip angle can increased torque value. The highest torque is found in variations number of blades 6 and inlet blade angle of tip section 46° which is 4.1 Nm.

**Keywords:** Blade number; inlet blade angle; propeller turbine; hydropower; ultra low head
An Experimental Study of a Car Maintenance Workshop
Layout Optimization

Agung Premono\textsuperscript{1,a), Matheus Victor P\textsuperscript{1), and Himawan Hadi Sutrisno\textsuperscript{1)}
\textsuperscript{1}Mechanical Engineering Department, State University of Jakarta
Email: \textsuperscript{a})agung-premono@unj.ac.id

Lead time is the duration between designing of a product and its production, or between ordering a product and receiving it. One of the car manufacturers in Indonesia has a rule that the maximum lead time for car maintenance in their workshop is 2 hour and 30 minutes. However, lead time in some of their workshops has exceeded the duration. In order to reduce the lead time of the car maintenance process, the workshop layout is optimized using three different layout models. The difference between these models refers to lies in the location of the tire balancing and spoorung stations. The spoorung and balancing station of the first model is located at the entrance area of the workshop, while the second model is located in the middle area of the workshop. The spoorung and balancing station of the third model is located close to the exit of the workshop. Data collected by measuring the time of car maintenance shows that the second model locating the tire balancing and spoorung station in the middle area of the workshop be the shortest lead time of the three in the car maintenance process.

\textbf{Keywords}: lead time, layout optimization, car maintenance workshop
ME-048

Design of Mussel Peeler Machine Ergonomic

Unggul Prabowo¹, Agung Prakoso Wicaksono², Renanda Herlian³, Yosua Heru Irawan⁴

Institut teknologi nasional yogyakarta, Jalan Babarsari, Catur Tunggal, Depok, Sleman, Yogyakarta, +62274487249
E-mail: ⁴ yhirawan@itny.ac.id

Indonesia is a maritime state. A country in which most of the territory is oceanic. Mussel is one of the most abundant commodities of seafood and The demand of it is high. The mussel extraction process is still done in manual way in Indonesia, It is not only waste a lot of time but it is also dangerous for the workers The design of this machine is conducted by Static bike modification atau by modifying a static bike ergonomic. Therefore, it is environmentally safe in its peeling process. The research aims to make the design of mussel Peeler machine, test the scallop machine to know the effective capacity of the machine, and know the level of satisfaction of the users. The research methods used are the identification of problems, machinery design and chains and machine trials. The resulting engine design consists of three main parts namely the axle as a peeler, the dual-chain transmission as a mobilizer, and two furnaces as a machine house and a boiling medium. The results of this study were quantitatively made by testing the 1.5, 2, and 2.5 kg of materials. Then the measurement of the users satisfaction level is performed subjectively. The conclusion is that it takes an average of 20 minutes to peel the mussels from all the three kinds of material tested.

Keywords: Ergonomic, Mussell, Machine, And Peeler
A Simulation Study on The Performance of ThermoXT-32/TiO2 Nanofluid in Double Pipe Concentric Heat Exchanger

Luqman Al Huda1,1, Heryoga Winarbawa2,1, Muhammad Reza Pradecta1,2, Arif Widyatama2,2*, Ardi Wiranata and Suhanan2,3

1Center for Energy Studies, Universitas Gadjah Mada
2Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada
Email: *arifwidyatama@ugm.ac.id

Heat exchanger performance can be significantly improved by utilizing nanofluid as working fluid. Therefore, this research aims to investigate the effect of nanofluid addition in the own designed double pipe concentric heat exchanger performance. To support the previous study, a simulation study using discrete particle model was carried out. The inside pipe was made of copper with 38.1 mm inner diameter and 1.5 m length while the stainless steel outside pipe had 76.2 mm inner diameter and 1.2 m length. The temperature and the mass flow rate was set at 60° C and 0.3 kg/s, respectively. In addition, the cold working fluid utilized Thermo XT-32/ TiO2 with 0.1 - 0.3 % volume fraction variation. The mass flow rate was also varied from 0.11 to 0.27 kg/s. After the independent grid test and model validation with the experimental data, the simulation study is conducted to reveal the detailed flow and heat transfer characteristics. It is found that the change of volume fraction and the mass flow rate strongly affected the heat transfer rate and the pressure drop. Finally, a good agreement with previous study and notable improvement with earlier model proofs that this study can be expanded to conduct further research and develop a new model to define the best operating condition for the double pipe concentric heat exchanger in various application.

Keywords: nanofluid, forced convection, Discrete phase model
ME-083

The Effect of Pressure and Temperature on Biodiesel Production using Castol Oil

Dandun Mahesa Prabowoputra¹, Agus Sartomo¹,³, Suyitno²*

¹Graduate School of Mechanical Engineering, Sebelas Maret University, Jl. Ir. Sutami 36 A, Central Java, Surakarta, 57126 Indonesia
²Department of Mechanical Engineering, Sebelas Maret University, Jl. Ir. Sutami 36 A, Central Java, Surakarta, 57126 Indonesia
³Agency for Assessment and Application of Technology, Tangerang, Banten, Indonesia

E-mail: *suyitno@uns.ac.id

Biodiesel is one of the new and renewable energies that can be used as a substitute for fuel. The use of biodiesel grows at an average of 7.0% per year which is relatively higher with other fuel growth in Indonesia. Research on Biodiesel is interesting. Simulation research has been carried out on biodiesel production. The simulation uses Aspen Hysys software. Simulations were carried out on the manufacture of biodiesel in castor oil and methanol. The ratio of methanol: oil is 2: 1. The simulation was carried out on pressure measurements of 202 kPa to 707 kPa at temperatures of 65°C to 85°C. This study aims to determine the effect of temperature and pressure on biodiesel yield. From this study, the yield of biodiesel was 93% with a purity of 97%. The method used for data collection is factorial design.

Keywords: biodiesel, simulation, castor oil, design factorial
Factorial Design of the Effect of Reaction Time and Reaction Temperature on Biodiesel Production

Agus Sartomo¹,³*, Suyitno², Dandun Mahesa Prabowoputra¹

¹Graduate School of Mechanical Engineering Department, Universitas Sebelas Maret, Surakarta, Indonesia
²Mechanical Engineering Department, Universitas Sebelas Maret, Surakarta, Indonesia
³Agency for Assessment and Application of Technology, Tangerang, Banten, Indonesia
E-mail: *agus.sartomo@bppt.go.id

Non-catalytic esterification supercritical methanol for biodiesel production from Free Fatty Acid (oleic acid, linoleic, lauric, myristic, palmitic, stearic, linolenic, arachidic, and behenic) was investigated. Four level factorial design of experiment was used to investigate the effect of reaction time (10, 15, 20, and 30 min) and reaction temperature (250 ºC, 290 ºC, 320 ºC, and 350 ºC) on biodiesel yield. Two variables were used to identify the significant effect and interaction from the study. The statistic calculation was validated using Analysis of Variance (ANOVA). The results show that reaction time, reaction temperature, and interaction of both have F-value of 16.87, 409.2, and 11.00 respectively. Degree of freedom for the numerator is 3 and denominator is 8, and obtained $F_{0.05,3,8}$ value is 4.07. Reaction time and reaction temperature have significant influence on yield of biodiesel production, because F-value of both greater than $F_{0.05,3,8}$. Besides, both of them also have significant interactions.

Keywords: biodiesel; factorial design; free fatty acid; ANOVA
Extraction and Characterization of Nanocrystalline Cellulose (NCC) from Ramie Fiber by Sulphuric Acid Hydrolysis

R. Faiz Listyanda¹, a), Kusmono¹, b), Muhammad Waziz Wildan ¹), and Mochammad Noer Ilman ¹)

¹Department of Mechanical and Industrial Engineering, Faculty of Engineering, Universitas Gadjah Mada, Jln. Grafika No. 2 Yogyakarta 55281, Indonesia.
Email: b) kusmono@ugm.ac.id, a) faizlistyanda@gmail.com

Nanocrystalline Cellulose (NCC) is a nano-sized material produced by removal of amorphous regions on cellulose fibers through acid hydrolysis. NCC gets a lot of attention because it has superior properties such as high strength, high modulus, high surface area and biocompatible. In the present study, sulphuric acid hydrolysis with different concentration was carried out to produce NCC with high crystallinity. The effect of sulphuric acid concentration on the characteristics of NNC was investigated in this work. The cellulose was extracted from the ramie fibers through some chemical treatments such as de-waxing in soxhlet apparatus, bleaching, and alkali treatments. NCC were isolated from extracted cellulose with sulphuric acid hydrolysis. The concentration of sulphuric acid was varied by 41, 44, 47, and 50%. The characterization of NCC were conducted through Fourier Transform Infrared Ray (FTIR), X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM), and Particle Size Analyzer (PSA). The results show that the smaller length of NCC was found with increasing higher sulphuric acid concentration. However, the crystallinity was decreased at higher sulphuric acid concentration. Based on the XRD analysis, the highest crystallinity index (90.7%) was obtained at the sulphuric acid concentration of 41%.

Keywords: Nanocrystalline Cellulose, Ramie Fiber, Crystallinity Index, Acid Hydrolysis
ME-109

Savonius Turbine Performance with Slotted Blades

_Catur Harsito^1 and Dominicus Danardono Dwi Prija Tjahjana^1,*, and Budi Kristiawan^1_

^1Universitas Sebelas Maret, Surakarta, Indonesia
E-mail: *danar1405@gmail.com

Non-renewable energy source will run out quickly and pollute dangerously the environment. This causes the change in using source of energy to the renewable energy which is clean and eco-friendly. Wind turbine is one of renewable energy which is eco-friendly and having abundant sources. Indonesia has wind velocity for about 4 m/s which is appropriate to be installed savonius wind turbine. This paper aims to measure savonius wind turbine performance by adding slotted 3mm, 5mm, 7mm, 9mm at 20%, 30%, and 40% wide of blade. In measuring the turbine, the researcher used blower fan as the source of wind with the wind velocity for about 3 m/s to 5 m/s. The result showed that applying slotted blades can increase torque starting. Therefore, it produced performance improvement at the condition of low angular velocity. While the highest power coefficient occurred when slotted blades position near from blade’s width.

**Keywords:** renewable energy; savonius wind turbine; gap slotted blades
Innovation on Increasing Savonius Wind Turbine Efficiency with Circular Cylinder as a Bluff Body in front of Its Returning Blade

Ikhsanudin Zaini¹,a), Okky Renaldy¹,b) and Bagas Ramadhan Ananto¹,)

¹Department of Mechanical Engineering, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
Email: a)ikhsanudin.zaini@gmail.com, b)renaldyokky@gmail.com

Renewable energy is produced from energy resources that naturally will not run out even sustainably if managed properly. Unfortunately, these renewable energy sources have not been fully utilized. One of the renewable energies that has not been utilized optimally is wind energy. Wind energy is collected by using wind turbines. One of the wind turbines that can be utilized is the savonius wind turbine. Savonius wind turbine work by utilizing differences in drag forces on advancing blade and returning blade. The difference in drag forces between the two blades produces torque which will make the rotor spin. In an effort to improve the efficiency of the Savonius wind turbine, this study used a circular cylinder as a bluff body placed in front of the returning blade. To achieve this goal, this study used a Savonius wind turbine which had a diameter (D) = 165 mm and height (H) = 213 mm, and a circular cylinder of with diameter (d) = 165 mm placed in front of the returning blade turbine. The circular cylinder is placed with a vertical distance ratio of y/D = 0.5 and horizontal distance ratio variations of S/D = 1.6; 1.7; 1.8; 2.0; 2.2. This study uses fan axial as a source of air flow with the help of honeycomb as a flow rectifier. The wind speed used is 4 m/s and 5 m/s. Wind speed is measured using an anemometer. Wind turbine shaft rotation is measured by a Tachometer. The dynamic torque produced by the turbine is measured using Brake Dynamometer. The amount of turbine output power is obtained from the rotation speed and dynamic torque. The results obtained from this study are expected to increase the efficiency of the turbine and to obtain an optimum horizontal distance ratio of a circular cylinder as a bluff body placed in front of the returning blade.

Keywords: Savonius turbine, Circular cylinder, Returning blade, Horizontal distances ratio of S/D, Efficiency
ME-118

Effects of Processing Parameters on The Tensile Strength of Injection Moulding Unidirectional Glass Fiber Reinforced Polypropylene Composite

Muhammad Alek Ad¹,¹, Heru Santoso Budi Rochardjo¹,² and Cahyo Budiyanthoro¹,³

¹Universitas Gadjah Mada, Indonesia

Email: ¹ muhammad.alek.a@mail.ugm.ac.id, ² heru-sbr@mail.ugm.ac.id, ³ cahyobudiyantoro@mail.ugm.ac.id

Composite is a type of material that has rapid development today. The study and development of science and technology related to this material is mostly carried out with various purposes. In this study, we will discuss about glass fiber reinforced polymer (GFRP) which consist glass fiber as reinforcement element and polypropylene as matrix. This composite is manufactured using MEIKI M-70B injection moulding machine. In manufacturing this composite, a combination of melting temperature and hydraulic pressure was carried out using Taguchi design of experiment. Taguchi design of experiment help us to find what is the most influence processing parameters in making this composite by eliminating a number of experiments. And we also use ANOVA to find the percentage contribution of each parameters. Furthermore, tensile test will be applied to the composite to obtain the composite tensile strength

Keywords: Composite, Glass Fiber Reinforced Polypropylene, Tensile Strength, Taguchi Method, ANOVA
Analysis and Topology Optimization Structural Design Excavator Bucket Tooth Using Finite Element Method

Suryo H. Sumar\textsuperscript{1,1}, Fawwaz M. Wijdan\textsuperscript{1,2}, Wijaya A. Yogi\textsuperscript{2,a}, Saputro E.W\textsuperscript{1,3}, Harto\textsuperscript{1,4}

\textsuperscript{1} Diponegoro University, Indonesia

Email: \textsuperscript{1} sumarhs.undip@gmail.com, \textsuperscript{2} wijdanmf@student.undip.ac.id, \textsuperscript{a} yogiwijayaadi@gmail.com, \textsuperscript{3} ewsaputro@student.undip.ac.id, \textsuperscript{4} harto@students.undip.ac.id

Bucket tooth is one important part of the excavator bucket. Bucket tooth serves as a divisive material that also serves to avoid wear and damage to the bucket. In this paper the author optimizes the bucket tooth design on the market so that it can produce a lighter design but has almost the same strength as the initial. To determine the type of material used to do various tests namely hardness test, composition elements test, and micrographic test. After the static linear simulation to get the maximum stress value Von-Misses on the design to determine the right material to proceed at this stage topology optimization. From the results of a linear static simulations using finite element method obtain a maximum stress von-misses value of 653 MPa so that the selected material is alloy steel hardox 500 has a value of yield strength of 1300 MPa. Topology optimization results obtained from mass loss on the design of variable 1 at 1.261 kg and on the design of variable 2 of 0.466 kg. In addition to the maximum stress variation von misses on variation 1 is unchanged while the second variation increased by 5.55 MPa. The safety factor for variation 1 is 1.99 and for variation 2 is 1.97 which can be said the value of the stress that occurs is declared safe.

Keywords: Bucket tooth excavator, Finite element analysis, topology optimization.
The study of microstructures and microdamage in composite materials has been an important key in designing composites because it directly affects the mechanical properties and overall performances. One of the main challenging issues regarding microdamage in composite materials is the interfacial damage, which is strongly related to the interfacial adhesive strength between fiber and matrix. A review on current research progress in the field regarding the study about interfacial damage, i.e., single fiber fragmentation test and push-out test, is presented. A brief explanation of the methodological approach used in this review, i.e., analytical, experimental, and numerical methods, are also included. This review focuses on various techniques and parameters which demonstrate how the interfacial damage is initiated and what parameters are greatly making it worse. Discussion is extended to the suggestions for future works.

**Keywords:** Damage, Interface, Composite, Micromechanics
Effect of the Post Weld Heat Treatment on the Physics and Mechanics Properties of the Underwater Wet Welded Low Carbon Steel

Syaukaty Yasinta¹, Nurul Muhayat¹, Y.C.N. Saputro² and Triyono¹*

¹Mechanical Engineering Department of Sebelas Maret University, Surakarta, Indonesia
²UPTB Solo Technopark Technical Unit on Regional Development Planning Board Surakarta, Indonesia
E-mail: *triyonomesin@uns.ac.id

Underwater wet welding is the cheapest and easiest method in the maintenance and repairing of offshore engineering equipment construction. It have disadvantage due to the water environment such as the high cooling rate and the hydrostatic pressure. Post weld heat treatment (PWHT) was proposed to improve underwater wet welded joint. Underwater wet welding processes were performed in the water depth of 2.5 m and 5 m and with water flow velocity of 1 m/s and 2 m/s. PWHTs were conducted in constant temperature of 560°C and holding time of 75 minutes. For all underwater wet weld joint, Heat Affected Zone (HAZ) has higher hardness that weld metal and base metal. HAZ and weld metal in the water depth of 5 was harder than that of in 2.5 m and in land weld. It was due to acicular ferrite content in weld metal in the water depth of 5 was more than that of in 2.5 m and in land weld. PWHT made the HAZ and weld metal have the homogeneous hardness due to recrystallization of microstructure.

Keywords: Low carbon steel; underwater wet welding; post weld heat treatment; weld metal; HAZ
ME-147

Effect of Electrospinning Distance Between Needle Tip and Collector to Fabricate ZnO Nanofiber as Photoanode of Dye-Sensitized Solar Cells

Zainal Arifin\(^1,a\), Syamsul Hadi\(^1,b\), Hanung Nugroho Jati\(^1,c\), Singgih Dwi Prasetyo\(^1,d\), and Suyitno Suyitno\(^1,e\)

\(^1\)Department of Mechanical Engineering, Universitas Sebelas Maret, Surakarta 57126, Indonesia

Email: \(^a\)zainal_arifin@staff.uns.ac.id, \(^b\)syamsulhadi@ft.uns.ac.id, \\
\(^c\)hanungnugrohojati@student.uns.ac.id, \(^e\)suyitno@uns.ac.id, \\
\(^d\)singgihdwiprasetyo22@student.uns.ac.id

Dye sensitized solar cells (DSSCs) is a promising photovoltaic technology that still needs a lot of improvement in manufacturing processes for mass production. This paper studies direct deposition method to enhance the manufacturing steps of semiconductor layer on conductive substrate. Electrospun ZnO nanofibers are directly coated on transparent conductive oxide (TCO) glass by electrospinning machine. The variation electrospinning distances between needle tip and collector from 5, 7, and 9 cm were applied on this work to examine its effects on ZnO nanofiber morphology. The results showed that at 7 cm electrospinning distance between needle tip and collector produced small, regular and unbroken ZnO nanofiber structure. Furthermore, it also produced the highest solar cell’s performance under irradiation of AM 1.5 simulated sunlight (100 mW/cm\(^2\)) than the other electrospinning distances.

**Keywords:** Electrospinning; Direct deposition method; ZnO nanofibers; Electrospinning distances; Dye-sensitized solar cells;
The Influence of Electrospinning Flow Rate Parameter on ZnO Nanofiber as Photoanode of Dye-Sensitized Solar Cells

Muhammad Zuhdi Khusaini\textsuperscript{1,a), Hanung Nugroho Jati\textsuperscript{1,b), Suyitno\textsuperscript{1,c}, Syamsul Hadi\textsuperscript{1,d) and Zainal Arifin\textsuperscript{1,e)}}

\textsuperscript{1}Department of Mechanical Engineering, Sebelas Maret University, Surakarta, 57126, Indonesia

Email: \textit{a) muhzuhdik@student.uns.ac.id, c) suyitno@uns.ac.id, b) hanungnugrohojati@student.uns.ac.id, d) syamsulhadi@ft.uns.ac.id, e) zainal_arifin@staff.uns.ac.id}

A nanofiber-based of dye-sensitized solar cell (DSSC) attracts high interest for researchers due to its high efficiency, low cost, and mass production availability. This paper investigated the electrospinning machine to fabricate ZnO nanofiber and will be used as photoanode of DSSC. Direct deposition method was applied on electrospinning machine to directly capture the liquid jet electrospun of ZnO solution on transparent conductive oxide (TCO) glass. Flow rate variation of 4, 6, and 8 µl/min were conducted to investigate its effects on ZnO nanofiber morphology. The results showed that at a flow rate of 4 µl/min produced small average droplet size, and uniform morphology with a diameter of 253.70 nm. Furthermore, it also obtained the highest electrical efficiency of DSSC due to high of dye absorbance and electron excitation.

Keywords: Dye-sensitized solar cell; Electrospinning; Direct deposition method; Flow rate; ZnO nanofibers;
Mechanical Properties of Pouch Battery Constituents

Putri Nur Halimah¹, ² a), Bentang Arief Budiman¹, ² b), and Poetro Lebdo Sambegoro¹, ² c)

¹Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung
²National Center for Sustainable Transportation Technology, Institut Teknologi Bandung

Email: a) putri_nurhalimah@yahoo.co.id, b) bentang@ftmd.itb.ac.id, c) poetro@ftmd.itb.ac.id

The use of battery has been growing rapidly. Various types of it are developed because of the diverse market demands. One of the famous types with its lightweight characteristic is pouch battery. Pouch battery consists of thin layered sheet metal which each part holds its own characteristics and mechanical properties. The characteristics of each part sums up the whole characteristics of the battery entirety. One of the results reported that though the battery’s main protector is made of only thin layer metal, it combines good strength and good energy absorption capability. These performances can be optimized by increasing the casing thickness, but the availability of space and aim to maintain good specific spatial energy of pouch battery should be considered also. Therefore, it is important to observe each part’s characteristic since each of them can be optimized separately to improve the overall battery’s performances.

Keywords: Mechanical properties, Pouch battery, Constituents
The Effect of Slotted Blade on The Performance of Savonius Wind Turbine

Agung Dwi Nugroho1, Dominicus Danardono Dwi Prija Tjahjana1*, Budi Kristiawan1

1Universitas Sebelas Maret, Surakarta, Indonesia
E-mail: *danar1405@gmail.com

The increase of energy needs and the depletion of fossil fuel sources makes society must use clean and renewable energy sources. Wind energy is a promising renewable energy today, because it is easy to obtain, abundant and environmentally friendly. Wind turbines utilize wind kinetic energy available to be converted into mechanical and electrical energy. Savonius is a vertical axis type wind turbine that has advantages such as simple construction, low investment costs, and high initial torque at low speeds. This study aims to identify the effect of Savonius turbine performance on slotted blade geometry. The study was conducted experimentally by varying the slotted position. The fan blower is used as a source of wind which requires the speed from 3 m/s to 6 m/s. The results showed that variations in slotted blade can increase the initial torque at low tip speeds resulting in an increase of turbine performance.

Keywords: renewable energy; savonius wind turbine; Slotted Blades
Experimental Study on The Effect of Number of Archimedes Turbine Blades in Closed Flow

Ihsan Pratama Rushadiawan¹,a and Dwi Aries Himawanto¹,b

¹ Sebelas Maret University, Indonesia

Email: a rushadiawanihsan@gmail.com, b dwiarieshimawanto@gmail.com

Pico hydro utilizes the flow of water energy into electrical energy with the help of turbines and generators (maximum electric power of 5kW). Archimedes screw turbine is an elongated turbine with a spiral blade that surrounds its axis (shaped like a screw). The advantage of this turbine is that it can work in low head, fish-friendly, relatively easy installation process and low maintenance. The turbine geometry consists of internal radius (Ri) of 40 mm, external radius (Ro) of 74 mm, pitch distance of 2.4 Ro (88.8 mm), turbine length of 621.6 mm and the angle of screw blade of 30°. Variations in the number of blades used are 1, 3 and 5 with discharge variations of 1.4 l/s; 2.1 l/s and 2.8 l/s. The purpose of this experiment is to explain the effect of the number of Archimedes screw turbine blades on turbine performance at head 1.2 m and the angle of turbine shaft slope is 30°. Turbine with 1 blade produces the highest power and efficiency, with mechanical power of 24.6 Watts, electrical power of 9.6 Watts and efficiency of 0.75%.

Keywords: Pyco hydro, Archimedes screw turbine, Number of blade
Material Selection of Continuous Stirred Tank Reactor for Biogas Conversion from Palm Oil Mill Effluent

W Wulandari¹,a), R Dwimansyah¹, H N Anindita¹, R Hanafi¹, B A Firmandoko¹ and H Hermawan¹

¹Agency for the Assessment and Application of Technology, Jl. MH Thamrin 8, Jakarta, 10340, Indonesia
Email: a)winda.wulandari@bppt.go.id

Palm Oil Mill Effluent is converted by using Continuous Stirred Tank Reactor. It requires a certain material to be able to get maximum performance. It commonly uses metal or concrete material. Material selection for Continuous Stirred Tank Reactor is important because it is influenced by several factors including Palm Oil Mill Effluent fluid and system mechanism that occur in Continuous Stirred Tank Reactor. The purpose of this study was to select Continuous Stirred Tank Reactor material for bio-conversion of Palm Oil Mill Effluent into biogas. The parameters which have become comparisons in this study are material characteristics and its costs. The results of this study indicate that mild steel material is a suitable material used in this Continuous Stirred Tank Reactor construction. Mild steel materials with coating process make the material resistant to corrosion, function relatively well, and the price is relatively affordable.

Keywords: Biogas, POME, CSTR, Digester, Material Selection
Drilling of AISI 316L Stainless Steel: Effect of Coolant Condition on Surface Roughness and Tool Wear

Ahmad Zubair Sultan¹,a) Safian Sharif²,b) and Denni Kurniawan³,c)

¹Department of Mechanical Engineering, Politeknik Negeri Ujung Pandang, Makassar 90245, Indonesia
²School of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru 81300, Malaysia
³Mechanical Engineering Programme Area, Universiti Teknologi Brunei, Gadong BE1410, Brunei Darussalam
Email: ¹ahmazubairsultan@poliupg.ac.id, ²safian@utm.my, ³denni.kurniawan@utb.edu.bn

This study examines the effect of coolant condition on surface roughness of AISI 316L austenitic stainless steel workpiece and on tool wear during drilling using uncoated carbide drill. The drilling was done under flood cooling, minimum quantity of lubrication (MQL) using palm olein, and dry machining. Drilling was performed on a CNC machining centre using spindle speed of 955 rpm and feed rate of 24 mm/min with drill of 4±0.01 mm diameter, 130° point angle and 30° helix angle. Drilling under flood cooling was performed using commercial water based mineral oil (6% mineral oil) with flow rate of 18.4 l/h. MQL technique applied mist coolant of palm olein with flow rate of 27 ml/h from 5.5 bar air pressure. For dry machining, no coolant was applied. Surface roughness (Ra) was measured with surface roughness tester with setting of 0.8 mm cut-off length and 4 mm sampling length for each measurement. The surface roughness is averaged from twelve measurements at different points on the drilled hole. Tool wear was measured after particular time interval during drilling. It was found that the surface roughness resulted from drilling under flood cooling was significantly lower than that of MQL and dry machining. For surface finish resulted by worn tool, the surface roughness was higher compared to when new tool was used for all coolant conditions. Using the tool life resulted under flood cooling as the benchmark, it was found that dry drilling could only achieve 5% of the tool life while MQL drilling resulted better with 68% of flood cooling’s tool life. The cooling conditions showed different tool failure modes as well. For flood cooling, tool failure modes were uniform flank wear and chipping on primary cutting lips. For MQL, excessive flaking on flank face was identified as tool failure mode. For dry machining, the failure modes were margin wear, outer corner wear and catastrophic failure.

Keywords: Drilling, Coolant, Surface roughness, Tool wear
Experimental Study of the Influence Inlet Blade Geometry on Performance Propeller Turbine for Pipe Inline Installation

Hasan Bisri¹, D D D Prija Tjahyana¹, Dwi Aries Himawanto¹,*

¹Departement of Mechanical Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia
E-mail: *dwiarieshimawanto@gmail.com

Hydropower, especially irrigation channels have received attention as renewable energy in reducing the energy crisis. Irrigation channels have the potential as a Pikohidro scale power plant. The very low head can be utilized using a type of reaction turbine. A good reaction turbine that works on a low head is a type of propeller turbine. The head used in this study is the dynamic head. The propeller rotor in this study has blades 5, a diameter of 84.8 mm, and a blade thickness of 2 mm. The addition of the bulb body in this study was used to increase the liquid fluid flow rate; the bulb ratio is 0.6. The water discharge used is varied from 7 L/s, 8.5 L/s, and 10 l/s. The tip angle of the tip is varied from 36 °, 29 °, 23 °, and 19 °. This study aims to determine the effect of blade inlet on turbine performance in horizontal flow in the pipe. The highest yield at the tip 29 angle is producing 38.5 watts at 400 RPM rpm, and efficiency reaches 70%. However increasing the value of the inlet angles on tip does not linearly increase the shaft power value. A blade with a 36 ° entry angle has the smallest performance, the power produced shaft power is only 20.80 watt at 400 RPM.

Keywords: inlet blade angle; propeller turbine; hydropower; ultra low head
Experimental Study of the Effect of Blade Angle on Pico Tubular Bulb Turbine Performance in Horizontal Flow

Akhmad Nurdin¹, Syamsul Hadi¹, Dwi Aries Himawanto¹,∗

¹Department of Mechanical Engineering, Faculty of Engineering, Sebelas Maret University, Surakarta, Indonesia
E-mail: ∗dwiarieshimawanto@gmail.com

At present, most of the small hydropower research literature focuses on the head between 2 and 30 meters, in contrast to the ultra low head (ULH) between 0 and 3 meters undeveloped. ULH hydropower, especially for horizontal flow is interesting to develop because it is renewable, sustainable, simple, low cost, and environment-friendly. One type of ULH hydropower application in horizontal flow is the tubular channel, while the type of turbine used is a propeller. Efforts to increase the velocity of water flow and direct the current to the turbine in the tubular channel applying the bulb body. The blade angle is related to the gap between the blades in the turbine and will affect the discharge, so the performance of the turbine is also affected. This study aimed to determine the effect of blade angle on the propeller turbine characteristics on horizontal flow. The number of blades in this study was 5, with the bulb ratio used 0.6. Blade angle variations of 20°, 25°, 30° and 35° with each tested at 7 L/s, 8.5 L/s, and 10 L/s. The results of this study indicate that the slope of 25° and flow rate 10L/s produces the most optimal shaft power with a value of 50.55 Watts at 400 RPM.

Keywords: blade angle; propeller turbine; hydropower; ultra low head
ME-201

Characteristics of Mechanical Properties of Coconut Fiber and Natural Rubber with Different Fraction Weights

Sigit Arrohman¹,a, Kuncoro Diharjo¹,b, and Dody Ariawan¹,c

¹Sebelas Maret University, Indonesia
Email:  a sigit_arrohman@student.uns.ac.id, b Kuncorodiharjo@ft.uns.ac.id, cDodyAriawan@ft.uns.ac.id

Indonesia has the largest coconut land in the world with an area of 3.88 million hectares. Land capable of producing 3.2 million tons of coconut. The Indonesian rubber industry has an investment opportunity of US $ 3 billion. Coconut and rubber will become coir fibre. This composite increase selling value of the product. This composition consists of 3 combinations of weight fractions. That is the composition of coconut fiber: natural rubber is (1) 70:30(2) 40:60(3) 50:50. Tests were carried out to determine the mechanical properties of composites. Micrographic photos and images. The composite treatment that has the greatest strength feature is a 50:50 fraction. The lowest weight fraction is the 70:30 fraction. The best micro structure is a 50:50 fraction. Best coir fibre obtained is a mixture with a weight of 50:50.

Keywords: Coconut fiber, Micrographic, Mechanical properties
Wind pump was a familiar technology for Indonesian farmer especially for salt production process. Pumping power for very low lifting and circulating of sea water was required for the evaporative salt production. Reciprocating pumps were the most familiar pump type for coupled directly to the crack shaft of wind mill. Centrifugal reaction pump were a simple centrifugal pump type that could operate at very low shaft speed and very low water head and could be used as an alternative pump in salt production.

This experiment study investigated the centrifugal reaction pump for very low water head lifting of 1.0, 1.5, 2.0, 2.5 and 3.0 meter head respectively. The pump diameter was 1.5 meter with 5 centimeter pipe diameter. The pump was operated at 60 rpm up to 160 rpm shaft speed.

The experiment resulted that the pump cut on shaft speed was depend on the water head. Higher water head has also has the higher cut on shaft speed. The lower shaft speed has higher efficiency compared to the higher shaft speed. At the various water head, the pump efficiency has similar values at high speed (120 rpm and up).

**Keywords:** wind pump, centrifugal reaction pump, very low head, cut-on shaft speed, pump efficiency
Finite Element Analysis of Needle Penetration on Skin: Effect of Needle Tip Shape

Lau Yunn Yang\textsuperscript{1,a}, Fethma M Nor\textsuperscript{1,b}, and Denni Kurniawan\textsuperscript{2,c}

\textsuperscript{1} Curtin University, Malaysia
\textsuperscript{2} Universiti Teknologi Brunei, Brunei Darussalam
Email: \textsuperscript{b} fethma@curtin.edu.my, \textsuperscript{c} denni.kurniawan@utb.edu.bn

Penetration of a needle into skin is related to the mechanics of needle insertion. During penetration, shape of needle tip affects the skin response. In this study, a finite element model is developed to study the skin’s elastic and plastic response during acupuncture needle insertion. Three needle tip shapes (i.e., convex, concave, and straight angle) were generated to be inserted into a three layer skin model representing stratum corneum, epidermis, and dermis. Diameter of the needles are 80 μm and for the skin model, the thickness of first layer is 15 μm, second layer 50 μm and third layer 1235 μm, assigned with corresponding material properties. It was found that at the same penetration depth, the maximum stress and the stress distribution on skin are almost similar, with the highest was caused by the convex shaped needle and the lowest by concave shaped needle.

Keywords: Needle, Finite element analysis, Tip, Skin, Stress
Environmental conditions are very influential in the forming of aluminum welding defects. Temperature, humidity, and air flow rate are factors that determine the content of hydrogen gas in an environment. The solubility of hydrogen in molten aluminum metal is very high. When the molten aluminum metal solidifies, hydrogen gas will be trapped in the metal and form porosity. This study aims to identify the aluminum welded defects caused by environmental conditions by assembling a welding isolation chamber that can be set temperature, humidity and air flow rate. Welding was carried out at temperature variations of 20 °C, 25 °C, 30 °C, relative humidity variations of 65%, 72%, 80%, and air flow rate of 1.5 m/s, 1.7 m/s, 2.0 m/s. The results showed that the lower the temperature, the less porosity in the weld metal due to the low solubility of hydrogen at low temperatures. Welding process which was carried out with a relatively high humidity level will make the weld metal have higher porosity.

**Keywords:** Welding, Aluminum, Porosity, Humidity, Temperature, Air flow rate
A Novel Blind Chessboard Support System Featuring Magnetorheological Elastomer Sensor

Dimas Adiputra¹, Ardiansyah Al Farouq¹, Ubaidillah²,³, Rumi Iqbal Doewes⁴

¹Telkom University, Surabaya, Indonesia  
²Mechanical Engineering Department, Universitas Sebelas Maret, Indonesia  
³National Center for Sustainable Transportation Technology, Bandung, Indonesia  
⁴Faculty of Sport, Universitas Sebelas Maret  
Email: ²,³ ubaid.ubaidillah@gmail.com

Blind chess game has been included in the Paralympic sport. As the name suggest, the players are visual-handicapped athlete who sometimes forget to push the timer button for turn transition. Therefore, in this paper an algorithm for a novel blind chess support system is presented. The algorithm consists of two parts. In the first part, the noises from the novel magnetic induction sensor are discarded for accurate detection of the chess pin movement. Then, in the second part, the player’s turn transition is handled where the active timer is changed automatically without the needs of pushing the timer button. The algorithm has been tested in a practice game. The result is the player can play the chess game without need to push the timer button. Therefore, the novel blind chess support system can be implemented for assisting a blind chess game by handling the turn transition automatically.

Keywords: blind chess; paralympic; visual handicapped; algorithm; noise removal; turn transition
Traditional salt farmers at Demak Region of Central Java Province used wind pump for water lifting in salt production process. Simple construction and technology was main reason for the sustainability of the wind pump that consisted of horizontal axis wind mill, transmission and reciprocating pump. The farmers has skill and ability to produced, maintained and operated the wind pump.

This experiment study investigated the characteristics of the traditional wind mill from the region that has even number of blades. The experiment used two blades and four blades for study. The diameter of the blade was 195 cm. Shaft power output was connected to the electric generator to convert shaft power to electric power. An electric circuit with bulb lamps is used as electric controlled load.

The experiment resulted that the wind mill with both of the blades variation could operate up to about 250 rpm on 3.4 up to 5.0 m/s wind speed. The maximum torque, tip speed ratio and coefficient of power for two blades was 1.8 Nm, 5.9 and 8.6. The maximum tip speed ratio and coefficient of power for two blades was 2.0 Nm, 5.4 and 10.2.

**Keywords:** traditional wind mill, Rembang region, tip speed ratio, coefficient of power
The influence of Magnesium Oxide and Monmorillonite on the Flame Retardant and Flexural Strength of Fiber Glass-Unsaturated Polyester Composites

Sahid Bayu Setiajit\textsuperscript{1,a}, Kuncoro Diharjo\textsuperscript{1,b} and Wijang Wisnu Raharjo\textsuperscript{1,c}

\textsuperscript{1} Departement of Mechanical Engineering, Engineering Faculty, Sebelas Maret University, Indonesia

Email: \textsuperscript{a} sahidbayu.sb@gmail.com, \textsuperscript{b} kuncorodiharjo@ft.uns.ac.id

The improvement of flame retardant and bending strength of glass fiber reinforced unsaturated polyester composites is carried out by the inclusion of magnesium oxide (MgOH) and montmorillonite (MMT). On the composite, MgOH and MMT were functioning as filler materials. The filler materials filled 60\% of the composite volume. The ratio of MgOH:MMT was varied from 60:0, 45:15, 30:30, 15:45 and 0:60. The hand lay up method was chosen for the manufacture of composite specimens. The effect of MgOH and MMT materials on composite properties such as bending strength and fuel properties has been investigated. The changes in fracture morphology of composite were observed by SEM. The results showed that the decrease in MgOH and the addition of MMT encouraged an increase in flame retardant and a decrease bending strength of composite.

Keywords: magnesium oxide, monmorillonite, flame retardant, flexural strength
Bus is one of massive transportation tool that play crucial role for Indonesian people mobility. It is very influential on the high level of fuel consumption because in general most of the buses in Indonesia are still using the combustion engine so the impact on fuel reserves are depleting. Due to the importance of bus as massive transportation tool, many accidents of bus happened such as rolled over accident, therefore this research aims to obtain the recommendation of the material on the frame structure of the bus power SHERA which is strong and able to withstand the load of the rollover. In Europe, there is a bus standard that regulates the safety of the bus when the rollover accident occurred, that is ECE R66. This reasearch discusses the voltage and displacement on the frame structure of the bus when the accident occurred rolled out to measure the security of the bus in accordance with the ECE R66 standard. The application of ECE R66 was performed by providing load impactor on the side of the bus with the speed and angle of impactor that is determined based on the dimensions of the bus. The analysis is done by the writer by using the elements of up to and with software help Alatir Hyperworks / RADIOSS. This research uses 3 kind of material with different properties which aimed at getting light material and does not reduce the safety bus electricity factors, the material in use the JIS 3445 STKM 13A, Aluminium 6005A T6 and Aluminium 6061 T6. The analysis result of the form of the voltage and displacemen
t concentration on the side of the next to the structure order the bus electricity. The magnitude of the displacement on the part is beyond the limits safe (residual space). Therefore, the structure order the bus electricity using three material types are safer if exposed to the load impactor or rolled over. From the third material is recommended on electric bus SHERA is a frame structure bus power with aluminum material 6061 T6 because it has a distance between frame structure with safe limits of the largest amounting to 19,296 mm and the aluminum material 6061 T6 has the weight of the lightest in the appeal of a second material that is of 7.465 kg weight such that the weight of the vehicle and its occupants.

Keywords: rollover, displacement, finite element methode, and residual space
ME-236

Computational Study of Biogas-Air Mixing Homogeneity in The Mixer of Dual Fuel Conversion Kit

Nazaruddin Sinaga¹, Maizirwan Mel², Qoriatul Fitriyah³, Dinesh Dhande⁴, and Bagus Suryasa⁵

¹ Diponegoro University, Indonesia
² International Islamic University Malaysia, Malaysia
³ Politeknik Negeri Batam, Indonesia
⁴ AISSMS College of Engineering, India
⁵ Universitas Islam 45 Bekasi, Indonesia
Email: ¹ nsinaga.ccfed@yahoo.com

The utilization of biogas as an alternative renewable fuel is increasingly applied to reduce the fuel consumption of diesel engines, by modify it to dual fuel engines. To produce high performance and efficiency, the homogeneity of mixing between air and biogas is needed in the mixer chamber. This research was intended to study computationally the mixing process in the mixer chamber of a small diesel engine, which was modified to the dual fuel engine, and the effects of flow rate and concentration of methane on mixing homogeneity. The purpose of the study was to obtain a design and flow condition which produced the best mixing homogeneity for two types of mixer. The study was conducted utilizing the finite volume method. The variation of methane concentrations were 60%, 70%, and 80%, while the biogas flow rates were varied between 0.45 to 1 kg/hour. The input material was modelled with the species transport model with diffusion inlet without reaction. The effect of three turbulence models was studied, namely the standard k-epsilon turbulence model, k-epsilon RNG and k-epsilon realizable. From this study, it was found that the use of all turbulence models did not show a significant differences in calculation results. It was also found that the mixer-1 has a better homogeneity than the mixer-2 with the homogeneity in order of 80%. It was also found that with the higher the biogas flow rate, the higher the mixing homogeneity.

Keywords: biogas, homogeneity, mixer, mixing, computational
Swirling Number Effect on the Mixing Quality of Air-CNG Mixture in the Intake Manifold of CNG-Diesel Dual Fuel Engine

Nazaruddin Sinaga¹,a, Bambang Yunianto¹,b, Eflita Yohana¹,c, Maizirwan Mel²,d, and Hamdani Umar³,e

¹ Diponegoro University, Indonesia
² International Islamic University Malaysia, Malaysia
³ Universitas Syiah Kuala, Indonesia
Email: a nsinaga.ccfed@yahoo.com

Swirling flow is widely used in engineering applications. It can increase the turbulence intensity and the mixing homogeneity. Its application in the intake side of the dual fuel biogas-diesel engine is expected to significantly improve engine performance and efficiency as well as the quality of exhaust gases. This research was intended to numerically study the effect of swirling and Reynolds numbers on the mixing process in the intake manifold of a small dual fuel CNG-diesel engine. The study aims to find out the relation among the swirl number, methane concentration, Reynolds number and the mixing homogeneity in the intake duct. The swirling number were 0 to 1.2, while the Reynolds number were varied between 150,000 and 250,000. The flow was modeled with the species transport, with diffusion inlet but without reaction, and the standard k-epsilon turbulence model. It was found that the swirling number had a significant effect on the mixing quality, where the higher the swirling number, the higher the turbulence intensity in the outlet region. The effect of Reynolds number showed a great influence on the tangential velocity of the mixed fluids, which provides the highest homogeneity. It can be concluded that the swirling and Reynolds number has a strong relationship with the mixing homogeneity.

Keywords: air-CNG, CNG-diesel, dual-fuel, mixing quality, swirling number
Aluminium is the most used metal after steel. It was caused the aluminum has low specific gravity and strength so the aluminum can withstand higher loads compared to steel at the same weight. Recently requirements to improve the strength of aluminum is very urgent to reduce consumption of metals (aluminium). One method can be used to increase the strength of aluminum is to reduce grain size. Reducing grain size in an aluminum can be done by thermomechanical process. This process requires high internal energy, the biggest internal energy source is obtained from the dislocation. High dislocation density can be achieved with deformation low temperature even a cryogenic temperature. In this research, the dislocation density measured with lattice strain. The material of this research was technical pure aluminium with length 100 mm, width 10 mm and height 10 mm respectively. The deformation process carried out with impact testing machine and the temperature process was 0, 25, -50 and -75 °C. The deformation predicted with microhardness test and lattice strain calculated from X-ray diffraction.

The test results showed the highest increment of lattice strain was obtained from the deformation process at a temperature of -50 °C. It is due to decreasing temperature make the dislocation more difficult to move and will increasing Lattice strain. The plastic deformation process at a temperature of -75 °C only increasing lattice strain slightly compared to the deformation process at a 50 °C. The increasing lattice strains were similar to increasing aluminum hardness.

Keywords: Aluminium, temperature, lattice strain, XRD
Experimental Investigation of Blades Number of Savonius Water Turbine on Performance Characteristic

Dwiseno Wihadi¹,a and Stefan Mardiku¹,¹

¹Sanata Dharma University, Yogyakarta
Email: a) stefan@usd.ac.id

The use of water energy in irrigation channels has not been widely carried out. Water and air are very important types of fluid. Beside main support of human life, water is energy producer which has long. Water energy conversion in channels does not cause substantial losses, problem of sound, space optimization. This experimental investigate the effect of blades number in Savonius water turbine to show the performance of turbine. Turbine is conducted with 2, 3, and 4 blades with 8 meters of water channel. The result showed that blades number of 2 can more improve than 3 or 4 of blades number the performance of water turbine which are represented by power coefficient and tip speed ratio.

Keywords: Savonius turbine, water energy, blades number.
Design and Aerodynamics Analysis of Rear Wing Formula Student Car Using 3 Dimension CFD (Computational Fluid Dynamics)

Mohammad Arief Dharmawan¹, Dominicus Tjahjana¹,a), Budi Kristiawan¹, Sarah Pertiwi¹

¹Mechanical Engineering Department, Universitas Sebelas Maret, Surakarta, Jawa Tengah, Indonesia 57126, Indonesia
Email: a) ariefd@student.uns.ac.id, b) danar1405@gmail.com

The Formula SAE is competitions which held by Society of Automotive Engineers. The Formula SAE competition challenge teams of university undergraduate and graduate student to design, develop and compete with a small formula-style vehicle. Aerodynamics is crucial at these series of events to demonstrate the high performance of the vehicle. Aerodynamic packages such as rear wing are significant to produce downforces so slips are reduced and increases cornering and braking performances. The objective of the research was to study the aerodynamic comparison between added rear wing by using Eppler 423 Airfoil in a different angle of attack. The rear wing is attached on Ahmed body with 30° rear slant which is scaled as formula student car. These studies were done in three dimensional (3D) computational fluid dynamic (CFD) simulation in 3 different velocities. The results of these researches are the best angle of attack at 12°. At this angle of attack has lift coefficient -0.4516 and drag coefficient 0.4253.

Keywords: Formula Student, Aerodynamics, Rear Wing, Eppler E 423, Computational Fluid Dynamic (CFD), Ahmed Body, Lift Coefficient, Drag Coefficient.
ME-257

The Effect of Vegetable Oil Pressure on The Mist Cooling Mist on The Steel Surface Roughness that is Processed ith A Milling Machine

Mahfud Ihsan\textsuperscript{1,a}, Aminnudin Aminnudin\textsuperscript{1,b} and Yanuar Rohmat Aji Pradana\textsuperscript{1,c}

\textsuperscript{1} State University of Malang, Indonesia
Email: \textsuperscript{b} aminnudin.ft@um.ac.id

The machining process in the manufacturing industry has developed very rapidly. Conventional machining process is the solution when the work piece is not effective if it is done using a non-conventional machine. The conventional process is an option because the process is simple and costs are low. One of the most versatile conventional machines for metal cutting is the milling machine. The milling process in the manufacturing industry is a process that is often used because many complicated processes can be done using this machine. During the refining process, it takes the cooling process. One of the cooling methods during the metal cutting process is mist cooling. In this research, we used vegetable oil as a coolant.

This research method is by experiment. This study aims to determine the results of the surface roughness of St60 steel using variations of spindle rotation (360, 490 and 720 rpm), temperature pressure on mist cooling (0.5; 1.5 and 2.5 bar), feeding speed 75 mm /min, using the method of upgrading up milling. The research finding showed that the highest or roughest surface roughness level occurred at 360 rpm spindle rotation with pressure on 1.5 bar mist cooling with an average (Ra) of 2.65 µm. While the lowest level of surface roughness is at 720 rpm spindle rotation with pressure on 2.5 bar mist cooling with an average (Ra) of 1.29 µm. It can be seen that the mist cooling pressure greatly affects the surface roughness.

Keywords: Mist cooling, milling, vegetable oil, roughness
ME-259

The Effectiveness of Minimum Quantity Lubrication (MQL) SiO$_2$ Nanoparticle Enriched Cutting Fluids in Milling Process of Hardened Steel

Sukmaji Indro Cahyono

1Mechanical Engineering Department of Sebelas Maret University, Indonesia Vocational Study of Mechanical Engineering Sebelas Maret University, Indonesia

Email: *sukmaji@ft.uns.ac.id

Automotive part such as shaft and gears are commonly produced by flame hardened of carbon steel medium. The increases of temperature in critical milling zone while machining process effect to the quality of workpiece and tool head. Decreasing the critical milling zone temperature by employed cutting fluid will increase the health risk of the operator and threaten environment. Enriched cutting fluid using SiO$_2$ nanoparticle in minimum quantity lubricant (MQL) system as proposed solution was investigated in present paper. Mist the enriched cutting fluid are prayed on the surface of workpiece and tool head in the milling process. The SiO$_2$ volume fraction parameter are varied to achieved the optimal combination between concentration and process. The surface quality of workpiece was measure by surface roughness standard testing and tool wear index was compared by image processing in Matlab. The temperature in critical milling zone are recorded to measure cooling performance of MQL process. Finally the improvement of enriched cutting fluid and MQL system become reference to the common rail diesel part production in diesel engine automotive industry.

**Keywords:** Minimum Quantity Lubricant, nano-lubrication, enriched cutting fluid.
ME-261

Numerical Solution of Forced Convection in Fluid Darcy-Brinkman-Forchheimer Porous Medium using The DMLPG Method

Pranowo Pranowo¹ and Agung Tri Wijayanta²

¹ Universitas Atma Jaya Yogyakarta, Indonesia  
² Sebelas Maret University, Indonesia  
Email: ¹ pran@mail.uajy.ac.id

Laminar forced convection heat transfer inside a porous channel is carried out numerically. The Darcy-Brinkman-Forchheimer model is used to describe the single phase fluid flow in a porous medium. The model and the energy equation are discretized by Direct Meshless Local Petrov–Galerkin (DMLPG) method using pressure-correction scheme on colocated nodes. The algebraic equations were solved iteratively using GMRES method. The DMLPG method is truly meshless method based only on number of arbitrarily scattered nodes. The numerical results have been compared with the analytical solutions and obtained numerical data. The comparisons show that the proposed method is highly accurate.

Keywords: forced convection, porous medium, DMLPG method
Characteristics of Successive Droplets Impacting The Aluminum Hot Surface around The Nucleate Boiling Region

Arif Widyatama\(^1,a\), Akmal Irfan Majid\(^1\), Teguh Wibowo\(^1\), Deendarlianto\(^1\) and Samsul Kamal\(^1\)

\(^1\) Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada, Indonesia
Email: \(^a\) Arifwidyatama@ugm.ac.id

The purpose of this research is to investigate the phenomena of successive droplets impacting the aluminum hot surface. It is understood that each region produces different behavior therefore depth investigation is essentially needed. This research will be useful to support the development of metal industry especially in the spray cooling area. In the present work, the Aluminum is used as the material. The surface temperature ranged from 110°C - 240°C where the regime of onset boiling occurs. The droplet diameter was 2.8 mm. In addition to spreading ratio and apex height, the contact angle and the spreading velocity is also measured by using a specific image processing technique. This sequence algorithm works on the basis of the binary recognition process where the object is marked as the white color and the black color represents the background. It is supported with high speed video camera data captured on 2000 fps. As a result, the obtained quantitative data successfully reveals the behavior of the successive droplets and can support the further heat transfer analysis study to achieve the most effective spray cooling condition in the aluminum hot surface.

**Keywords:** successive droplet, spray cooling, hot surface
ME-268

Analysis of The Effect of Magnesium Addition in All-Si Alloy using Steer Casting Method on Physical and Mechanical Properties

Teguh Triyono¹,a, Eko Surojo¹,b, and Vicky Tri Utomo¹

¹Universitas Sebelas Maret, Indonesia
Email: a teguhtriyono@staff.uns.ac.id, b ekosurojo@staff.uns.ac.id

The stir casting process is the union of particles into molten metal with mechanical stirring, then poured into the mold. This study aims to determine the effect of adding magnesium on Al-Si alloys using the stir casting method on tensile strength, hardness, and microstructure. The process of making specimens using the stir casting method with a speed of 400 rpm for 5 minutes at a temperature of 650°C with a variation of 1%, 1.5%, 2%, 2.5% Mg from the weight fraction and pouring temperature 725°C. Tests carried out include tensile testing, hardness and microstructure. Testing of tensile strength using the ASTM E8 standard, hardness testing using the ASTM E10 standard and microstructure using the ASTM 407 standard. The results of microstructure testing showed that the increasing Mg there was the presence of Mg2Si precipitates in Al-Si alloys. The presence of Mg2Si precipitates resulted in increased mechanical properties of aluminum alloy. This is evidenced by the results of testing tensile strength and hardness increasing with increasing variation of Mg used. The highest tensile strength value was obtained in the addition of 2.5% Mg which was equal to 149.35 N / mm² and the highest hardness value was obtained in the addition of 2.5% Mg which was equal to 85.05 BHN.

Keywords: AlSi Alloy, Magnesium, Stir casting, Tensile Strength, Hardness
The research of design and technology of wind turbine for electricity developed rapidly due to environment negative effect of fossil fuel power pant. Based on the advantage such as low sound, low average wind speed, no harm to the bird, low manufacturing cost and installation, the savonius wind turbine are highly potential to choice. Despite it have high negative torque and low efficiency with Coefficient of performance (Cp) range between 0.12-0.18, a researcher established the review of augmentation techniques as problem solver. The highest Cp was reached to 0.52 with complex design. The design of augmenter with was compared but rotor dimension and number of blade were different and make it difficult to observe in detail. The present paper investigate the designs of various augmenter by using CFD software. The number of blade, sweep area and dimension are same. The TSR versus Cp for various augmenter become reference to the user to choice the proper design for their electricity power plan.

Keywords: CFD, Augmentation technique, tip speed ratio, coefficient of performance.
ME-272

The Performance Evaluation of Horizontal Twin Screw Conveyors for Grain Collector Machine Application

*Cahyono, SI\(^1\,^2\). T T

\(^1\)Mechanical Engineering Department of Sebelas Maret University, Indonesia
\(^2\)Vocational Study of Mechanical Engineering Sebelas Maret University, Indonesia

Email: *sukmajji@ft.uns.ac.id

The agriculture product have high sensitivity to the water content or humid air for storage in certain time. After harvesting the agriculture product such as paddy grain the requirement of drying process are must to prevent fungus or insect while storage. In mass production and harvesting in a short time, the drying process use solar heat as energy source. In tropical country such as Indonesia, the weather condition is difficult to predict and it required high capacity of grain collector machine to collect dried grain in a field dryer. The present paper is focusing on the evaluation of horizontal twin screw conveyors performance with covering a half tubular casing. The space between cover and screw conveyor, torque and rotation speed are influenced significantly to the motion of the paddy grain. An analytical mathematic are approach to predict the capacity performance of screw conveyor instead of CFD simulation of vortex motion the paddy grain inside the conveyor was illustrated.

Keywords: Horizontal screw conveyor, vortex motion, CFD, Collector machine.
The characteristics of each component of a different aircraft such as the hexagonal bolt which functions to combine several components into one part that has a non-permanent nature. This requires that the component must be heat resistant, corrosion and high hardness, to determine the microstructure and chemical composition of the hexagonal bolt then testing. This study uses quantitative research methods, namely the use of some quantitative data obtained from the test results to be processed in a table with the results of testing Microstructure and Chemical Composition on the hexagonal bolt. Microstructure testing on hexagonal bolt components is shown to be more dominant in the pearlite phase than the ferrite phase. The chemical composition of the hexagonal bolt shows that Iron (Fe) = 97,0%; Carbon=0,445%; Manganese (Mn) = 0,884%; Chromium (Cr)= 0,479%; Silicon (Si)= 0,241%; Molibdenum (Mo)= 0,201%; and Nickel (Ni)= 0,357% are medium carbon steel. Correlation between microstructure testing and chemical composition in hexagonal bolt components material has high heat resistance, corrosion resistance, and has a high hardness because more pearlite phases and the composition of iron (Fe) and manganese (Mn) that form material properties. Manganese (Mn) has corrosion resistance properties, increases material strength, and makes component durable. Therefore the strength of the hexagonal bolt is very important and the addition of several elements that help the properties of the main element.

**Keywords**: Hexagonal bolt, microstructure, cessna, and chemical composition.
Electrical Engineering
Analysis Curve of Maximum Power and Torque Turbine Generated by Vertical Axis Wind Turbine Based on Number of Blades

Langlang Gumilar\textsuperscript{1, a)}, Muhammad Afnan Habibi\textsuperscript{1, b)}, Dwi Prihanto\textsuperscript{1, c)}, Hendro Wicaksono\textsuperscript{2, d)}, Jade Rosida Larasati\textsuperscript{1, e)}, Achmad Gunawan\textsuperscript{1, f)}

\textsuperscript{1}Electrical Engineering, Faculty of Engineering, Universitas Negeri Malang, Jalan Semarang 5, Malang 65145, Indonesia

\textsuperscript{2}Departement of Industrial Engineering, Jacobs University, Bremen, Germany

Email: \textsuperscript{a)}langlang.gumilar.ft@um.ac.id, \textsuperscript{b)}afnan.habibi.ft@um.ac.id, \textsuperscript{c)}dwi_prihanto@um.ac.id, \textsuperscript{d)}h.wicaksono@jacobs-university.de, \textsuperscript{e)}Jaderosida97@gmail.com, \textsuperscript{f)}ahguneer@gmail.com

Renewable energy have advantages such as free of air pollution and the availability of energy source always available in nature. Problem that is currently trending is how renewable energy technology can produce as much power as possible. For this reason researchers continue to develop renewable energy technologies. In this article the vertical axis wind turbine (VAWT) performance will be presented to produce power with variations in the number of blades. The goal is to obtain higher output power than previous research. Wind turbines with different number of blades will produce different output power as well. The experiment will use turbines with 2, 3 and 4 blades. The different number of blades will affect the value of the turbine power constant (Cp), this value is very influential on the output power and torque turbine. The results of this research are for vertical turbine with 2 blades, produce a maximum power 489.48 W and torque 17.35 N.m. In the turbine with 3 blades, produces a maximum power 499.89 W and torque 17.72 N.m. The next for the turbine with 4 blades, produces maximum power 516.43 W and torque 18.3 N.m. The maximum power of VAWT with 4 blades 516.43 W in this research is higher than the maximum power in previous research 505.69 W. The maximum power of the turbine is obtained when the turbine at rotation speed 33 rpm, while the largest torque can be generated when the turbine at rotation speed of 25 rpm.

Keywords: VAWT, Power, Torque, Blade, Wind
Optimalization Harmonic Shunt Passive Filter Using Detuned Reactor and Capacitor Bank to Improvement Power Quality in Hybrid Power Plant

Langlang Gumilar\textsuperscript{1,a)}, Denis Eka Cahyan\textsuperscript{2,b)}, Arif Nur Afandi\textsuperscript{1,c)}, Dezetty Monika\textsuperscript{3,d)}, Stieven Netanel Rumokoy\textsuperscript{4,e)}

\textsuperscript{1}Electrical Engineering, Faculty of Engineering, Universitas Negeri Malang, Jalan Semarang 5, Malang 65145, Indonesia
\textsuperscript{2}Informatic Engineering, Faculty of Math anf Science, Universitas Sebelas Maret, Jalan Ir. Sutami No.36 A, Surakarta, Jawa Tengah 57126, Indonesia
\textsuperscript{3}Electrical Engineering, Politeknik Negeri Jakarta, Jalan Prof. DR. G.A. Siwabessy, Kukusan, Beji, Depok, Jawa Barat 16424, Indonesia
\textsuperscript{4}Electrical Engineering, Politeknik Negeri Manado, Jalan Raya Kampus Politeknik, Buha, Manado 95254, Indonesia

Email: \textsuperscript{a)}langlang.gumilar.ft@um.ac.id, \textsuperscript{b)}denis.eka@staff.uns.ac.id, \textsuperscript{c)}an.afandi@um.ac.id, \textsuperscript{d)}dezetty.monika@elektro.pnj.ac.id, \textsuperscript{e)}rumokoy@polimdo.ac.id

In electric power systems generally not only consists of one type of power plant, but consists of various types of power plants such as power plants with fossil fuel sources and renewable energy sources. To utilize wind power plants and solar panels, storage media such as batteries are needed. The charging and discharging process requires a power electronic device. As is known that power electronic devices consist of materials or nonlinear loads made of semiconductor materials that can cause harmonics in the electric power system. This research was conducted in the laboratories of the G4 Building, Department of Electrical Engineering. The G4 building is also interconnected with grids, wind power plants, solar panels and backup generators. The combination of all nonlinear loads creates high harmonics. To mitigate harmonics and reduce Total Harmonic Distortion-Voltage (THD-V) value a harmonic filter is needed. Passive harmonic filters have a disadvantage, namely that one passive harmonic filter can only mitigate one dominant order of harmonics and the value is predetermined. This article will discuss optimization of passive shunt filters using detuned reactors and capacitors bank or can be called Shunt Hybrid Power Filters (SHPF). The purpose of optimization is to improve the performance of shunt passive filters to be more effective and efficient in mitigating harmonics with THD-V values that are fluctuate and dominant harmonic orders that change as well as in harmonic active filters. In the research method, 3 scenarios will be made as comparison in the final results. From the test results in scenario 1, optimalization shunt passive filter using detuned reactor and capacitors bank (SHPF) was able to reduce THD-V from 16.65% to 2.61% with 5th order dominant. In scenario 2, the SHPF is able to reduce the THD-V from 19.74% to 3.04% with the 7th order dominant. In scenario 3, SHPF was able to reduce the THD-V from 28.04% to 3.36% with an 11th order dominant. From all the simulation results, it can be concluded that optimization shunt passive filter using detuned reactors and capacitors bank is still able to mitigate harmonics with high THD-V values and dominant orders that change even though the parameters of SHPF are the same as the previous scenarios. Improved shunt passive filter harmonic performance after being optimized with detuned reactors and capacitors bank can approach the performance of harmonic active filters.

Keywords: Harmonic, THD, Nonlinear Load, Mitigation, Power Plant
EE-057

Preliminary Research of Surface Electromyogram (sEMG) Signal Analysis for Robotic Arm Control

Pringgo Widyo Laksono\textsuperscript{1,2,a)}, Minoru Sasaki\textsuperscript{2,b}, Kojiro Matsushita\textsuperscript{2,c}, Muhammad Syaiful Amri bin Suhaimi\textsuperscript{2,d}, and Joseph Muguro\textsuperscript{2,3, e)}

\textsuperscript{1}Department of Mechanical Engineering, Gifu University, Yanagido 1-1, Gifu, Japan

\textsuperscript{2}Department of Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

\textsuperscript{3}Department of Electrical Engineering, Dedan Kimanthi University of Technology, Nyeri, Kenya.

Email: \textsuperscript{a)}x3912008@edu.gifu-u.ac.jp, \textsuperscript{b)}sasaki@gifu-u.ac.jp, \textsuperscript{c)}kojirom@gifu-u.ac.jp, \textsuperscript{d)}syaiful_1076@hotmail.com, \textsuperscript{e)}muguro.joseph@gmail.com

Human-robot interactions have gained popularity in the recent past, particularly in the advent and revolution of industry 4.0 era. There are still open research issues to be addressed, e.g., human-machine interaction, especially in robotic operation using bio-signal. This paper presents surface electromyography (sEMG) signal analysis of the motion of upper limb muscles. The objective is to highlight the difference of sEMG signal produced by various upper limb motions using basic signal processing. The overall target is how this information can be applied to a robot control scheme. Three motions are proposed based on the 2 degrees of freedom (DOF) between joint elbow and shoulder. Three sEMG channel signal is captured using a DAQ unit comprising of pre-amplifier and NI USB 6008 and a laptop running LabVIEW software. The analysis is conducted using Matlab software. The result indicates that the sEMG signal produced a characteristic feature that can be applied for controlling the robotic arm more intuitively.

Keywords: Human-machine interactions, sEMG, signal processing.

Amin Suhaajo^1,a), Roni Apriantor^1,b), Muhammad Mukhlisin^1,c), Ariaji Prichi Gamayuda^1,d), Annissa Mahardika^1,e) and Galih Prasetyo^1,f)

^1) Politeknik Negeri Semarang, Indonesia

Email : a) amin@polines.ac.id, b) amin@polines.ac.id, c) mmukhlis2@gmail.com, d) ariaji.prichi@gmail.com, e) amahardika88@gmail.com, f) a8_galih@yahoo.com

Water is a natural resource that has an important role in life. One source of water that is often used comes from rivers. However, in the process of drainage, there is often pollution in the form of chemicals and domestic waste. In addition, without good management, river water can also cause disasters such as floods. Therefore, it is necessary to have an integrated system that has real-time monitoring capability of the quality and the level of river water which interconnected to cloud media to prevent these problems. To get information on river water quality and its level, sensors with high accuracy are needed.

The purpose of this research is to test the accuracy of the sensors installed in the prototype flood detection and river water quality monitoring system. So the information delivered is in accordance with reality.

The accuracy is tested on pH sensors, EC sensors, ultrasonic sensors, and temperature sensors. The average ultrasonic sensor measurement error is 0.045%, the average measurement of the pH sensor error is 0.121%, and the average temperature sensor error measurement is 0.315%. While the average sensor EC measurement error is 0.315%.

Keywords : sensors, river water, cloud, accuracy
EE-066

Human-Machine Interface for Game Control Using Neck SEMG Signal

Joseph Muguro$^{1,2,a}$, Minoru Sasaki$^{1,b}$, Kojiro Matsushita$^1$, Waweru Njeri$^{1,2}$, Pringgo Widyo Laksono$^{1,3,c}$, and Muhammad Syaiful Amri$^1$

$^1$Department of Mechanical Engineering, Gifu University, Yanagido 1-1, Gifu, Japan
$^2$School of Engineering, Dedan Kimanthi University of Technology, 657-10100, Nyeri, Kenya
$^3$Department of Industrial Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

Email: $^a$ x3912104@edu.gifu-u.ac.jp, $^b$sasaki@gifu-u.ac.jp, $^c$pringgo@ft.uns.ac.id

In the recent past, surface Electromyography (sEMG) signals has been effectively applied in control interfaces for robots, prosthetic hands, legs and other areas. Few works has focused on neck EMG control in spite of the neck being central to human movements and engagements. We propose a neck EMG model that estimates head movements and apply the signals to control a game developed in Unity 3D engine. The game involves randomly falling and accelerating objects. The user slides the paddle using neck EMG to intercept as many objects. EMG signal is rectified and FIR filtered and used to control the position of a sliding probe of the game in real-time. The results confirm the applicability of the interface and ease of use in that there is little or no calibration needed. The control interface, which is intuitive and computationally low cost in implementation can be applied in multiple areas that involve neck activity. The system can be applied in control, rehabilitation as well as gaming interface to enable entertainment for the disabled.

**Keywords:** Unity3D engine, HMI, sEMG, Game control
EE-067

Analysis of Load Flow and Continuous Power Flow Method with Static VAR Compensator (SVC) for Static Voltage Stability Analysis
A Case Study of 500 KV Java-Bali Electrical Power System

Chico Hermanu Brillianto Apriboiw, Oktavian Listiyanto, Muhammad Hamka Ibrahim, Agus Ramelan, and Joko Slamet Saputro

1Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
Email: a) chico@ft.uns.ac.id

Demand for electricity is increasing rapidly, the consequence of this is a threat to the stability of the electrical system, one of which is the voltage stability. FACTS or flexible alternating current transmission system is electronic equipment capable of regulating electrical power transmission that can be used to overcome stability problems. This study will analyze the comparison of SVC use with UPFC as an equipment model from FACTS to overcome the stability of the electric power system on the most critical buses. Simulations are carried out using PSAT using a case study: a 500 kV Java-Bali network. Then the stability of the voltage is observed using the help of the PV curve which can show the value of the voltage conditions in each operating condition. SVC installation in the Java-Bali 500 kV case does not reduce the active power losses or reactive power, but also the addition of length λ is 0.233 p.u. (6.01%) and compared to the addition of length λ in the UPFC of 0.38 p.u. (9.82%) and there is a reduction in active power losses of 0.002 p.u. or 0.203% but there is an increase in reactive power losses of 0.007 p.u. or equal to 0.676%.

Keywords: Static Var Compensator (SVC), Unified Power Flow Controller(UPFC), and Flexible Alternating Current Transmission System (FACTS).
Simulation Single Fuzzy Logic Controller in Maximum Power Point Tracking

Fajar Budi Utomo¹, *)

¹) Research Center for Standardization and Human Resources, National Standardization Agency of Indonesia
Email: *)fajarbudiu@gmail.com

With the emergence of issues about the energy crisis, global warming and pollution, the use of renewable energy began to be improved. Solar panels are one of the renewable energy sources that are easy and widely utilized. One of the problems of using solar panels is the efficiency problem. In this paper presents design and simulation maximum power point tracking (MPPT) with single fuzzy logic controller (SFLC). Based on the simulation results, MPPT with SFLC can work properly despite any disruption.

Keywords: Renewable Energy, MPPT, and Single Fuzzy Logic Controller.
Automated Guided Vehicle Implementation as Urine Volume Monitoring and Waster Based Internet of Things

Daniel Aquino Purba\textsuperscript{1,\textit{a)}} Muhamad Iqbal Zidy\textsuperscript{2,\textit{b)}} Muhammad Hamka Ibrahim\textsuperscript{3,\textit{c)}}

\textsuperscript{1}Department of Electrical Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
\textit{a)}} aquinodothebest@student.uns.ac.id, \textit{b)}} miqbalzidny5@gmail.com \textit{c)}} hamka@staff.uns.ac.id

This article explains about designing Automated Guided Vehicle robot based line follower that will be implemented on health care system to waste urine in potty. Patient that lay down in hospital bed causing decreasing of their mobility to go to the toilet. Potty used to collect urine from patient so that urinating can be done in bed without going to the toilet. After couple time, urine that collected in potty have to be wasted. Automated Guided Vehicle (AGV) is a robot which can move automatic and delivering object, with a work principle of line follower robot combined by arm robot, this robot can bring potty with urine, and recording data urine produced by patient and waste it automatic.

\textbf{Keywords:} Potty, Line follower, Internet of Things, and Automated Guided Vehicle
Utilization of Bluetooth Wireless for SOFC Test Rigs with Android Smartphone Device

Darjat¹,², Sulistyo², Aris Triwiyatno¹, Hot Asi¹

¹Department of Electrical Engineering, Diponegoro University, Semarang, Indonesia
²Department of Mechanical Engineering, Diponegoro University, Semarang, Indonesia
Email: ¹dr.darjat@gmail.com

Currently, smartphone android device is commonly used because it has powerful hardware and several of useful features. This hardware can be combined for monitoring performance measurement test of solid oxide fuel cell (SOFC). The purpose of this research is to develop monitoring wireless device through bluetooth connectivity along with the application interface android smartphone device and the operating system for the completeness of equipment test (SOFC). Method developed is performance measurement of SOFC associated with android Smartphone system device. Measured variable are such as operating temperature 1000oC, current, voltage, and resistance directly (real time). This system consists of data acquisition device by using arduino microcontroller which is integrated with current sensor, thermocouple, voltage divider, RTC, memory (SD Card) and bluetooth. Android smartphone device and the operating system through the features that have been designed in this research are able to monitor and measure the performance of SOFC directly (real time) through the wireless network bluetooth.

Keywords: SOFC, bluetooth, android, smartphone
Evaluation the performance of low-frequency vibration calibrator.

Fajar Budi¹,*, Bondan¹, Chery Chaen¹, Maharani Ratna¹

¹Research Center for Standardization and Human resources, National Standardization Agency of Indonesia

Email: *) fajarbudiu@gmail.com

In 2017, the Research Center for Metrology developed a low-frequency vibration calibrator. This calibration system is composed of mechanical and control components. The mechanical component consists of a DC motor and vibration table, and the control component consists of a microprocessor. The type of control used is open-loop control. In this paper, an evaluation of the calibration system is presented. The method used to evaluate is to use system simulation and testing. The tested frequency is 0.5-1.5 Hz. Based on the results of simulation and testing, it is known that there are differences in the output frequency between control components and mechanics.

Keywords: Low-frequency vibration calibrator, Evaluation, and Performance
Optimal Energy Control of DC Motor using Fuzzy Logic Controller to Supervise PID Control

Hari Maghfiroh\textsuperscript{1,a), Hamka Ibrahim\textsuperscript{1,b) and Ryoki Maftuadi\textsuperscript{1,c)}}

\textsuperscript{1}Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

Email: \textsuperscript{a) hari.maghfiroh@gmail.com, \textsuperscript{b) hamkanen@gmail.com, \textsuperscript{c) martfuadiryoki@student.uns.ac.id,}}

Electric motor, both AC and DC, is an actuator that is widely used in industry. However, both of them have different characteristics. DC motor has some advantages such as easy to control the speed and position [1][2][3]. DC motors are widely used in steel rolling mills, electric trains, electric vehicles and robotic actuators [2][4]. Research in DC motor speed control has been done by a lot of researcher that only base on performance viewpoint as in [5]. Maghfiroh et.al. [6] investigates the performance of three control method which are PID, Fuzzy, and LQR in DC motor control in both performance and energy viewpoints. They conclude that LQR has better result both in performance and energy. In this paper, we propose PID control supervised by Fuzzy Logic Controller (FLC). FLC supervise PID to eliminate the drawback of PID which is small control range and to control the energy used by PID control. Therefore, PID control become adaptive and the control energy can be maintained. Figure 1 illustrates the connection of experimental component used.

Keywords: DC Motor, Motor Control, PID, Fuzzy
The existence of electric vehicles is believed to be a solution to solve issues in the transportation sector nowadays. The development of electric vehicles that are rapidly growing is the motive of the author to conduct research in analyzing the use of power consumption in electric car prototypes. Research is carried out by focusing on data processing from two fundamental components in an electric vehicle, which are the battery and electric motor.

The motor used in this car is 2 kW brushless DC (BLDC) motor type and lead acid battery. A controller will be used in order to regulate the operation of the electric motor. The research was conducted successfully with two methods: operation of electric car without load and with load on the road. In conditions with no load, the average motor power is obtained at 229.7 watts; in conditions with load on the road, the average motor power is obtained at 639.7 watts. The power efficiency obtained during the test gets a percentage value of up to 84.30%.

Keywords: Electric vehicle, Brushless motor, Motor controller, Lead acid, Motor power, and Power efficiency.
Analytical Study of Temperature Effect on Current and Voltage of Battery at Charging and Discharging Condition on Electric Vehicle

Sifa’Us Wulaning A.1), Miftahul Anwar1),*), Ferdiansyah Ashil F.1), Jusuf Abimas P.1), Irwan Iftadi1), Sunarto Kaleg2), Abdul Hapid2), Sukmajii Indro Cahyono3), and Kuncoro Diharjo3)

1)Universitas Sebelas Maret, Indonesia
2)Research Center for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia
3)Department of Mechanical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia
Email: *)miftahwar@ft.uns.ac.id

Electric vehicle uses batteries as an energy source to drive electric motors. Lead-acid battery is a battery used since the first appearance of electric vehicle on the late 1800s. But the battery is heavy, could only travel for short distance and need long time to charge, so people back to using conventional vehicle. This research was conducted to see the relation between battery temperature with battery current and voltage to find the factors that could make batteries perform better. Censors of current, voltage and temperature installed on each battery to monitor the values during charging and discharging in flat and rising road. Mathematical calculations are performed to determine the capacity and voltage values of each battery cell. The result of this research is temperature value increase when batteries supply higher current to electric motor, while voltage is decreasing, also the value of battery capacity has dropped dramatically when the battery temperature exceeds 60℃. By that, to increase battery performance, current that supplies electric motor needs to be limited by adding the gear box, use constant current method for charging and cooling device could be added to certain battery cell that experienced highest temperature rise.

Keywords: Electric vehicle, Lead acid, Battery Temperature, Battery Current and Voltage, SOC, Monitoring System, Charging/Discharging, MATLAB, and Simulink
Desain and Simulation Linear Quadratic Gaussian (LQG) for Pan-Tilt Face Tracking Camera Servos

Agus Ramelan\textsuperscript{1,}\textit{a)}, Joko Slamet Saputro\textsuperscript{1,}\textit{b)}, Chico Hermanu Brillianto Apribo\textsuperscript{1,}\textit{c)}, Muhammad Hamka Ibrahim\textsuperscript{1,}\textit{d}) and Subuh Pramono\textsuperscript{1,}\textit{e})

\textit{1)}Universitas Sebelas Maret, Indonesia
Email: \textit{a)} agusramelan16@gmail.com, \textit{b)} jssaputro89@gmail.com, \textit{c)} chico@ft.uns.ac.id, \textit{d)} hamkanen@gmail.com, \textit{e)} subuhpramono@gmail.com

The 2DOF face tracking system consists of two servo motors (pan and tilt) and a camera. Both are integrated with each other and are tasked with accurately tracking each facial movement. The high performance of the system depends on the desired specifications, that is the servo can move smoothly according to facial movements. Therefore it is necessary to design an appropriate servo control method. This paper presents the Linear Quadratic Controller (LQG) control method that is simulated to the servos. The design steps include system modeling, LQG control design, and simulation. The LQG control method is one of the optimal control methods, so this paper also discusses the basic principles of optimal control design. The output of the paper can be a reference in the implementation of the servo control system that will be connected with a face tracking control system.

Keywords: Face tracking, Linear Quadratic Gaussian, Pan and Tilt Servos.
EE-113

Design and Development of Realtime and Portable Water Quality Monitoring System for Agriculture Irrigation

Yuana Ayub Sunarya¹,α), Muhammad Hamka Ibrahim¹,β), Chico Hermanu¹,γ), Subuh Pramono¹ and Meiyantra Eko Sulistyo¹

¹)Sebelas Maret University, Indonesia
Email : α)ayub@student.uns.ac.id, β)hamka@staff.uns.ac.id, γ)chico@ft.uns.ac.id

Water pollution in developing countries continues increase every year, almost every river as one of water sources have been polluted from low to high levels. Polluted river water unconsciously used by agricultural business actors as an irrigation source for their agricultural land which indirectly causes damage to yields and planting media. In order to find out the quality of irrigation water used, a minimum parameter of quality of irrigation water is needed, namely pH, TDS, and temperature. The parameter value is sent to smartphone via bluetooth connection and can also be accessed through the website because the device can be connected to the internet. The parameter data can be stored in graph files or tables. This device successfully measures pH, TDS, and irrigation water temperature accurately with an accuracy rate of + 5% with an optimal distance of 7 meters with bluetooth connection and with a 720 mAh battery, this device can be used continuously for 2 hours in full working condition. Energy usage when device is fully work are 1.09 watts. This device can continuously monitor the quality of irrigation water used, so agricultural entrepreneurs can control the water used for irrigation sources better.

Keywords : Water pollution, bluetooth, pollution monitoring and irrigation water.
IDENTIFICATION OF EXISTING DORMITORY BUILDING POTENTIAL TO BECOME GREEN BUILDING IN EFFICIENCY AND ENERGY CONSERVATION ASPECT

Anis Rahmawati¹,a), Taufiq Lilo Adi Sucipto²,b), Muhammad Kunta Biddinika³,c) and Rosi Marta Da Huba²,d)

¹)Lecturer / Researcher, Indonesia
²) Universitas Negeri Sebelas Maret, Indonesia
³) Tokyo Institute of Technology, Japan
Email : a) anisrahmawati@staff.uns.ac.id, b) taufiqlilo@fkip.uns.ac.id, c) mkuntab@gmail.com, d) rdahuba@gmail.com

Increasing energy consumption in the building sector has a negative impact on the environment. The green building concept is the answer to minimize the negative impact of buildings on the environment. The Green Building Council Indonesia (GBCI) establishes green building criteria where one aspect of its assessment is Energy Efficiency & Conservation (EEC) which is related to energy consumption saving. This article aims to identify the potential to become a green building in an existing student dormitory buildings through qualitative research with case studies in a student dormitory located in Surakarta. The results obtained indicate that the potential of the dormitory building to be developed to attain the green building criteria on EEC aspects according to GBCI standards are: the installation of kWh meters, take monthly kWh meter records, redact standard operating procedures of energy management, the implementation of a written energy saving campaign, acquire IKE electricity, the use of energy saving lamps, the implementation of energy audits, the preparation of guidelines for the operation and maintenance of building equipment systems, and the use of alternative power plants.

Keywords : Energy efficiency and conservation, existing student dormitory building, green building, and green building potentials
Design of A Telemedicine Robot using Behavior-Based Control Architecture

Nanda Ferdana\textsuperscript{a), Andi Adriansyah\textsuperscript{b), Setiyo Budiyanto\textsuperscript{c), Julpri Andika\textsuperscript{d)\textsuperscript{)}}

Department of Electrical Engineering, Universitas Mercu Buana Jl. Meruya Selatan, Kembangan, Jakarta 11650, Indonesia

Email: \textsuperscript{a)}nandaferdana39@gmail.com, \textsuperscript{b)}andi@mercubuana.ac.id, \textsuperscript{c)}sbudiyanto@mercubuana.ac.id, \textsuperscript{d)}julpri.andika@mercubuana.ac.id

Designing a telemedicine robot is a challenging task. Complexity, incomplete prior knowledge of the environment, and unexpected situations set strict requirements for both the hardware and software components of the robot. The robot should also have the ability to perceive and to handle inaccurate and imprecise sensors. Finally, the robot needs also to achieve high level and complex goals with an imperfect actuator at a limited time and fast response. Several robotics architectures have been proposed that try to cope with the above problems. Most of the architectural style described in the technical literature can be classified into four categories: deliberative control architecture, reactive control architecture, hybrid control architecture, and behavior-based control architecture. The behavior-based approach has been established as the main alternative to modern robot control. The paper will present the design and prototype of a telemedicine robot using behavior-based control architecture. The main function of this robot is to handle some action of medical processes and transport several materials within the hospital to reduce risks in the hazardous zone. Several behaviors will design to assist the robot, such as: remotely control, seeing the situation, and detecting obstacles when the robot maneuvers. Modeling and simulation of the robot with those behaviors have been performed and tested. After that, a prototype of a real robot also designed. The robot is built using ATmega2560, ESP01, motor drivers, and three ultrasonic sensors. Then the reading sensor results are processed to get the PWM value that corresponds to the distance of the legible barrier. Internet communication is used to control the robot remotely with GUI (graphical user interface) on computer devices. Based on some experiments performed, the behavior-based control architecture has a good performance for the telemedicine robot. The robot can do their tasks well, able to control remotely, seeing the situation, and maneuver according to plan with velocity control to avoid colliding.

Keywords: Telemedicine Robot; Behavior-based; Control Architecture
EE-153

Design and Development of PC-based Photovoltaic Test and Measurement Device for Photovoltaic Quality Inspection

Kharis Akbar Baharizky¹,a), Muhammad Hamka Ibrahim¹,b) and Muhammad Nizam¹,c)

¹)Sebelas Maret University, Indonesia
Email : a)16.kharis@gmail.com, b)hamka@staff.uns.ac.id, c)muhammad.nizam@staff.uns.ac.id

Photovoltaic (PV) generator is very suitable for use in Indonesia which has a solar radiation intensity of 4kWh / m² and has a practical system and installation. Therefore the number of PV generator uses continues to increase, especially in the household scale. But in the selection of solar panels to be used and knowing the performance of a solar power plant there is no specific system that can be used based on these two things. Therefore we need a device that can measure the power output of two solar panels at the same time to be compared and a performance monitoring system that displays the power generated by the PV systems along with the temperature and intensity of sunlight on the surface of solar panels practically and economically. Voltage, current, temperature, and light intensity are measured using sensors whose measurement data is processed by a microcontroller, then sent to display in LabVIEW and can be stored for analysis. The result is that this tool successfully tested two solar panels with different brands in standard conditions with a PV power of 11% greater than PV 2. For performance monitoring, the results of efficiency of PV 1 is 15.8% and PV 2 is 14.6%.

Keywords: Photovoltaic, Testing method, and performance monitoring
EE-157
Public Street Lighting Control and Monitoring System using Internet of Things

Andi Adriansyah\textsuperscript{a)}, Setiyo Budiyanto\textsuperscript{b)}, Julpri Andika\textsuperscript{c)}, Arif Romadlan\textsuperscript{d)}, Nurdin Nurdin\textsuperscript{e)}

Department of Electrical Engineering, Universitas Mercu Buana Jl. Meruya Selatan, Kembangan, Jakarta 11650, Indonesia
Email: \textsuperscript{a}) andi@mercubuana.ac.id, \textsuperscript{b}) sbudiyanto@mercubuana.ac.id, \textsuperscript{c}) julpri.andika@mercubuana.ac.id, \textsuperscript{d}) arif.rama18@gmail.com, \textsuperscript{e}) nurdin05@gmail.com

At present, public street lighting system control at most of the urban is only by manual control, a control switch set in each of the streets lamps which are inefficient in power consumption and a waste of human resources, and cumbersome to operate the street light opening and closing time. Several methods tend to overcome these problems, such as a time-control method that is, from time to time opening and closing control, and time-optical-control method that is, from time to time with light intensity control. However, these methods also face other problems because of un-integrated systems, such as monitoring and maintenance of lamps condition and power consumption. This paper is tended to design an automation control and monitoring of the system based on the Internet of Things (IoT) system to address the problems. Several sensors, such as PZEM-004T and Light Dependent Resistor (LDR), Arduino Mega 2560 microprocessor system, relays, and a software graphical user interface, are utilized in this research. An Ethernet system with ThingSpeak application is used for telecommunication between the public street lighting system with a monitoring system. Based on several experiments, it can be said that the proposed system able to maintain the public street lighting system more satisfaction, low maintenance system, and accurate.

**Keywords:** Public street lighting; Control and Monitoring System; Internet of Things
EE-172

People Detection and Tracking Methods for Intelligent Surveillance System

Wahyu Kurniawan¹ and Sutrisno Ibrahim¹,*¹

¹Universitas Sebelas Maret, Indonesia
Email: *¹sutrisno@staff.uns.ac.id

The ability to automatically detect and track people is a key component of intelligent surveillance system (ISS). ISS is able to automatically analyze surveillance camera data with limited human intervention. In this research, robust people detection and tracking methods are studied for public surveillance system. The proposed method composed of background-foreground segmentation and people detection using mixture of gaussians (MOG) and histogram of oriented gradients (HOG) and then followed by multi object tracking (MOT) method for people tracking. The proposed method is tested on a closed circuit television (CCTV) system at the engineering faculty of Sebelas Maret University (UNS) Surakarta.

Keywords: Intelligent surveillance system (ISS), people detection, people tracking, and closed circuit television (CCTV)
EE-184

A User-Friendly Fuel Cell System Simulator for an Electric Vehicle Application

Inayati Inayati¹,*

¹)Universitas Sebelas Maret
Email : *inayati@staff.uns.ac.id

Fuel cell technology becomes more interesting for electric vehicle and power generator as it has higher efficiency and has no harmful emission. The knowledge and awareness about fuel cell needs to be transferred to the students as they are the potential user for the future. This project was aimed to develop a user-friendly model-based simulator for a fuel cell system to improve student's understanding without a real working fuel cell system. The simulator was developed under LabVIEW platform, based on the mathematical model for each fuel subsystem, including the battery pack for the electric vehicle application. The scope of the simulator was to visualize the performance of a polymer electrolyte membrane fuel cell stack at various operating condition and throughout its current density, fuel and air consumption, power requirement for its balance of plant, and the battery state of charge status. Factors affecting the fuel cell stack performance such as electrochemical reaction kinetics, charge transfer, and mass transfer of hydrogen and oxygen were also considered in the developed model. Using this simulator, the students are able to learn about the power flow among the fuel cell system components and the battery pack.

Keywords : Simulator, Fuel Cell System, Electric Vehicle, LabVIEW, and User-friendly.
Performance Analysis of MMSE based Interference Suppression in MU MIMO System

Subuh Pramono 1,a), Budi Basuki S 2, Eddy Triyono 2, Agus Ramelan 1,b), Chico Hermanu B A 1,c), and Muhammad Hamka 1,d)

1Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, Indonesia.
2Department of Electrical Engineering, Politeknik Negeri Semarang, Semarang, Indonesia.

a)Corresponding author: subuhpramono@staff.uns.ac.id
b)agusramelan@staff.uns.ac.id
c)chicohermanu@gmail.com
d)hamkanen@gmail.com

Multiple users are served simultaneously in MIMO system, it potentially triggers an MUI. Precoding schemes are developed to suppress interference. By suppressing the interference that means it is increasing the performance of MIMI system in term of BER, sum rate and CDF. This work compares three precoding schemes including MMSE TH, MMSE BD, and ZF BD. Based on numerical results, the MMSE TH outperforms than the MMSE BD and ZF BD precoding schemes. At specific BER 10^{-3}, The MMSE TH requires 6.6 dB of SNR, it is the lowest value than the MMSE BD and ZF BD. In addition, maximum CDF (probability sum-rate is 100 %) of the MMSE TH is reached at 6 bps/Hz, the MMSE BD is 4 bps/Hz and the ZF BD is 3 bps/Hz, respectively. Although, the MMSE TH precoding has higher computational complexity but it can suppress effectively the MUI thus increasing the performance of MU MIMO system.
EE-198

Modbus HMI Bluetooth for outseal PLC

Djoko Untoro¹, *)

¹) Sanata Dharma University, Indonesia
Email : *) joko_unt@usd.ac.id

PLC is widely used as a controller with input in the form of switches and sensors and output in the form of coils. PLC can be connected with HMI to facilitate the operation of the PLC. The usual HMI is installed on a PLC in the form of a stand-alone PC HMI and HMI that is connected via serial or ethernet cable. HMI in the form of wireless is rarely found. In this paper, we will show the use of HMI that is connected to Bluetooth on an outward PLC (locally made PLC). PLC is programmed with a ladder diagram Selector 4 channels with input in the form of switches and output in the form of coils (lights). Lights can be selected via the switch. Difficulties in the PLC with input using the switch are not easily changed from afar. The designed HMI provides facilities for direct control mode, ALL ON mode, ALL OFF mode and toggle mode. HMI uses a smartphone with the HMI Modbus app. The Smartphone screen can be used as a monitor and in the form of a touch screen as input. The screen size of 5.5 inches, the pixel size of 720 1280 is capable of displaying 7 switches and 4 indicators.

Keywords: Modbus, HMI Bluetooth, OutSeal PLC, and Selector.
EE-200

Performance Evaluation of VPPM Visible Light Communication Demodulator Using Analog Comparator Front End.

Muhammad Hamka Ibrahim1, *) Miftahuddin Irfani1, Annisa Hanifa1 and Subuh Pramono1

1) Universitas Sebelas Maret, Indonesia
Email: *) hamkanen@gmail.com

In visible light communication (VLC) systems, it is mandatory to control both data transmission and lighting. Modulation technique such as pulse position modulation (PPM), is used to resolve dimming control and flicker mitigation. This paper presents performance evaluation of Variable Pulse Position (VPPM) demodulator using analog comparator front end. Analog Front End (AFE) of VPPM demodulator can be implemented using Analog to Digital Converter (ADC) or analog comparator. In matter of hardware complexity, comparator AFE has less complexity compared to ADC AFE. As a tradeoff, comparator AFE has less performance compared to ADC AFE. This paper shows that the performance of comparator AFE can be improved by increasing sampling rate of demodulation.

Keywords: VPPM, AFE, Comparator, ADC, and dimming.
Demand for electricity is increasing rapidly, the consequence of this is a threat to the stability of the electrical system, one of which is the voltage stability. FACTS or flexible alternating current transmission system is an electronic equipment capable of regulating electrical power transmission that can be used to overcome stability problems. This research will analyze the use of SVC and STATCOM as an equipment model from FACTS to overcome the stability of the electric power system on the most critical buses. Simulations were carried out using PSAT using case studies: a 500 kV Java-Bali network. Then the stability of the voltage is observed using the help of the PV curve which can show the value of the voltage conditions in each operating condition. SVC installation in the Java-Bali 500 kV case doesn’t reduce the active power losses or reactive power, but also the addition of length λ is 0.233 p.u. (6.01%) and compared to STATCOM installation in Java-Bali 500 kV case can’t too reduce the active power losses or reactive power, but also the addition of length λ at STATCOM of 0.149 p.u. (3.85%).

Keywords: STATIC VAR COMPENSATOR (SVC), STATIC SYNCHRONOUS COMPENSATOR (STATCOM), continuation power flow (CPF)
The rapid growth of renewable energy sources and the demise of fossil fuels are causing rapid growth of battery application. The lifespan of battery is expected to be long and it is affected by battery charging and discharging. When charging battery, the charger must consider battery type, voltage and temperature. Smart programmable power supply is implemented as battery charger which has flexibility to adjust different parameter such as battery type, nominal voltage, current limit and temperature limit. The smart power supply is reconfigurable by virtual instrument software in personal computer (PC). The smart power supply has voltage range 1.4 to 22 V with 0.1 V resolution and maximum current 2 A with 0.1 A resolution.

**Keywords:** battery, power supply, virtual instrument, and charging
The Design of Automatic Syringe Shaker as the Supporting Device for Method of Dissolved Gas Analysis Transformer Oil in PT.PLN APP Karawang

Ratih Rachmatika¹,a), Augustinus Sujono¹, and Chico Hermanu B.A.¹

¹Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret Surakarta
Email: a) ratihrachmatika11@gmail.com

Insulator oil in the transformer serves as a coolant as well as to dissolve these harmful gases in order not to be freely circulated. Identifying the type and the number of dissolved gas concentration in the oil can give information that there will be failure indication which occurs in the transformer. Method for identifying and analysing dissolved gases in the oil is called as DGA (Dissolved Gas Analysis). The result of DGA was influenced by the extraction quality of gas contents in the oil. Procedure of taking oil samples for DGA testing was by using Syringe. In using Syringe, after taking oil samples into Syringe and then Syringe was shaken to separate dissolved gas components. Utilization of Syringe in the shaking process was less maximal because it had to shake manually for each Syringe. Automatic Syringe Shaker can shake the transformer oil automatically. Size of this Myrkos Field Package is the length of suitcase in 43 cm, the width is 31 cm, and the height is 13 cm, it consists of three pieces of Syringe with the width of Syringe place in 25 cm. Automatic Syringe Shaker has the mode of manual and automatic operation to determine the shaking time. This device uses DC motor as the driving source of Syringe tube.

Keywords: Transformer Oil, Automatic Syringe Shaker, DC Motor
Design Close-Loop Control of BLDC Motor Speed using PID and MPPT Method in Solar Power Water Pump with MATLAB/SIMULINK

Chico Hermanu Brillianto Apribowo\textsuperscript{1,a)}, Hari Maghfiroh\textsuperscript{1}, Arifian Tri Laksita\textsuperscript{1}

\textsuperscript{1}Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
Email: \textsuperscript{a})chico@ft.uns.ac.id

In this research, the design of close loop BLDC motor speed control was designed with several simulation test conditions and also discuss the differences of boost converter and without. The BLDC motor specifications used in this research are 3 phase, constant voltage is 80 V\textsubscript{peak} L-L / krpm and the moment of inertia is 0.000553 J (kgm\textsuperscript{2}). The specifications of the solar were Canadian CS5T 130M with a maximum power = 129W. The test results on the boost converter without using controls have fluctuating voltages, and the output voltage is ± 34 V. Whereas when using PID controls, the output voltage is stable and the voltage is ± 135 V. In simulation conditions 5 with PID control circuits have THD values amounting to 1.72%, which corresponds to the standards specified by IEEE for voltages below 1 kV = <5%. The simulation test results with several conditions have made a difference in the results of the motor speed response. Based on the results of the simulation test, it is known that the speed control with the PID control circuit has better results compared to the open loop circuit.

Keywords: Close Loop Control, BLDC Motor, Boost Converter, PID Control
Design and Implementation of the Alcohol Sensor Monitoring System Based on Internet of Things

Muhammad Nizar Aldy, Jihan Nabillah, Muhammad Raihan Hafiz, and Feri Adriyanto

1Department of Chemical Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
2Department of Electrical Engineering, Sebelas Maret University, Surakarta 57126, Indonesia

Email: 1)nizaraldy@student.uns.ac.id, 1)jihan26@student.uns.ac.id, 2)raihan_hafiz99@student.uns.ac.id, 2,*feri.adriyanto@staff.uns.ac.id

This paper describes the design and implementation of Alcohol sensor based on Internet of Things (IoT). The designed system is composed of a resistor, capacitor, operational amplifier, Arduino Mega 2560, and OLED display. The system collects the electronic signals caused by resistance changes from a built-in Analog-to-Digital Converter (A/D) in microcontroller, and displays alcohol concentration in LCD display finally. The measuring concentration range of the designed alcohol meter is from 3% to 80%. This paper describes the data collection, processing and display of the designed alcohol meter in detail. Captured data are broadcasted through internet with an ESP8266 Wi-Fi module. The projected system delivers sensors data to an API called ThingSpeak over an HTTP protocol and allows storing of data. The proposed system works well and it shows reliability. The prototype has been used to monitor and analyse real time data using graphical information of the Alcohol concentration.

Keywords: Alcohol sensor, resistor, capacitor, operational amplifier, Arduino Mega 2560, and OLED display, ESP8266 Wi-Fi module
Simulation and Modelling of Smart Inverter Performance for Grid Connected Photovoltaic Systems

Salman Al Farisi¹, Attar Al Mufashal Rasyid², Berlianne Shanaza Andriany³, and Feri Adриyanto⁴,*

Department of Electrical Engineering, Sebelas Maret University, Surakarta 57126, Indonesia

Email: alfarisislmn@gmail.com¹, rasyidattar@gmail.com², berlianneshanaz@gmail.com³, feri.adriyanto@staff.uns.ac.id⁴,*

The development of electricity in Indonesia sourced from Photovoltaics (PV) has several advantages. Until now the price of modules is still too expensive to meet the needs of the overall home burden. In addition to the lack of energy stability, PV only works during the day, so a tool that can combine electrical energy from PV with the PLN Grid is needed. This paper describes the simulation and modelling of smart inverter performance for grid connected PV systems. The designed system is composed of rectifier diode as ADC, MOSFET for switching, transformer, IC control as data processing and ESP8266 as communication modul. From the modelling data, it can be seen that these components has been described and demonstrated in detail. Compared to the SPWM inverter data at 24 V DC, the output of AC voltage of 26 V and 22 V for without resistive load and with resistive load, respectively.

Keywords: smart inverter, rectifier diode, ESP8266 Wi-Fi module, and SPWM
Comparative Study of Electric Vehicles in Urban Areas in Indonesia

Muhammad Nizam¹,*

¹Universitas Sebelas Maret, Indonesia
Email: *nizamkh@gmail.com

Urban transportation has consumed enormous energy in Indonesia; the second largest energy consumption after households energy consumption. This study aims to compare the performance of electric vehicles in urban areas in Indonesia, 18 cars consisting of 6 internal combustion engine (ICE) vehicles, 6 Hybrid vehicles, and 6 Plug-in Hybrid vehicles that are used as electric vehicles in three major cities in Indonesia (Surakarta, Surabaya, Denpasar). Fuel use data, declining CO levels, and studies on battery use are needed to design the best electric vehicles suitable for use in major cities in Indonesia. Test results showed that there was a significant reduction in the use of energy consumption for electric vehicles. Studies also show that a decrease in environmental CO can not be significantly carried out. It is because most plants still use coal as the source. It can be concluded that the use of electric vehicles is very suitable for use in urban areas in Indonesia and the average distance traveled for the battery needed is a battery with a range of 100 km per day.

Keywords: HEV, ICE, PHEV, and Electric Vehicle
EE-224

Energy Optimal Control of DC-drive Conveyor using LQR Method

Hari Maghfiroh\textsuperscript{1,a)} , Miftahul Anwar\textsuperscript{1,b)} and Muhammad Gunawan\textsuperscript{1,c)}

\textsuperscript{1}Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

Email: \textsuperscript{a)} hari.maghfiroh@gmail.com \textsuperscript{b)} miftahwar@ft.uns.ac.id \textsuperscript{c)}muhgunawan013@student.uns.ac.id

Electric motor, both AC and DC, is an actuator that is widely used in industry. DC motor has some advantages such as easy to control the speed and position [1][2][3]. DC motors are widely used in steel rolling mills, electric trains, electric vehicles and robotic actuators [2][4]. Research in DC motor speed control has been done by a lot of researcher that only base on performance viewpoint as in [5]. Maghfiroh et.all. [6] investigates the performance of three control method which are PID, Fuzzy, and LQR in DC motor control in both performance and energy viewpoints. They conclude that LQR has better result both in performance and energy. In this research, LQR control is implemented in DC-drive conveyor to achieve energy optimal control. First, DC motor is modeled from experimental data and then system model is built in MATLAB/ Simulink. Base on simulation result, LQR control is built in Arduino to control DC-drive conveyor.

**Keywords:** dc motor, motor control, pid, lqr
EE-225

Active Power and Reactive Power Control using Fuzzy-PID Compensator for grid-connected Inverter

Bagus Fatkhurrozi¹,a) and Hery Teguh Setiawan¹,b)

¹) Universitas Tidar, Indonesia

Email: a) bagusf@untidar.ac.id, b) hery.teguh.s@untidar.ac.id

New and renewable energy is an alternative energy source to produce clean electricity. Commonly new and renewable energy sources are spread in several places, depend on the geographical contour of the region. The smart grid is the solution to interconnecting multiple energy sources into the grid. One of the important issues in the smart grid is the power instability on the grid itself. The current study provides a simulation of reactive power and active power control of grid-connected inverter. The concept of DQ frame was used to modeling the close loop control system of the grid-connected inverter. Simulation of the grid-connected inverter using PID compensator and Fuzzy-PID compensator presented. The simulation result shows that grid-connected inverter using fuzzy-PID compensator can provide good performance for power reference change.

Keywords: Smart grid, active power, reactive power, grid-connected inverter, DQ frame, PID compensator, and Fuzzy-PID compensator.
EE-228

Plug-in Hybrid Electric Vehicle Mode Selection Strategy for Full Battery Consumption and Known Road Slope Condition

Muhammad Hamka Ibrahim1,*, Hari Maghfiroh1 and Muhammad Nizam1

1)Universitas Sebelas Maret, Indonesia
Email: *)hamkanen@gmail.com

Plug-in hybrid electric vehicle (PHEV) has two modes, using electric drive only (EV Mode) and using both electric drive with combustion engine (Hybrid HV mode). PHEV fuel consumption can be optimized by selecting most efficient mode for known road slope condition. Typical road slope can be divided into uphill, downhill and flat road. This paper presents measurements of PHEV energy consumption per distance for each road slope case. In case of full battery consumption, the optimal mode selection strategy is determined for each road slope case. This paper shows that the mode selection strategy using known route and road slope condition can achieve less fuel consumption compared to default PHEV configuration with no strategy.

Keywords: Plug-in hybrid electric vehicle, electric mode, hybrid mode and battery.
THE NEED FOR NATIONAL STANDARD OF X-BAND RADAR TECHNOLOGY TO DETECT RAINFALL AND DISASTER MITIGATION

Ajun Tri Setyoko¹, Endi Hari Purwanto, Reza Lukiawan² and Meilinda Ayundyahrini³

National Standardization Agency of Indonesia

Email: ¹ajun_ts@bsn.go.id, ²lukiawan@bsn.go.id, ³meilinda.ayundyahrini@bsn.go.id

Indonesia is an area with high convective activity so that it often results in high intensity rain. This has the potential to cause disaster, especially in areas prone to flooding and landslides. Currently technology to monitor rainfall uses weather and satellite radars, which are relatively expensive. Indonesia is developing a relatively cheaper commercial radar-based rain radar technology. One of them is the use of ship radar. This radar is the development of the ship's x-band radar technology which was developed into LAPAN’s radar detection rain. In its development, quality standards are needed to ensure radar performance can operate properly. In this study a Focus Group Discussion (FGD) was conducted by inviting key informants to developers of rain radar technology and searching literature studies related to x-band rain radar technology in Ecuador, Italy, France and Denmark. From the research results obtained critical parameters in the development of x-band rain radars are output power, pulse repetition frequency, pulse length, signal beam width and spatial resolution. In developing the performance of x-band rain radars there needs to be an anti-clutter system and radar signal processing.

Keywords: National standard, X-band, Rainfall radar
DESIGN OF BATTERY MANAGEMENT SYSTEM (BMS) FOR LITHIUM ION BATTERY

Muhammad Nizam¹,a), Hari Maghfiroh¹,b) and Kirana Dyah Utari Kusumaputri¹,c)

¹)Universitas Sebelas Maret, Indonesia
Email : a) muhammad.nizam@staff.uns.ac.id, b) hari.maghfiroh@staff.uns.ac.id, c) 17.kiranadyah@gmail.com

The number of advantages of lithium ion batteries, ranging from high energy density, to the longevity of life is a consumer attraction. Along with its high demand, the use of lithium ion batteries is also increasingly complex, for example for electric vehicles to smart grids. This complexity requires that lithium ion batteries be used in specific conditions, for example for needs battery pack, lithium ion batteries must have the same voltage if they are to be connected in series. If this condition is not met, of course the safety and durability of the battery is at stake. Battery Management System (BMS) comes as a solution to these problems. This study aims to design a BMS with three main features, namely monitoring, balancing and protection features. BMS is designed using an Arduino Nano microcontroller. The test results show the performance of BMS for monitoring voltage values has a root mean square error (RMSE) of 0.00706 or an accuracy of 99.29%, while the mean relative standard deviation (MRSD) value is 0.258% or a precision level of 99.74%. Protection features can function well to overcome problems such as over-charging, over discharging, and over temperature. The process balancing works well in keeping the battery voltage value at 4.2V.

Keywords : Battery Management System, Lithium-Ion, Balancing, Protection, and Monitoring.
EE-243

Construction Design of Multistage Axial Field BLDC Motor

Fahrul\textsuperscript{1)}, Rusdhianto Effendi\textsuperscript{2)}, Mochammad Rameli\textsuperscript{3)}

\textsuperscript{1)}Morowali Metal Industries Polytechnic – Morowali, Indonesia
\textsuperscript{2,3)}Sepuluh Nopember Institute of Technology – Surabaya, Indonesia
Email: fahrul_best87@yahoo.com\textsuperscript{1)}, ditto@ee.its.ac.id\textsuperscript{2)}, rameli@ee.its.ac.id\textsuperscript{3)}

BLDCM technology has been developed on design construction method, that is mechanic construction design, design construction of rotor magnetic, and design construction of stator coil. This research applying multistage design construction by using magnet based on number of poles in the stator. That matter aims so in order when there is commutation on the stator, then all the magnets on the rotor can interact with the active number of poles in the stator. For the design construction of the stator coil, this research applying the stator coil construction on opposite direction for each pole. Therefore in order to generate field in the opposite pole, it only takes half cycle of the pulse commutation.

Keywords: Brushless DC Motor, Multistage, Rotor Construction
The Automated Guided Vehicle (AGV) refers to an automatic transportation system that is used to move material or object horizontally. The main benefit of implementing AGV is the efficiency of cost and time in production floor especially for material handling tasks. Since its introduction in 1955, the AGV system has been developed significantly and some are commercially available in the market today. One of them is ANT (Autonomous Navigation Technology) developed by BlueBotics. ANT is a control instrument which enables a vehicle to be an AGV. The vehicle can be built and customized by the customers based on their needs. The purpose of this research is to build a prototype of AGV based on ANT and to test its performance. The prototype consists of DC motor and driver, LIDAR sensor, transmission system, and the body frame part. The aspects of performance to be tested are the ability of mapping, localization, and navigation. The test results show that the AGV prototype based on ANT controller has a very good performance.

**Keywords:** Automated Guided Vehicle, Automation, Material Handling
EE-255

An Anomaly Detection Method for Predictive Maintenance of Electric Motor

Yoga Satriawan\textsuperscript{1,a)} and Joko Slamet Saputro\textsuperscript{2b)}, Chico Hermanu\textsuperscript{2}

\textsuperscript{1}Bandung Institut of Technology Jl. Ganesa No. 10 Coblong Bandung Jawa Barat 40132.
\textsuperscript{2}Sebelas Maret University Jl. Ir. Sutami No. 36A Jebres Surakarta Jawa Tengah 57126
Email: \textsuperscript{a)}y.satriaw@gmail.com, \textsuperscript{b)}jssaputro89@gmail.com

Maintaining the equipment in a good performance is mandatory for business. It needs to reduce production cost, minimize downtime, maintain product quality, safety and reduce risks. Maintenance department shall predict whether the equipment may fail in near future to minimize downtime. Parameters data which we used in this paper are temperature and vibration. We used anomaly detection to predict failure of the equipment. Anomaly detection is the one of the methods which can be used to predict the failure. It detects anomalies in time series data with numerical values that are uniformly spaced in time. We combine the detection using some variety of spikes like ZSpike, TSpike, SlowTrend and Bidirectional Level Detector. We maintain also spike sensitivity to get the accurate predictions

\textbf{Keywords :} Predictive Maintenance, Anomaly Detection, Failure of Electric Motor, temperature, and vibration
An Implementation of Linear Quadratic Regulator (LQR) for Skid-Steer Mobile Robot Movement

Joko Slamet Saputro\textsuperscript{1,a)}, Agus Ramelan\textsuperscript{1,b)}, and Hari Maghfiroh\textsuperscript{1,c)}, Yoga S Satriawan\textsuperscript{2}

\textsuperscript{1}Department of Electrical Engineering, Sebelas Maret University Jl. Ir. Bandung Institute of Technology Jl. Ganesa No. 10 Coblong Bandung Jawa Barat 40132. Sutami No. 36A Jebres Surakarta Central Java 57126

Email: \textsuperscript{a)}issaputro89@gmail.com, \textsuperscript{b)}agusramelan16@gmail.com, \textsuperscript{c)}harimaghfiroh@staff.uns.ac.id

Motion planning is one of the fundamental problems in the navigation of autonomous robots. The aim of this research is to make the robot move following the path from the initial position to the goal. The first thing to do was create a map of the environment that would be used to set the initial robot, identify the static obstacle, and find the path. The path creates using A* (A-star) algorithm, then it used as the reference path. The Design of Linear Quadratic Regulator (LQR) aims to track the reference path by the robot, in designing this control used the Pioneer 3-AT robot model based on the current robot position against the reference robot position. That delta position of path following system is a combination of LQR error tracking and advanced feed control. Designed control would be simulated first to see the system behavior using MobileSim software that was integrated with MATLAB. The implementation was using Skidsteer Mobile Robot integrated with Controller to follow the path from start to the goals in the room condition.

Keywords: LQR, Path Following, Error tracking, Skid-Steer, Mobile Robot, and A-star
The influence of discharge current to temperature distribution of Lithium ion cells

Sunarto Kaleb\textsuperscript{1,a)}, Abdul Hapid\textsuperscript{1,b)}, Miftahul Anwar\textsuperscript{2,c)}, Feri Adiyanto\textsuperscript{2,d)}, Hillga R. Radhita\textsuperscript{2,e)}, Sukmai I. Cahyono\textsuperscript{2,f)}, and Kuncoro Diharjo\textsuperscript{3,g)}

\textsuperscript{1}Research Center for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia
\textsuperscript{2}Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia.
\textsuperscript{3}Department of Mechanical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia.

\textsuperscript{a)}Corresponding author: suna021@lipi.go.id
\textsuperscript{b)}abdu003@lipi.go.id
\textsuperscript{c)}miftahwar@ft.uns.ac.id
\textsuperscript{d)}feri.adiyanto@staff.uns.ac.id
\textsuperscript{e)}hillga@gmail.com
\textsuperscript{f)}sukmai@ft.uns.ac.id
\textsuperscript{g)}kuncorodiharjo@ft.uns.ac.id

Lithium-ion is used in battery electric vehicles as an effective and efficient energy storage medium. The energy density and life cycle of Lithium-ion battery are better than lead-acid batteries. But for Lithium-ion batteries, like every other battery, when operating in a high discharge current which causes an increase in battery temperature. This increase in temperature causes degradation in the performance of available electrical capacity of the battery. An experimental method was carried out to determine the effect of discharging current of the 18650 Lithium-ion cells to the surface temperature of the battery. The first measurement was carried out on a cell by installing three temperature sensors to measure the surface temperature distribution of the battery. The temperature sensors are each installed at 16mm (point A), 32mm (point B) and 48mm (point C) from the positive end of the battery. The initial treatment before the Lithium-ion cell test is charging up to a voltage of 4.2Vdc, then drained to a voltage of 2.7Vdc. Constant discharging currents are applied to the cells i.e. 3.5A, 7.5A, 11A, and 15A, respectively. The second measurement was carried out on a battery module consisting of 35 cells arranged in 7 cells in series and 5 cells in parallel (7S5P). Each temperature sensor is installed in the center of the cell (point B). The cell with the sensor was put in the middle of the series or parallel of the battery module. Before the discharge current, the battery module is charged to a voltage of 29.4Vdc. Constant discharge current is applied to the battery modules i.e. 15A, 20A, 25A, and 30A, respectively. The result of the temperature measurement of a cell (point B) to time shows that the 15A discharge current produces the highest temperature compared to 3.5A, 7.5A, and 11A. The temperature at point A has a lower tendency compared to points B and C. The temperature of point D in the direction of the series and parallel arrangement shows a tendency for higher temperatures compared to other points. This condition indicates that the highest temperature concentration of the battery module is in the middle of the battery cell arrangement.

Keywords: Lithium-ion Battery, Discharge Current, and Temperature Distribution.
EE-282

Current-Voltage Monitoring of Plasma Arc Discharge Submerged in Water for Nanoparticles Fabrication

Lia Anjarwati\textsuperscript{1)}, Miftahul Anwar\textsuperscript{1,*)}, Yan Mahardhika\textsuperscript{1)}, Ramanda Fadhillah\textsuperscript{1)}, Chico Hermanu Brillianto Apribowo\textsuperscript{1)}, Teguh Endah Saraswati\textsuperscript{2)} and Yuana Ayub\textsuperscript{1)}

\textsuperscript{1)}Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia
\textsuperscript{2)}Department of Chemistry, Faculty of Mathematics and Natural Science, Universitas Sebelas Maret, Indonesia

Email : *) miftahwar@ft.uns.ac.id

This article presents electrical properties measurement of the nanoparticle preparation process using the Submerged Carbon electrodes for continuous fabrication of carbon nanoparticles with good uniformity. On the other hand, during arc discharge power consumption or the discharge process is important to understand. Therefore, this article aims to design and to build voltage-current monitoring device to monitor the fluctuation of the arc during the process. The current monitoring device was made using Hall-based current sensor, while voltage was measured directly between two electrodes. The data from those sensors were processed and monitored using data acquisition system. The analysis of measured current and voltage was made by varying the current from the arc source i.e., 10, 20, 40, 70 and 100 A.

\textbf{Keywords} : Arc discharge, carbon electrodes, nanoparticles and power consumption.
EE-285

A Novel Low PAPR Preamble for Very High Throughput WLAN IEEE 802.11ac 80MHz System

Wahyul A. Syafei*), Achmad Hidayatno*), Ajub A. Zahra*) and Subuh Pramono$)

*)Department of Electrical Engineering, Diponegoro University
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang 50275, Indonesia
$)Department of Electrical Engineering, Universitas Sebelas Maret Jl. Ir. Sutami 36 A, Jebres, Surakarta 57126, Indonesia

*)Corresponding author : wasyafei@live.undip.ac.id

This paper proposes a novel low peak to average power ratio (PAPR) preamble to be used in very high throughput WLAN IEEE 802.11ac 80 MHz system. Partial transmit sequence technique was exploited to obtain a novel phase rotation set. Implementing this phase rotation set into 80 MHz system of the VHT WLAN IEEE802.11ac’s preamble reduced the PAPR of the signal, significantly. It was 1.4 dB lower than the PAPR of conventional extension of IEEE 802.11ac 80 MHz and even 1.6 dB lower than the PAPR of HT WLAN IEEE802.11n 40MHz.

Keywords : PAPR, preamble, WLAN, IEEE802.11a/n/ac, very high throughput, PTS.
EE-286

DESIGN VARIABLES REACTIVE POWER COMPENSATOR USING MAGNETIC ENERGY RECOVERY SWITCH (MERS) FOR INDUCTION MOTOR

Chico Hermanu Brillianto Apribowo 1, 2,a), Luthfy Makhmudy1, Oktavian Listiyanto1

1Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
2National Center of Sustainable Transportation Technology, Indonesia
a)Corresponding author: chico@ft.uns.ac.id

Saving electricity in an induction motor can be done by compensating for reactive power, so that the power factor can be increased. The purpose of this study was to determine the characteristics of the MERS as a reactive power compensator in an induction motor. The method used is designing reactive power compensator using magnetic energy recovery switch and IoT-based power monitoring. Before designing a reactive power compensator, simulation be used as a reference in the design of the reactive power compensator. The result of the application of MERS as a reactive power compensator is to increase power factor to 0.75 from previous 0.70. Power monitoring has a reading error at a voltage of 1%, current of 2.43%, and power factor 0.8%.

Keywords: MERS, reactive power compensator, power factor
Experimental Method for Improving Efficiency on Photovoltaic Cell with Using Floating Installation Method

Chico Hermanu Brillianto Apribowo 1, 2, a), Abyan Habibie 1, Zainal Arifin 3, Feri Adriyanto 1

1 Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
2 National Center of Sustainable Transportation Technology, Indonesia
3 Mechanical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
a) Corresponding author: chico@ft.uns.ac.id

Electrical energy is the key in the development of human civilization, it causes an increase in electricity production using fossil fuels. This causes the emergence of the need for commissioning Solar PV plants in large scale. The large scale of the project has the problem of land requirement needed for the project that not always available. Installing the Solar PV plants on water bodies like oceans, lake, and reservoir can be an interesting option. Floating type solar panel can have a numerous advantages, one of them are the increase in power yield while also lowering the working temperature of the solar panel. Test carried to measure the influence of floating method by measuring the performance of the solar panel. The data shows that by using this method there has been an increase in power yield by 30.54%. However, in regard of temperature, an increase of 6.42% occurred at the time of testing.

Keywords: photovoltaic cell, PV cooling, floating, temperature, efficiency
The increasing of electricity needs are the same with high consumption of fossil energy used as fuel for production in Indonesia. As a solution, the new and renewable energy can be a new thing to prevent the problem of dependence on fossil fuels. Through the use of renewable energy, the problem is that renewable energy is very dependent on nature, which can lead to an unstable electricity supply and requiring a small construction site. Therefore, the development of various new renewable energy sources is a way to solve the problems. The use of floating photovoltaic technology can solve the problem of land use planning. This study aims to design a hybrid generator with the addition of floating PV technology, perform an economic analysis and calculate the value of the payback period. The results of this study were carried out 2 hybrid generator scenarios. Scenario 1 with PV and Wind Turbine composition with an NPC value of Rp, 32,372,170,000, COE value of Rp, 1,224 / kWh and payback period of 18 years and 6 months. While scenario 2 consists of a PV with an NPC value of Rp, 29,711,250,000, a COE value of Rp, 1,157 / kWh and a payback period of 17 years and 7 months.

**Keyword:** Hybrid Power Plant, Floating PV, Economic Analysis
EE-289

DESIGN AND IMPLEMENTATION OF CLOSED-LOOP CONTROLS FOR SMART CHARGING LITHIUM ION BATTERY UNS USING SWITCHING TECHNIQUE BOOST CONVERTER

Chico Hermanu Brillianto Apribowo¹, ²,a), Muhammad Akmal¹
¹Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
²National Center of Sustainable Transportation Technology, Indonesia
ᵃCorresponding author: chico@ft.uns.ac.id

Battery Charge Regulator (BCR) is needed in the solar power system, but the battery is often easily damaged because the charging current is excessive and or the temperature is too high (> 40 ℃). This is due to the effect of the solar panel voltage being fluctuating and the battery condition is fickle. Therefore, it is necessary to manufacture BCR that can regulate the constant current, the voltage is not excessive, and perform charging at a safe temperature. In this research BCR was made with constant current charging method. Current control is done using the MOSFET switching technique. In order for a constant current to be generated, closed loop control is used with a current sensor as a feedback sensor. The duty cycle of switching is regulated through a microcontroller based on the current read by the sensor. In addition, a temperature sensor and a voltage sensor are used as a feedback sensor so that charging runs safely. The results of the experiment show success with a constantly maintained current at 1.5 A and 2 A. The battery temperature is lower than 40 ℃. The battery charge voltage is lower than 14.7 V. And the battery voltage is lower than 13.8 V.

Keywords: Battery Charge Regulator (BCR), closed loop control, switching technique, PLTS
Optimization of 4G LTE (Long Term Evolution) Network Coverage Area in Sub Urban

Subuh Pramono 1,a) Lia Alvionita 1,b) Mustofa Danang Ariyanto 1,c) Meiyanto Eko Sulistyo 1,d)

1 Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, Indonesia

a)Corresponding author: subuhpramono@gmail.com

b)liaalvionita@student.uns.ac.id
c)mustofadanang@student.uns.ac.id
d)meiyantoekosulisty@gmail.com

Nowadays, 4G LTE (Long Term Evolution) telecommunication technology that has spread throughout Indonesia is growing rapidly. However, the coverage of 4G LTE has not been implemented well in Indonesia, one of them is in Sragen. So to be able to increase the quality of 4G LTE network, it is necessary to optimize the coverage area of 4G LTE network in Sragen by using the physical tuning method, which is to adjust the antenna tilt, azimuth antenna, power. Key Performance Indicator is a reference to determine the performance of a network. The measured parameters are RSRP (Reference Signal Reception Power), RSRQ (Reference Signal Reception Quality), SINR (Signal Interference Noise Ratio). The results from the optimization are the percentage of RSRP was initial 45.87% to 75.58%, an increase of 29.72%. While the RSRQ value increased by 20.78%, with an initial value was 27.84% to 48.62%. SINR increased by 5.29% with an initial percentage was 4.87% to 10.16%.
EE-291

Analysis and Optimization of 4G Long Term Evolution (LTE) Network in Urban Area Technique on 1800 MHz and 2100 MHz Frequencies

Subuh Pramono 1,a), Mustofa Danang Ariyanto 1,b) Lia Alvionita 1,c) and Meiyanto Eko Sulistyo 1,d)

1 Department of Mechanical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Indonesia

a) Corresponding author: subuhpramono@gmail.com
b) mustofadanang@student.uns.ac.id
c) liaalvionita@student.uns.ac.id
d) meiyantoekosulistyo@gmail.com

Technology in sector communication is growth rapidly, which is marked by the increasing number of facilities offered, for example the growth of data, voice and video communication. The technology that can answer these communication demands is Long Term Evolution Advananced (LTE-A) technology. To optimize the quality by using a combination of frequencies on LTE-A. This research comparing results of non-Carrier Aggregation (Non-CA) and Carrier Aggregation (CA). The frequency band that use existing frequency one of cellular operator in Surakarta 1800 MHz and the additional frequency for CA 2100 MHz. The result shows 67.7% of user served by Non-CA technique with single frequency band of 1800 compared 80.3% for the CA technique and 82.7% for CADS. In term of throughput, the results show that Non-CA technique have downlink throughput 1432 Mbps compare to the CA technique of 5713 Mbps and CADS3 5600 Mbps. This simulation using Forsk Atoll with 10 times iteration show that CA technique with inter-band non-contiguous increase network quality in terms of capacity and throughput.
Design of a Hydroponic Monitoring System with Deep Flow Technique (DFT)

Subuh Pramono 1,a), Arif Nuruddin 1,b) and Hamka Ibrahim 1, c)
1Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Surakarta, Indonesia
a) subuhpramono@gmail.com
b) arifnuruddin67@student.uns.ac.id
c) hamkanen@gmail.com

Hydroponics is the transformation or management of water which used as support for growing plants and where the roots of plants absorb the necessary nutrients. Hydroponic agriculture is very suitable for develop in an urban area where the land is sufficiently narrow to allow plant cultivation. Plants are grown in hydroponics as well as conventional plants require adequate nutrition in terms of quantity and type. The aim of the research is manufacturing of hydroponic monitoring system in realtime and design of mobile app as display to show the result of monitoring. Among the parameters to be taken into account are pH, TDS, EC and temperature. The parameter values are sent to the Blynk application over an Internet connection. Parameter data can be monitored in real-time via the Blynk application and saved on a micro-SD card in tabular form. This device successfully measures pH, TDS, EC, solution temperature, temperature and humidity, as well as the height of solution. This device can connect to the Blynk application and send the parameter values to the Blynk application and display it on the LCD screen of the device. In addition, this unit can control the solution pump and spray pump with automatic adjustments. The using of this device makes it possible to monitor the quality of the hydroponic solution and to control the pump continuously so the hydroponic owner know the condition of the hydroponic system.
Computer Science
Preparation of human resources (HR) is important for the construction and operation of the Nuclear Power Plant (NPP) since the project preparation phase. Preparation is carried out through education and training related to nuclear reactors. The use of nuclear reactors as learning laboratories is needed to support these activities. This research aims to design an Internet Reactor Laboratory (IRL) Application that can be operated on Android devices. The application developed using LabVIEW Data Dashboard software with data source from the IRL database. The application is evaluated to determine application compatibility with various screen sizes of Android devices, delay time, data accuracy level, and satisfaction assessment of IRL Application users. The IRL program design results consist of IRL host computer programs as a data centre, and the IRL Application. The test results show that the IRL application can be run on all aspect ratios with a minimum screen resolution of 640 x 360 pixels. The average delay time needed to call the first data is 4.089 seconds, and 1.234 seconds for the next data. The average data accuracy rate is 99.95% with the maximum accuracy is 100%, and the minimum accuracy is 99.10% in the reactor period data. Based on the assessment, the level of satisfaction of users of the IRL Application was found to be in the category of satisfied, both overall, and in aspects of ease of use of applications, information quality, and interface quality.

**Keywords:** Internet reactor laboratory, Data dashboard, Android, Labview
CS-012

Challenges for Standardization: Hyperspektral Technology to Supports Indonesian Food Security

Meilinda Ayundyahrini\textsuperscript{1,a)}, Endi Hari Purwanto\textsuperscript{1}, Reza Lukiawan\textsuperscript{1}, and Ajun Tri Setyoko\textsuperscript{1}

\textsuperscript{1}Center for research and Human Resources Development, National Standardization Agency of Indonesia, Jakarta, Indonesia

Email: \textsuperscript{a)meilinda.ayundyahrini@bsn.go.id

A significant increase in population compared to the decline in food sources is a problem, especially developing countries such as Indonesia. Many things have been prepared by the government from all related lines in a synergy to strive for food security stability. Provision of fast, accurate, up-to-date, and objective information on agricultural resources is a demand for the information and communication era. Remote sensing using hyperspectral technology is an alternative solution. Hyperspectral has many potential uses in monitoring the environment and natural resources. Hyperspectral has channels between 100-500, different from multispectral which only has a less than 10 bands channel. High channel differences make the data obtained by hyperspectral more complete. The development of the standard hyperspectral processing method as a form of guarantee that is used as the basis of certain policies. This study uses a technocratic approach. The data used to support this research are secondary and primary data. Primary data collection uses a Focus Group Discussion of key informants with the Triple (intellectuals / academician), B (businessman), and G (government). Data analysis uses SWOT qualitative analysis to identify problems, obstacles, opportunities and mapping of the use of remote sensing with hyperspectral technology in supporting national national food security programs. Things that need to be prepared to minimize deficiencies through SWOT analysis are standardization of image quality, accuracy of data processing results, and reference reflectance characterization of objects.

**Keywords:** Remote sensing, hyperspectral, food security, SWOT, Standardization
Performance Comparison in Simulation of Mandelbrot Set Fractals Using Numba

Gilbert Gutabag\textsuperscript{1,a}, Gahizi Emmanuel\textsuperscript{1,b}, and Pranowo Pranowo\textsuperscript{1,c}

\textsuperscript{1}Universitas Atma Jaya Yogyakarta, Indonesia

Email: \textsuperscript{a} gutabagaonline@gmail.com, \textsuperscript{b} thegammy2008@gmail.com, \textsuperscript{c} pran@mail.uajy.ac.id

The modern computer contains processors which have more than one cores. Python programming languages are slow compared to level languages like C and C++ because it uses Global Interpreter Lock (GIL) which execute one thread at the time even if computer processors have many cores. One way to accelerate Python bytecode is to change from using Global Interpreter Lock (GIL) to using Low-Level Virtual Machine (LLVM). This paper presents a performance comparison of python code on simulation of Mandelbrot set fractals which use iterative functions systems in the three scenarios using pure python code, using numba which use just in time (JIT) compilation of python code and using numba CUDA to run python code in parallel. The comparison measure used is the execution time of the python program. The result shows that the python program run in parallel using numba CUDA is 1856 times faster than pure python code on CPU and 14 times faster than python code using numba just in time compilation (JIT). Fractals have many application which needs faster computation like video games creation, flight simulation, and cryptography for security purpose.

Keywords: Fractals geometry, Mandelbrot set, Parallel Computing, Numba, CUDA
In this era of development of information and communication technology (ICT) has led to the increase of information sharing on the internet. Internet users are facing security problem during information sharing in which unauthorized receivers can gain access to the information transmitted. Information hiding during the transmission of information via the internet is one of the techniques used to keep the secrecy of the information from an unauthorized person. Steganography is an art or science of hiding information by storing the secret information in the redundant bit of image, audio, video or text in such ways that it reduces suspicious to unintended recipients. This paper presents the acceleration of hiding information in an image by converting it to Mandelbrot fractals using Numba. This steganography approach converts secret information stored in the form of an image to Mandelbrot fractals which can look like terrains, ocean view or mountain and it has the advantage of reducing suspicious to the unauthorized recipients. The result shows that the Numba performs 96 times fast compared to normal python function.

**Keywords:** Mandelbrot set, Numba, Steganography, Fractal Geometry, JIT
Deep Learning for the Recognition of Javanese Batik Patterns

Danis Aditya Mardani¹,ᵇ, Pranowo¹,a), Albertus Joko Santoso¹,c)

¹) Magister Teknik Informatika, Universitas Atma Jaya Yogyakarta
Email: a) pranowo@uajy.ac.id, b) danisadityamardani01@gmail.com, c) albjoko@staff.uajy.ac.id

Batik is one of the cultural heritages of a special Indonesian nation. Because of its diversity and uniqueness on October 2, 2009, Batik was first established as Masterpieces of the Oral and Intangible Heritage Humanity by UNESCO. To maintain sustainability, continuous research is needed. Although the topic of research on batik is already common, the introduction of batik patterns still has challenges that need to be resolved. One of the challenges of pattern recognition is in terms of classifying batik motifs. To simplify the work of computers in classifying, in this case the implementation of Deep Learning is needed by using the Convolutional Neural Network (CNN) method. The Convolutional Neural Network (CNN) method is one of the architectures in Deep Learning, this method is more effective for classifying images such as batik patterns because the Convolutional Neural Network method has a convolution operation. In this operation the image will be extracted every feature so that it can produce patterns that can facilitate classification. In the process of training the Convolutional Neural Network method requires heavy computation and not a short amount of time, therefore the use of GPU performance is needed to speed up the training time. The experimental process begins by compiling five classes of data sets of batik images, the class consisting of batik parang rusak, batik kawung, batik nitik, batik ceplok, and batik lereng with a total of 750 batik images as data sets. The data set was then trained using the Python programming language and GPU CUDA. The test results using cross-validation can achieve an accuracy of 90.14%. So that the results of the above tests can be concluded that Deep Learning using the CNN method can be used to classify batik patterns well.

Keywords: Batik, Deep Learning, CNN, Cross Validation, Image Recognition
Facial expression is one way of expressing emotions. Face emotion recognition is one of the important and major fields of research in the field of computer vision. Face emotion recognition is still one of the unique and challenging areas of research because it can be combined with various methods, one of which is deep learning. Deep learning is popular in the research area because it has the advantage of processing large amounts of data and automatically learning features on raw data, such as face emotion. Deep learning consists of several methods, one of which is the convolutional neural network method that will be used in this study. This study also uses the convolutional autoencoder (CAE) method to explore the advantages that can arise compared to previous studies. CAE has advantages for image reconstruction and denoising images, but we will explore CAE to do classification with CNN. Input data will be processed using CAE, then proceed with the classification process using CNN. Face emotion recognition model will use the Karolinska Directed Emotional Faces (KDEF) dataset of 4900 images divided into 2 groups, 80% for training and 20% for testing. The KDEF data consists of 7 emotional models with 5 angles from 35 different people. The test results showed an accuracy of 81.77%.

Keywords: Deep Learning, Face Emotion, Convolutional Autoencoder, Convolutional Neural Network
Indonesia is one of the largest coffee producing and exporting countries in the world. The development of the coffee business has progressed quite rapidly, starting from the level of farmers, suppliers, coffee cafes, to ordinary consumers. Besides the increasing progress of the coffee industry in Indonesia, there are still many problems that cause material losses and a sense of dissatisfaction for both business and coffee lovers. The problem that arises is because the industry is still run a lot by using a system of trust between the parties concerned. It is difficult for a simple system to distinguish between one coffee variant and another. The need for an information technology-based system that can help identify and ensure directly that the coffee needed and enjoyed is in accordance with what is desired. The information system that will be built can classify the types of coffee based on the image. The introduction of these image patterns uses Deep Learning. Training the Deep Learning algorithm to detect coffee types accurately requires a large number of images for training data. The recognition method uses the Convolutional Neural Network which can be used to recognize objects in an image and is often used to classify data in the form of images. The current CNN method trend is used for image classification problems due to the very high level of accuracy. CNN will classify each image prepared as training data for the introduction. Data is collected by taking pictures of coffee beans using a camera. This data collection contains 4 types of coffee from Indonesia (Garut, Gayo, Kerinci, Temanggung) with 617 images of coffee beans. After testing, the system can recognize objects with an accuracy of 70.68%.

Keywords: Coffee, CNN, Classification, Deep Learning
Feature extraction is an effort to get a small number of the basic information from a large number of the whole information. In a chord recognition, feature extraction is an effort to get a small number of a chord information signal from a large number of a chord information signal. In this case, a small number of a chord information signal are called feature extraction coefficients. This paper proposes a feature extraction method that can be used for a chord recognition. The proposed feature extraction method can give a smaller number of feature extraction coefficients than the previous results. Basically, the proposed feature extraction method can be described in a more detail as follows. Firstly, signal transform using FFT (Fast Fourier Transform). Secondly, signal processing using SHPS (Simplified Harmonic Product Spectrum) and logarithmic scaling. Thirdly, signal feature extraction using segment averaging and subsampling. In this paper, the proposed feature extraction method was tested using guitar chords. The test results using guitar chords showed that the proposed feature extraction method could give recognition rate up to 98.57% by using seven feature extraction coefficients.

**Keywords:** chord recognition, feature extraction, segment averaging, subsampling
Investigation of Time Domain Features for EEG-based Emotion Recognition With Naïve Bayes Classifier

Nur Yusuf Oktavia

Institut Teknologi Sepuluh Nopember Surabaya, Indonesia
Email: nuryusuf26@gmail.com

Currently, emotions recognition has been attracting a lot of interest for researchers in various field, so as in the study of human-computer interaction (HCI). One of an interesting issue in HCI emotions study is the use of physiological signals, such as electrocardiograph (ECG), blood vessel pressure (BVP), electroencephalograph (EEG), and any others signals to recognize emotions. Among all physiological signals, EEG is known to be the most reliable modality to understand emotions processing and perceptions. Therefore, this study observed emotions recognition through EEG signals by investigating emotions cue from time domain features extraction for differentiating two class of emotions, namely, happy and sad. We developed an EEG based emotion dataset from 12 participants with 4 recording channels of EEG cap, i.e., AF3, AF4, O1, and O2. The time domain features of mean, standard deviation and number of peaks were extracted from alpha and beta frequency bands. For the recognition, we train the features set into Naïve Bayes learning classifier. From the results, it was shown that feature of mean gives the highest contribution to the classification. Moreover, from the observation of frequency bands, the combination of alpha and beta bands tend to provide better accuracy in emotion recognition rather than using alpha or beta frequency alone. The highest classification result of Naïve Bayes reached 87.5% accuracy of emotions recognition with 66% split testing option.

Keywords: Emotion from EEG, Statistical features, Naïve Bayes Classifier
Soil Moisture Clustering using the K-Means Clustering method in the UNS's Agricultural Laboratory at Jumantono

Yusuf Budi Kurniawan¹, Winarno¹,* and Wiranto¹
¹Universitas Sebelas Maret, Indonesia
Email: *win@staff.uns.ac.id

UNS has an Agricultural Laboratory located in Jumantono, this laboratory is used by the Faculty of Agriculture to conduct experiments and practices. There are many technologies used there, but there are no devices to detect soil moisture. The purpose of this study was to classify soil moisture using K-Means Clustering in the Agriculture Laboratory.

The data in this study are the results of the humidity sensor readings from devices made that are installed in the UNS Agricultural Laboratory soil. The humidity sensor used is 4 pieces and the data obtained from sensor readings will be updated every 10 minutes. The data is then processed to classify land based on its humidity using the K-Means Clustering method.

The results of this study indicate that the results of soil studies based on humidity levels can be divided into 4 classes. The first is saturated soil with a humidity of 50 - 70%. The second is the capacity of the land with 20-30% humidity. Then there is the point of wilting the soil with a humidity of 10-20%. Finally there is dry land with a humidity of less than 10%.

Keywords: K-Means Clustering, Soil Moisture, Soil Classification
Detection of Forest Fire Used Multi Sensors System for Peatland Area in Riau Province

Evizal Abdul Kadir\textsuperscript{1,a)}, Sri Listia Rosa\textsuperscript{2,b)}, Rizdqi Akbar Ramadhan\textsuperscript{3,c)}

\textsuperscript{123}Department of Informatics Engineering, Faculty of Engineering, Universitas Islam Riau Jl. Kaharuddin Nasution No.113 Marpoyan, Pekanbaru, Riau, Indonesia 28284

Email: \textsuperscript{a)}evizal@eng.uir.ac.id, \textsuperscript{b)}srilistiarosa@eng.uir.ac.id, \textsuperscript{c)}rizdqiramadhan@eng.uir.ac.id

Forest fire is one of the major issue in Indonesia, especially in Riau province because forest fire very dangerous impact on environments and people because of haze and carbon emits from the fire. The most technology to detect fire hotspot so far is using satellite image then process to determine number hotspot and the location. Some weakness in this technology which is in bad weather or cloudy then satellite system cannot penetrate. In this research propose ground sensor system which is using multi sensors related to the parameters of fire, especially fire in peatland area with a special case of fire. Common parameter of the fire such as temperature, smoke, haze, and carbon dioxide applied in this system then measure the indicator used the special sensor. Results of every sensor analyze by apply to intelligent computer programming and algorithm to determine fire hotspot and location. Results show based on integrated multiple sensors, determination of fire hotspot location and intensity more accurate comparison to the use of single sensor determination. Data collected from every sensor keep in an internal database and in some of the period generate a graph for a report as well as for record.

Keywords: Forest fire, Multi sensor, Peatland, WSNs
Application of Demand Responsive Bus Priority Traffic Signal Control at One-Way System with Contra Flow under Mixed Traffic Conditions

Budi Yulianto¹,* and Setiono Setiono¹

¹Sebelas Maret University, Indonesia
Email: *budi.yulianto@ft.uns.ac.id

The development of traffic in the central business district area along the Brigjend Slamet Riyadi Street, Surakarta City, Indonesia, is relatively dense and not in accordance with the development and changes in the environmental situation. These phenomenon makes traffic jam at the signalized intersections. Transportation planning related to management and traffic engineering, and infrastructure needed to be done to parse the traffic problems. Based on the vision of the local government related to sustainable transportation, then the Brigjend Slamet Riyadi road will adopt a one-way system with a contra flow for public transport. In order to improve the performance of signalized intersection, therefore, needs to be installed bus priority traffic signal control at signalized intersection. The aim of this research is to design demand responsive bus priority traffic signal control at signalized intersection to minimize vehicles delay and bus travel time. The extension and recall methods at Vehicle Actuated Traffic Signal Control have been developed and evaluated by using VISSIM microscopic simulation tool. The performance of these methods has been evaluated at mixed traffic conditions of developing country where the traffic is untidy, traffic streams consist of different types of vehicles with a wide variation in their static, dynamic and operating characteristics, and with a particularly high proportion of motorcycles. The simulation results show that performance of bus priority traffic signal control better than fixed time control in terms of vehicle delay and bus travel time.

Keywords: bus priority, traffic signal, simulatio, VISSIM, mixed traffic
CS-183

Android-based application of dispensation licensing system for urban freight transport

Budi Yulianto1,*, Setiono1
1Sebelas Maret University, Indonesia
Email : * budi.yulianto@ft.uns.ac.id

In an effort to monitor and control the urban freight transport, the Municipal Government of Surakarta city shall issue a dispensation license for the freight vehicle through the inner city road in Surakarta City. Nevertheless, the facts on the ground indicate that traffic violations by freight vehicles against the provisions of existing regulations in Surakarta city are relatively high. Thus it has the potential to decrease the level of safety, road service and environmental sustainability. This is because the current dispensation licensing system is still conventional so that it is prone to illegal levies and violations. The aim of the study is to develop an administrative system for dispensation license for the freight vehicle through inner city road based on internet and android technology. This system makes it easy for freight transport operators to apply for dispensation license, avoid the practice of illegal levies and as a means of supervision, guidance and law enforcement between government agencies related to the operation of freight transport that is more effective, efficient and transparent. The study result is Android-based application of dispensation licensing system for urban freight transport, called SIMABA.

Keywords: Android, Freight transport, Dispensation, Violation and SIMABA
Parallel Simulation of Pattern formation in a reaction-diffusion system of Fitzhugh-Nagumo Using GPU CUDA

Alfredo Gormantara¹, Pranowo²

Informatics Engineering Graduate Program, Universitas Atma Jaya Yogyakarta
Email: alfredohappy0105@gmail.com¹, pranowo@uajy.ac.id²

This paper describes the numerical simulation of the reaction-diffusion equations of FitzHugh-Nahumo model. This model is one of Turing systems, which can be used as a mathematical model of pattern formation in animal skin. The model is solved numerically using finite difference method while the time evolution is discretized by using explicit Euler scheme. For reduction the elapsed time, the parallel algorithm based on Graphical Processing Unit (GPU) with CUDA was used. This study compares the elapsed time of the CPU and GPU, numerical experiments were carried out using various mesh sizes. The results show that parallel implementation of GPU achieves acceleration up to 12 times faster than the serial CPU implementation.

Keywords: FitzHugh-Nahumo model, Pattern formation, simulation, Parallel, GPU CUDA.
Currently social media is develop rapidly, twitter is a widely used social media for disseminating the expression user. Then for it only be used also for dissemination expression user include presidential election. This study aims to analyze all obtained from Twitter obtain electability predictions of presidential candidates. LexiconBase method and Support Vector Machine (SVM) are used. The preprocessing data stage uses Part-Of-Speech Tagging, chi-square test, and aggregating opinion on the entity (NN & NNP) which aims to avoid low recall from the lexicon-based method. The data used takes tweets both in Indonesian and English with a number of datasets of 2000 tweets which is separation of two opinions from each presidential candidate. From the polarity accuracy, the positive score was 13.90%, weakly positive 14.00%, strongly positive 6.50%, negative 1.30%, weakly negative 6.50%, strongly negative 3.20% and neutral 54.40%.

Keywords: Sentiment Analysis, Twitter, Lexicon-Base, SVM
The Line Segmentation Algorithm of Indonesian Electronic Identity Card (KTP-el) for Data Digitization

Yasmin Afifah¹,a), Augustinus Sujono¹, Chico Hermanu Brillianto Apribowo¹

¹Electrical Engineering Department, Faculty of Engineering, Sebelas Maret University, Surakarta 57126, Indonesia
Email: a) jasmine.afifah@student.uns.ac.id

The Indonesian Electronic Identity Card (KTP-el) become a source of information for its owner identity which has a lot of use in administrative purpose. The biodata segment of KTP-el consisted of multiple lines, each of the lines is unique in terms of length and wide which is become a problem in digitizing data using Optical Character Recognition (OCR). Therefore, line segmentation algorithm must be applied, this research proposed the line segmentation algorithm using rectangular cropping and Tesseract OCR. First, the algorithm cropped the owner biodata and the line indicator. There are three line indicators, which are below the ‘alamat’, ‘tempat/tanggal lahir’ and ‘nama’ area. Then, OCR reads all of the cropped area. If the line indicator value is blank, then those segment known has two lines. The OCR result is converted into an array which is separated by lines. The algorithm exercised into four different conditions which are, KTPel with two lines of address; two lines of date and place of birth; two lines of name; and one lines for every segment. Result of the applied algorithm manage to reach 85% from 30 samples. Failure in line segmentation is caused by a threshold value that is not optimal.

Keywords: Line segmentation, optical character recognition, Indonesian Electronic Identity Card, Tesseract OCR, Python.
CS-216

Big Data & Early Alert (Anomaly) Detection in Paiton Coal-Fired Power

Akbar Rachmad V#, Adhi Eko Apriyanto#, Henry Pariaman#

#Pembangkitan Jawa Bali, Ketintang Baru 11 Street, Surabaya, 60231, Indonesia
Email: #akbar.rachmad@ptpj.com, #adhi.eko@ptpj.com, #pariaman@ptpj.com

This paper proposes using Big Data and Similarity Based-Modelling (SBM) to identify early alert in online monitoring of Paiton Coal-Fired Power Plant operating system. Similarity based modeling (SBM) is a technique whereby the normal operation of a system is modeled in order to detect faults by analyzing their similarity to the normal system states. First proposed around two decades ago, Big Data and SBM has been successfully used for fault detection in varied systems. This method use historical operational data that has been filtered to eliminate outlier data/bad data. That filtered data become predicted data. After that, come actual data from Site and it will be compare with predicted data using SBM Method to search the condition of predicted data that almost the same with the actual data. If there are difference and at a certain time range, it will show the Early Alert. Early Alert is the indication of disturbance and has five (5) priority. The higher indication of disturbance, the priority also higher. With this method, Forced Outage can be reduced so that Power Plant’s Reliability can be good.

Keywords: Big Data, Similarity Based Model, Online Monitoring
Framework of Low Cost IOT System to Monitor Coal Mining Wastewater Quality

Abdi Suryadinata Telaga\textsuperscript{1,2,a) and Radix Rascalia\textsuperscript{2,b)\textsuperscript{1}}

\textsuperscript{1}Construction and Building Engineering Department, Politeknik Manufaktur Astra, Komp. Astra International Tbk, - Gedung B Jl.Gaya Motor Raya No.8 Sunter II Jakarta 14330- Indonesia

\textsuperscript{2}System Information Department, Politeknik Manufaktur Astra, Komp. Astra International Tbk, - Gedung B Jl.Gaya Motor Raya No.8 Sunter II Jakarta 14330- Indonesia

Email: a)abdi.telaga@polman.astra.ac.id, b)radix.rascalia@polman.astra.ac.id

Water is one of essential element to support life ecosystem. While water is abundant in earth, but clean water is not always readily available. Therefore, water usage must be cautiously planned. Coal mining industry is one of the industries that consumes enormous amount of water. The industry needs 800-3000 gallons to produce 1 ton of coal. The consumption pushes local water resource to the limit. Therefore, mining company has responsibility to conserve water. However, the problem is not only the water consumption, but also the pollutants from the mining process. Wastewater must be properly treated before the water returned back to water resource. Indonesian government required coal mining company to frequently report wastewater quality to ensure the treated wastewater quality meet government regulation. Therefore, online monitoring is required to be able to monitor wastewater continuously. Advancement of low cost IOT technology allows deployment of wastewater IOT system in remote area. Therefore, the paper presents framework of low cost IOT system for wastewater quality monitoring. Further, the paper discusses the advantage and disadvantage of low cost IOT system. Then, cloud based IOT system architecture is selected as the architecture is suitable for remote area. In addition, dashboard presentation of wastewater quality is designed for web-based and android application. Deployment the IOT system in mining site confirms the applicability of the framework.

Keywords: Framework, IoT monitoring system, and wastewater quality.
Littering is mostly done by Indonesian people. Community indifferently throws out garbage not in the place provided. Seen, in public places there is a lot of garbage scattered about. This makes the environment dirty, uncomfortable and unhealthy. There needs to be an effort to change the bad habits of this society. By way of being reminded when people throw litter. So that there is a reminder that it will form a mindset from the community. From being indifferent to being indifferent to the waste produced. With this change in mindset it will also change the habits of the community. The camera is used as a sensor to detect people who throw garbage. Image processing needs to be done to determine when people litter. In processing this image produces variables that determine when people throw garbage. The placement of the camera will determine the effectiveness of the detection results. This is related to the distance from the camera to the object to be detected. Where the limited resolution of the camera makes the detection distance become limited.

**Keywords:** Image Processing, Littering, Camera
CS-251

Android-based parking violation reporting application

Budi Yulianto¹,* and Setiono Setiono¹

¹Sebelas Maret University, Indonesia
Email: *budi.yulianto@ft.uns.ac.id

Conditions in the field are often encountered by traffic violations caused by weak law enforcement with the limitations of law enforcement officers in its implementation in terms of human resources and the system. Vehicle drivers commit traffic violations, where they park their vehicles on pedestrian area, cyclist lane, roads that are prohibited for parking. In order to minimize traffic violations, a tool is needed to support law enforcement, especially in relation to the reporting system of traffic violations. The reporting tool must be effective, efficient and transparent in its reporting system. The purpose of the study is to conduct parking management and develop an Android-based parking violation reporting application called Buset Parking Law App. The results of the analysis parking characteristics in the study area indicate that vehicle parking violations are very significant. The implementation of the Buset Parking Law App shows that this application is easy to use, accurate, and transparent.

Keywords: Android, Parking management, Traffic violations, Law enforcement
Mobile, Fast Response, and Interactive Measurement Tool of Psychological Disorders under Android Based Smartphone

Wahyul A. Syafei*a), A. Ediati&), D. V. S. Kaloeti&), J. Ariati&), Subuh Pramono§), M. A. Virzawan#), and A. B. Prasetijo#)

*a)Department of Electrical Engineering, Diponegoro University, Indonesia
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang 50275, Indonesia
&)Faculty of Psychology, Diponegoro University, Indonesia
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang 50275, Indonesia
§)Department of Electrical Engineering, Universitas Sebelas Maret, Indonesia
Jl. Ir. Sutami 36 A, Jebres, Surakarta 57126, Indonesia
#)Department of Computer Engineering, Diponegoro University, Indonesia
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang 50275, Indonesia

Corresponding author : wasyafei@undip.ac.id

Keywords: Psychological disorder; DASS-21; android; mobile; interactive; fast response; waterfall; blackbox testing

Depression, anxiety, and stress are common psychological disorders that has been suffered by human. Since the number of sufferer has been increasing fast, recently, it becomes important to measure the level of those disorders and offer practical solutions. Usually, psychological disorders are measured by Psychologists using Depression Anxiety Stress Scale (DASS) – 21 form which consists of 21 questionnaires that should be filled, honestly. However this type of measurement is not attractive, time consuming, boring, and making the psychological disorders even worse. This research aims to develop a mobile, fast response, and interactive measurement tool of psychological disorders, in android based smart phones. Waterfall method which consists of system analysis, design, implementation, and testing is chosen to develop this application software. The measurement is based on the DASS-21 calculation scale to define the level of depression, anxiety, and stress. Black-box testing shows that the developed application software runs as expected. Validation result of the psychological disorder level which was examined by comparing it to the result from the test data demonstrates high accuracy.
Chemical Engineering
CE-004

Photodegradation of Batik Waste with Graphitic Carbon Nitride using UV - BLB

Bagas Cahyadi¹, Leony Inatsan Pertiwi¹, Anatta Wahyu Budiman¹* and Queenta Perdania Putri¹

¹Sebelas Maret University
Email: *budiman@staff.uns.ac.id

Bulk g-C3N4 are successfully prepared by simple pyrolysis method at 550°C. X-ray diffraction, nitrogen adsorption – desorption, transmission electron microscopy and UV – Visible diffuse reflectance spectra techniques were used to analyze the samples. The characterization results indicate that bulk g-C3N4 has high surface area 145.6 m²g⁻¹, large pore size of 4 nm, pore volume of 0.27 cm³g⁻¹ and the complete bulk g-C3N4 has hexagonal crystals. The prepared catalyst photoreduction with narrow bandgap 2.25 eV excellent for rodhamine B degradation. The effect of g-C3N4 addition in photoreduction of rodhamine B has been carried out, 5 samples with different concentration of rodhamine B was investigated. The result included the determination of optimum amount g-C3N4, maximum concentration of rodhamine B that can be degraded, and photoreduction type. The result shows that the optimum condition were 100 mg g-C3N4, 60 ppm of rodhamine B, and 90 minutes of photoreduction. The highest percentage of rodhamine B degradation was 87.44 % using UV Black Light Blue lamp for 88 minutes irradiation. As the time of irradiation increases, the degradation of rodhamine B increases too. The amount of g-C3N4 enhancing the adsorption of rodhamine B and favouring the mass transfer.

Keywords: photoreduction, rhodamine B, g-C3N4
Bontang LNG Plant Operational Strategy to Manage Ethane Refrigerant Inventory During Low NGL Extraction

Rendra Prasetiyo

PT Badak NGL, Bontang, Kalimantan Timur, Indonesia
Email: rendrap@badaklng.co.id

Bontang LNG Plant has been operated for more than 40 years since the initial startup in 1977. The total installed capacity is 22.5 MTPA. Due to the declining of feed gas delivery, now only 3 trains out of 8 are in operation, producing approximately 10 MTPA LNG. This feed gas decline leads to lower refrigerant either extracted or consumption. Therefore, PT Badak NGL decide to put one of two refrigerant bullets in idle condition since 1996.

Since 29 May 2017 Bontang LNG Plant receives new feed gas source which is considered lean. This leaner feed gas composition results on lower LPG content in feed gas. Previously ethane composition in feed gas was 3.9 %, while since mid of 2017 the composition was decrease into 2.8 %.

As consequence of feed gas declining and composition shifting, extracted refrigerant become significantly lower than original design. Times required for bullet replenishment become approximately 50 times slower and potentially cause start up delay due to lack of refrigerant for makeup. Therefore, additional C2 refrigerant bullet which previously put on idle are required to be reactivated to buffer sufficient amount of inventory.

The bullet reactivation provides additional 160 m3 of inventory which able to accommodate the worst potential case of multiple train start up.

Keywords: Declining feed gas, Lean gas, Refrigerant Optimization, Plant Operational Issues, Inventory Management
Production Of LiNi$_{0.6}$Mn$_{0.2}$Co$_{0.2}$.2O$_2$ via Fast Oxalate Precipitation for Li-Ion Batteries

Arif Jumari$^a$, Khikmah Nur Rikhy S., Refarmita Nur Halimah, Agus Purwanto, Luthfiatul Azizah Aini, Mintarsih Rahmawati

Sebelas Maret University, Jl. Ir. Sutami No.36A, Jebres, Surakarta, Indonesia 57126
Email: $^a$arifjumari_ft@staff.Uns.ac.id

Lithium-Ion (Li-Ion) battery is one of the secondary battery developed today. One of the important components of Li-Ion is cathode. Lithium Mangan Cobalt (LMCO), the last developed cathode material, had some disadvantage such as not resistant to high temperatures and short cycle performances. While Cathode material of LiNi$_{0.6}$Mn$_{0.2}$Co$_{0.2}$.2O$_2$ had some advantages of good structure stability, higher safety in high temperature and higher capacity. Here in this research the substance of nickel was inserted to the cathode material. The aim of the research was to synthesize LiNi$_{0.6}$Mn$_{0.2}$Co$_{0.2}$.2O$_2$ through simple and fast method of co-precipitation. Metal sulphate of Nickel, Mangan and Cobalt with a certain ratio were reacted with excess of Sodium hydroxyde. Metal hydroxyde formed was then precipitated with the co-precipitate of oxalic acid and pH adjuster of ammonia. Metal hydroxyde obtained was then reacted with Lithium hydroxyde in high temperature of solid state. The product yielded was characterized by XRD, FTIR and electrochemical performance analyser. Thr result showed that LiNi$_{0.6}$Mn$_{0.2}$Co$_{0.2}$.2O$_2$ with the exces of 5% Lithium gave the good performance with the capacity of 80 mAh/gram.

Keywords: Li-ion battery, cathode material, co-precipitation
Synthesis of Co/Ni – hydroxyapatite by Electrochemical Method

Adrian Nur¹*, Anatta Budiman¹, Arif Jumari¹, Fauziatul Fajaroh², Nazriati², M. Novalianto Sangadji¹, and Hanifah Ayu Pratiwi¹

¹Department of Chemical Engineering, Sebelas Maret University
²Department of Chemistry, State University of Malang

Email: *adriannur@staff.uns.ac.id

Electrochemical synthesis has been used for in-situ metal-hydroxyapatite production effectively because of the ease of controlling good metal synthesis and dispersion. This condition is very interesting to produce a catalyst in the form of a Co/Ni-hydroxyapatite composite used for hydrogen production from storage as a hydride chemical. The novelty of this research is the electrochemical synthesis of in situ metal-hydroxyapatite catalysts (together with electrochemistry of hydroxyapatite formation and Co/Ni impregnation). The advantages of hydroxyapatite as a catalyst support and electrochemical method in situ were combined in this study. The set of the experimental equipment consist of an electrochemical cell and a DC power supply. The electrochemical cells consist of a 250 ml volume acrylic container containing an electrolyte solution containing NiCl₂ and CoCl₂. This solution is made by dissolving Na₂H₂EDTA.2H₂O pro analyzer. Anode and cathode electrodes in the form of a rectangular carbon rod measuring 5.2 cm x 2 cm. The electrochemical cells are connected to a DC power supply which functions to give a potential difference between the two electrodes where the current density can be varied according to the specified variable.

Keywords: Hydroxyapatite, Cobalt, nickel, electrochemical, synthesis
Reprocessing Through Coprecipitation of NCA Cathode Scrap Waste for Cathode Material of Li-Ion Battery

Arif Jumari\textsuperscript{a)}, Enni Apriliyani, Agus Purwanto, Adrian Nur, Soraya Ulfa Muzayannah
Sebelas Maret University, Jl. Ir. Sutami No.36A, Jebres, Surakarta, Indonesia 57126
Email: \textsuperscript{a)}ariffjumari\_ft@staff.Uns.ac.id

Lithium Nickel Aluminium Oxide, LiNi0.8Co0.15Al0.05O2, or LiNCA is one of the famous kind of Lithium ion battery which have high capacity and high energy density. During production of LiNCA batteries, scrap waste containing metals such as Cobalt Nickel and Aluminium was produced. This waste can not be released directly to environment and the metal contained had an economic value. The aim of the research was to recover the metals and reprocess to be material of LiNCA as cathode material of LiNCA batteries. The method used was hydrometatalurgy consisting leaching and coprecipitaion. The scrap was leached by sulphuric acid and assisted hydrogen peroxide in a certain time and temperature. The liquor of metal sulphate was the reacted with Sodium hydroxide. Hydroxide of metals formed was then precipitated by adding a chelating agent. The hydroxide of metals was finally reacted with lithium hydroxide for forming LiNCA in solid state. The product obtained was characterized XRD, FTIR and SEM as well as electrochemical performance analyzer. The result showed that the recovery of Nickel, Cobalt and Aluminium were 98.9843\%, 97.3582\%, 96.0579\% respectively. XRD examination showed the product had the same the diffraction peaksof LiNCA, i.e. JCPDS #87-1562

Keywords: NCA cathode scrap waste, reprocess, hydrometallurgy, leaching, coprecipitation
The battery material production is potentially established in Indonesia, but now its development is still an idea. Further research is required to support a realistic effort of the battery material production to get the optimization of the lithium ion battery material. One of the most desired lithium ion batteries is LiFePO4. The advantages of LiFePO4 battery are environmentally friendly (because it doesn’t contain heavy metals), the raw materials are abundant in Indonesia, and excellent thermal stability. An effective and efficient synthesis method is needed to optimize the synthesis of LiFePO4. Based on these characteristics, the selected method is co-precipitation. Co-precipitation method can eliminate impurities which dissolved in water so the product be cleaner. Co-precipitation is done at moderate temperature for an hour. The raw materials are FeSO4, (NH4)H2PO4, and Li2CO3. These materials are dissolved in aquadest using H2O2 as oxidizing media and NH3 as pH control. This research studied the effect of sintering time (10 hours, 20 hours and 30 hours) in inert condition. LiFePO4 products are characterized by XRD, SEM and electrochemical properties. The pattern of XRD shows that the peaks of product are similar to the pattern of JCPDS Card No 40-1499. The LiFePO4 product with 20 hours sintering has smaller amount of impurities than the LiFePO4 product with 10 hours sintering. Whereas the LiFePO4 product with 30 hours sintering has the highest of the concentration of impurities. Based on SEM analysis the particle size is still in submicron. Meanwhile electrochemical properties to identify its discharge capacity/gram.

**Keywords:** Lithium battery, LiFePO4, Co-precipitation Method, Sintering time synthesis
CE-036

Study The Effect Of UV-B Mutation On Biodiesel Microalgae Botryococcus braunii Using Esterification, Transesterification And Combination Esterification-Transesterification

Widjaja, Arief\(^1,a)\), Prashantyo, Muhammad Hafizh\(^2,b)\) and Ramadhani, Anggia Putri\(^3,c)\)

Departement of Chemical Engineering - Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

Email : \(^a)\) arief_w@chem-eng.its.ac.id, \(^b)\) muhammad.hafizhp@gmail.com, \(^c)\) anggiapr99@gmail.com

Biodiesel from microalgae as third generation is promising sustainability and eco-friendly energy source. The objective of this study was comparing of biodiesel microalgae Botryococcus braunii conversion process with UV-B mutations using esterification, transesterification and combined esterification-transesterification processes. The yield conversion lipid to biodiesel of UV-B and normal variables using esterification method were 63.14% and 21.93% with 1 : 10 ratio molar alga oil : methanol, temperature 60\(^\circ\)C, 1.5% (wt%) H\(_2\)SO\(_4\), and mixing intensity 200 rpm for a reaction time of 2 hours. While the transesterification method of UV-B and normal variables doesn’t form biodiesel with 1 : 7 ratio molar alga oil : methanol, temperature 60\(^\circ\)C, 0.5% w/w NaOH catalyst, and mixing intensity 200 rpm for a reaction time of 1 hour. Furthermore, the combination esterification-transesterification of UV-B and normal variables were 46.69% and 31.82%. In the first stage esterification mutation and normal variable to lessen acid value from 24.13 to 0.567 mg KOH/g and 23.21 to 0.486 mg KOH/g. It was using 1 : 8 molar ratio alga oil : methanol with H\(_2\)SO\(_4\) catalyst 1.5% (wt%), temperature 60\(^\circ\)C at 400 rpm for 2 hours. The next stage transesterification was conducted at molar ratio 9:1, KOH catalyst concentration 0.75% (wt%), temperature 65\(^\circ\)C at 600 rpm for 1 hour. The results showed that the UV-B mutation had a higher biodiesel yield than normal variable. Biodiesel was analyzed by Gas Chromatography (GC) characterization and acid value.

**Keywords:** Biodiesel, Botryococcus braunii, esterification, mutation, transesterification UV-B
Mechanical Properties of Films from Carboxy Methyl Glucomannan and Carrageenan with Glycerol as Plasticizer

Fadilah¹,a, Ari Diana Susanti¹, Sperisa Distantina¹, Dea Putri Purnamasari¹, and Jihan Fahrizal Ahmad¹

¹Chemical Engineering Department, Faculty of Engineering, Universitas Sebelas Maret, Surakarta 57126, Indonesia
Email: a) fadilah@staff.uns.ac.id

Edible films from carboxymethylglucomannan (CMG) and carrageenan with glycerol as plasticizers are very possible to minimize the environmental pollution. Effect of composition of solid materials and the addition of glycerol were studied. The films were made by casting method, with variation of the composition of the solid materials are 5:15; 10:10; 15:5 (w/w) for CMG and carrageenan. The influence of glycerol were studied on the amount of as 5%, 10%, and 15% (v/v) in each variation of the composition. Edible film then tested its mechanical properties, such as tensile strength, elastic modulus, and elongation test using Universal Testing Machine (UTM). The results of this study showed that the highest tensile strength and elasticity modulus of edible film were obtained from combination of 5 gram CMG and 15 gram carrageenan with 5% glycerol addition. The value of tensile strength and elasticity modulus were 25.607 MPa and 320.09 MPa, respectively. While the highest elongation was found in films made by 15% addition of glycerol., resulting in the film elongation of 17%.

Keywords: edible film, carboxymethylglucomannan, carrageenan, glycerol, mechanical properties
In a quest to produce cathode material for lithium ion batteries that can increase the electrochemical performances, nickel rich cathode materials were synthesized via coprecipitation method. The addition of the precipitant agent (oxalic acid, tartaric acid and NaOH) serves to improve the performance of electrochemical batteries and control the morphology of cathode synthesis result. Based on FTIR, all precursor Nickel Manganese Cobalt (NMC) exhibit functional groups of hydroxide and carbonate. The XRD patterns of NMC show a peak at 003 and 104. Scanning electron microscopy showed that precursor NMC are sphere like shape with aggregates. The cathode materials were built into type full cell battery using artificial graphite as the counter anode. The results obtained the best discharge value from sample LNMC-OA of 12.66 mAh/g. All samples were tested for specific capacity stability by carrying out charge-discharge for 100 cycles. And the result is that all samples can still work in the 100 cycle. The results suggest that appropriate precipitant agent incorporation could lead to enhanced electrochemical performances of batteries.

**Keywords:** LNMC, coprecipitation, electrochemical performances, charge discharge.
A Brief and Rapid Method of Synthesizing LiFePO4/C for Lithium Ion Battery

Atika Aulia Novita Sari\textsuperscript{a}, Diajeng Putri Suciutami\textsuperscript{a}, Luthfi Mufidatul Hasanah\textsuperscript{a}, Agus Purwanto\textsuperscript{a}

\textsuperscript{a}Department of Chemical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami 36 A, Surakarta, Central Java 57126, Indonesia

Email: \textsuperscript{a)}agu spur@uns.ac.id

In the present, battery is one of the promising electrical energy storage. The most widely used is a secondary lithium ion battery. However, some challenges, such as explosive and non-environmentally friendly material of lithium ion battery need further research in innovation. LiFePO4/C as cathode of battery offers an answer to overcome the limitations due to its advantages of environmentally friendly material, abundant material, high thermal stability, and long cycle. Solid state and coprecipitation are the easiest method to synthesize LiFePO4/C in industrial scale because it doesn’t use lot of complicated equipment. The co-precipitation method is able to remove water-soluble impurities. This study concerns on crystallinity, and morphology which are analyzed by X-Ray Diffractometer, and Scanning Electron Microscopy. From the XRD pattern, the peak of LiFePO4/C are in accordance to the jcpds card no. 083-2092, but there still presence an impurity of Fe2O3. Based on SEM images, the range of particle sizes from the solid state method is 0,72 µm to 4,92 µm with the most particle distribution at 0,72 µm. Whereas, the range of particle sizes from the co-precipitation method is 0,32 µm to 1,32 µm with the most particle distribution at 0,61 µm.

Keywords: LiFePO4/C, lithium ion, secondary battery, solid state, co-precipitation
Waste lube oil is categorized as hazardous and poisonous waste based on government regulator. For minimizing the effect on the environment, it should be refined to remove the amount of impurities or decomposition substances. Used lube oil usually used to be treated to be valuable lubricant oil products. The last step of this refinery is the final fractionation process that uses vacuum distillation principles. This process aims to separate heavy lube oil and light lube oil products based on the specifications of the class III base oil. The specifications of class III lube base oil are saturation must be over 90%, sulfur content must be below 0.003%, and viscosity index higher than 120. Before doing optimization, a base case was made with temperature condition 250°C and reflux ratio 1.2 so we get product with saturation percentage, sulfur content and the viscosity index at bottom product 89.7%, 0.0032%, 161.772 and 95.57%, 0.0292% and 112.69 in the distillate respectively. Aspen Plus software was used for design and optimizing the final fractionation process to obtain an effective column with minimum TAC. Two variables were used in the optimization process, that is the temperature of the feed 250-300°C with 10°C interval and reflux ratio of 1.2-3 with an interval 0.2. The results showed that a minimum total annual cost at temperature feed 290°C and reflux ratio 1.2 with saturation percentage, sulfur content and the viscosity index at bottom product 93.6%, 0.0072%, 154.202 and 92.28%, 0.0193% and 122.95 in the distillates respectively. The total annual cost was found to be USD 83,059 per year.

Keywords: waste lube oil, final fractionation, vacuum distillation, light fraction, heavy fraction
Light Fraction Separation Process Design Using PreFlash Drum Continued To Vacuum Distillation To Determine Minimum Total Annual Cost (TAC)

Renanto Handogo1*, Alfin Nur Rofiq1, Vira Ferdi Murdabahari1 and Juwari Juwari1

1Institut Teknologi Sepuluh Nopember
Email: *renanto@chem-eng.its.ac.id

Used oil refinery is one of the sustainable recycling technologies to reduce waste of used lubricating oil. In the beginning of used oil refinery steps, there is a pre-treatment process to remove light fraction i.e. water, light ends, and gasoil. Therefore, process design of light fraction separation is needed to obtain the optimum condition of pre-treatment process. Light fraction separation was carried out in two stages, the removal of water and light ends, then gas oil separation of lubricating oil mixture. Removal of water and light ends at pre-flash drum unit is operated at 100-160 oC and at atmospheric pressure. While gas oil separation is performed on a vacuum distillation gas oil removal unit, this is due to the components of the gas oil has a boiling point range 68-281 °C. Aspen Plus v10 is used to perform the simulation of pre-treatment process. Variable of pre-flash drum is the temperature of the feed flow, while variable of vacuum distillation column is the ratio between reflux actual to reflux minimum with the range of 1.2-3. The optimum conditions in the pre-treatment process of water, light ends, and gas oil removal from used lubricating oil mixture is temperature feed pre-flash drum at 160oC, while the vacuum distillation reflux ratio at R/Rmin 1.2. The percentage of water content removal from used lubricating oil mixture on pre-flash drum column is 96.70%, light ends content removal from used lubricating oil mixture on pre-flash drum column is 61.65%, and gas oil content removal from used lubricating oil mixture on vacuum distillation column is 90.37%. With these conditions, the minimum total annual cost was found to be 158661 US$/yr.

Keywords: sustainable recycling, used oil, pre-treatment, pre-flash drum, vacuum distillation column
CE-052

Kinetics of Hydrothermal Decomposition of Glucose in Ethanol-Water Solutions

Bregas Siswahjono Tatag Sembodo\(^1\), Dwi Ardiana Setyawardhani\(^1\), Anisa Darma Briliant\(^1\) and Kintan Marchika Putri\(^1\)

\(^1\)Universitas Sebelas Maret
Email : *bregas@staff.uns.ac.id

The hydrothermal process for biomass has become an alternative for producing various chemical compounds for industrial and fuel use. In this study, glucose is hydrothermally processed in ethanol-water solution so that it decomposes into various chemical compounds. The purpose of this study was to study the hydrothermal reaction kinetics of glucose decomposition in ethanol-water solutions and study the chemical composition of the reaction products produced. Experiments of hydrothermal process of 5 grams glucose in 70 mL of 20% ethanol solution with variations of residence time 0, 30, 60, 80, 100, 140, 160 and 180 minutes were carried out in a magnetic stirred autoclave with a capacity of 150 mL to reach temperature of 200°C. After heating during various times, the autoclave is immediately removed from the heater and cooled immediately with an air fan. Processed material is removed from the autoclave, washed with ethanol solution, and filtered to separate the non-dissolved solid and the liquid phase. The solid residue which has been separated from the liquid phase is then dried in an oven at 105°C for 24 hours. The composition of the filtrate was analyzed using the GC-MS method and the glucose concentration was analyzed by the Lane Eynon method. Prior to GC-MS analysis, the filtrate was distilled at atmospheric pressure until remaining solid residue. The samples analyzed by GC-MS were distilled above 100°C to ensure the absence of water and residual glucose in the sample.

The glucose decomposition reaction in this study was a 2nd order reaction with activation energy of 13806.45 J/mole. The results of the GC-MS analysis showed that the reaction products of the glucose decomposition mostly contained three compounds, i.e. 2-dibutyl amino ethylamine, 5-ethoxymethyl furfural (EMF), and methyl 12-hydroxy-9 -octadecenoate (methyl ricinoleate).

**Keywords:** hydrothermal, glucose, decomposition
Kesambi Oil Extraction Using the Solvent Extraction Method

Yunita Merlin Tamara, Wahyu Nur Hidayat, Nur Asma Azizah, Dwi Ardiana S.
Department of Chemical Engineering, Universitas Sebelas Maret Surakarta Jl.
Ir. Sutami No.36 A Kentingan Surakarta 57126 Telp/Fax (0271) 637457
Email : dwi_ardiana@yahoo.com

Kesambi oil was strongly presumed can be used as raw material for biodiesel due to its fatty acid compositions are almost the same with other biofuel oils. This study examined that determine the differences of kesambi oil from extraction using four types of solvents in quality and quantity, knowing the quality of kesambi oil according to SNI 3741:2013. The method is solvent extraction by comparing the type of solvent (Etanol, Petroleum Eter, n-Hexana, Aceton) in solvent volume of 200 ml, 225 ml, 250 ml, 275 ml. The result showed that extraction with hexane and petroleum eter is the highest yield between 32-64%, optimum oil density with etanol solvent, extraction using etanol gives the lowest viscosity so that better oil quality is obtained. Kesambi oil has 0,19 % water, 2.5 meq O2/kg peroxide, 4.04 mgrKOH/ gr acid, 32.8 mgrKOH/gr, has yellow color and normal smell. The result showed that the quality of kesambi oil is classified as a standart quality of vegetatuon oil in accordance SNI 7431:2015 and kesambi oil has potential biodiesel material.

Keywords: Kesambi oil, Solvent Extraction, Vegetatuan oil
Bio-CSTR for Biogas Production from POME treatment – Technology & Design Analysis

Joni Prasetyo\textsuperscript{1*}, Semuel Senda\textsuperscript{1}, Winda Wulandari\textsuperscript{1} and Nabila Anindita\textsuperscript{1}

\textsuperscript{1}BPPT, Indonesia
Email: *joni.prasetyo@bppt.go.id

Bio-CSTR, bio Continues Stirring Tank Reactor, is the heart of any biochemical process in which enzymes, microbial, or plant cell systems are used for manufacture of a wide range of useful biological products. The performance of a bio-CSTR is influenced on many parameters and functions. Complexity and interconnection process in a bio-CSTR will affect to the material of bio-CSTR such as biological, chemical, physic and mechanical. The using of POME, a liquid waste of palm oil industry, has low pH, containing suspended solid, microbial processing that produces corrosive biogas like H2S. Therefore, an assessment was required due to observe and analyze the effect for bio-CSTR made of mild stainless steel. It is important to closely monitor the parameters like internal and external mass transfer, fluid velocity, and shear stress. The effects of such variables on biological cultures have been addressed in this work. Sophisticated and sound bioreactor design with unique performance characteristics is essential in production of useful biogas from POME. Understanding of the behavior in bio-CSTR would result in improved reactor designs, reactor operation, and modelling tools, which are important to optimize throughput rates and minimizing cost. The paper discusses the bio-CSTR design and various processes in bio-CSTR, which are useful for biogas production from POME.

Keywords: POME, bio-CSTR, mild SS, biogas, chemical and mechanical effect
Preliminary Study of Activated Carbon as Support Catalyst For Low Cost Methanol Production from Biomass Syngas

Fusia Mirda Yanti1,a), Asmi Rima Juwita1, Novio Valentino1, S.D Sumbogo Murti1, Joni Prasetyo1, Hens Saputra1, Shiori IGUCHI2, Reiji NODA2

1Center of Technology Energy Resources and Chemical Industry, Agency for Assessment and Application of Technology. 625 Building, Technology Energy Cluster, PUSPIPEK, South Tangerang.
2Chemical and Environmental Engineering, Graduate School of Science and Technology, Gunma University, 1-5-1, Tenjin-cho, Kiryu-shi, GUNMA 376-8515, Japan

Email: fusia.mirda@bppt.go.id

Energy demands have increased substantially over the last decade and consequently alternative energy sources are becoming a greater necessity. Therefore researchers are focusing on the development of processes and technologies that are environmentally-friendly, whilst ensuring reasonable standards of living throughout our world. Biomass is one of the more important potential sources for the production of synthetic fuels and energy. Biomass syngas as the intermediate product of utilization biomass to liquid fuel, biomethanol. In recent times, methanol production has been significantly augmented in energy and chemical industries as it is an essential molecule for chemical synthesis and other utilities such as clean transportation fuel. The assessment of methanol production for low cost, low temperature and low pressure was conducted by catalyst that has been developed. The role of the catalyst is the key to achieve optimal conditions through lower activation energy. Focus of this work has developed low cost catalyst for methanol synthesis. The catalyst of methanol synthesis was prepared by impregnation method of Cu and Zn with activated carbon as a support catalyst. The as-synthesized catalyst was then characterized using XRD, XRF, SEM-EDX, and BET. The result of XRD showed the catalyst has the same component (Cu, Zn) with crystallite diameter of CuO is 36.87 nm. The result of the SEM showed catalyst was collected on one site, but still in the relatively good distribution. From the BET surface area analyzer, the catalyst synthesized has higher surface area

Keywords: renewable energy, methanol, biomass, syngas, activated carbon, catalyst
Dye Sensitized Solar Cell (DSSC) with Immersion Time Variation of Working Electrode on The Dye of C4 Plant Chlorophyll of Corn Leaves (Zea mays L.)

Reka Anggraini\textsuperscript{1a}, Fahru Nurosyid\textsuperscript{1b} and Triana Kusumaningsih\textsuperscript{1c}

\textsuperscript{1}Physics Department, Faculty of Mathematics and Natural Science, Sebelas Maret University
\textsuperscript{2}Chemistry Department, Faculty of Mathematics and Natural Science, Sebelas Maret University

Email: \textsuperscript{a}rekaanggraini@student.uns.ac.id, \textsuperscript{b}fahrunurosyid@staff.uns.ac.id, \textsuperscript{c}triana_kusumaningsih@staff.uns.ac.id

Dye Sensitized Solar Cell (DSSC) performance is mainly influenced by the amount of dye absorbed in the working electrode. The amount of dye absorbed is influenced by several factor, including the immersing time of working electrode in dye. This study aims to obtain the effect of the immersing time of working electrode on the efficiency of DSSC with C4 plant chlorophyll of corn leaves as a sensitizer. The working electrode used was TiO\textsubscript{2} semiconductor. Dye is made from 1 g of corn leaves which is dissolved in 50 mL of acetone. The immersing time variations used were 1, 6, 12, 24, and 48 hours. The characterization applied were a UV-Vis spectrophotometer to measure the absorbance of the solution and absorbance of dye-coated work electrode layers, Keithley I-V Meter to measure the efficiency and conductivity of dye solution. The absorbance of the solution from the dye chlorophyll of corn leaves is located at a wavelength of 450 nm - 500 nm and 650 nm - 670 nm. The absorbance of the coating from the working electrode soaked in chlorophyll dye from immersion 1 hour increased to immersion 6 hours and then decreased continuously at immersion 12, 24 and hours. The efficiency and conductivity results showed the similar trend to the absorbance of the working electrode layer. The highest efficiency was obtained at immersing time of 6 hours which was 9.12 x 10^{-2}\%. The highest conductivity was obtained at immersing time of 6 hours which was 8.95\Omega\cdot m^{-1}.

Keywords: immersing time, chlorophyll, corn leaves, efficiency
CE-136

The Effect of Variation In The Type Of Contact Between Electrodes And Dye On Dye Sensitized Solar Cell Efficiency

Riski Kusumawati\textsuperscript{1a}, Fahru Nurosyid\textsuperscript{1b} and Agus Supriyanto\textsuperscript{1c}

\textsuperscript{1}Physics Department, Faculty of Mathematics and Natural Science, Sebelas Maret University

Email: \textsuperscript{a}Riskikusumawati@student.uns.ac.id, \textsuperscript{b}fahrunurosyid@staff.uns.ac.id, \textsuperscript{c}agusf22@staff.uns.ac.id

This research investigated the influence of variation in contacts between electrodes and dye on the efficiency of Dye-Sensitized Solar Cells (DSSC). The aim of this research was to obtain the influence of the type of contacts between electrodes and dye on the efficiency of DSSC module. There are three variation of contacts type namely using the copper paste, carbon paste and silver paste. The dye used was dye chlorophyll from spinach leaf, dye anthocyanin from the dragon fruit peel and dye from ruthenium N719. The DSSC module formed from the DSSC cells which combined using the external type Z series connection. The active area of each DSSC cells used is 1 cm x 9 cm. The characterization used was the UV-Vis spectrophotometry and Keithley I-V meters. This characterzation is aimed to determine the absorbance of the dye and the electrical properties of cells and modules. The characterization results show that the cells have almost the same absorbance level and the module that given silver paste can produce the best efficiency. The efficiency of chlorophyll module that given silver paste is 0.0107\% . The efficiency of anthocyanin module that given silver paste is 0.0125\%. Ruthenium module with silver paste can produce an efficiency of 0.0354\%.

\textbf{Keywords}: immersing time, chlorophyll, corn leaves, efficiency
Preliminary Study of Lithium Nickel Cobalt Aluminum Oxide Synthesized by Flame Assisted Spray Pyrolysis

Tika Paramitha¹, b), Hendri Widiyandari², c), Agus Purwanto¹, a), Cornelius Satria Yudha¹, d), Adi Prasetya¹, Muhammad Al Dhiyaul Haqqi Azmi¹

¹Department of Chemical Engineering, Faculty of Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami 36 A, Surakarta, Central Java 57126, Indonesia
²Department of Physics, Faculty of Mathematic and Natural Science, Universitas Sebelas Maret, Jl. Ir. Sutami 36 A, Surakarta, Central Java 57126, Indonesia

Email : a) aguspur@uns.ac.id, b) tikaparamitha@staff.uns.ac.id, c) hendriwidiyandari@staff.uns.ac.id, d) cornelyudha@student.uns.ac.id

This paper concerns on characteristics of Lithium Nickel Cobalt Aluminum Oxide (NCA). NCA were synthesized by flame assisted spray pyrolysis (FASP), followed by heat treatment at 800°C for 6 hours. The preparation conditions such as chelating agent and precursor flow rate were varied to optimize NCA particles. Two types of chelating agents were citric acid (NCA-citric acid) and nitric acid (NCA-nitric acid). Furthermore, the precursor flow rate were 40 mL/h and 100 mL/h. The highest product of NCA particles was produced at the precursor flow rate of 100 mL/h using both of chelating agents. The structure and morphology of NCA were characterized by XRD and SEM, respectively. From XRD spectra, NCA with hexagonal and layered structures were successfully synthesized and matched with JCPDS 87-1562. Based on SEM images, the irregular-shaped and micron-sized particles were formed. Moreover, electrochemical studies showed that NCA-nitric acid obtained the highest initial specific discharge of 67.72 mAh/g.

Keywords : NCA, flame assisted spray pyrolysis, cathode, Li-ion battery
Influence of Different Types of Filler on The Properties of Polymer Gel Electrolyte Membranes for Li-Ion Battery Applications

Endah Retno Dyartantia, Agus Purwanto1, I Nyoman Widiasa2 and Heru Susanto2

1Department of Chemical Engineering, Universitas Sebelas Maret, Surakarta, Indonesia
2Department of Chemical Engineering, Diponegoro University, Semarang, Indonesia
Email: endahrd@gmail.com

Poly(vinylidene fluoride) P(VDF) polymer gel electrolytes (PGEs) membranes with different types of filler such as nano clay, ZnO and SiO2 from fly ash, were prepared by non-solvent induced phase separation (NIPS) method. The electrochemical properties, compatibility with electrodes and the performances of lithium-ion batteries using these gel electrolyte membranes are investigated. It is observed that ionic conductivity of these gel electrolytes with nano-clay filler exhibit more stable ionic conductivity and the charge-discharge performance than those containing ZnO and SiO2 from fly ash. A highest ionic conductivity of 5.62 x 10^{-3} S.cm^{-1} was accomplished at room temperature for 8 wt% adding of nano-clay filler. The charge-discharge performance of a battery using these membranes was inspected using coin cells (LiFePO4/MCMB) composed of electrolytes membranes based on PVdF/PVP. This battery with different filler maintains 97.7% of initial capacity after 50 cycles at a 0.2 C rate. It is remarked that the type of filler is an influential factor that impacts the value of electrolyte uptake, electrochemical properties, and performance of the lithium-ion batteries.

Keywords: PVDF, Polymer Gels Electrolyte, Filler, Lithium-Ion battery
CE-192

The Urea Release Rate of Bead Gel Based on Kappa Carrageenan, Pectin, and Glucomannan

Sperisa Distantina\textsuperscript{a)}, Scila Ardanari Santoso\textsuperscript{b)}, and Melia Citrawati\textsuperscript{c)}

Chemical Engineering Department, Engineering Faculty, Universitas Sebelas Maret, Jl. Ir. Sutami 36 A Surakarta 57126, Indonesia.

Email: \textsuperscript{a)} sperisa_distantina@staff.uns.ac.id, \textsuperscript{b)} scilasantoso@gmail.com, \textsuperscript{c)} melia.citra99@gmail.com

In this paper, bead gels based on natural polymer for controlled release matrix of urea as fertilizer were prepared. The effects of composition of kappa carrageenan – glucomannan – pectin on the rate of urea release were investigated. The mixture solution of natural polymers were injected into palm oil layer and dropped into KCl and CaCl\textsubscript{2} solution forming bead gel. The dried bead gels were immersed in glutaraldehyde solution and then heated of 110\textdegree C during 15 min. The certain urea was transferred into bead gel by immersion method. The dried bead gel containing urea were release test in water medium. The concentration of urea was measured at certain interval time of release test. It is found that proposed mathematic model may describe the urea release rate from matrix into water. The composition mixture of kappa carrageenan-pectin and mixture of kappa carrageenan – glucomannan produced different properties of the obtained bead gels. Glutaraldehyde crosslinked bead gels may be potential as urea controlled release matrix.

Keywords: bead gel, urea, release, controlled
CE-193

Biodiesel Production from Waste Cooking Oil By using Zirconia Catalyst

Diah Ayu Almaas Salwa\textsuperscript{a}, Khoirun Nisa\textsuperscript{b}, Alfi Hasanah\textsuperscript{c}, and Widayat\textsuperscript{d}

\textsuperscript{1}Department of Chemical Engineering, Faculty of Engineering, Diponegoro University, Semarang – Indonesia

Email: \textsuperscript{a}knisa@student.undip.ac.id, \textsuperscript{b}salwaalmaas@gmail.com, \textsuperscript{c}alfihasanah4@gmail.com, \textsuperscript{d}yayat_99@yahoo.com

Biodiesel has chemical and physical properties similar to petroleum diesel so that it becomes one of the alternative energies. In this research, biodiesel was produced with esterification and transesterification reactions by assisted zirconia catalyst. Zirconia catalyst was prepared from zirconia sand as natural resources in Indonesia. The physical and chemical process was used in preparation of catalyst. The catalyst was characterized with XRD and SEM analysis. Zirconia catalysts used have tetragonal crystal structure and are amorphous. Biodiesel production is carried out at 60°C with simultaneous transesterification and esterification. Analysis of changes in chemical structure and formation of FAME were analyzed using GC-MS. The results of this study are the greater the percent weight added, the higher the value of FAME and the lower biodiesel obtained has density, viscosity and FFA contents. Biodiesel product was similar with SNI of biodiesel.

Keywords: biodiesel; catalyst; simultaneous; zircon.
CE-202

Application of titanium doped g-C3N4 for the degradation of toxic dyes in textiles wastewater

Anatta Budiman1*, Bregas Sembodo1, Ahmad Alviansyah, and Irma Benita1
1Universitas Sebelas Maret
Email: *budiman@staff.uns.ac.id

Graphitic carbon nitride (GCN) is becoming a potential material for organic synthesis, electrodes, photocatalyst, and hydrogen storage. Moreover, it only consists of carbon and nitrogen elements that makes environmentally safer and cheaper than metal-based material. Various techniques have been introduced to improve GCN photocatalytic efficiency as combination with other semiconductors, doping with noble metals and non-metals, the modification of morphology like porous GCN or nanostructures GCN. The nanosheet form is known to be one of the most potential way to improve the catalytic efficiency of GCN by improving the catalyst’s surface area. In this study, we have compared several ways of exfoliation method of GCN to form nanosheet carbon nitride (NSCN) such as thermal and acid leaching for the application of organic waste degradation. Exfoliation of GCN by 1 M nitric acid was found to have the highest surface area than thermal exfoliation method. As photocatalyst for degradation of organic dyes, the performance of NSCN are superior compared to GCN with 92% conversion for 40 minutes irradiation under UV light.

Keywords: carbon nitride, catalyst, organic waste, degradation
Silica from geothermal power plant waste was studied as filler for rubber compound. Utilization of geothermal silica will be beneficial both to the rubber and power industries. Rubber industries got benefit from its low cost and the potential as reinforcing filler in rubber compounds, and power industries benefited by resolving waste problems in the geothermal facilities. The effect of geothermal silica addition on the rubbers compound and vulcanizate were investigated. The rheometer, FTIR, UTM and SEM were used to studied the vulcanization process, development of crosslink and mechanical properties of the rubber. The results showed that the compound using geothermal silica had faster curing time, better swelling properties, but lower mechanical properties compared to commercial silica.

**Keywords:** geothermal, silica, filler, rubber
Investigation on Fluid Mechanics Performances in Packed Bed Catalyst using Computational Fluid Dynamic (CFD)

Ari Diana Susanti\textsuperscript{1,a)} and Yazid Bindar\textsuperscript{2,b)}

\textsuperscript{1}Department of Chemical Engineering, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36 A Surakarta, Indonesia
\textsuperscript{2}Department of Industrial Engineering, Institut Teknologi Bandung, Jl. Ganesha 10 Bandung, Indonesia

Email: \textsuperscript{a)}aridiana@staff.uns.ac.id, \textsuperscript{b)}yazid@che.itb.ac.id

The overall performances of the catalyst bed are contributed by each performance of catalyst. There are several types in shape of catalysts those used in industrial field. The arrangement of the catalyst in the packed bed are mostly random. As the result, there will be found several orientation of catalyst in the reference to the axial flow of process fluid in the packed bed. In this study, four types in shape of catalyst are investigated. Those are 7-spoked wheels, 7-holed wheels, cog, and clover leaf shape. The fluid mechanic performances on the catalyst bed will be assessed in terms of pressure drop, flow pattern, and accessible fraction of the surface of the catalyst by the process gases. Investigation was conducted using Computational Fluid Dynamic (CFD) method. The CFD was applied for single particle and double particles of catalyst with several possible catalyst orientation in the bed. The highest fluid flow velocity was found at inclined catalyst orientation that was 3.3636 m/s. For horizontal catalyst orientation, the fluid flow velocity reached 3.0800 m/s and 0.3262 m/s for vertical catalyst orientation. At inclined catalyst orientation, the fluid velocities through the interior side of the catalyst were varied due to collision effect between fluid flow and the walls of the interior of the catalyst. Conical structure of the surface of the catalyst will affect to the accessibility inside of the catalyst. Its also found that random arrangement of catalyst in the bed will improve the effect of fluid mixing and avoid the catalyst bridging phenomena.

Keywords: computational fluid dynamic, fluid mechanics, performance, packed bed catalyst
Innovation in communication and information technology affects the increases in electronic devices supply. Unfortunately, most of them filled with metal and inorganic materials, which causes accumulation of nondegradable electronic waste. This problem requires great attention in developing some electronic material parts that can be degraded when discharged as waste. Polylactic acid is one of the biodegradable polymers which its properties are comparable to the synthetic petroleum-based polymers such as polyethylene terephthalate (PET), polypropylene (PP), etc. This research aims to develop conductive polymer composites (CPCs) by tailoring the electrical conductivity of polylactic acid through blending with graphite. The polylactic acid/graphite was processed by using a mini extruder. Graphite composition was varied from 5%, 10%, and 15% (%w). The samples characterized using SEM, FTIR, and electrical conductivity test. The result showed that the electrical conductivity enhanced in the presence of graphite. The mini extruder was able to make homogeneous distribution of graphite in the biocomposite

**Keywords:** Conductive, Polymer, Poly Lactic Acid, Graphite, Blending
Characterization of Secondary Metabolite Isolated from Ethyl Acetit Fraction of Petrosia alfiani Sponge from Barrang Lombo Island

Rahmayanti

Morowali Metal Industries Polytechnic – Morowali, Indonesia
Email: rahma.pilm@gmail.com

Sponge represent one of marine biota which very prospective as the natural compounds resource. The purpose of this sponge characterization is to find active compound.

The research methods included sample preparation, maceration, partition, fractionation, and purification. Isolates obtained were analyzed by TLC and its melting point was tested. Furthermore, the molecular spectroscopy data: IR, 13C NMR and 1H NMR. The result indicates that it is found three compounds in ethyl acetic fraction of P. alfiani sponge. Based on phytochemical test and spectroscopy was knowed that compound 1 is terpenoid, compound 2 is carboxylic acid, and compound 3 is β-sitosterol.

Keywords: Characterization, Secondary Metabolite, Petrosia alfiani Sponge
Catalytic pyrolysis of plastic waste over zeolite MOR catalyst

Joko Waluyo¹*, Devaliandra Ramadhana¹ and Aji Putra Perkasa¹

¹Universitas Sebelas Maret
Email: *jokowaluyo@staff.uns.ac.id

Plastic wastes are not biodegradable material and have a negative impact on the environment. The aim of this study is to covert HDPE plastic bag waste to hydrocarbon fuel using thermal and catalytic cracking. Pyrolysis was carried out on batch pyrolyzer with a heating rate of about 2.5 – 4°C/min. The pyrolyzer temperature was increased to the desired temperature of 350 and 400°C. Pyrolysis was conducted with and without a catalyst. Natural zeolite from Klaten- Indonesia that has a main structure mordenite phase was used as a catalyst for catalytic cracking. The presence of a zeolite catalyst can increase the yield of pyrolysis oil. At 350°C and pyrolysis without catalyst, the yield of pyrolysis oil was 13.9% while with catalyst was 40.9%. Whereas at 400°C the yield 32.2% and 41.2% respectively. The GC-MS result shows that the oil product contained hydrocarbon in the gasoline range.

Keywords: Plastic, HDPE, Pyrolysis, Zeolite, Mordenite
Tar is the impurity in the syngas from the gasification of biomass because it can cause blockage, corrosion, and poison the catalyst for the use of synthesis gas. One attempt to remove tar is by using a catalyst with a steam reforming reaction. In this study, toluene is used as tar model. The natural zeolite from Wonosari that contain 75-80% mordenite crystalline phase is used as a catalyst after modification by ion exchange, acid leaching, and impregnated Nickel. Na and K as impurities in the zeolite can be removed by ion exchange and acid leaching which has an impact on increasing surface area. Addition of Nickel can increase the activity of steam reforming catalysts, with tar conversion up to 95.6%. Steam reforming of toluene was carried in a tubular reactor having a diameter of 2 cm at atmospheric pressure with temperature variations of 550°C, 650°C, 750°C and the residence time 0.17; 0.33; 0.5 kg.hr/m3. The activation energy for zeolite catalyst with Nickel impregnation was 113.92 kJ/mol and pre-exponential factor $3.99 \times 10^6$ m$^3$/kg.hr. The reaction is controlled by the surface reaction of the catalyst, as shown by Thiele Modulus results, The Weisz Prater criterion and Mears criterion.

**Keywords**: tar removal, biomass gasification, modified zeolite, mordenite
Effect of Na-Citrate on instant rice processing to lower the glycemic index

Joko Waluyo\textsuperscript{1a}, Yusi Prasetyaningsih\textsuperscript{2b}, Ida Maya Sari\textsuperscript{1} and Fenny Tri Ariyani\textsuperscript{1}

\textsuperscript{1}Universitas Sebelas Maret
\textsuperscript{2}Politeknik TEDC

Email: \textsuperscript{a}jokowaluyo@staff.uns.ac.id, \textsuperscript{b}yusi.prasetyaningsih@poltektedc.ac.id

Rice is the main food for most people in Indonesia. However, to cook rice it takes a long time around 40-50 minutes. How to make rice to be more easily consumed. Instant rice is one solution with the precooking and drying process. Indonesia also has a region that is often hit by natural disasters due to its geographical location, so rice is fast becoming the main requirement as a practical staple food. The purpose of this study is to make instant rice with a low glycemic index so that it can be consumed by people with diabetes mellitus. The method used in making this instant rice is soaked - cook - freeze - dry it. The rice is soaked using 2-7\% Na-citrate solution at 50\degree C, for 2 hours. The ratio of rice with a soaking solution is 1: 2. Rice is needed up to pH 7 then accepted using rice cookers. Cooked rice is frozen in the freezer at -4\degree C for 24 hours. Rice which has been liquefied by the thawing process uses warm water at 60\degree C. Rice is then heated at 70\degree C for 4-5 hours. Instant rice is ready to be brewed (rehydrated) using boiling water. Instant rice rehydration time reaches 5.49 minutes. The glycemic index test results showed an instant glycemic index value of 51.69 with a nutrient content that did not increase significantly.

Keywords: instant rice, rehydration time, glycemic index
Synthesis of Biodiesel from Kapok (Ceiba pentandra L.) Seed Oil through Ultrasound-Enhanced Transesterification Reaction

Ratna Dewi Kusumaningtyas\textsuperscript{1,a)}, Muhammad Yasir Adhi Utomo\textsuperscript{1)}, Pipit Risky Nurjanah\textsuperscript{1)}, Dwi Widjanarko\textsuperscript{2)}

\textsuperscript{1}Chemical Engineering Department, Faculty of Engineering, Universitas Negeri Semarang, Indonesia

\textsuperscript{2}Mechanical Engineering Department, Faculty of Engineering, Universitas Negeri Semarang, Indonesia

Email: \textsuperscript{a) ratnadewi.kusumaningtyas@mail.unnes.ac.id}

Biodiesel is among the prospective renewable energy due to its superior properties as fuel such as environmental friendly, non-toxic, biodegradable, resulting low pollutant emission, having high energy value and high cetane number, as well as can be readily applied in diesel machine. Biodiesel is also among the priority in the Indonesian national blue print on new and renewable energy development 2005-2025. Currently, Biodiesel is commonly produced through alkaline-catalyzed transesterification of vegetable oil which is conducted in conventional batch reactor. However, this process shows several drawbacks for instance the low reaction conversion. To overcome this challenge, process intensification of biodiesel production using ultrasound-enhanced transesterification process in batch reactor was employed in this work. The feedstock used for biodiesel synthesis in this work was kapok (Ceiba pentandra L.) seed oil. The oil contains gum and high free fatty acid (FFA) as much as 8.89%. Therefore, prior to the transesterification reaction, two steps of pretreatment processes i.e. degumming process for gum removal and esterification for reducing the FFA content until it reach the value below 2%. The main transesterification reaction was then performed by using ultrasound enhanced batch reactor which was operated at the frequency of 20 Hz and temperature of 60\degree C in the presence of KOH catalyst. The reaction time was fixed 60 minutes. On the other hand, the molar ratio of methanol to oil was varied at 1:4, 1:5 and 1:6, and the catalyst concentration was studied at 0.5, 1, and 1.5\% \text{ w cat/ w oil}. It was found that highest yield was obtained at the reaction conducted using 0.5\% catalyst and the molar ratio of 1.6 with the reaction conversion of 99.82\%. This result was higher that yield resulted by the conventional process performed at the similar condition which revealed the yield of 90\%. Biodiesel produced using ultrasound-enhanced reactor fulfilled the SNI standard of properties in term of viscosity and density.

\textbf{Keywords} : biodiesel, ultrasound, esterification, transesterification, kapok seed oil
Synthesis of Green Diesel Through Hydrodeoxygenation Reactions of Used Cooking Oil over NiMo/Al2O3 catalyst

Sd Sumbogo Murti*, Fusia Mirda Yanti and Atti Sholihah

*BPPT, Indonesia

Email:*sd.sumbogo@bppt.go.id

Biodiesel is an alternative fuel that can be renewed and is more environmentally friendly. In this study, biodiesel was produced from waste vegetable cooking oil through the initial treatment reaction (saponification) which then carried out by transesterification reaction. Furthermore, hydrodeoxygenation was carried out over NiMo/γ-Al2O3 catalyst in batch autoclave reactor to produce green diesel. The reaction conditions were conducted at 30 and 50 bar and temperatures of 300, 350, 400 and 450°C. Characterization of gas products were conducting using GC-TCD, while the liquid products using GC-MS. Biodiesel and green diesel are calculated using %yield and quality analysis such as % FFA, density, flash point, pour point and cetane number were investigated. The result of characterization of gas products using GC-TCD shows the components of H, O2, CO, CH4 and CO2 which indicate the selectivity of the hydrotreating HDO reaction to DCO/DCO2 and fracturing. While green diesel biodiesel liquid products contain methyl ester and ethyl ester compounds with saturated and unsaturated hydrocarbon chains with a range of C11-C25 and alkene hydrocarbon compounds. The analysis of the quality of biodiesel and green diesel showed in accordance with quality standards of biodiesel. The effect of reaction condition to produce green diesel were studied to elucidate the hydrodeoxygenation process.

Keywords : Green diesel, waste vegetable cooking oil, hydrodeoxygenation, NiMo/Al2O3 catalyst
Performance of Amberlyst 35 Wet as Solid Catalyst for Glycerol Esterification with Oleic Acid

Diana¹,a) and Nur Indah Fajar Mukti²,b)

¹,²,³Department of Chemical Engineering, Faculty of Industrial Engineering, Universitas Islam Indonesia, Yogyakarta, Indonesia
Email: a) diana@uii.ac.id, b) nurindah_fm@uii.ac.id

Glycerol Monooleate (GMO) is an emollient and emulsifier that is widely used in cosmetics and food products. GMOs can be produced by esterification of oleic acid with glycerol. This reaction will not only produce GMO, but also Glycerol Dioleate (GDO) and Glycerol Trioleat (GTO). The presence of GDO is tolerable while GTO is the undesired product. The aim of this study is to develop low-cost and efficient conditions for esterification of oleic acid with glycerol in order to produce emulsifier. The performance of Amberlyst 35 wet was studied under various operating conditions, i.e: reaction temperature, the molar ratio of oleic acid to glycerol, and catalyst loading. Effect of the catalyst mass ratio on acid (1-5%), the molar ratio of oleic acid/glycerol (1: 1-1: 8), and the reaction temperature (120-170°C) on acid conversion were studied to obtain the optimal reaction conditions.

Keywords: Amberlyst 35 Wet, Solid Catalyst, Glycerol Esterification, Oleic Acid
CE-279

Improvement of Efficiency of Dye-Sensitizer Solar Cells (DSSC) Transparent by Optimizing of Anthocyanin Dyes Hybrid Dyenamo Yellow (DN-F01)

N E-H Diyanahesa¹, A Supriyanto², and A H Ramelan²²

¹Physics Department, Graduate Program, Sebelas Maret University Jl. Ir. Sutami 36A Keningan Jebres Surakarta, 57126
Email: nadiyahesa@gmail.com¹, agusf22@staff.uns.ac.id²

To improve the efficiency of the DSSC circuit, light absorption from organic dyes must reach the maximum visible and near infrared spectrum values. This research examined improvement of efficiency DSSC transparent by optimizing of natural dyes hybrid synthetic dye (DN-F01). Composition of natural dyes in this research used anthocyanin (black rice and black sticky rice). Anthocyanin dyes and DN-F01 with optimized choice of agents indicated that improved photovoltaic impacts contrasted with single individual dye sensitization and increased the absorption of solar light and allowed utilization of the photon energy more efficiently. With using spin coating method, FTO glass with TiO₂ as working electrode and opposite electrode used FTO glass with platinum paste. To determine the efficiency of DSSC for characterization of electrical properties using Keithley I-V meter. The highest efficiency of the DSSC circuit is obtained from a combination of Black Rice Dye and 1% DN-F01 which is equal to efficiency (η) reached 1.065 % with an open circuit voltage (Voc) of 378 mV, short circuit current density (Isc) of 1.235 mA with fill factor (FF) of 0.656.

Keywords: Dyenamo Yellow, Anthocyanin Dyes, Dye-Sensitized Solar Cells, Photosensitizer
Note:

...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................
...........................................................................................................