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ACISE

PROGRAM BOOK

International Joint Conference of

2016 2nd International Conference of Industrial, Mechanical, Electrical, and Chemical Engineering (ICIMECE) and 2016 Annual Conference on Industrial and System Engineering (ACISE)

Supported by :

IEEE

RISTEKDIKTI

Yogyakarta, Indonesia
October 6 - 7, 2016

Organized by :

PROGRAM BOOK

International Joint Conference of 2016 2nd Industrial, Mechanical, Electrical, and Chemical Engineering (ICIMECE) and 2016 Annual Conference on Industrial and System Engineering (ACISE)

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Organized by :

Universitas Sebelas Maret (UNS)

Universitas Diponegoro (UNDIP)

Institut Teknologi Bandung (ITB)

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Yogyakarta, Indonesia

October 6 - 7, 2016

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Welcome Message

On behalf Organizing, Steering, and Technical Program Committee, it is my privilege to welcome you to the Joint International Conference of The Second Industrial, Mechanical, Electrical, and Chemical Engineering & Industrial and System Engineering (ICIMECE & ACISE 2016).

The ICIMECE & ACISE 2016 organized by Faculty of Enigeering - Sebelas Maret University in collaboration with Faculty of Enigeering - Diponegoro University, and the School of Electrical and Informatics, Institute Technology Bandung (ITB), and the Institute of Electrical and Electronics Engineers (IEEE) with technical co-sponsored by the Indonesia Section C Chapter and Indonesia Section SP/ED/E/PES Joint Chapter.

The first ICIMECE (formerly known as IMECE) was held in 2015 while the first ACISE was held in 2014 as a domestic conference. This year, these two conferences are joined together 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 namely ABG (Academic–Business–Government) forum, to share ideas and to present the works of scientists, engineers, educators and students. Speakers from Australia, Indonesia, Japan, Malaysia, South Korea, the Republic of the Philippines, the United Kingdom, The People's Republic of China and Turkey were submitted articles to this conference.

In closing, It was our great honor and pleasure to accept the responsibilities and challenges of Conference General Chair. We hope that the conference will be stimulating, informative, enjoyable and fulfilling experience for all who attend it.

Organization and Committees

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Sebelas Maret University
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Bandung Institute of Technology
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Anugerah Widiyanto

PROGRAM SCHEDULE
International Joint Conference of 2016 2nd International Conference of Industrial, Mechanical, Electrical, Chemical Engineering &2016 Annual Conference on Industrial and System Engineering (ICIMECE & ACISE 2016)

Royal Ambarrukmo Hotel Jogjakarta, Jl. Laksda Adisucipto No.81, Daerah Istimewa Yogyakarta 55281, Phone:(0274) 488488

Day-1: Thursday, October 06, 2016

TIME	PROGRAM ACTIVITIES
07.00 – 09.00 a.m	Conference Registration
09.00 – 09.10 a.m	Opening Ceremony by MC (support by HMTI UNS)
09.10 – 10.55 a.m	- National Anthem - Reporting Speech of SC of IC IMECE by Dean of Faculty Engineering, Sebelas Maret University, **Dr.techn.Ir. Sholihin As'ad, M.T** - Reporting Speech of SC of ACISE by Dean of Faculty Engineering, Diponegoro University, **Ir. M. Agung Wibowo, MM, MSc, PhD** - Opening Speech by UNS' Rector, Prof Dr. Ravik karsidi, MS - Keynote Speech by Director of Quality Asurance on behalf Ministry of Research, Technology & Higher Education : **Prof drh Aris Junaidi, Ph.D** - MoU signment between UNS and PT Festo Indonesia
09.55 – 10.15 a.m	***Coffe Break***
10.15 a.m – 12.10 p.m	Keynote Speech I : **Drs Slamet Ajji Pamungkas M.Eng.** Head of Sub-Directorate Information and Data Analisys Badan Ekonomi Kreatif
	Keynote Speech II : **Prof. Amran Rasli, Director of ICC**, Universiti Teknologi Malaysia Theme: "Contribution of innovation and technology commercialization at Universities to National Economic Growth: a case study from ICC-UTM Malaysia"
	Keynote Speech III : **Assoc. Prof Erdem Cuce, Ph.D - Bayburt** University. Theme"Technology Commercialization in Energy"
	Keynote Speech IV : **Mr.Safri Susanto, S.T. Didactic Manager PT Festo di Indonesia**. Title : Industri 4.0 is All about Future Production Process

	Discussion and Question/Answer with Keynote Speakers Moderator : **Retno Tanding Suryandari SE., M.E,.Ph.D (Sebelas Maret University)**
12.15 - 01.00p.m	**Photo Session & L U N C H**
01.15 –03.00 p.m	Parallel Session I (@presentation 20")
03.10 – 03.25 p.m	**Coffee break**
03.25 – 05.15p.m	Parallel Session II (@presentation 20")
07.30- 09.00 p.m	Conference Dinners - *Speech from International Office,* - *Sponsorship Reward* - *Award Announcement* - *Performace Art from*

*) Request from committee

Day-2, Friday, October 07,2016

TIME	PROGRAM ACTIVITIES
08.00 – 08.45 a.m	Conference Registration
08.45 – 09.15 a.m	**Coffe Break**
09.15 – 11.15 a.m	Keynote Speech V : **Prof. Muhammad Nizam, ST., MT., Ph.D** Professor of Power Systems, Universitas Sebelas Maret Theme: "Commercialization of Renewable Energy: Economic Opportunities and Energy Management"
	Keynote Speech VI: **Sarjiya, ST., MT., P.hD.** Chair of Power and Energy Society Chapter, IEEE Indonesia, Universitas Gadjah Mada, (UGM). Talk Title: "Commercialization of Renewable Energy: Power System and Technology"
	Keynote Speech VII : **Warsono M., ST., M.Phil.,** General Manager Transmission of East Java and Bali Region, PLN. Talk Title:"Commercialization of Renewable Energy: Policies and Regulations"
	Discussion and Question/Answer with Keynote Speakers Moderator : **Dr. Singgih Saptadi, ST. MT** (Diponegoro University)
11.15 a.m – 12.30 p.m	**Friday Shalah**
12.30 – 01.00 p.m	**Lunch Break**
01.00 – 03.10 p.m	Parallel Session III (@presentation 20")
03.10 – 03.25 p.m	Coffe Break
03.25 – 05.15 p.m	Parallel Session IV (@presentation 20")

Keynote Speaker

Chief of Badan Ekonomi Kreatif

Biography

Triawan Munaf

Triawan Munaf was born in Bandung, November 28th1958. Triawan is son from couple Bahar Munaf and Etty Munaf. He married with Luki Ariani. They are parents from Virania Munaf and Sherina Munaf. He became Kepala Badan Ekonomi Kreatifafter officialy inaugurated by the president of Indonesia, Ir. Joko Widodo, on26th January 2015, through Keputusan Presiden (Kepres) Nomor 9 P year 2015. He became the first chief for the new estabilished institution that has the same level with the ministry. Badan Ekonomi Kreatif is a new estabilished state institution that used to be a part of Ministry of Tourism and Creative Economy.

Triawan engaged in the field of advertising and founded *Euro RSCG AdWork*on 26th December1989. On of his klien is Partai PDI Perjuangan. The PDI Perjuangan icon,white mouthed bull is one of his creation.

Director, UTM Innovation and Commercialisation Center, UTM

Biography

Prof. Amran bin Muhammad Rasli Ph.D

Mr. Amran bin Md. Rasli is a respected figure in Innovation and Commercialization Center, Universiti Teknologi Malaysia. He was born on June 5th, 1961 in Kuala Lumpur,

Malaysia. On 1983 he got his B.A. (Statistics) with C.G.P.A. of 3.00 from California State University, Chico, California, until 2005 with his PhD in Society, Business &Globalisation from Roskilde University, Denmark.

Mr. Amran has many professional qualifications or memberships which he has been joining until now, from a member of SPSS User Group to an advisory member and board of Trustees to the Asia Pacific Business, Innovation and Technology Management Society (Jan 1, 2012-Dec 31, 2015). He also had a consultancy or training since 1991. Many awards have been given to him, such as Represented Malaysia for the APEC-HRD-BMN Project in Developing Cross-Cultural Training for SMEs on Interactive CD-ROM. He attended the first Project Meeting and Inception Workshop on January 18-20th, 1997 in Sydney, Australia, and the latest one is Anugerah Khidmat Cemerlang in conjunction with Citra Karisma Universiti Teknologi Malaysia 2013. Not only awards, he also has many research records which he had made since 1991 until now.

Technology Commercialization in Energy Bayburt University, Turkey

Biography

Erdem Cuce, Ph.D

Dr. Erdem Cuce has received his PhD from the University of Nottingham on sustainable building technologies.He has worked on numerous scientific projects in the scope funded by notably EU, TSB, DECC, EPSRC, BRITISH COUNCIL, TUBITAK and international based commercial companies. He has strong numerical, computational, experimental and simulation skills as well as comprehensive CFD techniques based on UDFs for thorough performance assessment of physical systems. Currently, he is the author or co-author of over 70 scientific papers notably in high-impact SCI journals and prestigious international conference proceedings.

His latest book “Toward thermal superinsulation technologies in buildings: Latest developments in glazing and building fabric” has been released in August 2015 by German Publisher LAP Lambert Academic Publishing.

He is currently working as a visiting scientist in the Institute of Sustainable Energy Technologies at the University of Nottingham. He is also working as an expert in energy optimization, energy conservation and energy management strategies with a consultant role.

Didactic Manager PT Festo

Biography

Safri Susanto, S.T.

Safri Susanto, he wa born February 29th 1976. He is currently working as a Didactic Manager PT Festo from 2007 until now. He is also working as trainer fit for change module 1, 2, dan 3 in Sales Training Program Festo A.G from 2012 until now. He worked as Product and Market Specialist Merger and Accuisition LabVolt Inc. Quebec Canada on period 2013 – 2014. In 2005 until 2008 he worked as Lecturer of Pneumatic and Hydraulic University of Indonesia F-MIPA Akademi Teknik Bogor.

Profesor of Power System, Universitas Sebelas Maret

Biography

Prof. Muhammad Nizam, ST., MT., Ph.D

Muhammad Nizam, He was born in Surakarta July, 20th 1970.He received his B.Eng and M.Eng degrees in Electrical Engineering from Universitas Gadjah Mada (UGM), Indonesia and Ph.D degree in Electrical Engineering, Universitas Kebangsaan Malaysia, Malaysia, in 1994, 2002 and 2008 respectively.

Since 1998, he had been with the Faculty of Engineering of Universitas Sebelas Maret (UNS) and was a full professor there since 2011.

He received Bronze Medal, in Intelligent Power Quality Monitoring Instrument 19th International Invention, Inovation and Technology Exhibition, Kuala Lumpur, Malaysia, 9th-11th May 2008 , Organized by MTI, Malaysia, 2008. His research interest includes reliability

and economic operation of power systems, optimization in the power systems, power system dynamic and stability. He is a member of IEEE, PII.

Chair of Power and Energy Society Chapter, IEEE Indonesia, Universitas Gadjah Mada

Biography

Sarjiya, ST., MT., P.hD.

He was born in Yogyakarta, Indonesia, in 1973.He received his B.Eng and M.Eng degrees in Electrical Engineering from Universitas Gadjah Mada (UGM), Indonesia and Ph.D degree in Electrical Engineering, Chulalongkorn University, Thailand, in 1998, 2001 and 2008 respectively.

He is Chair of Power and Energy Society Chapter, IEEE Indonesia. His research interest includes reliability and economic operation of power systems, optimization in the deregulated power systems. He is a member of IEEE, PII, and, MKI.

General Manager Transmission of East Java and Bali Region, PLN

Biography

Warsono M., ST., M.Phil.,

Warsono, graduated from the Department of Electrical Engineering and Information Technology Universitas Gadjah Mada, Indonesia in 1994. He received Master of Philosophy in Power Engineering & Management from University of Abertay, Dundee, UK in 2000. He is General Manager Transmission of East Java and Bali Region, 2015.

Oral Presentation Guidlines

1. **Prepare Presentation**
   Each oral presentation will be 20 minutes (long maximum) followed by Q&A. Length presentation material should be in accordance with your time allotted. You are kindly requested to be at the presentation room at least 15 minutes before the session starts. Please refer to conference book or schedule to find your assigned schedule and sesssion. The presentation format is in power point presentation (ppt and pptx) and pdf.
2. **Backup Copy Presentation**
   Recommended to copy your presentation file in conference location. You can update your file 1 hour before conference at Registration Desk.
3. **Suggestions for a good presentation**
   - Slide Detail
     Each slide should have a maximum of five points or short sentences. Slides should represent summary points of your discussion rather than your verbal presentation in totality. Please avoid using transitions between slides and within slides as these become distracting.
   - Number of slides
     The duration of your presentation will determine the number of slides that is acceptable. As a general rule, if your presentation takes 15 minutes in duration, 5 slides would be acceptable. However, your presentation style may suggest a different time required each slide. Please plan the slides carefully. Remember you'll talk about your slides not read them.
   - Font
     Font type and size is determined by personal preference. Basic fonts such as 'times new roman' or arial are easy to read. A font size of 26-30 is acceptable.
   - Content
     As described above, the content of your slides should be brief. Your presentation should have a distinct introduction, body conclusion and Acknowledgements.
   - Images and Illustrations
     Always check for the presence of copyright notices and watermarks on images downloaded from the Internet or copied from another source. Copyright notices are not always visible on images, however, this does not mean that one does not exist. When in doubt, you should seek written permission from the publisher before using any images or illustrations in your conference presentation, as this will most definitely be required if you submit your paper for Publication at a later stage. Additionally, if you are using personal photographs, you will need to obtain written permission from all of the people whose identity is visible in the photograph.

Conference Informations

Official Language

The official language of the conference is English. All presentation including discussion shall be made in English.

Badges

All the participants are asked to wear their name badges in order to enter the session room.

Registration Desk

The registration desk is available on Karaton I

Lunch

Lunch will be served at Royal Restaurant with Lunch Ticket.

Gala Dinner

Date : Thursday, October 6th 2016
Time : 07.30 – 09.00 PM (GMT +7)
Venue : Pendopo Royal Ambarukmo Hotel
Dress Code : Formal / Batik

All registered participants are invited to attend gala dinner free of charge. A full course meal and entertainment will be provided.

Necessary Information

Passport and Visa

Passport must be valid for minimum six months. Visa On Arrival (VOA) is granted to foreigners who intend to visit Indonesia for tourism, social and culture, business or government duties. This VOA is granted to foreign nationals who fulfill requirements and conditions upon arrival in indonesia. The following is the list of countries that can apply for VOA in Indonesia.

Algeria
Arab Emirate
Argentina
Australia
Austria
Bahrain
Belgium
Brazil
Bulgaria
Cambodia
Canda
China
Cyprus
Czech Republic
Denmark
Egypt
Estonia
Fiji
Finland
France
Germany
Greece
Hungary
Iceland
India
Ireland
Italy
Tunisia
Japan
Kuwait
Laos
Latvia
Libya
Liechtenstein
Lithuania
Luxembourg
Maldivies
Malta
Mexico
Netherland
Monaco
Norway
New Zealand
Oman
Panama
Poland
Portugal
Qatar
Romania
Russia
Saudi Arabia
Slovakia
Slovenia
South Africa
South Korea
Spain
Suriname
Sweden
Switzerland
Taiwan
United State of America
United Kingdom
United Arab Emirate

Airport and Airport Tax

Adi Sucipto International Airport *(Indonesian : Bandar Udara Internasional Adi Sucipto)* is an airport in Jogjakarta. It is located on Jalan Raya Solo Km 9. There is no airport tax because the tax include in price of ticket.

Currency

Only indonesian currency (Rupiah) is acceptable at regular stores and restaurants. Certain foreign currencies and major credit cards are accepted by most hotels, restaurants, and souvenir shops. The change rates 1 USD is about 13.300 IDR.

Language

Bahasa Indonesia is the national language.

IDD (International Direct Dialing)

Country Code : +62

City Code : Jogjakarta +62-274

Police

Magelang Km 12, Sleman 55514

T : (+62 274) 868424

Hospital and Drug Store

Hospital

1. JIH Hospital
   Ring road utara, Sleman, Jogjakarta
   T : (+62 274) 4463535
2. Panti Rapih Hospital
   Cik Di Tiro 30, Caturtunggal, Depok, Sleman, Jogjakarta.
   T : (+62 274) 563333
3. Condong Catur Hospital
   Manggis 6, Condongcatur, Depok, Sleman, Jogjakarta.
4. Dr. Sardjito Hospital
   Kesehatan 1, Sekip, Sinduadi, Sleman, Jogjakarta.
   T : (+62 274) 587333
5. Bestheda Hospital
   Jenderal Sudirman 70, Jogjakarta
   T : (+62 274) 586688
6. Jogja Hospital
   Wirosaban Barat 1, Sorosutan , Umbulharjo, Jogjakarta.
   T : (+62 274) 371195

Drug Store

1. K-24 Ambarukmo
   Laksda Adisucipto 150A, Ambarukmo
   T : (+62 274) 489233
2. Husada Bima Perkasa
   Laksda Adisucipto 56A, Jogjakarta
   T : (+62 274) 7103288

Transportation

There are some option transportation like bus, taxi, or train to get conference venue in Ambarukmo Hotel Jogjakarta.

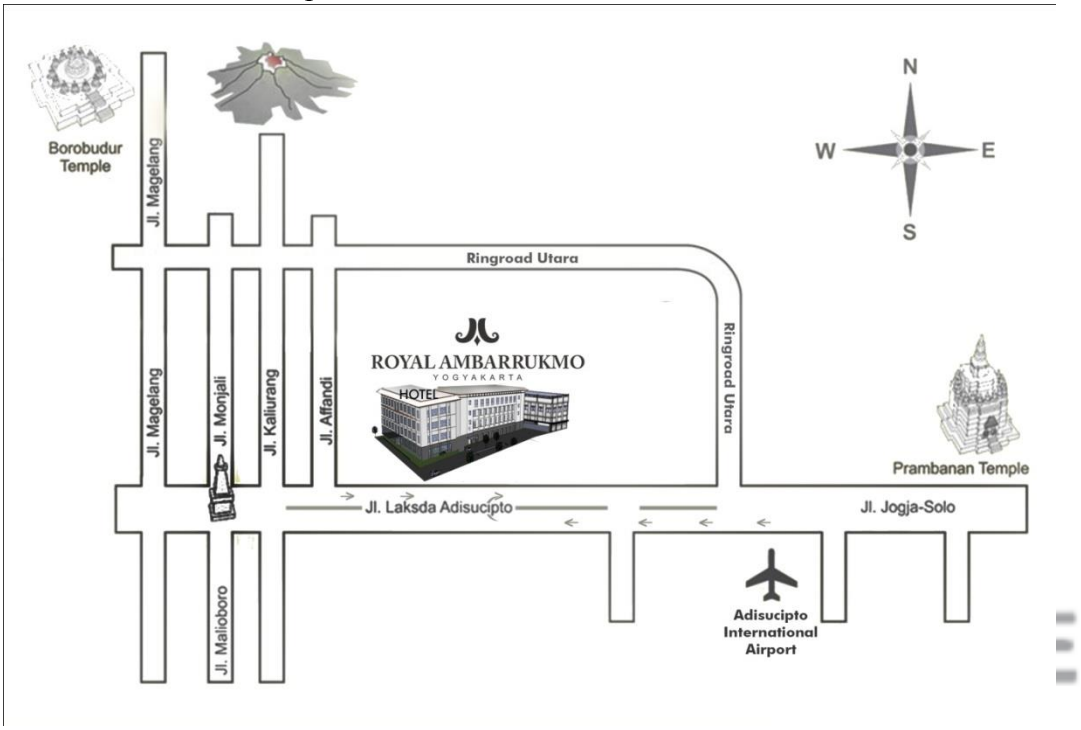
Transjogja

Transjogja is a city bus with many of facilities, such as air conditioner and services well. The bus is operated from 05.30 – 21.30 (GMT + 7 hour).

- From Adi Sucipto Airport, Jogjakarta
  The Adi Sucipto Airport is located on Jalan Raya Solo Km 9, it's about 5 km from Hotel. The covenient transportation to reach Ambarukmo Hotel is Bus Transjogja corridor 1A and 1B. The price about 3500 IDR. Another transportation to get Ambarukmo Hotel is to take an airport taxi. The taxi operate with argo system.
- From Tugu Station, Jogjakarta

Tugu Station is located on Jalan Pasar Kembang Sosro Menduran, it's about 5 km from Hotel. The transportation from this station to conference venue can take Bus Transjogja corridor 1A and 1B. The price about 3500 IDR.

- From Maguwo, Jogjakarta
  Lempuyangan Station is locaten on Maguwoharjo, Sleman, it's about 5.4 km from Hotel. The trasportation from this station to conference venue can take Bus Transjogja corridor 1A and 1B. The price about 3500 IDR.
- From Bus Station Giwangan
  Public transportation that can be used to get the conference venue is by Bus Transjogja corridor 3B and stop at Adi Sucipto Airport and then continue with bus transjogja corridor 1A or 1B. The price is about 3500 IDR.



Indonesia in Brief

Indonesia is the world's fourth-most-populous country in the world. The Indonesian national motto is "Unity in Diversity" or in Sansekerta language is "Bhineka Tunggal Ika". There are some 300 ethnisc groups, a result of both the country's unique geography and history. Indonesia has 250 distinct langugae with Bahasa Indonesia as natitonal language. Six religions are formally recognized in Indonesia and have official national holidays commemorating events of importance to their followers.

Indonesia is divided into 31 provinces, which 2 special regions (*Daerah Istimewa Yogyakarta* and *Nanggroe Aceh Darussalam*), and 1 special capital city that is Jakarta. Indonesia has three time zones that is Western Indonesia Time (GMT +7), Central Indonesia Time (GMT + 8), East Indonesia Time (GMT + 9).

Jogjakarta

Yogyakarta also **Jogja** or **Jogjakarta**, is a city and the capital of Yogyakarta Special Region in Java, Indonesia. It is renowned as a center of education (*Kota Pelajar*), classical Javanese fine art and culture such as batik, ballet, drama, music, poetry, and puppet shows. Yogyakarta was the Indonesian capital during the Indonesian National Revolution from 1945 to 1949, with Gedung Agung as the president's office. One of the districts in Yogyakarta,Kotagede, was the capital of the Mataram Sultanate between 1575 and 1640.

The city of Yogyakarta is an administrative part of the Yogyakarta Special Region which has the status of a province in Indonesia. The regencies of Bantul and Sleman have population densities far higher than the surrounding countryside (over 1,500 per square kilometer) and are effectively dormitory communities of the greater area of Yogyakarta. Within the greater Yogyakarta area lies the city of Yogyakarta called *Kota Yogyakarta*.

The area of the city of Yogyakarta is 32.5 square kilometres (12.5 square miles). While the city spreads in all directions from the *kraton* (the Sultan's palace), the core of the modern city is to the north, centered around Dutch colonial-era buildings and the commercial district. Jalan Malioboro, with rows of pavement vendors and nearby market and malls, is the primary shopping street for tourists in the city, while Jalan Solo, further north, is a shopping district more frequented by locals. At the southern end of Malioboro, on the east side is the large local market of Beringharjo, not far from Fort Vredeburg, a restored Dutch fort.

BEAUTIFUL DESTINATION of YOGYAKARTA

CANDI PRAMBANAN

Prambanan is the largest Hindu temple of ancient Java, and the construction of this royal temple was probably started by Rakai Pikatan as the Hindu Sanjayas answer to the Buddhist Sailendra's Borobudur and Sewu temples nearby.

Getting There : Using Transjogja take number 1A from Plaza Ambarukmo. The first one leaves around 6AM, then every 20 minutes. Depending on traffic, the journey normally takes around 30 minutes, but can take an hour when traffic is heavy. From the terminal station, cross the busy road, turn right, and walk around 300 metres to the pedestrian entrance.

Operating Hours : 7.30 A.M – 5.00 P.M
Website : http://corporate.borobudurpark.com/node/20

MALIOBORO STREET

Malioboro Street is a major shopping street in Yogyakarta. It lies north-south axis in the line between Yogyakarta Kraton andMount Merapi.

Getting There : Using Transjogja take number 1A from Plaza Ambarukmo, then stop at Maliboro Street Transjogja Stop.

Operating Hours :8.00 A.M – 9.00 P.M
Website :-

KASONGAN VILLAGE

Kasongan village is the dwelling place of kundis, which means earthenware jugs and later refers to people who make any earthenware jug-like as kitchen tools and ornaments.

Getting There : With a private vehicle, from the center of Yogyakarta . You can through the streets of Bantul . Upon entering km 5.6

in Bantul road on the west there is a red arch-shaped corridor that reads Kasongan .

Saptosari - Tepus Directions to Baron

POK TUNGGAL BEACH

Pok Tunggal Beach has a beautiful panorama with white sand and karst. On the east side and the west coast is flanked by towering cliffs.

Getting There : With a private vehicle route can be through : Yogyakarta - Piyungan - Patuk , Sambipitu -ArahBunder Forest - Ivory - Logandeng -Siyono - BPD Monument Roundabout - Jl . KyaiLegi- South Ring Road - Jl . KRT Djojodiningrat - Jl .Girisubo - Wonosari - Jl .Saptosari - Tepus - PokTunggal .Or : Yogyakarta - Imogiri , Bake - Jl .

The purpose of this study was to determine what kind of waste that occurs during the process, as well as suggestions for improvements using the concept of Lean Supply Chain and Value Stream Mapping, and look for the cause of the problem using the 5 Whys method. The most influential types of waste during the process stream is Waiting Time (20.42%), and Non-Value Added activies of 51.9%. By using 5Whys, the largest cause of waste found are the length of the truck waiting for the cargo, numbers of crane are already inproper, and the absence of the scheduling and charge allocation. Recommended solutions are scheduling and allocation, creation of special line in the warehouse, and supplying cranes with appropriate load speed. Based on improvement suggestions, total NVA predicted to be reduced to 59.8%

7D1-4
02.10 P.M

THE ANALYSIS OF MARKET KNOWLEDGE COMPETENCE EFFECT AND RESEARCH & DEVELOPMENT (R&D) TOWARD THE POLICY MAKING OF NEW PRODUCT DEVELOPMENT

Bambang Purwanggono, Agung Sesuko and Wiwik Budiawan

Dept. of Industrial Engineering, Diponegoro University, Indonesia

Abstract

this study has three purposes. The first purpose of this study is to examine the effect of size of enterprise on the extent to which internet technology assimilates into the daily operations of the enterprise. The second purpose of this study is to examine the effect of the critical success factors on the adoption of internet technology, and the third purpose of this study is to examine the effect of adoption of internet technology on the performance of the enterprise. One hundred and thirteen SMEs of batik in Pekalongan, Central Java Province was chosen as a sample of this study. Data for this study was collected using questionnaire and personal interviews. Then, the data from the questionnaire were analyzed with Statistical Package for Social Sciences (SPSS). This study found that the critical success factor for adoption of internet technology is different between small enterprises and medium enterprises. The impact of adoption of internet technology for the performance of enterprise is higher in the medium size of enterprise than in the small size of enterprise

7D1-5
02.30 P.M

Technical Feasibility for Commercialization of Lithium Ion Battery as a Substitute Dry Battery for Motorcycle

Indah Kurniyati[1], Wahyudi Sutopo[2], Roni Zakaria[3] and Evizal Abdul Kadir[4]

[1]*Laboratory of Business and Logistic System, Departement of Industrial Engineering, Sebelas Maret University,Indonesia*

[2]*Industrial Engineering and Techno-economics Research Group, Departement of*

Industrial Engineering Faculty of Engineering, Indonesia

[3]*Departement of Industrial Engineering Faculty of Engineering, Sebelas Maret University*

[4]*Wireless Communication Centre, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, Malaysia*

Abstract

Dry battery on a motorcycle has a rapid rate of voltage drop, life time is not too long, and a long charging time. This are problems for users of dry battery for motorcycle. When the rate in the voltage decreases, the energy storage in the battery is reduced, then at the age of one to two years of battery will be dead and can not be used, it makes the user should replace the battery. New technologies development on a motorcycle battery is lithium ion battery. Lithium ion battery has a specification that has been tested and possible to replace dry battery. Characteristics of lithium ion battery can answer the question on the dry battery service life, the rate of decrease in voltage and charging time. This paper discusses about the technical feasibility for commercialization of lithium ion battery as a substitute cleaning in motorcycle battery. We proposed methodology of technical feasibility goldsmith commercialization by using a model of the technical feasibility and reconfirm the technical standard using the national standard of motorcycle battery. The battery has been through all the stages of the technical feasibility of the goldsmith model. Based on the results of the study, lithium ion batteries have the minimum technical requirements to be commercialized and has been confirmed in accordance with the standard motorcycle battery.This paper results that the lithium ion battery is visible to commercialized by the technical aspect.

PARALLEL SESSION SCHEDULE

Friday, 7th October 2016 01.00 – 03.10 P.M.

Room : Karaton I
Session : Manufacturing and Quality Management II
Chair : Dr. Eko Liquiddanu

7E1-1
01.10 P.M

Multi-Objective Optimization Model of CNC Machining to Minimize Processing time and Environmental Impact

Aulia Hamada, Cucuk Nur Rosyidi and Wakhid Ahmad Jauhari

Department of Industrial Engineering Faculty of Engineering, Sebelas Maret University, Indonesia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Technical feasibility for commercialization of lithium ion battery as a substitute dry battery for motorcycle

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Technical Feasibility for Commercialization of Lithium Ion Battery as A Substitute Dry Battery for Motorcycle

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Abstract. Dry battery on a motorcycle has a rapid rate of voltage drop, life time is not too long, and a long charging time. These are problems for users of dry battery for motorcycle. When the rate in the voltage decreases, the energy storage in the battery is reduced, then at the age of one to two years of battery will be dead and cannot be used, it makes the user should replace the battery. New technology development of a motorcycle battery is lithium ion battery. Lithium ion battery has a specification that has been tested and possible to replace dry battery. Characteristics of lithium ion battery can answer the question on the dry battery service life, the rate of decrease in voltage and charging time. This paper discusses about the technical feasibility for commercialization of lithium ion battery for motorcycle battery. Our proposed methodology of technical feasibility by using a goldsmith commercialization model of the technical feasibility and reconfirm the technical standard using the national standard of motorcycle battery. The battery has been through all the stages of the technical feasibility of the goldsmith model. Based on the results of the study, lithium ion batteries have the minimum technical requirements to be commercialized and has been confirmed in accordance with the standard motorcycle battery. This paper results that the lithium ion battery is visible to commercialized by the technical aspect.

INTRODUCTION

Indonesia is a developing country which is highly consumptive. Especially in a motor vehicle. According to Badan Pusat Statisika Indonesia, The sales of motor vehicle in Indonesia increased from year to year [1]. The data of motor vehicle's sales in Indonesia of the last ten years is shown in Figure 1.

It can be seen that sales of motorcycles in Indonesia are greater than the sale of the car. Increased demand for motorcycles in Indonesia are accompanied by increased demand for motorcycle battery. So the business opportunities motorcycle battery is quite large. One of the technology aspect which is becoming a main discussion in Indonesia is the battery industry [2]. A battery is an electrochemical device which converts electrochemical energy to electrical energy [3]. Energy storage and energy conversion has become the basic need as well as the key issue concerning with our daily life [4].

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FIGURE 1. Motorcycle and Car Sales

Source: [1]

The first function of a battery is to starter [5]. At the time of ignition is off and will be turned, it takes the initial driving force to rotate the crankshaft, so the piston can move up and down, then there was a burning in the combustion chamber, and the engine came to life. Once the engine is on, the starter is turned off by disconnecting the starter switch relationships. To run the starter system in particular dynamo starter used power supply, and the supply of electricity is supplied by a battery. From these functions, it is known that the battery is a major component in a motorcycle. Therefore, this study examines the motorcycle battery.

Battery Technology is always developing over time. Indonesia is one of country who developed battery technology. Lead acid battery is the first type of rechargeable battery. It is a battery that has long been used by the whole world [6]. Dry battery on a motorcycle has a rapid rate of voltage drop, life time is not too long, and a long charging time. These are problems for users of dry battery for motorcycle. When the rate in the voltage decreases, the energy storage in the battery is reduced, then at the age of one to two years of battery will be dead and can not be used, it makes the user should replace the battery. New technology development of a motorcycle battery is lithium ion battery. Lithium ion battery has a specification that has been tested and possible to replace dry battery.

Rechargeable lithium which are names by Sony Corp., Commercialized for the first time in 1991 which a relatively affordable price [7]. The developed motorcycle battery based on $LiFePO_4$ for cathode material. Lithium-ion (Li-ion) is one type of rechargeable batteries [8]. Lithium-ion batteries are one of battery technology with the best energy storage ratio [9] and it has a relatively low self-discharge [10]. Battery with lithium material are able to store three times energy more than other materials, it gives a competitive advantage and makes the key element for batteries. Moreover, The advantages of lithium–ion batteries are higher energy density to weight ratio, longer life time, and no memory effects [11]. Lithium ion batteries for motorcycles has the disadvantage that the size of the battery terminals do not match when paired with a motorcycle that has a long clamp. Furthermore, the material of lithium ion battery material of lithium ion batteries are not available in Indonesia as well as production scale is limited, so the price of lithium ion batteries are more expensive compared to lead acid batteries so it takes a technical feasibility testing to determine how the technical quality of lithium ion batteries.

The advantage of lithium ion battery makes Indonesian battery company develop lithium ion batteries and want to commercialize that battery in Indonesia. Moreover, the market for motorcycle batteries are widely available, so the availability of markets for lithium ion batteries motorcycle certainly provided. In the development of new products required the identification of the technical aspects, market aspects, and environmental organizations [12].

According to [13], in making investment each company will find a way to get the maximum benefit for the company's survival. Because of this, the feasibility analysis is needed [14]. The term feasibility study is frequently used in state of product development processes. There are two primary examination aspects: economic feasibility and technical feasibility. While the economic science the term "feasibility study" is clearly defined, in a technical sense the term is used in very different ways [15]. Feasibility studies aim to show the risks and opportunities of an investment that is being planned or already in process. There are five areas of feasibility, it consists technical, operational, legal, scheduling, and economic [16].

Business feasibility study is a study of a business plan that not only analyze feasible or not feasible business is built, but also when operated on a regular basis in order to achieve maximum benefit for an unspecified time [17]. The feasibility study was instrumental in the investment decision-making process. From the definition above can be concluded that the feasibility study is an attempt to analyze an investment plan using some aspects of the investment plan with regard to the outcome and sacrifice in order to predict the degree of success of these investments.

In an attempt to analyze the feasibility of lithium ion battery for motorcycle, it is important to conduct feasibility analysis from a technical aspects. This study discusses about the technical feasibility of lithium ion battery for motorcycle as a substitute dry battery.

RESEARCH METHOD

The problem in this paper is how the technical feasibility of lithium ion battery for motorcycle. Fig. 2 is a description of the process of evaluation the technical of lithium ion battery for motorcycle. The product is lithium ion battery based Lithium Ferro Phosphate ($LiFePO_4$) 12 V 3 Ah. $LiFePO_4$ as cathode material [31]. The researcher conducted a study of feasibility study and commercialization model to learn about how to evaluate the feasibility.

The first step to develop the technical feasibility of the product based on the Goldsmith commercialization model. In developing the technical feasibility, there are five steps such as test technical features, develop working models, assess preliminary manufacturability, and finalize the design of the technology. Fig 3 shows the explanation of research approaches to develop technical feasibility. In establishing the technical feasibility has been constructed, this research method uses the concept of Technical Readiness Level (TRLs). The technology is said to fulfill the indicators for each stage of TRL if it has the minimum value of 80%.

The second stage is comparing the technical specifications of lithium ion battery for motorcycle with the technical standardization of motorcycle battery. The standard that is used in this research is motorcycle battery standard of national standard Indonesia.

The output of this study be used for future research which analyze the feasibility of investment products.

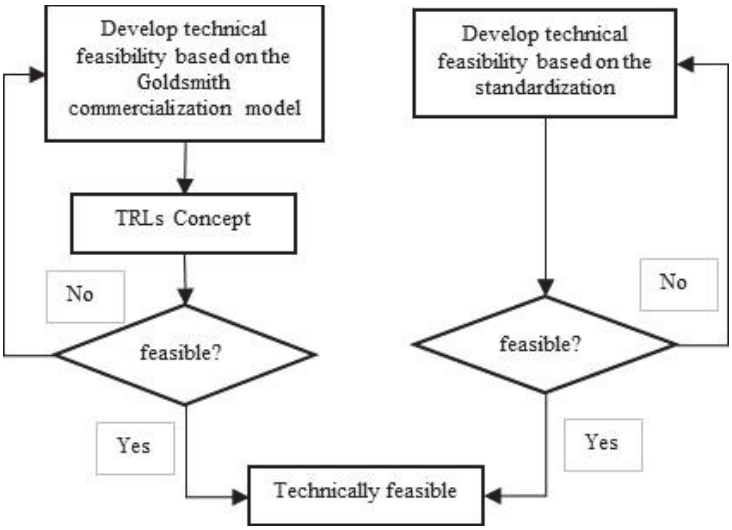

FIGURE 2. Research Approach

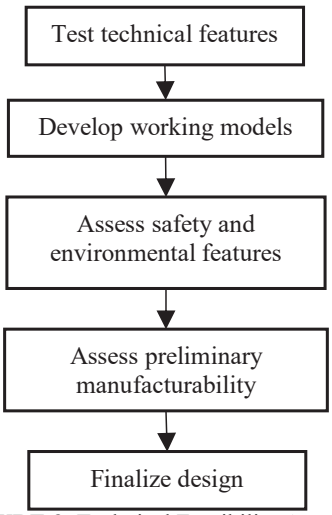

FIGURE 3. Technical Feasibility Approach

Source: [18]

RESULT AND DISCUSSION

Technical evaluation was conducted to determine the feasibility of the project are used to answer whether the project in question is quite reliable, secure, and reliable [19]. The technical evaluation of the lithium ion battery for motorcycle has a main focus the value of technical specification the lithium ion battery for motorcycle and evaluation system according to standard.

Test Technical Features

Test technical features are aimed to prove that the technology can work as a standard. In this research, there are two parts in this stage: technical specifications and technical test research according to standard.

Technical Specification

Regarding the evaluation of the comparison, technical specification of motorcycle battery will be as shown in Table 1. There are two types of batteries that are now used for motorcycles in Indonesia, namely wet and dry battery

TABLE 1. Comparison Between Lead Acid Battery And Lithium Battery

Criteria	Wet Battery (*Lead Acid*)	*Maintenance Free*	
		Lead Acid	*Lithium Ion*
Battery/ Capacity	*Lead acid* / 12 V 3,5Ah	*Lead acid* / 12 V 3,5Ah	$LiFePO_4$ / 12 V 3,5Ah
Voltage	12,1 V	12,4 – 12,6 V	14,4 V
Battery cell	6 cells (@2V / cell)	6 cells (@2, 1V / cell)	4 cells (@3, 2V / cell)
Life Time (years)	1 – 1,5	1,5 – 2	4 - 5
Charging time	5 h	5 h	1,5 h
Weight (kg)	1,7	2	0,5
Size (L X W X H) (mm)	150 x 87 x 93	114 x 71 x 94	68,53 x 42,5 x 52

accumulator. The battery uses lead acid materials. Dry battery has the same characteristics with the lithium ion battery that is equally not require treatment or so-called maintenance free. From Table 1. It can be seen that the lithium ion battery has a technical specification that is better than the wet and dry battery.

The cells of lithium ion battery in the battery are less than lead acid battery. That is because of lithium can store more energy than the lead acid. Then lithium ion battery charging time is faster than the lead acid batteries. That is

because the lithium ion batteries have no memory effect. Memory effect is a situation where charging is done by two stages. The stages are completely discharged and re-charging. The process of charging the lithium ion battery only adds energy storage or re-charging. So that the charging time lithium ion batteries are shorter. Batteries lighter weight due to the atomic mass of lithium is much smaller than the atomic mass of lead, tin, IE 6.939 for the atomic mass of lithium and 207.19 for the atomic mass of tin.

Technical Test Research According To Standard

Regarding the evaluation of the evaluation system according to standard as shown in Table 2. This evaluation shows the result of lithium ion battery test. The test results compare with the SNI requirement. SNI is Indonesian National Standard.

Table 2 presents the list of evaluation criteria and the test result of lithium ion battery. The prerequirement in that table is based by Indonesian national standard of motorcycle accumulator type BTX-4. It is because the capacity of BTX-4 as same as lithium ion battery for motorcycle. Based on the above table shows that test results of lithium ion batteries meet the criteria of SNI.

TABLE 2. The Result of Performance of Lithium Battery for Motorcycle

Criteria	Prerequirement	Result	Explanation	Source
Nominal voltage	12 V	14,4 V	Passed	SNI 4326:2013[a]
Capacity	3 Ah	3,5 Ah	Passed	SNI 4326:2013[a]
Dimension	85 X 70 X 113 (mm)	52 X 42,5 X 68,53 (mm)	Passed	SNI 4326:2013[a]
Life Cycle	275	2000	Passed	SNI 4326:2013[a]

[a]SNI for vehicles accu

Develop Working Model

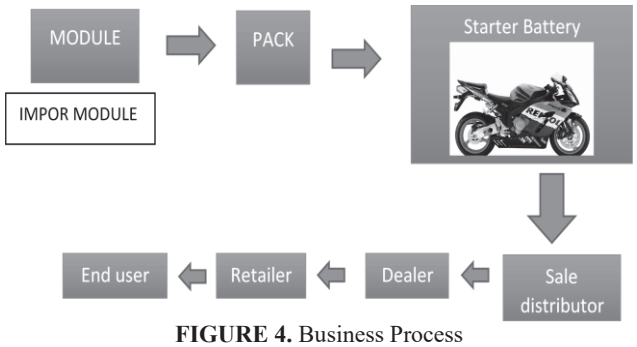

FIGURE 4. Business Process

Develop a working model in this research is the identification of business processes of lithium ion batteries for motorcycles. Here is the business process of lithium ion battery in Indonesia.

Lithium ion batteries for motorcycles imported from aboard, then tested in the company's technical feasibility in Indonesia. Lithium ion battery specifications adapted to the standard specification battery in Indonesia. After qualifying for a technical test, then the battery wrapped and sold through wholesalers, etc.

Safety and environmental features

Checking the potential safety and environmental hazards carried out to identify the potential harmful effects of the new product development and environmental hazards that may occur on the commercialization undertaken.

A process undertaken in the development of lithium batteries is to check the technical performance of the battery. In the process, the workers doing potentially dangerous are the direct contact of chemicals that the risks of irritation to eyes, skin, and respiratory, doing the packaging manually and mechanical handling, batteries are explosive, flammable, and corrosive so when testing the potential of the explosion, fire and electrical hazard [20].

The identification of waste of the lithium ion battery. The waste of battery production can be classified as non hazardous waste. Hazardous waste from the battery only in case of leakage. The leakage of the battery may pose risks such as fire, explosion, release of hydrogen fluoride gas and the risk of exposure to irritant ingredients contained within the battery.

Assess Preliminary Manufacturability

The initial assessment of manufacturing an assessment effort undertaken for planning the manufacturing of a technology. In assessing initial manufacturing, some assessment done by looking at the factor contribution to the value-added chain and availability of raw materials [21]. Identification of the value-added chain made because of the added value of a new product development efforts are important factors.

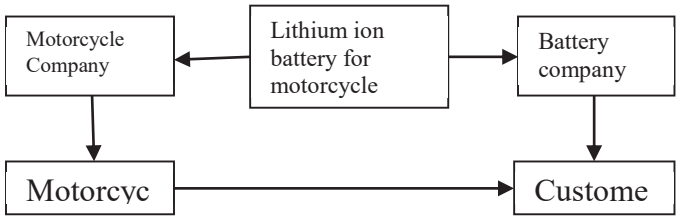

FIGURE 5. The Value Added of Lithium Ion Battery for Motorcycle

Sales of lithium ion batteries for motorcycles currently dominated by Taiwan, China, USA, and Canada. In Indonesia lithium ion battery has not commercialized officially yet. There are no companies that commercialize lithium ion battery for motorcycles. Parallel importation occurs when an importer is entering the genuine goods in parallel, then together with the licensee is authorized to sell the goods at a cheaper price than the same goods by authorized licensees of the brand owner [22]. The value added of the product is shown in fig. 5.

Battery manufacture in particular a motorcycle battery to get a review of evaluation to develop a new type of motorcycle batteries is that lithium ion batteries. Where it is known that lithium ion batteries for motorcycles yet formally commercialized by the company in Indonesia. This makes the business opportunities for the battery company to commercialize the battery. Motorcycle companies may consider using a lithium ion battery for their bike. It could be a value added to the motorcycle used batteries with new technology.

The material of lithium can not be founded in Indonesia yet. Most of the lithium market is dominated by four main suppliers. At 2011, the US Geological survey estimated 70% of the 34,000 tonnes' world lithium production was dominated by Chile (37%) and Australia (33%).

Sales of lithium ion battery is not yet officially available in Indonesia, it makes market opportunities for the company that will commercialize lithium ion battery in Indonesia.

Finalize Design

Finalize design is done to determine the use of lithium battery components. Cathode material is an important part of the research. The cathode material of lithium ion batteries is widely explored today are $LiCoO_2$, $LiNiO_2$, $LiMn_2O_4$ [23].

Among the above cathode materials, $LiCoO_2$ is toxic and very expensive. Pure $LiNiO_2$ could not be commercialized because of safety concerns subsequent to exothermic oxidation of the organic electrolyte with the collapsing delimited Li_xNiO_2. The cathodes $LiCoO_2$, $LiNiO_2$, $LiMn_2O_4$ have higher open circuit voltage, but have lower capacities [24-25]. $LiFePO_4$ suits well because of its low cost, on-toxicity, and environmental benignity. Due to this advantage, $LiFePO_4$ is attracting greater than attention as a promising new cathode electrode material for lithium-ion batteries. LiFePO4 consists of lithium as a single ion that serves as energy storage, Fe as conjugates, and PO_4 as salt or weak acid. The result of the component of material on show in Figure 6.

TABLE 3. Comparison of The Properties of Different Cathodes

Property	$LiNiO_2$	$LiCoO_2$	$LiMn_2O_4$	$LiFePO_4$
Avg. Voltage (V)	3.65	3.84	3.86	3.22
Theo. Capacity (mAh g^{-1})	265	274	117	170
True density (g cm^{-3})	4.73	5.05	4.15	3.6
Specific energy (Wh kg^{-1})	219.8	193.3	154.3	162.9
Energy density (Wh L^{-1})	598.9	557.8	418.6	415
Materials cost	1.628	1.824	1.159	1.219
Energy cost (Wh US$$^{-1}$)	6.08	5.05	5.97	6.31

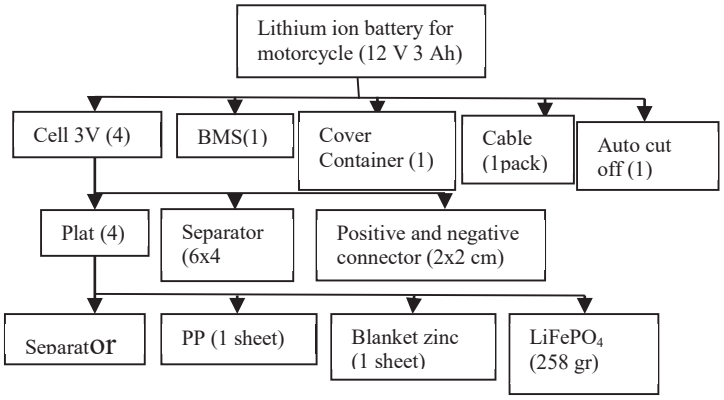

FIGURE 6. The bill of material

$LiFePO_4$ is attracting greater than other attention as a promising new cathode electrode material for lithium-ion batteries. Besides that, we would give comparison between $LiFePO_4$ battery and Ca-ion battery. Calsium-ion batteries are a new uses for larger scale energy storage system [27]. Ca-ion batteries have attracted much attention a next-generation batteries to replace lithium ion batteries. Ca-ion has a lower cost and higher safety than Li-ion because Ca is more abundant than Li. Ca-ion battery has lower voltage than lithium ion battery, but it has higher capacity than the lithium ion battery. There is one hindrance to the application of Ca. There is no appropppriate electrode material in which calcium ions can be put on and extracted reversible because of the roundly substantial iconic radius of calcium ion [28].

TABLE 4. Comparison of Li-ion Battery and Ca-ion Battery

Property	Li-ion	Ca-ion
Voltage (V)	3.22	3.0
Capacity (mAh g^{-1})	170	288
Applicability	Portable and stationary needing high load currents and endurance	Portable and stationary needing high load currents and endurance

Source : [29]

TRLs Assessment

This research uses the concept of TRLs as an approach to determining the technical feasibility which has been constructed. There are readiness indicators that can present a value of TRL. Each of the indicators rated according to the degree of readiness (Scales 0%, 20%, 40%, 60%, 80% and 100%). This research assesses the level of readiness of lithium ion battery for motorcycle by mapping the correlation of technical feasibility and the TRLs concept has been developed by [26].

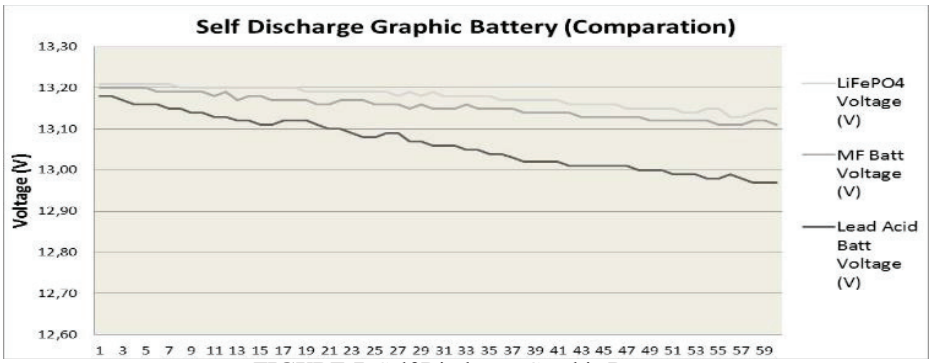

FIGURE 7. Self Discharge Graphic Battery

According to the calculation of TRL, it was found that the lithium ion battery for motorcycle occupied on the TRL 6. The TRL results are 80%. The indicator level indicator 6 is the last level of the design group applied, which states that the test results prove technically feasible. There are six indicators on level 6 is the condition of the operating environment had actually known, the investment needs for equipment and fabrication processes are identified, M & S performance technology systems in the operating environment, parts manufacturing or fabrication approve and accept the results of laboratory testing, the prototype has been tested with an accuracy of laboratory high on a simulated operational environment (which is actually outside the laboratory), and the test results prove technically feasible.

Lithium ion batteries for motorcycles has been tested on a simulated operational environment. The tests are carried out on several types of motorcycles. Motorcycle used in the test is Yamaha Mio Sport, Yamaha Mio J, Honda Beat CW, Honda CB 150 R, Honda Scoopy Sport, Yamaha Jupiter MX, Honda Supra X, Yamaha V-Ixion, Suzuki Satria F. From the test results showed that lithium ion batteries for motorcycles can be used on all motorcycles were tested unless Yamaha Mio Sport and Yamaha Mio J. that is because the size of the lithium ion battery terminals do not match the size of the clamp motorcycle. The tests are also conducted to measure the self-discharge of lithium ion batteries. Results of testing the battery self-discharge is shown in Fig. 7. The lithium ion battery has self-discharge is longer than the lead acid batteries and battery MF.

These products do not meet the indicator level 7 because, some aspects have not been made in full and the product is not yet ready to do the initial production.

From the results of this paper, battery manufacture in particular a motorcycle battery to get a review of evaluation to develop a new type of motorcycle batteries is that lithium ion batteries. Where it is known that lithium ion batteries for motorcycles yet formally commercialized by the company in Indonesia. This makes the business opportunities for the battery company to commercialize the battery.

Motorcycle companies may consider using a lithium ion battery for your bike. It could be an added value for the motorcycle used batteries with new technology. Consumer motorcycle battery users can determine battery performance comparison between wet batteries, dry batteries and lithium ion batteries. From these data, the consumer may consider the purchase of a motorcycle battery that fit their needs.

CONCLUSION

This paper analyze the technical feasibility of lithium ion battery for motorcycle. In assessing the technical feasibility of product evaluate the technical specification of the product and compare it with the standard of motorcycle battery. Lithium ion battery for motorcycle has superior specifications compared with the dry battery. The advantages are higher energy, long life, lighter and smaller than dry battery, and no memory effect. Based on this research show that the performance oh this battery in accordance with the standard of motorcycle battery in Indonesia. The lithium ion battery for motorcycle occupies on the TRL 6, which states that the test results prove technically feasible. These are signs of lithium ion batteries for motorcycles technically feasible

According to the specification owned by the battery and sales of lithium ion battery is not yet officially available in Indonesia, it makes market opportunities for the company that will commercialize lithium ion battery in Indonesia. Suggestion for further research will be more about how the market opportunity of the lithium ion battery for motorcycle in Indonesia.

ACKNOWLEDGEMENT

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