Simulation of Impact Azimuth Angle on Specific Energy Output of a Fixed Mounting Rooftop PV System in Jakarta, Indonesia

Elieser Tarigan

Department of Electrical Engineering, and PuSLET
University of Surabaya, Surabaya 60293, Indonesia

elieser@staff.ubaya.ac.id

Abstract. One of the key performances of a PV system is specific energy output, which is calculated based on energy output compared to the input solar irradiation under operating conditions. The specific energy output is affected by many factors, mainly by the amount of solar irradiation received by the module. This work presents the simulation of impact azimuth angle on specific energy output by the fixed mounting rooftop PV System in Jakarta, Indonesia. Simulation is carried out using SolarGIS PVPlanner by varying roof orientation, which is correlated with module azimuth angle. The tilted of the module is assumed 30^{o}, fixed with the common residential roof tilt in Jakarta, Indonesia. It is found that the highest annual specific energy output is about 1,243 kWh/kWp produced by module orientation of Northeast, while the lowest is produced by module facing South with specific energy output about 1,098 kWh/kWp.

Keywords: *azimuth angle, PV system, rooftop, specific energy*

INTRODUCTION

It has been generally recognized that the use of fossil energy results in greenhouse gas emissions that impact the global climate, besides the fossil energy resources are depleted [1]–[3]. To ensure energy sustainability and development, we need to find alternative energy sources. Solar electricity using photovoltaic (PV) technology is one of the promising and environmentally friendly energy resources that can be exploited for reducing fossil-based energy consumptions [4]–[6].

The Indonesian Government, through the Ministry of Energy and Mineral Resources (MEMR) has established the General National Energy Plan (Rencana Umum Energy Nasional, RUEN), which targeting 23% of national energy demand will be supplied with renewable energy by 2025 [7], [8]. Solar electricity using photovoltaics (PV) is projected to be generated about 6.5 GW by 2025, as apart of 45 GW of total various renewable energy generations [7], [9].

In the urban area densely populated like Jakarta, one of the limitations of PV system implementation is limited open space for placing solar modules. To attempt the solar electricity energy-mixed target, the Government recently introduced the photovoltaic (PV) rooftop system policy, so-called MEMR Regulation No 49/2018 (Permen ESDM No 49/2018) [10]. Under this regulation, the customer of the National Electricity Company, PLN are allowed and encouraged to install a PV system on their building roofs. The produced energy by the PV system can be self-consumed, and the surplus energy can be exported or fed into the grid. The regulation is valid for commercial, residential, and public buildings.

In the rooftop PV system, the solar panels are mounted on a tilted roof of the buildings. The slope and the azimuth of the PV panels are homogeneous, and they do not shade each other. The solar panels are mounted using an attached rail on the roof. This is to allow back-side ventilation for panels cooling. The output of the PV system in

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the form of DC current is usually directly converted by an inverter before connecting to a low-voltage grid. For this type of system, no electricity storage is required.

The amount of energy produced by a PV system depends on many factors. One of the most important factors is the amount of global solar irradiance received by PV modules to be converted into electricity. The global solar irradiance consists of direct, diffuse, and reflected components [11], [12]. For the direct component, the amount of radiation depends on the angle of incidence, where one of the components is the azimuth angle. Practically, azimuth angle (γ) is the orientation of the panel counted clockwise from the North direction (Fig.1 (a)). The solar modules for the rooftop PV system are commonly installed according to and following the building's roof orientation. That means the azimuth angle of the modules depend on the roof orientation (Fig. 1 (b) and (c))

There were quite many studies and implementation of the rooftop PV system in many different countries worldwide were found in the literature [13]–[17]. However, limited studies on rooftop PV systems could be found for the Indonesian situation [18], [19].

This paper studies the impact of azimuth angle on specific energy output by the fixed mounting rooftop PV System in Jakarta, Indonesia. The studies are carried out using computer simulation using SolarGIS Pvplanner [20], [21]. The objective of the study is to estimate and figure out the specific energy output of rooftop PV system for different roof building orientation. It is expected that the information found will be a useful reference in promoting solar energy in Indonesia.

METHODS

The specific energy output is one of the key performances of a PV system. The specific energy output is the amount of energy output in comparison with the input solar irradiation under operating conditions. It is affected by many factors, mainly by the amount of solar irradiation received by the module. The specific energy output is calculated by comparing PV system energy output Eout, in kWh to maximum power capacity, Pmax, in kWp under STC. Therefore, the unit of the specific energy output is kWh/kWp. Mathematically it be expressed as:

$$Specific\ Energy\ Output\ = \frac{Eout, AC}{P\max, STC} \quad (1)$$

where Eout, AC is energy output for the actual condition; Pmax, STC is power capacity under standard test conditions.

The specific energy output of the PV system is simulated in this work by varying the azimuth angle (γ) under the climate of Jakarta, Indonesia. The simulated PV system is rooftop and grid-connected system type. The modules' orientation and slope are assumed to be fixed and the same with angles of the roof building. The average slope of the roof of the residential building in Jakarta is about 30° [22], hence in the simulation, the tilt of the module β = 30° was taken as shown in Fig.1 with the variation of azimuth angle (γ). The other input parameters are summarized in Table 1.

TABLE 1. Input parameters for simulation

Parameters	Input Parameters
Geographical coordinates	-6.175394, 106.827183 (-06°10'31", 106°49'38")
Time zone	UTC+07
Terrain Elevation	3 m
Land cover	Urban areas
Population density	17354 inh./km²
Terrain azimuth	flat
Terrain slope	0°
Location on the map	https://apps.solargis.com/prospect/map?c=-6.175394106.827183,10&s=-6.175394106.827183
PV module type	c-Si - crystalline silicon (mono or polycrystalline)
The geometry of PV modules	Tilt 30°
Inverter type	String inverter
Transformer type	Standard transformer
Snow and soiling losses at PV modules	Monthly soiling losses up to 3.5% · Monthly snow losses up to 0.0%
Cabling losses	DC cabling 1.0% ; DC mismatch 0.5% ; AC cabling 0.4%
System availability	98.0%

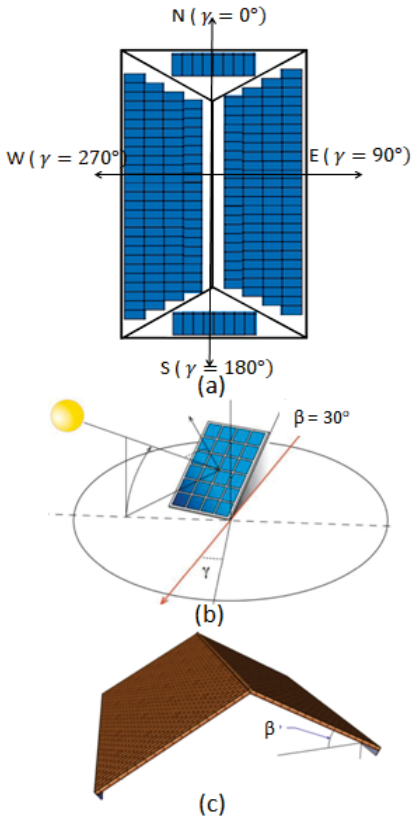


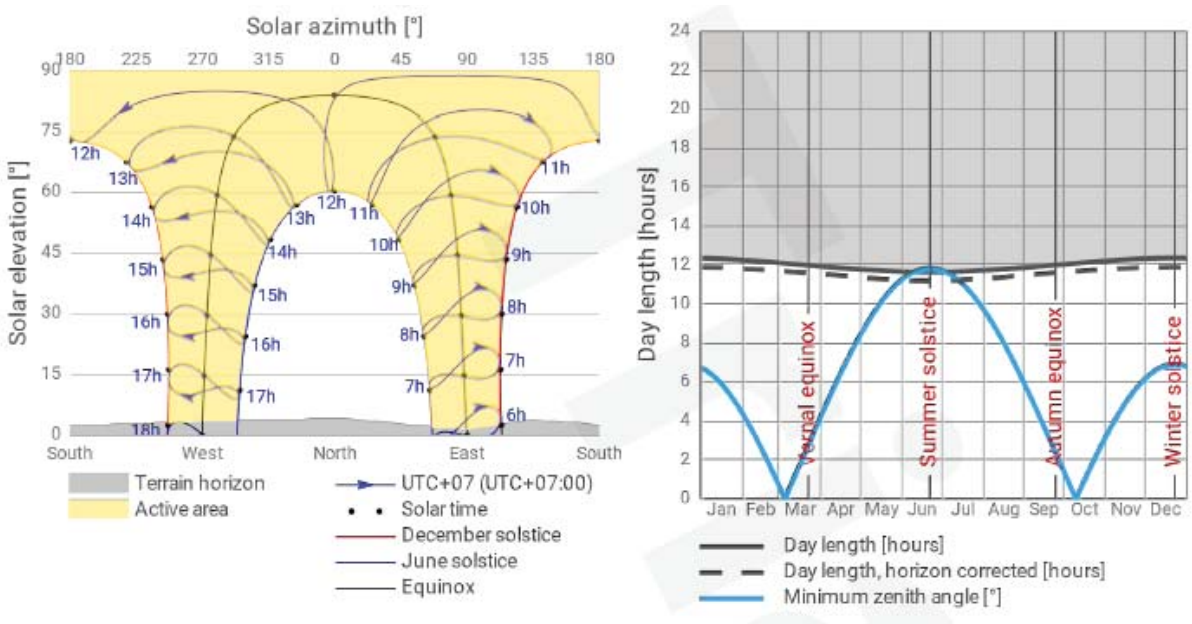
FIGURE 1. (a) Modules zimut angle (γ) corresponds to the roof orientation; (b), (c) Azimuth angle (γ) and of the roof tilt (β) simulated

As previously mentioned, simulation is carried out using SolarGIS PVplanner by varying roof orientation each for direction: North (γ = 0º), North-East (γ = 45º), East (γ = 90º), South-East (γ = 135º), South (γ = 180º), South-West (γ = 225º), West (γ = 270º), and North-West (γ = 315º). SolarGIS PV Planner software applies numerical simulation from input parameters and climate databases for the specific area. The solar insolation is interpolated from the real measurement data of the nearest weather station.

RESULTS AND DISCUSSION

Solar Energy Potential

Assessment of availability of solar at the specific location requires the site meteorological data such as solar irradiation, radiation components, day length, sun path, and temperature, etc. Fig. 2 (a) shows the Sun path in Jakarta over a year. The sun path indicates the active area with solar and civil time, terrain horizon, and the module horizon. The day length variation and solar zenith angle in Jakarta over a year are shown in Fig. 2 (b). It can be seen that any obstructed objects by a higher terrain horizon would cause a shorter period of the Sun is above the horizon in comparison to the astronomical day length.



(a) (b)

FIGURE 2. Sun path (a); and Solar zenith angle and day length (b) over a year in Jakarta

The global solar radiation consists of direct, diffuse, and reflected components. The daily average of global irradiation in the horizontal plane in Jakarta is shown in Fig.3. It is obviously seen that solar irradiation in Jakarta is dominated by diffuse components throughout the year, while the simulation results did not show the reflected component. It was found that the highest value of global solar irradiation is about 7.74 Wh/m^2 per hour during 12:00 – 13:00 in September, and the highest daily average is about 5.63 kWh/m^2 for the same month. In comparison, less solar irradiation happens during December, January, and February. It might be due to the rainy season during these periods. The lowest irradiation was found during February, with a daily average of 3.62 kWh/m^2. The annual solar irradiation in Jakarta is found about 1688 kWh/m2 per day with a daily average of 4.69 kWh/m^2. This value is relatively similar to the reported similar other areas in Indonesia [23]. The daily ambient temperature in Jakarta from 26 – 28^{o}C as shown by line graph in Fig. 3.

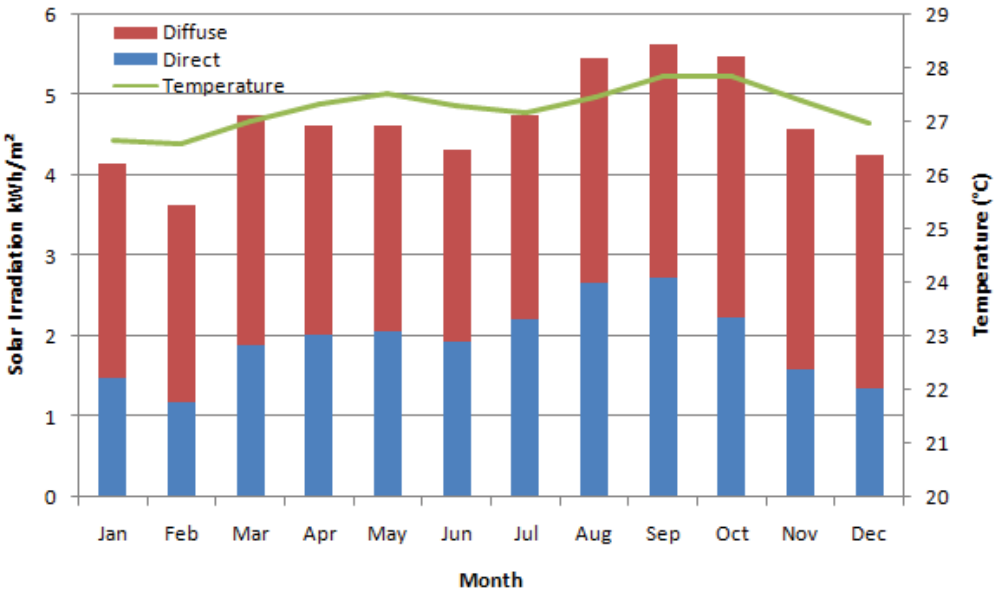


FIGURE 3. Global irradiation and air temperature in Jakarta

PV system Specific Energy Output

The monthly specific energy output of crystalline silicon (Si-c) PV system for the fixed roof with different orientation or module azimuth angle in Jakarta is shown in Table 2. The highest specific energy output is found at about 132.34 kWh/kWp per month, i.e., during August for the North roof orientation (module azimuth angle = 0o). In comparison, the lowest value is about 71.94 kWh/kWp during February for the same roof orientation.

The highest annual energy is produced by module orientation of Northeast, while the lowest is by module facing Southwest. Comparison of the annual energy-specific output for different azimuth angles of the PV system in Jakarta is summarized in Fig. 4. From the figure, it can be concluded that the highest specific energy output of rooftop PV system in Jakarta would be produced by a system with azimuth angle module around of 0º – 45º or facing around North to North-East orientation.

TABLE 2. Monthly average specific energy output of PV system in Jakarta

	Specific Energy Output fo Different Module Azimuth Angle [kWh/kWp]							
Month	0° (N)	45° (NE)	90° (E)	135° (SE)	180° (S)	225° (SW)	270° (W)	315° (NW)
Jan	76.73	80.95	88.25	94.55	97.38	93.77	87.43	80.43
Feb	71.94	72.90	75.69	78.53	80.52	79.73	77.55	74.27
Mar	101.36	102.86	102.41	99.74	96.92	95.93	97.44	99.05
Apr	107.72	107.64	101.49	91.78	84.02	85.18	92.42	100.72
May	116.84	113.48	101.29	85.57	74.86	80.44	93.91	107.86
Jun	113.16	108.52	94.32	76.89	65.66	72.84	88.27	103.91
Jul	123.17	118.57	103.92	85.70	73.79	81.05	97.09	113.35
Aug	132.34	128.02	116.15	101.71	92.83	98.84	112.12	124.79
Sep	123.86	122.53	117.90	111.51	107.61	109.17	114.87	120.08
Oct	109.43	111.87	115.04	116.79	117.06	114.70	112.53	109.96
Nov	85.86	91.24	98.82	104.35	105.58	100.62	94.06	87.90
Dec	77.69	83.96	92.98	99.74	101.29	95.61	87.65	80.30
Yearly	1,240.10	1,242.52	1,208.00	1,146.86	1,097.52	1,107.90	1,155.35	1,202.62

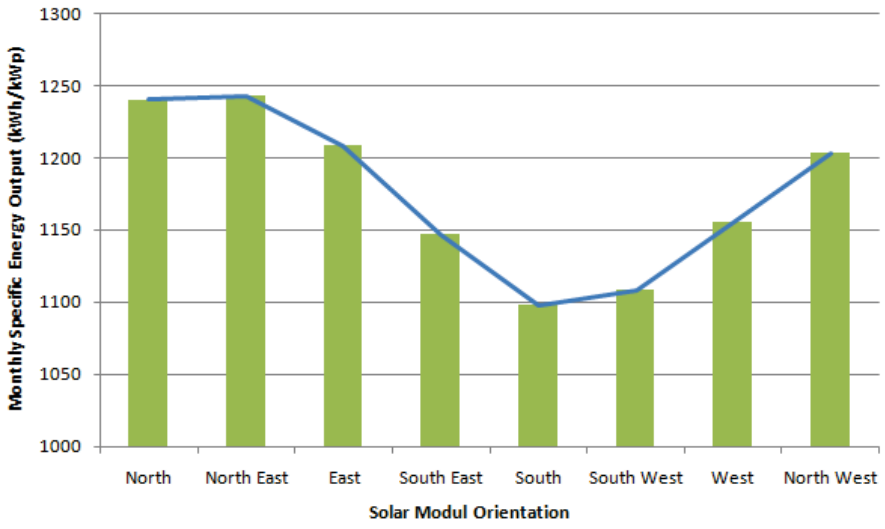


FIGURE 4. Comparison of the annual energy specific output for different azimuth angle of PV system in Jakarta

CONCLUSIONS AND RECOMMENDATIONS

Simulation of impact azimuth angle on the specific energy output of a fixed mounting rooftop PV system in Jakarta, Indonesia, has been carried out in this study. The variation of azimuth angle results in the monthly specific energy output varies from 1,107 kWh/kWp to 1,242 kWh/kWp. The highest specific energy output of rooftop PV system in Jakarta, with a fixed tilt angle of 30o would be produced by a system with azimuth angle module of around 0o – 45o or facing around North to North-East orientation. This would be a recommendation for further PV application, particularly for rooftop PV system in Jakarta, Indonesia.

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Design:	Ms. Tryza Adelia, S.Sn., M.Inf.Tech.

InCITE 2021 ORGANIZING COMMITTEE:
FACULTY OF ENGINEERING, UNIVERSITAS SURABAYA
DEAN BUILDING TB 2, RAYA KALIRUNGKUT
SURABAYA, 60293, INDONESIA

PHONE: +62-31-2981150, FAX: +62-31-2981151

EMAIL: incite@unit.ubaya.ac.id

WEBSITE:
https://incite.ubaya.ac.id
http://teknik.ubaya.ac.id

PREFACE

WELCOME FROM InCITE 2021 ORGANIZING COMMITTEE

Welcome to InCITE 2021! The third bi-annual international conference on engineering domain conducted by the Faculty of Engineering, The University of Surabaya (UBAYA). Due to the COVID-19 pandemic, InCITE 2021 is held as an online conference. Online conference opens the opportunity for many researchers around the globe to share their findings and learn from other global researchers with less restrictions.

InCITE 2021 invites three keynote speakers, well reputable global researchers in their research domain from Australia and Taiwan. Following each keynote session are two presentation sessions run in parallel.
This year, we received 66 papers submitted by researchers from four distinct countries (i.e., first author's country of origin): Indonesia, Australia, Taiwan, and Kazakhstan.

We employed a double-blind review to ensure a high standard and a minimum level of bias in the reviewing processes. This resulted in 56% of the submissions were accepted and will be published to the AIP Conference Proceedings.

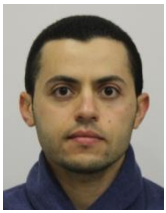
Authors of all accepted papers are to disseminate their findings during InCITE 2021 conference between 25 to 26 of August 2021. This presents a great opportunity for everyone, including the researchers, to discuss and further improve current achievements.

We thank all keynote speakers, presenters, and reviewers/scientific committees for the generous supports. We thank the University of Surabaya, the Faculty of Engineering UBAYA, and all InCITE 2021 committees that enable InCITE 2021.

We wish you a very pleasant and rich conference experience in InCITE 2021 and looking forward to seeing you again on InCITE 2023! Thank you.

Yours sincerely,
Asst. Prof. Dr. Jimmy
InCITE 2021 Organizing Committee

INVITED SPEAKERS



Dr. Ahmed Mourad
Postdoctoral Research Fellow
Information Engineering Lab (IELAB)
University of Queensland
AUSTRALIA

Prof. Chuan-Kai Yang, Ph.D
Professor
Information Management
National Taiwan University of Science and Technology
TAIWAN

Dr. Anton van der Vegt
Postdoctoral Research Fellow
EMPOWER, a Joint Venture between Queensland Health & the University of Queensland
University of Queensland
AUSTRALIA

ACKNOWLEDGMENT

International Conference on Informatics, Technology and Engineering 2021 (InCITE 2021) Organizing Committee wishes to express its gratitude and appreciation to:

Dr. Ir. Benny Lianto, MMBAT., Rector of Universitas Surabaya for consenting to be the guest of honour

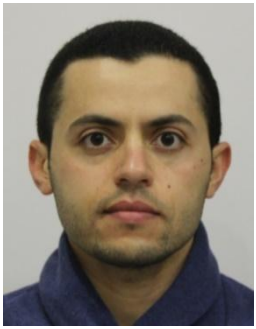
All invited speakers session, moderators and conference speakers, for their participation

All conference sponsors, supporters, exhibitors and advertiser for their generous support

All participants and other who have in one way or another contributed towards the success of this conference

KEYNOTE SPEAKERS

Dr. Ahmed Mourad



Dr. Ahmed Mourad is a Postdoctoral Research Fellow at the Information Engineering Lab (ielab), University of Queensland. His current research focuses on Conversational Systems in the context of Agricultural domain. AgAsk is a conversational agent that will provide access to agricultural R&D output (which is currently locked away into project reports, communications and scientific publications) leading directly to better, data-driven growing decisions. Through machine learning driven question-answering systems, AgAsk will elicit and understand growers information needs and preferences, providing contextualised access to insights in agricultural R&D.

He completed his PhD in Computer Science at RMIT University in 2019 under the supervision of Professor Mark Sanderson, Professor Falk Scholer and Associate Professor Walid Magdy. His research focused on the Influence of geographic biases on geolocation prediction in Twitter. Before the PhD, He worked as a Research Assistant at Qatar Computing Research Institute (QCRI) focusing on Information Retrieval and Sentiment Analysis on Arabic datasets. He also worked as a Software Engineer at large corporates including Microsoft and Mentor Siemens.

Prof. Chuan-Kai Yang, Ph.D

Prof. Chuan-Kai Yang, Ph.D received his Ph.D. degree in computer science from Stony Brook University, USA, in 2002, and his M.S. and B.S. degree in computer science and in mathematics from National Taiwan University in 1993 and 1991, respectively. He served as the chairman for the department of information management, National Taiwan University of Science and Technology, Taiwan, from 2017 to 2019, and is currently a Professor in the department. His research interests include computer graphics, scientific visualization, multimedia systems, and computational geometry. He has published over hundreds of research papers, including more than 30 SCI journal papers and more than 40 international conference papers.

Dr. Anton van der Vegt

Anton completed his PhD in Information Retrieval from The University of Queensland, co-sponsored by CSIRO. His reserach investigated the impact of time and knowledge constraints on the ability of clinicians to make high quality clinical decisions in the context of using a search engine to support this task. Anton proposed a minimal interaction framework, as an alternative to the traditional SERP (Search Engine Results Page) approach to clinical search. As a result of his research, numerous papers have been published in high ranking journals such as JASIST, JMLA and JDOC.

Prior to his PhD studies, Anton spent four years working in the UK, supporting the implementation of the National Programme for IT into the NHS; this included development and installation of clinical and administrative software systems to connect patient care across the UK. Through this work he developed a much better understanding of the unique challenges faced by clinicians and public healthcare organisations when implementing such systems. This experience, together with his thesis research informs his current role as PostDoctoral Research Fellow with EMPOWER, a Joint Venture between Queensland Health and the University of Queensland. The purpose of this JV is to create a scalable platform for clinicians to access intelligent information to improve clinical outcomes across Queensland.

ACTIVITY DETAILS

Place and date of event
August 25th – 26th, 2021
Location: Virtual Meeting

Day 1: Wednesday, August 25th 2021 (Time Zone: (GMT+7:00) Jakarta)

From	To	Activities	Venue
08.00	08.30	Registration	Main Virtual Room
08.30	08.45	Opening Ceremony: Welcome Speech By Rector of Universitas Surabaya: **Dr. Ir. Benny Lianto, MMBAT**	Main Virtual Room
08.45	09.15	**Keynote Session 1** Dr. Ahmed Mourad (University of Queensland, AUSTRALIA)	Main Virtual Room
09.15	09.45	Keynote Session 1 Closing + Photo Session	Main Virtual Room
09.45	10.00	Break	-
10.00	12.05	Parallel Session 1	Virtual Breakout Room
12.05	13.00	Break	-
13.00	13.30	**Keynote Session 2** Prof. Chuan-Kai Yang, Ph.D (National Taiwan University of Science and Technology, TAIWAN)	Main Virtual Room
13.30	14.00	Keynote Session 2 Closing + Photo Session	Main Virtual Room
14.00	14.15	Break	-
14.15	16.20	Parallel Session 2	Virtual Breakout Room
16.20	16.30	Closing Day I	Main Virtual Room

Day 2: Thursday, August 26th 2021 (Time Zone: (GMT+7:00) Jakarta)

From	To	Activities	Venue
08.00	08.30	Registration	Main Virtual Room
08.30	09.00	**Keynote Session 3** Dr. Anton van der Vegt (University of Queensland, AUSTRALIA)	Main Virtual Room
09.00	09.30	Keynote Session 3 Closing + Photo Session	Main Virtual Room
09.30	10.00	Break	-
10.00	12.05	Parallel Session 3	Virtual Breakout Room
12.05	13.00	Break	-
13.00	14.40	Parallel Session 4	Virtual Breakout Room
14.40	15.05	Awarding Session and Closing Ceremony	Main Virtual Room

Schedule on Parallel Session

PARALLEL SESSION 1

Venue: Virtual Meeting – Breakout Room Suro

Session Chair: Alexander Yohan

No.	From	To	Paper ID	Author	Paper Title
1.	10.00	10.25	43	Joko Siswantoro, Ida Bagus Made Artadana and M. Z. F. N. Siswantoro	Automatic Leaf Geometric Properties Measurement Based on Camera Parameters
2.	10.25	10.50	20	Vincentius Riandaru Prasetyo and Anton Hendrik Samudra	Hate Speech Content Detection System on Twitter using K-Nearest Neighbor Method
3.	10.50	11.15	30	Mohammad Farid Naufal and Selvia Ferdiana Kusuma	Weather Image Classification using Convolutional Neural Network with Transfer Learning
4.	11.15	11.40	33	Daniel Prasetyo	Implementing Directed Pairwise Judgement Approach in Web-based AHP Survey Application to Reduce Inconsistency Ratio
5.	11.40	12.05	29	Yenny Sari, Vincentius Riandaru Prasetyo and Kevin Liyansah	Designing a Recommender System based on the Application of Decision Tree Algorithm in Data Mining with KNIME

Venue: Virtual Meeting – Breakout Room Boyo

Session Chair: Esti Dwi Rinawiyanti

No.	From	To	Paper ID	Author	Paper Title
1.	10.00	10.25	63	Eric Wibisono, Iris Martin and Dina Natalia Prayogo	Genetic Algorithm with Adaptive Diversification and Intensification for the Vehicle Routing Problem
2.	10.25	10.50	23	Senapati C. Adisasmito, Pradipta Deffinika Pamungkas and Anas Ma'Ruf	Real-time Monitoring Design for Make-To-Order Industry
3.	10.50	11.15	44	Gunawan	Community Mobility during Covid-19 Pandemic and Tourism Performance: Data Mining Approach
4.	11.15	11.40	35	Hans Tanto, Hanijanto Soewandi and Indriati Bisono	Simple Heuristics for Scheduling Apache Airflow: A Case Study at PT. X

PARALLEL SESSION 2

Venue: Virtual Meeting – Breakout Room Suro

Session Chair: Eric Wibisono

No.	From	To	Paper ID	Author	Paper Title
1.	14.15	14.40	15	Markus Hartono	Kansei Engineering and Product-Service Systems (KEPSS) for Customer-centered Experience
2.	14.40	15.05	28	Indra Setiawan and Hernadewita	Reducing Lead Time of Production Process Using Integration Value Stream Mapping and Kaizen: A Case Study in the Side Board Division
3.	15.05	15.30	39	Esti Dwi Rinawiyanti, Xueli Huang and Sharif As-Saber	Integration of Corporate Social Responsibility for Improved Business Performance: Evidence from the Indonesian Manufacturing Industry
4.	15.30	15.55	55	Noverta Putra, Indri Hapsari and Dina Prayogo	Inventory System Improvement for Short-lived Item
5.	15.55	16.20	38	Hibarkah Kurnia, Choesnul Jaqin and Humiras Hardi Purba	Quality Improvement with PDCA Approach and Design of Experiment Method in Single Socks Industry in Indonesia

Venue: Virtual Meeting – Breakout Room Boyo

Session Chair: Emma Savitri

No.	From	To	Paper ID	Author	Paper Title
1.	14.15	14.40	42	Putu Doddy Sutrisna, Meyta Sanoe, Rifando Gogo Adiyaksa, Kristina Wahyu Agustine, Hadiatni Rita Priyantini, Prayogo Widyastoto Waluyo and I Made Ronyastra	The Effects of Material to Solvent Ratio on The Performances of Natural Dyes Extraction
2.	14.40	15.05	56	Rezha Rachmady, Ari Rahman and Wahyu Kunto Wibowo	Textile Wastewater Purification Using Corona Discharge Method
3.	15.05	15.30	10	Lieke Riadi, Ruth Chrisnasari, Joshua Kristanto, Cahaya Caesar Brigavida and Meyta Sanoe	Immobilization of Xylanase on Acid Pretreatment Bentonite as Green Biocatalyst
4.	15.30	15.55	41	Lanny Sapei, Rudy Agustriyanto, Endang Wahyu Fitriani, Zerravym Levy and Cindy Sumampouw	Rice Husk Ash for the Stabilization of the Outer Interfacial Layer of W/O/W Double Emulsion
5.	15.55	16.20	54	Delyana Ratnasari, Widiyastuti Widiyastuti and Heru Setyawan	One-Step Electrochemical Synthesis of Silica-coated Magnetite Nanofluids

PARALLEL SESSION 3

Venue: Virtual Meeting – Breakout Room Suro

Session Chair: Joko Siswantoro

No.	From	To	Paper ID	Author	Paper Title
1.	10.00	10.25	46	Alexander Yohan, Nai-Wei Lo and Kevin Valentino	A Design of Secure Supply Chain Management System with Blockchain Technology
2.	10.25	10.50	27	Susana Limanto, Endah Asmawati and Yusuf Wira Kencana Putra	School Finder, Intelligent Recommendation System for Elementary School Selection
3.	10.50	11.15	58	Andre Andre and Marcellinus Ferdinand Suciadi	The Online Attendance System Models for Educational Institutions
4.	11.15	11.40	36	Elieser Tarigan	Simulation of Impact Azimuth Angle on Specific Energy Output of a Fixed Mounting Rooftop PV System in Jakarta, Indonesia
5.	11.40	12.05	65	Christabel Parung and Prayogo Waluyo	Users' Perception of Digital Prototypes in Indonesian Fashion Industry: A Qualitative Study

Venue: Virtual Meeting – Breakout Room Boyo

Session Chair: Putu Doddy Sutrisna

No.	From	To	Paper ID	Author	Paper Title
1.	10.00	10.25	34	Puguh Setyopratomo and Lanny Sapei	Rheological Behavior and Antioxidant Activity of Carrageenan Extracted from Green Seaweed (Eucheuma cottonii) Using Alkaline Solution at Low Temperature
2.	10.25	10.50	49	Marta Devega Yuharma, Widiyastuti Widiyastuti, Ni Made Intan Putri Suari and Heru Setyawan	A Performance Study of Magnetite-Lignin Composites as Photothermal Materials in Solar Steam Generation System
3.	10.50	11.15	50	Diana Novita Sari, Mahardika F. Rois, Widiyastuti Widiyastuti and Heru Setyawan	Organosolv Lignin from Coir Fibers as Potential Biomaterials for Sunscreen
4.	11.15	11.40	53	Ratri Sekaringgalih, Widiyastuti Widiyastuti and Heru Setyawan	The Effect of Sodium Lauryl Sulfate on Silica Nanofluid Stabilization Using Microbubble Method
5.	11.40	12.05	60	Emma Savitri	Synthesis and Characterization of Chitosan-Allium Sativum Film

PARALLEL SESSION 4

Venue: Virtual Meeting – Breakout Room Suro

Session Chair: Christabel Parung

No.	From	To	Paper ID	Author	Paper Title
1.	13.00	13.25	32	Jimmy Jimmy and Vincent Riandaru Prasetyo	Sentiment Analysis on Feedback of Higher Education Teaching Conduct: An Empirical Evaluation of Methods
2.	13.25	13.50	26	Md. Hazrat Ali	Recent advances and application of Selective Laser Melting (SLM) in the aerospace industry
3.	13.50	14.15	25	Rudy Agustriyanto, Puguh Setyopratomo and Endang Srihari Mochni	Dynamic Study of Batch Milk Cooling Process at KUD SAE Pujon
4.	14.15	14.40	31	Ellysa Tjandra, Sri Suning Kusumawardani and Ridi Ferdiana	Student Performance Prediction in Higher Education: A Comprehensive Review

Venue: Virtual Meeting – Breakout Room Boyo

Session Chair: Elieser Tarigan

No.	From	To	Paper ID	Author	Paper Title
1.	13.00	13.25	52	Delta Ardy Prima	Implementation of Behavior Tree for Creating an In-Game Cut-Scene
2.	13.25	13.50	45	Putu Padmareka Deandra, Herry Santoso and Judy Retti B. Witono	Carbon Based Sulfonated Catalyst as an Environment Friendly Material: A Review
3.	13.50	14.15	9	Yu-Chung Tsao, Felix Arril Simbara Barus and Chien-Wei Ho	How energy efficiency, smart factory, and mass personalization affect companies in Industry 4.0
4.	14.15	14.40	18	Yoni Kristiawan, Edi Purwanto, and Rustono Farady Marta	The Role of Supply Chain Performance to Determine the Firm Performance

Simulation of impact azimuth angle on specific energy output of a fixed mounting rooftop PV system in Jakarta, Indonesia

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Elieser Tarigan