PREFACE

Bismillahirrahmanirrahim,
Assalamu’alaikum Warrahmatullah Wabarrakatuh,

First of all, we apologize for the inconvenience in the 13th ISIEM 2021 event, due to current condition and situation of COVID 19. The situation made us has to make some critical modification in the event, including: online presentation of keynote speaker, online presentation for all candidates that cannot attend the seminar, but we hope we all remain excited to continue to contribute to research publications. Nonetheless, we are trying to prepare this seminar as best we can.

This issue is published in line with the Thirteenth International Seminar on Industrial Engineering and Management (13th ISIEM) 2021. The articles cover a broad spectrum of topics in Industrial Engineering and Management, which are Quality Engineering Management, Decision Support System and Artificial Intelligent, Ergonomics, Supply Chain Management, Production System, Operation Research, and Industrial Management. These articles provide an overview of critical research issues reflecting on past achievements and future challenges. Those papers were selected from 137 abstracts, and we send these papers to AIP to be published there as an Open Access Proceeding Scopus. This statistic shows the high competition to get published on this proceeding. This issue and seminar become special as more delegates come and join from various country as well as universities. We host 90 delegates both from abroad and local.

The 13th ISIEM is hosted by eight universities, which are Universitas Pasundan, Universitas Esa Unggul, Universitas Trisakti, Universitas Tarumanagara, Universitas Al-Azhar Indonesia, Atma Jaya Catholic University of Indonesia, Universitas Pancasila and Universitas Mercubuana. This is the thirteenth years of the collaboration of those universities, and the first time we had MOU with AIP in America to publishing the papers that is indexed by Scopus. This is also the second years of our international partnership join committee with Chung Yuan Christian University – Taiwan, Yuan Ze University – Taiwan, Kasetsart University – Thailand and Bright Star University – Libya.

In this occasion, let us give special thanks to Prof. Yung-Tsan Jou, PhD (Professor and Chair Department of Industrial and Systems Engineering, Chung Yuan Christian University – Taiwan), Prof. Yun-Chia Liang, PhD (Professor and Chair, Department of Industrial Engineering and Management, Yuan Ze University – Taiwan), Elisa Lumbantoruan (President Director & CEO at ISS Indonesia, Independent Commissioner at PT Indosat Tbk, and Independent Commissioner at Garuda Indonesia) and Naraphorn Paoprasert, Ph.D (Researcher, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University – Thailand), for their contribution as keynote speakers, to Prof. Abdelnaser Omran from Brightstar University, and supported by Indonesian Association of Industrial Engineering Higher Education (BKSTI) and the Institution of Engineer Indonesia – Industrial Engineering Chapter (BKTI-PII). We are also grateful to all reviewers and editors, for their commitment, effort and dedication in undertaking the task of reviewing all of the abstracts and full papers. Without their help and dedication, it would not be possible to produce this proceeding in such a short time frame. I highly appreciate all members of committees (advisory, steering, and organizing committees) for mutual efforts and invaluable contribution for the success of seminar.

Wassalamu’alaikum Warrahmatullah Wabarrakatuh.

Dr. Winnie Septiani, ST, MSi, CIQaR
Chairman
13th ISIEM – Bandung, 28 July 2021

**The Conference Program**

**0830**
Zoom Meeting Open, Welcoming, Information, by the Committee

**0900**
Welcoming Remarks, Code of Silence, National Anthem by MC: Dr. Ir. Yodi Yugaswara, MT.

**0915**
Greetings Speech by Chairman Dr. Winnie Septian, ST, MSI, CIQaR

**0920**
Opening Speech by Prof. Dr. Ir. H. Eddy Jusuf, SP, Msi, MKom, Rector of Universitas Pasundan

**0925**
Partnership Ceremony by Representation of University Committee and Partner University

**0930**
The Keynote Session
Moderator, Riana Magdalena, SSI, MBA.

**0930**
Prof. Yung-Tsan Jou, Ph.D., Chung Yuan Christian University, Taiwan

**1000**
Naraphorn Paoprasert, Ph.D, Kasetsart University, Thailand

**1030**
Prof. Yun-Chia Liang, Ph.D., Yuan Ze University, Taiwan

**1100**
Elisa Lumbantoruan, Independent Commissioner at Garuda Indonesia

**Question and Answer 1130 - 1200**

**Lunch Break 1200 - 1300**

**Parallel Session 1300 - 1700**

*All time in WIB (Western Indonesian Zone - GMT+7)*
Join the 13th ISIEM Seminar Guideline

Dress appropriately. This is an international event with huge number of participants coming from many countries.

Please be aware of your surroundings. Adjust your work setup so that you face a window or are exposed to plenty of light, and make sure you use the virtual background given by the committee. It is recommended to put on the earpiece or headset equipped with microphone.

Leave the keyboard alone. It will prevent you from devoting your full attention to the meeting.

Check your connection. Make sure your network adapter, Wi-Fi or internet connection is in a working condition to avoid zoom meeting problems during the plenary and parallel sessions.

Mute the microphone. The honorable speakers will deliver great speeches. So please mute your microphone when you are not speaking to give other participants the ability to chime in and share their thoughts without any distraction.

The participant may turn off the webcam. During your presentation and or make a question, it is compulsory to turn on the webcam.

Stay seated and stay present. This conference will take around 8 hours of your day. It may be tempting to do other things during the meeting, but please refrain in doing so. Because you might miss out on key information or an opportunity to give input.
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The morning session is a Keynote Speeches session. During this session there will be no breakout room in Zoom platform. The noon session is a parallel session. Breakout room will be applied. The Author may enter the room as shown on the schedule of parallel session in the Program Book by click on [Breakout Rooms], then choose the room that you will make a presentation
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Prof. Yung-Tsan Jou, Ph.D., received his Ph.D. degree in Integrated (ME, ISE) engineering from Ohio University, Athens, OH, in 2003. He is the Chair and Associate Professor of Industrial and Systems Engineering at Chung Yuan Christian University, Taiwan. His research has made contributions in green design, human–system interface design, senior assistive devices, and usability or quality evaluation by using virtual reality tools, smart manufacturing, machine learning, and data analysis.

Naraphorn Paoprasert, Ph.D., is an associated professor at the Department of Industrial Engineering, Kasetsart University, Thailand. She received her Ph.D. from the Department of Industrial Engineering, University of Wisconsin-Madison, USA. Currently, she is a director of the International Graduate Program under the Department of Industrial Engineering. Her past research studies have been focusing on decision analysis and game theory, risk analysis, system simulation, process improvement, and economics analysis. The first research exposures were focusing on decision making to protect the system against natural disasters and terrorism. Later on, the focuses were on decision making in various fields such as agriculture, research fund allocation, education, etc.

Prof. Yun-Chia Liang, Ph.D., received his Ph.D. form Industrial and Systems Engineering, Auburn University – Alabama USA. He actives as Professor and Chair, Department of Industrial Engineering and Management, Yuan Ze University – Taiwan, Vice Director, the Smart Production and Innovation Management Research Center (SPIM), Yuan Ze University, Associate Editor, Journal of Industrial and Production Engineering (JIPE), Planning Committee, IEM Division, Ministry of Science and Technology (MOST), Taiwan, and many more academic activities.

Elisa Lumbantoruan, received Bachelor degree in Institut Teknologi Bandung on Mathematics. He has skill in Business Strategy, Strategic Planning, Business Planning, Business Development, Business Analysis, Risk Management, Management Telecommunications, Business Intelligence, Negotiation. He experiences in many enterprises and until now is the President Director & CEO at ISS Indonesia, Independent Commissioner at PT Indosat Tbk, and Independent Commissioner at Garuda Indonesia.
GLOSSARY

QM = Quality Management
SCM = Supply Chain Management
IECS = Industrial Engineering, Computer Science
EPD = Ergonomic, Product Design
PS = Production System
DAIS = Decision Analysis and Information System
OR = Operation Research
IS = Industrial System
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**Wednesday, 28 July 2021**

**Track: Production System (PS)**

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### Session 1 (13.00 – 15.00)

**Track:** Supply Chain Management (SCM)

**Session ID:** S1.3  
**Session Chair:** Dr. Ir. Sawarni Hasibu, MT. IPU  
**Session Parallel:** Dr. Hasbullah, ST., MT. IPM

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**Session 1 (13.00 – 15.00)**

**Track:** Decision Analysis and Information System (DAIS)

**Session Chair:** Dr. Ir. Zulfa Fitri Ikatrinasari

**Session Parallel:** Dr. Arief Suwandi, ST., MT., IPM

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**Track:** Operation Research (OR)

**Session ID:** S1.8

**Session Chair:** Prof. Yun-Chia Liang

**Session Parallel:** Christine Natalia, ST. MT

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**Track : Production System (PS)**

**Session ID:** S2.1

**Session Chair:** Dr. Ir. Nofi Erni, MM

**Session Parallel:** Taufiqur Rachman, ST, MT

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**Session 2 (15.00 – 17.00)**

**Track**: Industrial Engineering, Computation and Simulation (IECS)

**Session ID**: S2.8

**Session Chair**: Dr. Sumarsono

**Session Parallel**: Christine Natalia, ST. MT

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# PAPERS AND ABSTRACTS

## 13th-ISIEM-Paper 002 – QM

**Reducing Defect Products in Instant Noodles Production with Six Sigma**

R M Silitonga¹, Y T Jou¹, and M C Lin¹

¹Chung Yuan Christian University, Taoyuan, Taiwan

**Abstract.** Quality control is an essential thing in running a company, especially in the production process. The resulting product is inseparable from failure or nonconformity, as is the case experienced by Indofood (M) Food Industries Sdn. Bhd. It has a defect rate of 2.84% of instant noodle product scrap, which occurs in the middle of the production process, resulting in waste and loss. The purpose of this research includes the DMAIC (Define, Measure, Analyze, Improve, Control) approach, which is to define problems experienced by the company, measure current quality conditions, analyze things that cause product defects, provide solutions to overcome the causes of these problems and calculate design control measures. The results of this research indicate that the company's quality conditions from April to September 2018 suggest that the process does not meet specifications and must be improved even though the average sigma value produced has reached 4.24. The results show that three types of defects were found as the main contributor to the problems, namely dirty crushed, finely crushed, and broken crushed. The root cause of the problems was based on personal factors (operator problem), work method factors (process standard problem), and machine factors (machine problem), respectively.

**Keywords:** DMAIC, Instant Noodles, Quality Control, Six Sigma

## 13th-ISIEM-Paper 006 – IECS

**Structural Health Monitoring for Intelligence Structure: Damage Feature**

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⁴Department of Industrial Engineering, Faculty of Engineering, Andalas University, Andalas, Indonesia,
⁵Department of Mechanical Engineering, Faculty of Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

**Abstract.** Structural Health Monitoring (SHM) is a system to monitor and assess engineering structure’s integrity. It is crucial to avoid catastrophic failure, which often leads to material and immaterial loss. For the system to work, sensors should be placed on the structure to measure its deformation: strain, acceleration, velocity, or displacement. Then, the recorded data are analyzed to obtain damage-sensitive features, quantities for predicting the structural integrity. So far, the widely used features are natural frequency and mode shape. Vast engineers and scientists understand both. However, empirical evidence suggests the damage should have grown significantly to alter the natural frequency and mode shape to a detectable amount. This work intends to propose a feature that is more sensitive to damage than the natural frequency. We derive the feature from the Euler-Bernoulli Beam theory and evaluate its performance empirically for the case involving a cracked beam. The beam responses with and without crack subjected to loads are computed by the finite-element method. The proposed damage index is computed in the time domain at some observation points around the damaged area. The results are compared to those predicted by the change of natural frequency.

**Keywords:** Structural Health Monitoring (SHM), Damage Feature, Machine Learning, Natural Frequency, Mode Shapes, Beam Deformation, Euler-Bernoulli Beam.

## 13th-ISIEM-Paper 007 – PS

**Inventory Level Improvement with a Forecasting Methods in the Taxi Transportation Industry**

Muhamat Arifin¹,a) and Hasbullah²,b)

¹Student at Mercu Buana University (Jl. Alam Parung Raya, Bogor, Indonesia), ²Lecturer at Mercu Buana University
**Abstract.** The transportation service industry in Indonesia has developed quite rapidly. Inventory control is still not right, and found that the problem of spare parts overstock was 84% of the company's standard value is 20%. This study's suitable forecasting method uses a double moving average (DMA) with the smallest MSE value of 2.466. The purpose of this research for the company is to prove the proposed effective inventory method to the company to exploit inventory costs and to avoid dead stock/waiting parts. The research on radiator materials. The optimal inventory planning system uses the Fixed Period Requirements (FPR) method. Ordering with the lot size provides the smallest cost for the ordering and storage process by 47% compared to conventional methods carried out by the company and can provide an idea of when to order and how many orders per period. It can help coordinate with suppliers to meet company needs with routine supplier evaluations with a delivery lead time of 0 days.

**Keywords:** Fixed Period Requirements, inventory, forecasting, moving average.

**Bibliometric Mapping Of Biomass For Energy Supply Chain Model: Review and Future Research agenda**

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\(^1,2,3,4\)Departement of AgroIndustrial Technology, Faculty of Agricultural Technology, Bogor Agricultural University, PO Box 220 Bogor 16002, Indonesia

**Abstract.** Biomass is a waste that can be utilized for energy, with conversion technology can produce useful energy and can support activities in the agroindustry supply chain. The purpose of this study was to determine the trend of research in the field of biomass supply chain models for energy by analyzing through the review of several joint articles and the incorporation of bibliography, the frequency of joint appearance, and consideration of citations from the authors of articles, keywords, as well as providing direction on the focus of future research, the scope of research based on metadata four hundred articles in the Google Scholar database. Bibliometric Analysis Tool using VOSviewer, Harzing's Perish, or Publish software is used to analyze h-indexes. Mapping Conversion technology, Decision-making level at every stage in the biomass supply chain into energy using VOSviewer. The results of the bibliometric analysis concluded that biomass supply chain model into energy by using Thermochemical, Biochemical, and Physicochemical technology as well as the type of biomass used is biomass-derived from plant waste remains most widely used while the use of biomass-derived from rice-based crop waste, residential and industrial waste has not been optimal. For future research biomass as an energy source is focused on rice-based crop waste with consideration of rice-based biomass availability is quite abundant, but its utilization is not optimal.

**Keywords:** Bibliometric, Mapping, Biomass supply chain, Google scholar, VOSviewer

**Finding a Research Gap on Service Quality and Safety Improvement in Public Transportation**

Dian Mardi Safitr

Industrial Engineering Department, Faculty of Industrial Technology, Universitas Trisakti, Jakarta, Indonesia.

**Abstract.** Safety has become an essential issue in public transportation service quality. This literature review aims to identify the research trend and research gap in service quality and public transportation safety. Literature searching was directed using keywords of public transportation, service quality, road safety, bus rapid transit, and macroergonomics published at Science Direct, Proquest, Emerald Insight, and Springer. Articles being reviewed were published in the last fifteen years, 2005 to 2020. They were classified by the aim of the study and the methods. There are three primary topics in this literature review; public service quality, study of bus rapid transit (BRT) operation worldwide, and public transportation safety. From the review, there is a conclusion that the research agenda on public transportation using the macroergonomics approach is a novelty.

**Keywords:** public transportation, service quality, bus rapid transit, safety, macroergonomics.

**Decision Support System for Raw Material Supplier Selection by Using Fuzzy AHP-TOPSIS Method in PT Mulia Glass**

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\(^1\)Magister Teknik Industri, Fakultas Teknologi Industri, Universitas Trisakti, Jalan Kyai Tapa No.1, Jakarta Barat, 11440, Indonesia
**Abstract.** PT. Mulia Glass is a company that produces glass sheets. The raw materials procurement process which is conducted by previous purchasing division is only emphasized price and other subjective criteria. This research aims to design a Decision Support system (DSS) selection of raw material suppliers using the Fuzzy-AHP and TOPSIS methods. The design of a decision support system begins with the initiation and analysis system. System databases consist of the user database, suppliers, raw materials, criteria, comparison of criteria, master TFN, criteria weights and alternative values. Model Base consists of a Fuzzy-AHP model to determine the value of the criterion weights and TOPSIS model is used for supplier alternative alignment. The DSS implementation is designed using the PHP and MySQL programming languages. Criteria for the selection of raw material suppliers such as price, quality, time of payment, customer care, and service. Result of Fuzzy-AHP TOPSIS consists of rank with the first place is PT.C with evaluation value 0.578, second and place PT.A with a value of 0.414. The validation result of a manual calculation and DSS shows the same result, it is concluded that the raw material supplier selection DSS is valid.

**Keywords:** Supplier selection, raw material, DSS , Fuzzy AHP, TOPSIS

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**13th-ISIEM-Paper 011 – SCM**

**Methods and Approaches Mapping for Supplier Selection: Literature Review**

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**Abstract.** Supplier selection is one of the important stages that should be considered in supply chain management. Some researchers have researched the supplier's selection with different methods or approaches. This research aims to map the use of methods or approaches and criteria in the selection of suppliers. Article research was done through relevant journals selected by the selection of suppliers issued from 2013 to 2020. A total of 42 article journals were selected and analyzed. The stages start from the article research related to supplier selection. Then, the articles are identified and classified based on their method or approach. The grouping of supplier selection methods is divided into two namely a single model and an integrated model. The commonly used methods of the selection of suppliers in the single model are AHP, TOPSIS, VIKOR, SAW, and WP. Whereas, the integrated models that are commonly used are Fuzzy AHP, Fuzzy TOPSIS, Fuzzy AHP-TOPSIS, AHP-VIKOR, and Fuzzy-AHP & Fuzzy-TOPSIS. The use of a Decision Support System (DSS) assisting supplier decision making, is widely supported by a unified model group. The results of this research are expected to help researchers and companies choose methods to determine suppliers.

**Keywords:** Literature review, Supplier Selection, Criteria, Supplier Selection Method, DSS.

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**13th-ISIEM-Paper 012 – EPD**

**Redesign Plastic Waste Processing Machine by Using the Lean Product Development Method**

Nadiya Hasna Faktirah Hartanto1,a), Widya Nurcahaanty Tanjung1,b), Niken Parwati1,c), and Aprilia Tri Purwandari1,d)

1Industrial Engineering Major, Faculty of Science and Technology, Al Azhar Indonesia University, Komplek Masjid Agung Al Azhar, Jalan Sisingamangaraja, Kebayoran Baru, South Jakarta 12110

**Abstract.** It is known that the amount of plastic waste have increased for years and it has the potential to become dangerous for environment. There is a study that developed an integrated plastic waste processing machine called Creatics which have chopper and heating machine into one machine as alternatives to process plastic waste but it still have problems and room for improvement. It is necessary to develop a new design to redesign Creatics into a machine that could fix its constraints and a design that could meet the attributes that customer needs. The methods used in this research are Garvin’s dimension and Lean Design Solution Tools. Garvin’s dimension is used to identify which attributes of customer needs that must be prioritized and Lean Design is used to identify the problems that Creatics had clearly then make improvement based on it. Based on Garvin’s dimensions, five attributes of customer needs that must be prioritized are processed products must be useful, machine equipped with safety, environment friendly, ergonomic design, and easy to be repaired. By using the Lean Design Solution Tools, improvement have been made to fix problems that Creatics had into a new design that was carried out by CATIA Software.

**Keywords:** customer needs, garvin dimension, lean design
13th-ISIEM-Paper 013 – EPD

Risk Analysis and Safety Improvement of Plastic Waste Processing Machine
Azizah Andrea Risa Tassha Chairiyah1,a), Niken Parwati1,b), Aprilia Tri Purwandari1,c), and Widya Nurcahayanti Tanjung1,d)
1Industrial Engineering Major, Faculty of Science and Technology, Al Azhar Indonesia University, Komplek Masjid Agung Al Azhar, Jalan Sisingamangaraja, Kebayoran Baru, South Jakarta 12110, Indonesia

Abstract. Creatics is a plastic waste processing machine that integrating chopper and extruder component into one compact machine that produce various recycled products. This study was conducted to analyse the potential risk in Creatics machines operation. Several operation processes have potential risks that can affect user’s safety and machine’s durability. Failure risk analysis on Creatics machine was identified using the FMEA method, which gave value of RPN (Risk Priority Number) to determine which risk should be handled first. The result shows the top 3 highest RPN values: 405 found in the extruder, 324 found in the funnel component, and 233 found in the shredder component. The recommended actions to overcome these 3 failure modes are: (1) create a filter for extruder, (2) redesign funnel component that shown in Fig. 2 and add a bolt for the shredder.

Keywords: failure mode and effect analysis, plastic recycle process, risk priority number

13th-ISIEM-Paper 014 – DAIS

YBM University Tourism Building Location Selection With A Combination of Cut Off Point And AHP Topsis Method
N Laurentia1,a) and W Septiani2,b)
1,2Faculty of Industrial Technology, Campus A, Trisakti University, Jakarta 11440, Indonesia

Abstract. The objective of this research is to analyze the determination of the new campus construction that provides the most benefits from the three alternative options. Criteria selection was conducted by using cut off point method, meanwhile alternative location selection evaluation was conducted by using AHP and TOPSIS methods. The valuation was conducted by Board of Directors, Rector, Vice Rector, Rectorate Daily Executor, and a number of directors. Cut off point calculation produced 5 (five) highest criteria namely accessibility, environment, expansion, competition, and building cost. AHP TOPSIS measurement result produced an alternative location preferences namely Batam with a value of 0.6047, Yogyakarta with a value of 0.4453, and Bali with a value of 0.3667. Based on that, the recommended location is in Batam City with the highest preference value.

Keywords: decision analysis, location selection, cut off point, AHP, Topsis.

13th-ISIEM-Paper 015 – DAIS

Evaluation of E-Learning Implementation Using Student Readiness Instrument
M M Inderawati1,a), P T Huang2,b), R Sukwadi1,c), A Sugioko1,d), T Liana1,e), and Y T Jou2,f)
1Atma Jaya Catholic University of Indonesia, Jl. Raya Cisauk Lapan-Sampora, Tangerang, Banten, Indonesia.
2Chung Yuan Christian University, No. 200 Zhongbei Road, Chung Li, Taiwan.

Abstract. E-learning has become a compulsory learning model for almost all universities in Indonesia since the COVID-19 pandemic hit Indonesia. To improve the online learning process, universities need to carry out evaluations, such as measuring student readiness for e-learning. This study was conducted to identify indicators of student readiness in using e-learning, measuring student readiness scores in using e-learning, and finding out whether differences in gender, cohort by the entry year, and faculty affect e-learning readiness. This research used instruments that have been used in several previous studies, which consist of five dimensions namely Computer Self-Efficacy, Self-Directed Learning, Motivation, Learner Control, and Online Communication Self Efficacy. The respondents were students from X University (a private university) drawn proportionally from all faculties based on the number of students per faculty. The results showed that the e-learning readiness score in X University is good, which is in line with the fact that X University has been partially implementing e-learning before the pandemic period. In X University, gender and cohort entry year factors do not affect e-learning readiness scores, while faculty has an effect. This research also provides suggestions on what activities are needed to improve the implementation of e-learning in each dimension.

Keywords: online learning, e-learning readiness, e-learning evaluation, higher education.
Abstract. Industry 4.0 revolutions where all business processes using digitalization to make it easier which focuses on interconnectivity, machine learning and real-time data. While all processes transform into digital data, the data can help the company to know what they should improve. For the example is complaining process where the customer asks for something that the customer didn't get what must the customer get of the product or service. Most of big companies use social media for sharing information, handling customer complaints, and giving promotion to reach more customers. But some people also use social media to give reviews of product and service which reviews will affect to public's decisions to choose whose has the better product or service. While the data are collected, the data will be analyzed by sentiment analysis. Sentiment analysis is a method that is used to know what people think about and classify it into positive, neutral and negative sentiment. In this research, neutral sentiments will be removed, because neutral sentiments won’t be affected to the company about what public’s thought, thus the required data were data with positive and negative sentiment. The data in this research was collected through Twitter, because Twitter is known as one of popular social media in Indonesia which has character restriction up to 140 characters, thus public just expressed what they wanted to tell shortly and briefly. In order to improve the service, customer’s opinion on Twitter will be analyzed and classified by Naïve Bayes classifier. Data was collected by quota sampling up to 1000 tweets for each company. The classifier has performed well with the average of accuracy, sensitivity, precision, specificity was 90%.

Keywords: sentiment analysis, Naïve Bayes classifier, twitter, online transportation, fishbone.

Abstract. The purpose of this study is to develop the blue print of Intelligent Decision Support System (IDSS) in the supply chain network of Kenaf Natural Fibre Agroindustry (KNFA) which has not been much studied. This paper will be an important contribution to KNFA studies in Indonesia. This blueprint refers to the two echelons of the KNFA supply chain network, namely the upstream supply chain network (KNFA) and the middle-stream supply chain network (textile industry). The simulation of the inventory collaboration model in the upstream supply chain have been carried out on the Net Beans IDE 12.0 application. Consecutive research will carry out a simulation of the inventory collaboration model in the middle-stream supply chain network, and develop a digital platform with an Android studio application for smartphones based on android, and Net beans application for desktops.

Keywords: intelligent decision support system, inventory collaboration, performance, supply chain, value added

Abstract. It is common for customers to line up for buying train tickets at train stations in Taiwan, but it may cause some problems if the customers wait too long and miss the train. At certain rush hour periods, the queue length may pile up, and customer service satisfaction would go way down. In this study, the authors propose several alternatives for improving counter services at train stations to reduce the rush hour waiting time for buying train tickets at Zhongli stations in Taiwan. By using ARENA software, the model of a smart counter system was developed. The output of a model's performance was initially checked and validated with the real ticketing system at the first phase. Furthermore, four alternatives
developed to open or close counters automatically based on the customer waiting numbers were evaluated by simulation methods. The output of customer waiting time was analyzed with statistical tests to verify significant differences between the original and alternative models. According to the statistical results, an alternative model with three counters remaining open or close counter numbers based on pre-set customer waiting numbers has larger counter utilization rate and less required counters, and the average of customer waiting time is acceptable in the rush hour.

**Keywords**: simulation modelling, service improvement, simulation system, queuing simulation.

**13th-ISIEM-Paper 019 – IECS**

**Design and Evaluation of LoRa-based Mesh Network for Water Metering Infrastructure**

Rifki Muhendra 1,a), Naufal Ismail Kreshnaviyanto 2), Aisyah Amin 3), Paduloh Paduloh 1,b), Solihin Solihin 1), and Achmad Muazar1)

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**Abstract.** The demand for water meter monitoring has become urgent nowadays. For this reason, this research aims to develop a LoRa network for water meter infrastructure applications. We have designed a low-power measurement node using an 8-bit microprocessor and LoRa transceiver by connecting software for monitoring water consumption and remote data transmission. In this study, several schemes were made to measure Lora data transmission performance for point to point and mesh networks. The results showed that the LoRa value and the TX power and spread factor (SF) value, which was higher, could increase the data transmission range for point-to-point network schemes. SF 8 provides the most optimal data transmission performance in a mesh network scheme, both in direct transmission and multiple hops. The packet delivery rate is measured at 100%, with an average ping time of 582 ms for each hop. This design increases the time interval and reduces transmission failures in times of data congestion. Implementing a LoRa-based mesh network in residential areas automatically builds data transmission lines and connects with surrounding nodes to build a mesh network. Percentage of PDR measured for each node in the network above 97%.

**Keywords**: LoRa, Mesh, Packet delivery ratio, Spreading factor.

**13th-ISIEM-Paper 020 – IS**

**A Maturity Model of I4.0 in Developing Country: Challenges and Enablers in Indonesia for Using INDI 4.0 as A Measuring Instrument of I4.0 Readiness**

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**Abstract.** Industry 4.0 (I4.0) Readiness Index Indonesia (INDI 4.0) is an approach to measure readiness to adopt I4.0 in Indonesia as a basis to develop a roadmap and strategy towards I4.0. In Southeast Asia, Indonesia seemly left behind in the policy launch timeline of I4.0 initiatives as a national plan to improve competitiveness. Indonesia’s rank is lower than Singapore, Thailand, Vietnam, and Malaysia. From the INDI 4.0 initial assessment in 2018, Indonesia got a low score at an average of 1.992 (scale 0 to 4). This paper aims to identify challenges and enablers by comprehensive review to enhance INDI I4.0 effectiveness, so contributing more accurate measuring I4.0 readiness and strategy for both government and industry of Indonesia. This research used a multi-methodological approach, exploring articles, a qualitative approach, and participating in group workshops. This study found no differences in the general approach and principle in INDI 4.0 and other primary indexes used in other countries. It is similar in defining a roadmap, the steps in developing the I4.0 index and dimensions, and determining technology as the basis of measurement. From this finding, this study identified challenges and enablers in implementing INDI 4.0.

**Keywords**: Industry 4.0, INDI 4.0, readiness index, challenges, enablers
Resilient and Sustainable Supplier Selection: Trends in Criteria and Methods
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\textsuperscript{2}Bachelor Program in Industrial Engineering Universitas Kristen Maranatha, Jl. Prof. drg. Surya Sumantri, M.P.H. No. 65, Bandung, Jawa Barat, Indonesia.

Abstract. 2020 pandemic situation has pushed many organizations to think and act in order to survive. Resilient and sustainable supplier selection (RSSS) is important for companies facing this situation but there were few studies about this topic. This study tried to give basis for RSSS research by conducting descriptive study about criteria and methods that have been used by many researchers from 2014-2020. The results of this study can be useful for both researchers and practitioners by giving them basis for further development of their RSSS. This study used four step methods of systematic process in literature study, they are identification, screening, determining the eligibility of data, and summation process. RSSS criteria were grouped into general criteria, sustainable criteria and resilient criteria. The criteria were classified into the cost/price, quality, delivery, responsiveness and flexibility, environment, technology, total cost of ownership (TCO) and business metrics (for general criteria), economic, social and environmental (for sustainability criteria), redundancy, flexibility, information sharing, trust, visibility, velocity, leadership, innovation (for resilient criteria). The results showed the lack of development in TCO criteria and the growing interest of developing leadership, information sharing and innovation criteria in the 2020 articles. The methods used mostly were Multi Criteria Decision Making (MCDM) method with integration of order allocation using mathematical modelling.

Keywords: supplier selection criteria, sustainable, resilient, MCDM.

Parameter Tuning for Combinatorial Bees Algorithm in Travelling Salesman Problems
Natalia Hartono\textsuperscript{1,a}), Asrul Harun Ismail\textsuperscript{1,b,c}), Sultan Zeybek\textsuperscript{2,a)}, Mario Caterino\textsuperscript{3,d)}, Kaiwen Jhang\textsuperscript{1,e}) and Murat Sahin\textsuperscript{4,f})
\textsuperscript{1}Department of Mechanical Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK., \textsuperscript{2}Department of Computer Engineering, Fatih Sultan Mehmet Vakif University, Sutulce Neighb., Karaagac Road, 12/A, Beyoglu, Istanbul, Turkey, \\
\textsuperscript{3}Department of Engineering, University of Campania Luigi Vanvitelli, Aversa, via Roma 29, Italy, \textsuperscript{4}Department of Control Systems, Roketsan, 06780 Elmadag, Ankara, Turkey

Abstract. Bees Algorithm is one of the most used nature-inspired algorithms. There are five parameters applied in the basic combinational version of Bees Algorithm: number of scout bees, number of elite bees, number of best bees, number of elite sites, and number of best sites. Parameter tuning is one of the critical and time-consuming steps in metaheuristic algorithms. This research is the first parameter tuning study for Combinatorial Bees Algorithm (BA) for solving the Travelling Salesman Problem (TSP). The experiments are designed using Fractional Factorial Design, and four steps, including parameter setting and statistical analysing, are carried out. The TSP problem’s goal is to minimise the total path and find the lower number of the best cost. Comprehensive experiments have been done using varying TSPLIB datasets between 51 and 575 cities to minimise the total path and find the lower number of the best cost. Statistical results show that the best combinatorial BA parameters are the balanced scenario of local and global search.

Keywords: Bees Algorithm, Combinatorial Optimisation Problem, Metaheuristics, Parameter Tuning, Travelling Salesman Problem.

Research Opportunities on Energy Supply Chain Management
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Abstract. it is very important for energy supply efforts to see it as an integrated system. the energy supply chain is a discipline that offers a comprehensive and promising approach to this purpose. This article aims to analyze the published literature by identifying research opportunities. This goal is pursued through a bibliometric analysis of articles indexed in Scopus using the keyword "energy supply chain". There are three types of analysis conducted, namely metadata analysis, bibliometric analysis, and network analysis. Energy supply chain development is closely related to the green supply chain
and sustainable supply chain. This research arena is still relatively new, so there are opportunities to develop frameworks related to the energy supply chain. In addition, research opportunities are also open for location determination, resource allocation, performance measurement, and the development of quantitative models. One of the contributions of this article is that it can provide a clear definition of the energy supply chain research area.

**Keyword:** Supply Chain Management, energy, bibliometric analysis, VOS viewer, literature review

**13th-ISIEM-Paper 024 – QM**

**Analysis of Big Losses to Increase Productivity with SMED Method in Hand Sanitizer Products**

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**Abstract.** The World Health Organization (WHO) has set Covid-19 to be a global pandemic. Public awareness to wash their hands is increasing. The company studied is one of the companies that produces hand sanitizers, where hand sanitizers are useful as hand washing replacements for clean water or after washing hands with water. In the hand sanitizer production process, the productivity value measured by Overall Equipment Effectiveness is only 79.23%, still below the World Class Manufacturing standard, 85%. This low OEE value was due to the long changeover process of 180 minutes. Improvements using the Single Minute Exchange (SMED) method with the ECRS concept can reduce changeover time from 180 minutes to 100 minutes, resulting in an increase in the OEE value to 87.84%, where the Availability Rate value from 83.15% to 89.73%, Performance Rate from 95.52% to 97.97%, Quality Rate from 99.76% to 99.91% and all values exceed World Class Manufacturing standard.

**Keywords:** Hand Sanitizer, OEE, Six Big Losses, SMED.

**13th-ISIEM-Paper 025 – IS**

**Analysis of Optimistic Bias and Pessimistic Bias in Preparation for The New Normal**

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**Abstract.** The Government issued protocol scenarios that must be carried out during the new normal period. However, in fact, the number of positive cases of Covid-19 in Indonesia is increasing. It is known that the public's optimistic perceptions are influenced by awareness of the low risk of COVID-19. This study aims to identify optimistic bias when preparing to face the new normal and analyze the relationship between respondent qualifications and the level of optimistic and pessimistic bias. The data used in this study are actual data from the Indonesian Government, the number of positive COVID-19, the number of cures, and the number of deaths per day. Also, data on 58 respondents with the characteristics of workers who are still actively working were collected, consisting of men and women. The results show that optimistic bias occurs in the estimation of the number of positive victims and the number of deaths from COVID-19 cases, and Optimistic bias does not occur in the estimation of the number of recoveries of COVID-19 cases. Also, there is no difference in the accuracy of estimates between male and female respondents for positive cases, the number of cures, and the number of victims who died.

**Keywords:** COVID-19, New Normal, Optimistic Bias, Pessimistic Bias

**13th-ISIEM-Paper 026 – EPD**

**Analysis of Work System to Productivity with Work Stress as Moderating Variable**

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**Abstract.** PT Alakaska Extruding is a manufacturing company that produces steel extrusion. Based on the data, the extraction department has a problem with productivity. The preliminary study was conducted using interviews with the workers and obtained some problems. There was no job desk clearly, the workers have to work while on a day off, lack of safety awareness, radiation temperature machine 500°C, and less motivation. This research aim is to analyze the impact of work system, work stress as a moderating variable to productivity. The MOQS questionnaire was used to assess work system, DASS42 for work stress, and productivity questionnaire for productivity variable. SEM-PLS has been used to analyze the relationship of all variables. SEM-PLS results show that organizational conditions and environment have
high impacts to productivity. 79.1% of productivity is influenced by work system and work stress, but 20.9% is influenced by the other variables.

**Keywords:** macroergonomics, productivity, work system, work stress, SEM-PLS

### 13th-ISIEM-Paper 028 – DAIS

**Design of Sales Information System Based on Website at Amonyu Shop**

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**Abstract.** Amonyu Shop is an online shop that sells cosmetic and skincare products from Korea. This online shop sells products from social media. However, the owner of this shop experienced problems in getting customer order information data because consumer data is not well organized and often the customer was missed and not served. Based on these problems, an information system design based on a website is needed to make it easier for owners to get information and speed up transactions carried out by customers. Analysis of the current sales system and user requirement is carried out using PIECES analysis and then designing object-oriented diagrams and generate a database for the website. System design based on usability aspects. The result of this research is a website-based sales information system, and the usability value shows that all attributes have an average acceptance value of 4.413. So, it can be concluded that the sales website at Amonyu Shop has a high usability aspect because users understand when using the website.

**Keywords:** Online shop, system design, usability, PIECES analysis.

### 13th-ISIEM-Paper 029 – DAIS

**Decision-Making for Conducting Seismic-Surveying Activities on Oil and Gas Exploration Using Decision Tree and Utility Functions**

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**Abstract.** A seismic-surveying activity is one of the important activities in oil and gas exploration to determine the hydrocarbon content beneath the Earth’s surface. Furthermore, the government will pay the cost of exploration activities through cost recovery on the condition that the company is able to find commercial oil and gas reserves. The purpose of this study is to assist companies in deciding for conducting seismic-surveying activities to reduce losses in oil and gas exploration. The methods employed to evaluate this decision were the decision tree and utility functions. After carrying out brainstorming with experts in the field of oil and gas exploration, three alternative decisions were proposed: conducting drilling without carrying out seismic surveys, with 3D seismic surveys, and with seismic surveys through the Exploration Joint Venture Agreement (EJVA). The desired criterion is maximum company profit. Meanwhile, the uncertainties that may occur are the success in finding the reservoir or failing (finding dry hole). Moreover, the results of the interpretation of the seismic structure predictions indicated high and low structures with seismic surveys through the Exploration Joint Venture Agreement (EJVA). The desired criterion is maximum company profit. Meanwhile, the uncertainties that may occur are the success in finding the reservoir or failing (finding dry hole). Moreover, the results of the interpretation of the seismic structure predictions indicated high and low structures with reservoir categories at high, best, and low levels. The alternative evaluation was determined using the calculation of the Expected Monetary Value and Utility Function which provides options regarding the preferences for decision-makers. The results of the calculation indicated that the EJVA-seismic survey provides the highest value, namely 40,980,915.81 USD. Meanwhile, the VP exploration preference for the EJVA-seismic surveys was 0.403. Therefore, the recommended alternative for the company is to carry out an EJVA-seismic survey to minimize the risk of company losses in oil and gas exploration.

**Keywords:** exploration, seismic, decision tree, expected monetary value, utility function.

### 13th-ISIEM-Paper 030 – OR

**Dynamic Programming for Shortest Path Problem in a Multi-modal Transportation Network Comprising Intermediate Sinks**

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**Abstract.** Applications of shortest path problem (SPP) are important in transportation of material and public, city emergency way, and intelligent transportation system. The aim of this study is to optimize path for transportation networks.
with multiple intermediate sinks between an initial source and final sink. The presented problem is solved by developing a mathematical model using forward and backward recursive computations with objective to explore different modes of transportations for minimizing per unit cost to deliver raw material. The developed model is validated through a case study comprising rail, road and air as available transportation modes. Results of this case study show that rail mode has minimum distance (1475km) followed by mixed road-rail-air mode (1513km) and road mode (1527km). Talking about the cost to deliver one kilogram of material, the cost was minimum for train (0.3667 PKR), followed by road-rail-air (0.4335 PKR) and road (0.4668 PKR). However, decision can be taken on the basis of priorities such as cost, time, and due date. The outcomes of solving transportation problem with multiple sinks between an initial source and final sink can be used to optimize delivery of goods and services (courier, goods, medicines etc.).

Keywords: Dynamic programming, multimodal network, SPP, Transportation.

13th-ISIEM-Paper 031 – SCM

Hybrid Simulation of Supply Chain : A Review
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Abstract. One method that can be used to optimize supply chain is system modeling and simulation. A hybrid simulation system is system which shaped from any rate distinct simulation modelling and demonstrating systems (e.g. discrete event, framework elements, specialist-based) and a singular calculated simulation system when executed in PC programming, utilizes more than one simulation worldview. Hybrid models allow to solve different mathematical models using a digital computer related to a solving problems strategy. In this study, an analysis will be carried out from the results of previous research, regarding the efforts made to increase supply chain productivity by using hybrid simulation. Every scientific article goes through a rigorous selection process to get articles that are in accordance with the objectives of this research. The references are based on 2006-2020 with six stages of research implementation. The results show the approach using hybrid simulation methods is the best way to analyse and evaluate a supply chain. Each simulation approach can provide actual information required for improvement of the supply chain. Improvements are generally carried out on ongoing basis for each specified period. Hybrid simulation is useful for decision making, centralized, decentralized supply chain, flexibility appraisal and hazard management in supply chain.

Keywords: hybrid simulation, simulation modelling, supply chain, improvement.

13th-ISIEM-Paper 032 – DAIS

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Abstract. Sustainability assessment is an important stage in the implementation of sustainable development for the industry. This paper proposed a framework for an adaptive sustainability assessment for the industry in achieving industry 4.0 goals through a systematic literature review. This study analysed related papers to sustainability assessment in Scopus database using descriptive statistics and a Scientometric approach. A VOS-Viewer software was applied to find related keywords and gaps to develop an adaptive sustainability assessment model for the industry. The result showed that there were 13,099 papers related to sustainability assessment which were published in Scopus database since 1980. The keywords networks and gap analysis using VOS-Viewer indicated that artificial intelligence and Geographical Information Systems (GIS) offered a great potential framework for sustainability assessment. This study designed a comprehensive framework organized by sustainability indicators analysis, artificial intelligence modelling for the assessment, and GIS for the sustainability performance dashboard. Research in sustainability assessment offered great potential for further analysis in any area.

Keywords: Artificial intelligence, Geographical Information System, Sustainability assessment, VOS-viewer
13th-ISIEM-Paper 033 – QM

Improve The Quality of Korean Garlic Cheese Bread Using The Six Sigma Method
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Abstract. Quality control is the main thing that must be considered by a company because quality is a very influential factor in customer satisfaction. In this study, the identification of factors that inhibit the quality of Korean garlic cheese bread products was identified using the Six Sigma method. The purpose of implementing the Six Sigma method is as an analytical tool in order to optimize production and minimizing product defects. Based on the analysis conducted, there are five types of CTQ defects in bread production including sodden, unequal size, burnt, overbaked, and excess filling. Then, by doing a Pareto analysis, on the number of each type of defect, the main focus in repairing is three types of defects, namely sodden, unequal size, and burnt. The main factors causing the problem of this type of product defect are temperature, time, mixer speed, and butter dosing. By implementing the Taguchi method, the optimal combination is obtained including the mixing process time of bread dough for 10 minutes, the mixer working speed of 5 speed, room temperature of 27 °C, and dosing of butter as much as 35 grams. After implementation for ±3 weeks, the sigma level was increasing from 3.76 become 3.97.

Keywords: ctq, pareto, quality control, six sigma method, taguchi method

13th-ISIEM-Paper 034 – SCM

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Abstract. The EPC (Engineering Procurement Construction) industry is one of the largest industries in the world. However, in 2020, the Covid-19 pandemic forced the Indonesian government to issue a large-scale social restriction policy that slows down the national EPC industry’s growth. An EPC company addresses this challenge in Indonesia by transforming business processes in its SCM (Supply Chain Management) division. The division is expected to increase the SCM’s flexibility and efficiency in the Pandemic and New Normal era. This research was developed to assist a national EPC company map the SCM division condition’s current gap with stakeholders’ advanced SCM standards with the Rapid Assessment Procedure (RAP) approach. RAP is a flexible situational analysis approach that combines quantitative and qualitative tools to help decision-makers identify which areas need improvement. Based on this study’s results, it is recommended for companies to design SCM business process development from decentralized to hybrid form so that their business processes become more SCM oriented. As an initial step in the transformation, changes will be made to the flow and rules for coordination lines, workflows, and integration with other SCM division functions.

Keywords: EPC, SCM, RAP, Gap Analysis

13th-ISIEM-Paper 035 – SCM

Impact of Supply Chain Practices on Customers’ Retention
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Abstract. Due to the competitive business environment, companies have identified the need to improve supply chain (SC) practices for retaining their customer. This study explores the factors effecting retention of the customers by conceptualizing five dimensions of SC practices (delivery, customer relationship, after-sale service, responsiveness, standardization, and specification). The relationship between SC practices and retention of the customers is studied through questionnaire survey. The data collected from 521 respondents was analyzed using structural equation modeling to check significance of the proposed relations. The outcomes of the study indicate that the factors like delivery, after-
sale service, responsiveness, standardization, and specification impact retention of the customers, whereas "customer relationship" factor is insignificant.

**Keywords**: Supply chain, customers' retention, after-sale-services, responsiveness.

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**13th-ISIEM-Paper 036 – OR**

**Application of Fourier Grey Model (FGM) For Demand Forecasting and Markov Chain Method for Inventory Planning**

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**Abstract.** Based on the original Grey Model GM(1,1), the forecast accuracy of GM(1,1) have been modified using Fourier Series called FGM(1,1) to predict the demand of air compressor of compressor manufacturing industry. Markov Chain method have also been adopted to determine the optimal inventory with the minimum cost. The first step in this research is to determine the forecast value of demand for July 2020- December 2020 based on time series data in August 2019-June 2020. The calculation results showed that Fourier Series Grey Model (FGM) works better than the original GM(1,1), as evidenced by the better level accuracy of FGM(1,1) which are 9.66% of MAPE and 10.14% of RMSPE, while GM(1,1) gives 18.83% of MAPE and 23.64% of RMSPE. The next step is using time series data in August 2019-June 2020 and FGM forecasting results for inventory planning using Markov Chain Method. The results of the optimal inventory level can reduce the cost by 23%-64% of the company’s current inventory cost.

**Keywords**: Forecasting, Inventory Planning, Grey Model, Fourier Grey Model, Markov Chain

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**13th-ISIEM-Paper 037 – EPD**

**Usability Evaluation And Improvement Design Of Hospital Mobile Website**

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**Abstract.** Siti Aisyah Hospital is one of the public hospitals that has developed online information services through a website. But unfortunately, the website still does not meet several aspects of usability, namely ease of use, ease of learning, and ease of satisfaction. This study aims to improve the mobile website design by considering the usability aspect. The method used is Usability Testing and Heuristic Evaluation. Usability Testing is done by giving 15 respondents several tasks and distributing a USE Questionnaire to assess the current website. The results of the questionnaire show that the three factors still have a value below the middle value, namely 4. Then the Heuristic Evaluation is carried out by giving the questionnaire to 4 experts. The results show that some heuristic variables have a fatal error value called usability catastrophe or the website still has some problems. Then the proposed mobile website is designed according to the existing problems. Then the usability measurement was carried out again on the proposed mobile website using Usability Testing, USE Questionnaire and Heuristic Evaluation. The overall results show that there is a significant increase on the proposed website. The results of the questionnaire show that the four usability factors have a value above 4, while the Heuristic Evaluation questionnaire results show the cosmetic category which means the problem does not affect the user and don't agree which means there is no usability problem.

**Keywords**: mobile website, usability testing, USE Questionnaire, heuristic evaluation

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**13th-ISIEM-Paper 038 – IS**

**Waste Reduction Strategy Design Based on Risk Assessment and Cost Benefit Approach**

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**Abstract.** All kinds of work activities that do not add value along the process flow are waste, one of the concepts that minimize waste to improve performance is lean manufacturing. The company where the research is conducted is a factory that produces SHS sugar, as a company engaged in manufacture, efficiency and effectiveness of production is very important for the company. Waste reduction is one alternative to achieve it. In this research, waste reduction based on...
risk assessment and cost benefit analysis is discussed. Each waste has a root cause that has the impact and potential of events that vary and affect the goal so that it can be called as a risk. This study aims to get a strategy to reduce waste in order to get an effective and efficient production activity. The research begins by identifying waste in value stream mapping, followed by risk assessment and identification of the root cause of waste. There are 10 potential wastes are found with the wet material is root cause of the highest risk: the production stoppage. The proposed strategy from this research is a proposed design for the warehouse and develop a new standard operation procedure for burning raw materials and make a form for recording the submission of change of load and flow of the submission process. The outcome of this proposed strategy potentially can reduce the cost of loss approximately Rp 39.067.221,38.

**Keywords**: Lean manufacturing, risk analysis, benefit cost analysis, asset management, waste, sugar factory

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**13th-ISIEM-Paper 040 – DAIS**

**E-Commerce Application of Oil Palm Fresh Fruit Bunches Supply Chain**
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**Abstract**: The use of smartphone technology for social activities has a good effect on e-commerce activities, and many Indonesians have taken advantage of this technology. With this opportunity, the authors designed an e-commerce application for buying and selling oil palm fresh fruit bunches used by independent smallholders, traders, factories, and transportation. This application is intended to use a unified modeling language and the programming language Javascript MySQL database. This application can provide information on the availability of oil palm harvests advertised by farmers in this application. The application is also able to facilitate transactions, whether done by Cash Only Delivery or via transfer. This application is also enabled with the provider of selected or recommended palm fresh fruit bunches. There are recommendations for the availability of oil palm fresh fruit bunches by entering the value of needs for traders and mills. Then the system will display a map of the location points of the suppliers of oil palm fresh fruit bunches. Visual information on providers is also shown. The results of system testing have been able to carry out the design plan.

**Keywords**: E-commerce 1, Application 2, Fresh Fruit bunches 3, Palm oil 4.

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**13th-ISIEM-Paper 041 – PS**

**Design Model Forecasting and Delivery Requirement Planning for Fast Food Product**
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**Abstract**: PT. IKI is a company engaged in the culinary field with its main product being fried chicken, has a problem in its logistics activities, the first problem is the overstock in the stock of its chicken products which causes large storage costs, and the second problem is scheduling the distribution of its products that are not orderly so as to cause the delivery process to be less effective. See the problems that have occurred, this research was carried out to get the best forecasting model, then applied the Distribution Requirements Planning (DRP) method to distribute chicken products as optimally as possible. The research was conducted by doing forecasting by combining Multiple Neural Networks (MNN), Seasonal Naive Bayes (SNB), and ARIMA to obtain a forecasting model that is close to actual conditions in the field. The forecast results are used to determine Safety Stock, ROP, and lot sizing with FOQ for the distribution schedule with the DRP method. The results showed determination of forecasting by combining MNN, SNB, and ARIMA can balance the level of product inventory at the optimal amount and DRP method positively impacted a 25% reduction in distribution costs.

**Keywords**: Logistic, MNN, SNB, ARIMA, DRP

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**13th-ISIEM-Paper 042 – EPD**

**Comparative Analysis of Mental Workloads For Disruption Technicians And New Installation Technicians Using The NASA-TLX Method (Case Study: PT Telkom Akses Kandatel Sleman)**
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Abstract. PT Telkom Akses is a subsidiary of PT Telkom Indonesia that is engaged in providing construction services and managing network infrastructure. In this study, the mental workload measurement process was carried out on the disturbance technicians and the new installation technicians who were part of PT Telkom Akses Kandatel Sleman. Testing is done because it remembers the technician’s work, which involves humans’ physical and mental nature. The average mental workload value for disturbed technicians is 54.88 (high), and the average mental workload for new installation technicians is 34 (rather high). The difference between the average mental workload for the disrupted technician and the new installation technician can be caused by several factors, including the type of work, the level of difficulty of the job, the length of work, working time, and the influence of the work environment. It is necessary to provide recommendations to reduce each technician’s mental workload. These recommendations include adjusting tasks to technicians’ available work time, conducting work evaluations every month to reduce the risk of high mental workloads, providing education to employees and technicians about the importance of mental workload and work stress, and providing opportunities for technicians to carry out regular medical check-ups.

Keywords: Mental Workload, NASA-TLX, Distraction Technician, New Installation Technician

13th-ISIEM-Paper 043 – DAIS
Warehouse Management Analysis with Value Stream Mapping and 5S to Improve Efficiency Process Productivity
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Abstract. In meeting the needs of production demand, the warehouse is the heart of its services and is one of the strategic functions in reducing costs in the company, warehouse operations such as picking, storage, account for the largest cost of around 50-70% in its activities. With case studies on manufacturing companies in the oil and energy sector that aim to improve warehouse operational efficiency, initial data obtained from warehouse process problems at this company are warehouse operations, visual control, and work culture. By proposing a lean warehouse method with the concept of VSM, 5S uses waste analysis, which is carried out in the warehouse operation process, visualizes a future improvement, the result is a decrease in operating time activity by measuring loading-unloading activities by 31%, receiving 30%, and storage 22%. In the daily warehouse operational process, the results were 15%, Put Away 32%, and Picking 32%, with an average decrease in the added value of 27% and an average added value of 41%, as well as a better work culture change in terms of 5S.

Keywords: warehouse, VSM, 5S.

13th-ISIEM-Paper 044 – IS
Increasing Consumer Satisfaction and Loyalty with Product Innovation, E-Commerce and Reward Factors
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Abstract. The increasing number of emerging new micro and small food industry creates competition become more stringent and try new strategy idea in marketing. The purpose of the research is to analyze the influence of product innovation, e-commerce and reward on the satisfaction and loyalty of consumer mochi product in DKI Jakarta and West Java with Partial Least Square method using SmartPLS 3.0. Product innovation, e-commerce and reward have a significant positive effect with a moderate effect on consumer satisfaction and consumer satisfaction has a significant positive effect with a large effect on consumer loyalty of mochi product in DKI Jakarta and West Java. From the analysis, improvement and strategy to increase the number of sales of mochi product in DKI Jakarta and West Java based on the product innovation variable. Improvements made from indicators of variations in product flavor and size. Mochi product innovation with a strategy of developing in product flavor variation became the choice of most respondents to implement. The results of the implementation of this strategy have proven to be able to increase sales at one of the mochi product manufacturers in 9 months (Sept 2020-May 2021). The sales percentage increase to 31% from the previous year.

Keywords: Product Innovation, E-commerce, Reward, Consumer Satisfaction, Consumer Loyalty, PLS.
13th-ISIEM-Paper 045 – PS
The Smart Factory Model for Bogie Assembly Workshop in the Rolling Stock Industry
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Abstract. A rolling stock industry in Indonesia has been facing the problem of delays in delivering trainsets. One of the
delays came from the bogie assembling workstation, which was caused by unprepared work information and material
availability on the production shop floor. The proposed solution was to develop the Smart Factory that utilizes Internet of
Things (IoT), sensors and connectivity between departments within industry. The model consists of hardware such as
single board computer (SBC), RFID and QR-Code reader to read the information in shop floor. The data is sent and
stored to the database to be processed into decisions for other organizational units. Data is transferred using the internet
network and IoT devices. The model has specific User Interface that built in single board computer of Smart Factory. The
prototype of Smart Factory Model has been built in the laboratory scale. The simulation of the prototype showed that
the model could present the data precisely. The product structure model was used to create the material model which required
for production. Therefore, the operators worked based on the real time data from the material model.
Keywords: Production Systems, Smart Factory, IoT, Sensor, Bogie Assembly

13th-ISIEM-Paper 046 – DAIS
Implementation of Artificial Intelligence in Improving The Quality of Service System in Telecommunications Industry
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Abstract. Artificial Intelligence is a technology that can improve the quality of a product to meet consumer desires and
increase efficiency in a business process. The purpose of this study is to describe the development of artificial intelligence
implementation in the telecommunications industry. The method used in this research is by reviewing feasible journals
having been published and have a relationship with the things being studied. The result of this research is the
implementation of artificial intelligence for the telecommunication industry in terms of network is massive Machine-Type
Communication (MTC) which can connect up to one million devices in an area of 1 km². Implementation of AI in terms of
Human-Computer Interaction (HCI) is body gestures detector. The implementation of AI in terms of Billing & Contracts is
Call Detail Records (CDR) system that used for an effective and accurate billing system. AI is used to predict customer
needs in sales marketing, as well as improve automation of devices such as robotics and digital assistants to minimize or
optimize the workforce. In addition, the application of AI in terms of macro and regulation is an ORE (Open Source
Risk Engine) system used to identify all factors and conduct Monte Carlo simulations.
Keywords: Artificial Intelligence, Implementation, Review, Telecommunication.

13th-ISIEM-Paper 048 – QM
Production Quality Improvement Through Six Sigma: A Crude Palm Oil Industry Case Application
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Abstract. A Crude Palm Oil (CPO) industry needs quality control and assurance to win the competition. In reality, there
are products that do not meet the company standards. It can be seen from the measurement of several indicators that
exist in this CPO industry such as Free Fatty Acid (FFA) level, moisture and dirt level. FFA content in CPO production
often exceeds the standard level which can decrease CPO quality. The maximum FFA level in each CPO production is
3.5%. This research is done to control CPO quality, analyse the proportion of defects and production process capability,
analyse potential failure and identify the root cause of defects. Quality control analysis is done using SIPOC, CTQ,
variable control analysis and cause effects diagram. The result shows that the sigma value is 2.3. The sigma value
indicates that the industry is at less competitive condition. A production quality improvement plan then developed using 5W+1H. While from the control, the results of quality improvement are carried out by controlling mechanism.

**Keywords:** Crude Palm Oil (CPO), Free Fatty Acid (FFA), Quality Control, DMAIC

### 13th-ISIEM-Paper 049 – IS

**Strategy Designed toward Performance Improvement of Asset Management System**

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**Abstract.** Today, organizations face various severe challenges in maintaining their performance as well as providing value and benefit for their stakeholders. Especially for capital investment organizations. UPT. XYZ is a workshop unit under PT. ABC is responsible for performing locomotive maintenance. In regard to this special responsibility, UPT. XYZ has a high value of the asset within their organization. Therefore, an asset management maturity assessment is needed to determine the level of asset management maturity in the company. In this study, the ISO 55001: 2014 Self-Assessment Methodology Plus (SAM+) Tools is used to determine the level of maturity of the company's asset management in the 6 classes studied, and risk analysis is carried out in order to minimize the risk in asset management. From the results of this study, the overall results of the level of asset management amounted to 2.57 or in the category of development. Then in this study, a risk mitigation strategy is given for each root problem obtained from a root cause analysis using the Fault Tree Analysis of the 7 biggest risk events found and has a major effect on the benefit of asset management.

**Keywords:** Asset Management, Asset Management Maturity Assessment, Risk Management, Fault Tree Analysis

### 13th-ISIEM-Paper 050 – PS

**Development of Operation Scheduling Systems at Workstations with the Autonomous Distributed Manufacturing Systems (ADiMS) Concept**

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**Abstract.** Effective scheduling can result in improvements in many aspects in the production system. The system design focused on autonomous production elements that can independently distribute the workload of each elements. It can be achieved by combination of scheduling concepts, Autonomous Distributed Manufacturing Systems (ADiMS), Configurable Virtual Workstations (CVWS), Message Queuing Telemetry Transport (MQTT), and databases. The process of scheduling operations is done by giving autonomy to each production elements, distributing scheduling tasks to production elements, and coordinating the results of scheduling decisions according to the characteristics of the ADiMS concept that in line with Industry 4.0 concept. A software prototype for scheduling operations has been developed that quickly generate production scheduling from the product order, this system has the potential to answer the problem of scheduling operations at the job shop type workstation and further development can create a system that can provide rescheduling and schedule maintenance.

**Keywords:** Industry 4.0, Autonomous Distributed Manufacturing Systems (ADiMS), Configurable Virtual Workstation (CVWS), online scheduling.

### 13th-ISIEM-Paper 051 – QM

**Design and Implementation of Quality Metric Using Internal Control Method for Quality Control of Pertamina SPBU Digitization Project (Case Study PT XYZ)**

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**Abstract.** PT. XYZ is a company engaged in the field of telecommunications construction services. In this study case, XYZ assigned to execute the Pertamina SPBU Digitization project covering construction work, civil work, integration, and maintenance. The work was carried out at 89 gas station sites that were included in the West Bandung Witel work area coverage. In the project work process, there were many mistakes during civil work and integration carried out by a third-party vendor. After analyzing the cause of the error, it is known at the planning stage of PT. Telkom Akses does not do a
quality management plan that produces quality metrics. Lack of quality metrics in this project causes third-party vendors not to have project work guidelines that are specified with standard specifications. Project activities that do not have a clear quality plan can result in low-quality control that will have an impact on the quality of the project fulfill to the standard. Hence, this has an impact on longer project schedules and project costs increase. Therefore, in this study, a quality metric was designed as a tool in measuring the performance of a project using the internal control method. The results of the study show that with the help of the quality control method that is quality metric, helping the project achieve quality standards and track the progress of each activity so that the project runs according to a predetermined plan. The result of the study obtained 60 verified critical success criteria. Of the overall critical success criteria, there are 37 critical success criteria that have an OK value, 23 critical success criteria that are valued at NOK and no criterial success criteria are valued at N/A.

**Keywords:** Digitization, Quality Metric, Internal Control, Project, Control Quality

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**13th-ISIEM-Paper 052 – DAIS**

**Determination of Performance Ranking of MSMEs using Simple Additive Weighting Approach**

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**Abstract.** Determining the best choice among many alternatives is sometimes quite complicated, especially if it involves many decision criteria. This research was conducted in an Indonesian state-owned institution that provides capital assistance and guidance to MSME partners with the intention to help them grow. These MSMEs are grouped into clusters which limit the loan amount and the repayment period. This institution desired to get preference of which MSMEs that allowed to apply for a cluster upgrade, which means higher loan amount and longer repayment period. They prefer that only MSMEs with satisfying performance can apply for cluster upgrade. Therefore, they wanted to rank their 891 MSME partners from best to worst of performance wise. The Simple Additive Weighting (SAW) approach with the Linear Scale Transformation (Max) normalization method is used to find the performance rating of each MSME. Performance is measured by the increase of sales, assets, and labor. The total value from SAW then sorted to establish the best-to-worst performance list. The list would help the institution to decide whether the certain MSME is allowed to apply for cluster upgrade. By knowing which MSME has the best performance, the institution can continue their research to get the appropriate coaching method and policy to help their MSME partners to grow.

**Keywords:** MSME, Simple Additive Weighting, Performance rating, Max Normalization.

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**13th-ISIEM-Paper 053 – IS**

**Sustainability Index Measurement for Furniture Manufacture Strategy**

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**Abstract.** The development and improvement of the timber industry, especially furniture in Indonesia, significantly helps the construction of infrastructure in Indonesia. The involvement of sustainability in Sustainable Development Goals (SDGs) shows great concern for irreplaceable natural resources. Research Objectives measure the numerical value of sustainability and its influence on alternative corporate strategies from furniture companies. The research methodology is done by formulating strategies and measurements with sustainable mathematic models. First, the formulation of IFE-EFE Matrix strategy, SWOT analysis and Quantitative Strategic Planning Matrix (QSPM) assessment resulted in Grow and Build Strategy. Next is to design a sustainable index based on Ibrahim Garbie Triple Bottom Line (2017) namely environment, social, and economy by generating 17 KPIs out of 26 available KPIs. The measurement result can be taken into consideration of determining policies to improve the performance Overall Sustainability Index of 1.182. The company needs 1.182 times more effort than it has done now if the company wants to remain a sustainable company.

**Keywords:** Wood Industry, Sustainability Index, SWOT, Social, Environment, Economic.

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**13th-ISIEM-Paper 054 – EPD**

**Analysis of Quality Preferences for Cassava Chips Products**

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Abstract. Micro businesses are very developed today, with a wide variety of products that are produced and sold, such as food products, beverages, handicrafts, clothing, and others. However, the problems that occur in the Home Industry are not optimal in producing processed food products, one of which is cassava chips. The purpose of this study was to determine the differences in the position of the quality attributes of cassava chips based on the distribution of product samples, to determine the level of consumer desire and need for cassava chip products based on the results of the selection of cassava chips. sample of chips products and development of cassava chips using the Quality Function Deployment (QFD) method. The method used in this research is the Quality Function Deployment (QFD) method. The conclusion of this research is that the cassava chip products X, Y and Z have different advantages and consumer desires regarding the priority characteristics of the cassava chip product are the distinctive taste of the product, the aroma of the product is fragrant, the taste is diverse, and the price is cheap. The results of product development for the three types of products also vary according to product development needs.

Keyword: cassava chips, ukm, product development, quality function deployment, QFD

13th-ISIEM-Paper 055 – PS
Application of the Lean Method in Designing Layout of 4.0 Rubber and Plastic Manufacturing Plants
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Abstract. Today, the global competitive environment has greatly been impacting on industrial manufacturing companies in general and the plastic - rubber manufacturing industry in particular. They are facing requirements and challenges in improving productivity, quality and competitiveness to meet the needs of customers. Therefore, these companies need to build factories with not only flexible but also efficient production systems to create a closed life cycle for products from production to recycling. The purpose of this study is to present an approach to optimize plant layout design based on LPS theory incorporating 4.0 technology. One of these most important and beneficial goals is "Do-right-at-the-first-time" through a lean plant design using various methods of Lean, IoT, CPS, Bigdata, AR / VR, Cloud computing and visualization through 3D Sketchup simulation software. The results of this paper provide an overall model of a factory that integrates many aspects of layout, material flows, value flows, and relationship between people, machines as well as tools. An optimal design in the direction of mutual support will be built. From there, we can minimize the inefficiencies in production reality and bring strict management with the product life cycle that they create with existing IoT technologies.

Keywords: Lean production, industry 4.0, layout design.

13th-ISIEM-Paper 056 – IECS
The Effect of Problem Based Learning Method to Student Online Learning Performance During Covid-19
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Abstract. Covid 19 in early year of 2020 bought many impacts especially on academic setting. To minimize the spread of virus, Government in many countries prohibits onsite learning and suggests using distance learning. The learning method using internet communication can be use several ways. The research aims to investigate the problem-based learning or PBL to virtual class during pandemic. Mostly PBL were used in direct teaching or onsite where the student must visit the class along with the facilitator. The method begins with individual student assessment, developing teamwork, sharing case study, group assessment and problem-solving presentation. The full step of PBL implementation is discussed further includes the assessment. This research also gives student and also teacher hope that complex thinking still archive during pandemic and also solution for student or teacher who has low internet connection and difficult signal. PBL give more flexible time for learner and also teacher, more comfortable way to learn complex case and also less effort. The research shows that PBL could increase student comprehension give more flexibility in understanding the lesson but using student as center point of view.

Keywords: PBL, covid-19, online learning, problem-based learning, pandemic

13th-ISIEM-Paper 057 – IECS
Online Business System Design and Business Finance of Islamic Boarding School X Turmeric Powder in Selaawi
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Abstract. Islamic Boarding School X is a company that offers turmeric powder. Islamic Boarding School X also provides a website that can be used to introduce its products to consumers. As a new business idea, this research is about how business design and business feasibility analysis in terms of market, technical and financial aspects, as well as sensitivity analysis for several related variables and risk analysis. Based on the research that has been done, the NPV (Net Present Value) value is Rp255,006,001, the IRR (Interest Rate of Return) value is 37.68%, and the PBP (Payback Period) is for 2 years and 9 months. Based on the NPV value obtained, it is positive and the IRR value exceeds the MARR (Minimum Attractive Rate of Return) value of 9.95%. So it can be concluded that this business is feasible to run. The results of the sensitivity analysis show that this business is sensitive to an increase in raw material costs and a decrease in selling prices. So, it can be concluded that this business is feasible to run. The results of the sensitivity analysis show that this business is sensitive to an increase in raw material prices, labor costs, demand, and a decrease in selling prices.

Keywords: Business Design, Feasibility Analysis, NPV, IRR, PBP.

13th-ISIEM-Paper 058 – IS
Design of Conceptual Models for Comparison Analysis Between Conventional Methods And MCP Methods Based on Productivity and Logistic Performance in Cooperative X
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Abstract. The effort of the Cooperative X in improving the quality of milk at this time is by collaborating with Frisian Flag by building a technology-based Cooperative Collecting Point (TPK MCP). Not all TPK in Cooperative X became TPK MCP. There are differences between the TPK non-MCP and the TPK MCP, starting from the system for determining the price of milk and the business process there are gaps. In addition, there are still complaints from MPI to the cooperatives, it is necessary to analyze the logistics performance of the two TPK. Production, Cooperative still cannot meet the demand for milk from MPI. From these problems, it is necessary to analyze the non-MCP and MCP TPK based on Productivity, Logistic Performance and Milk Supply Business Processes. In order to make it easier to analyze, it is necessary to formulate a conceptual model. The design of this model is carried out by a method, namely by identifying the problem, reviewing literature, analyzing and compiling the model. However, in this research, analysis of the milk supply business process has not been carried out, so further research is still needed so that all problems in Cooperative can be resolved.

Keywords: Conceptual Model, Productivity, Logistics Performance.

13th-ISIEM-Paper 059 – PS
Waste Identification Using Value Stream Mapping in the Pig Launcher Production Process
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Abstract. Pig Launcher is an oil and gas pipe cleaning product produced by PT Farrel Internusa Pratama. Based on preliminary research, it is known that the Pig Launcher production process is still experiencing several problems, including a decrease in the amount of production due to excess lead time and defect. The purpose of this study is to identify the waste that occurs and propose some improvements using the lean manufacturing method. One of the lean tools used is Value Stream Mapping (VSM). Current State VSM is drawn to map the start of the value stream from the start to the end of production to its current state. Then an Activity Mapping Process is made to determine the type of waste that occurs. Based on the results of the Current State Value Stream Mapping, the total lead time is 65.17 hours and the Process Cycle Efficiency (PCE) value is 25%. While the percentage of activity obtained from the Process Activity Mapping of the production process at value added was 37.5%, non-value added was 25%, and necessary but non-value added was 37.5%. The types of waste identified are waiting, transportation, inappropriate processing waste, and underutilized people. Then some improvements are proposed based on the five types of waste. Proposed improvements include combining repetitive transportation activities, maintenance, organizing operator training and creating standard operating procedures.

Keywords: Lean manufacturing, Value Stream Mapping, waste, Process Activity Mapping.
13th-ISIEM-Paper 060 – EPD
Ergonomic Design Improvement of Plastic-Waste Processing Machine Based on Posture Analysis
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Abstract. Indonesia, as one of the world’s largest population countries, is facing several population-related problems, one of which is an emerging plastic-waste issue. It is predicted that plastic-waste in Indonesia continues to increase by at least 10% every year if not managed properly. A plastic-waste processing machine is, therefore, designed for chopping and melting plastic-waste in an integrated system. However, operators often suffer from pain when operating the machine for its unergonomic design. An analysis using NBM and RULA method, hence, is needed so that working postures complained by the operators can be identified and assessed in order to design a more ergonomic Creatics 2.0 machine using CATIA software and based on anthropometric data. After analyzing and redesigning Creatics, there are several size differences between the new and preceding versions of Creatics in order to create a more ergonomic design of the machine. so that it can reduce the risk that is on the Creatics.

Keywords: anthropometric, norder body map, rapid upper limb assessment

13th-ISIEM-Paper 061 – IS
Framework of Service Quality Evaluation in Supply Chain Management Using Integration of SERVQUAL, Kano and QFD in Cigarette Company XYZ: A Literature Review
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Abstract. Service quality is one of the essential values in Supply Chain Management (SCM). One of the elements from SCM is retailers. Both in principle and in practice, retailers must receive a good quality service from the producers so that the retailers then would not switch to other producers. The same system also applies to SCM practices in cigarette companies. As the largest tax contributor in Indonesia, cigarette companies certainly have a lot of demand which in one way or another has an impact on the large number of retailers needed with the objective that, for example, the consumers can enjoy the company’s cigarette products with utmost satisfaction. A lack of evaluation of service quality in cigarette companies can lead the retailers’ complaints. This research methodology is Systematic Literature Review (SLR). Objective of this present study is to provide an applicative framework for evaluating and improving service quality with integrate SERVQUAL, Kano and QFD methods. Besides, this integration of methods helped the researchers qualify analyses and also weighed in on the attributes that will be prioritized for improvement. In conclusion, cigarette companies must evaluate and improve service quality to build a good working relationship between the producer and the retailers.

Keywords: SCM, SERVQUAL, Kano, QFD, Cigarette Company

13th-ISIEM-Paper 062 – IS
Block Layout for Stationery Store Using Data-driven and Market Basket Analysis
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Abstract. Stationery stores are retail stores that sell all kinds of necessary office and school equipment, such as writing paper, envelopes, paint, musical instruments, etc. The problem in this store is that consumers are still looking for the goods to buy, and the goods are not arranged neatly. This increases the chance of consumers not buying other desired products because the structure of these products is unclear and invisible. On this basis, it is necessary to redesign the layout based on the existing transaction data of consumers. This article uses a data-driven method based on data basket technology, which is a data mining technology that can identify the strength of association between paired products purchased together, and can identify when two or more things happen at the same time co-occurrence model. The goal is to develop an effective analysis method to solve the actual stationery layout based on consumer behaviour. According to the calculation results, the market shopping basket analysis method determines that the products that are allowed to be purchased on an impulse are school stationery, drawing tools and painting tools, and these products prove that they have the minimum mutual influence specified threshold. Then, by using the activity diagram to identify the proximity level between all the paired product categories, the suggested layout is generated. Therefore, these suggested layouts can
greatly help the store obtain greater sales growth from the highest sales, and can help sell music products with media and decorative categories.

**Keywords:** Market-Basket Analysis, Activity-Relationship Chart, Stationery Store

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**13th-ISIEM-Paper 064 – OR**

**Determining the Location of Temporary Landfills with Simultaneous Set Covering Model**

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**Abstract.** The average amount of waste produced by the city of Yogyakarta reaches 260 tons per day. The volume of waste produced by the Ngasem-Gading sector (a sector in Yogyakarta City) exceeds the available temporary landfills' capacity. The volume of waste per day generated by households and markets is 293.76 m\(^3\), while temporary landfills' capacity is 189 m\(^3\). This study aims to determine the capacity of temporary landfills in accommodating waste sources with a simultaneous approach. The first step to address this inequality is location screening, which identifies facilities that can be enlarged and looking for new possible locations. The next step is to optimize using a set covering problem model by considering the capacity, type of facility, and area using pure integer non-linear programming (PINLP). From the processing results, it is obtained that it is sufficient to operate 13 of the 21 available facilities, with details of maintaining 5 old facilities, expanding 7 facilities, and opening 1 new facility. The total capacity of the 13 facilities is 315.18 m\(^3\) so it is expected to be able to accommodate sources of waste from the community and markets in the Ngasem-Gading Sector.

**Keywords:** temporary landfill, set covering problem, pure integer non linear programming

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**13th-ISIEM-Paper 065 – IECS**

**Design of Website and Web-Based Information System User Interface of PT XYZ with Human Centered Design Method**

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**Abstract.** Human-Centered Design method is a method of developing and designing user-centered systems based on user needs. Users tend to have difficulty in accessing information in the website and using the information system, it is a problem that is quite important because the website and information system become useless as it should be. The initial stage in this method is observation, which aims to find and better understand the problems that users face during testing, in order to know if the design provided can make it easier for users to use them. Testing will be conducted by assigning the user the task of interacting with the website prototype. After testing the user directly, the test results are obtained when the user uses the website and information system, the user feels the website and information system are quite understandable and easy to use. Responsive features were also added to make users feel helped when using websites across multiple platforms.

**Keywords:** User Interface, Human Centered Design, Website, Information System

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**13th-ISIEM-Paper 066 – DAIS**

**Clustering the Micro, Small and Medium Enterprises (MSMEs) in Yogyakarta City based on Technology Readiness Index 2.0 using K-Means Method**

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**Abstract.** MSMEs as one of the economic drivers and have important role in local economic growth. As pandemic condition that came in 2019, technology become an essential part of activities. If pandemic condition is continuing, MSMEs have to adopt the technology. In Yogyakarta city, there are many MSMEs that came from various backgrounds. But the segmentation of MSMEs' technology readiness has not been examined. This research took sample of the MSMEs in the Yogyakarta city. The purpose of this research was to clustering the MSMEs with Technology Readiness Index (TRI) 2.0. The methodology used is a survey of 180 MSMEs in the fields of food processing and clothing convections. The clustering was computed with K-Means algorithm in R software. The cluster of MSMEs based on five groups (explorers, pioneers, skeptics, paranoids, and laggards) from TRI's user segmentations. The results of the clustering were found only two groups from the sample and the groups were pioneers and skeptics. The number sample in the pioneers group was
59% and the skeptics was 41%. The pioneers have positive and little negative perceptions about using technology. The skeptics didn’t oppose technology but have low enthusiasm.

**Keywords:** Technology Readiness Index (TRI), K-Means clustering, Micro, Small and Medium Enterprises (MSMEs), technology readiness segmentation

### 13th-ISIEM-Paper 067 – QM

**Analysis of the Relationship between Composite Board Thickness and Its Ability to Muffle Sounds**

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**Abstract.** The environmental problems faced today are becoming more complex and dilemmatic. It encourages concern for the environment and energy to be very important. This increased awareness can be realized by using materials derived from waste. Waste can be classified into organic and inorganic. The test samples were fabricated from organic and inorganic waste which is called a composite board. Composite board was made from sawdust, coconut husk, and paper which are classified as organic waste, and styrofoam or inorganic waste. The objective of the study was to determine a difference in the damping ability of composite board. It was made with different thicknesses, such as 1, 2, and 2.5 cm. The results of the one-way analysis of variance (Anova) showed that there was no significant difference in the damping ability of composite board with a thickness of 1 cm, 2 cm, and 2.5 cm at a frequency of 125 Hz, 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, and 4,000 Hz.

**Keywords:** Anova, composite board, damping, organic and inorganic waste

### 13th-ISIEM-Paper 068 – QM

**Assessment for Technical Disruption Priority of Facilities By Used DMAIC Approach With FMEA Tool For Commuter Electric Train**

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**Abstract.** The main objective of this paper is to determine the performance of the KRL Komuter maintenance system at the Depok depot. The approach used is DMAIC to identify the main causes of failure to repair the maintenance process with a Failure Mode and Effects Analysis (FMEA). The research has identified the main factors that have caused the disruption of the electric trains handled by Depo Depok namely 1) The high level of disturbances that occur without prior warning, 2) The unavailability of spare parts, 3) The decrease of operational capability of component, 4) The deviation of the repair and maintenance activities compared to the SOP, and 5) The lack of knowledge and work experience of the technicians, in particular the new ones. In general, it has been found that the main cause of the disruption of the commuter trains are the failure of the propulsion system, both concerning the electrical and mechanical parts. Therefore, this research has suggested that improvement should be done mainly in the propulsion maintenance including a better compliance to the maintenance procedure/manual, a better spare parts availability in the depo, and a more adequate technicians in terms of numbers and skill.

**Keywords:** Transportation, commuter train; maintenance; quality improvement, DMAIC

### 13th-ISIEM-Paper 069 – IS

**An Evaluation of the Production Risk of Broilers Day Old Chicks in the Hatchery Unit using Z Score and Value at Risk**

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**Abstract.** Broilers are one of the growing livestock commodities; however, broiler farming is a high-risk business. Researchers have conducted a risk analysis related to broiler farming, but there has been no research on the specific
analysis of day-old chicken (DOC) production. DOC matters in mitigating the risk of broiler cultivation. This study aims to identify risks in the DOC hatchery unit and provide risk mitigation recommendations. This study uses the Z score method to determine the type of failure and value at risk for risk mapping. The results got seven production risks, namely infertile (59.52%), unhatched (22.39%), crack egg (4.90%), miss egg (4.43%), explode (4.20%), cull chick (3.17%), and damaged egg (1.39%). A review of DOC business processes in the hatchery unit shows that the risk mostly comes from external to the hatchery unit (66%). Mapping risk using value at risk results in two risks with high impact and high probability - infertile and unhatched egg. The infertile risk control recommendations are implementing SOP at the farm, checking temperature, and ensuring regular egg rotation. The risk of unhatched eggs is controlled by ensuring workers work carefully in the egg transfer process and use tools to avoid collisions.

Keywords: day old chicken, DOC, risk, hatchery unit, broiler, value at risk, Z score

13th-ISIEM-Paper 070 – QM

Actor-Objectives Analysis in Technology Transfer Systems in Agricultural Technology Parks Using MACTOR Analysis
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Abstract. The research aims to identify the actors involved in the technology transfer system in Agriculture technopark and analyze the potential of alliances or conflicts to achieve the goals. The analysis was carried out through a survey methodology. Data were obtained through interviews using questionnaires and focus group discussions on a group of informants selected according to specific criteria. MACTOR analysis is used to analyze the relationship between actors and actors-goals in technology transfer in ATP. The analysis results show that the actors playing a dominant role are the local government, the ATP manager, partner farmer groups, and researchers/extension workers. The four chief actors have the potential for an alliance to achieve system goals. Otherwise, actors such as universities, startups, and suppliers have the opportunity to cause several dreams to become divergent due to differences in interests. To conclude, the involvement of actors in the ATP technology transfer system is very much dominated by several actors in the driving subsystem, whereas the support subsystem is passive. The balance of the power of the actors will be obtained if the driving subsystem reduces its dominance by establishing mutually beneficial partnerships with actors in the supporting subsystem.

Keywords: actor analysis, Agro-technopark, MACTOR analysis

13th-ISIEM-Paper 071 – QM

Improving Capacity and Production Quality of The Footwear Industry: A Case Study of Binh Tien Company Limited, Vietnam
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Abstract. The introduction and implementation of suitable methods have had a notable impact on many manufacturing enterprises. By using the techniques of productivity enhancement and quality management tools, productivity has been increased by 50% in cutting step, the percentage of defect products is reduced by 5.1. Productivity and quality improvements in the two production areas in the rubber factory have been carried out. Time studying, labor measurement, standardization of employee motion and movements have been implemented. Analysis, finding the cause and proposing solutions to fix the defective product rate effectively improve productivity and quality. The research results have brought a high-productivity operating method and a way to control defect rate in order to reduce costs and increase competitiveness for businesses.

Keywords: Production, Capacity, Quality, Time Study, 5S
13th-ISIEM-Paper 073 – PS
Lean Manufacturing Implementation Strategy in The Pharmaceutical Industry Production Processes: A VSM And AHP Approach
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Abstract. Green Manufacturing is a new movement in the industrial world to minimize waste and gas emissions resulting from the production process or often called the zero-emission strategy. In the production process, the pharmaceutical industry cannot be separated from waste. The purpose of this research is to reduce the waste that occurs in the production process by using the lean manufacturing concept. The method used in describing the flow of material and information flow in this study is to use Value Stream Mapping (VSM). In addition, to obtain a better waste reduction strategy, the Analytical Hierarchy Process (AHP) method is used. The results showed that the activity that does not provide added value most often occurs in the filling process with a cycle time of 56241 seconds. The largest contribution that causes waste is the Human criterion with a weight of 0.465. The alternative strategy that can be obtained is to conduct training or training on lean manufacturing. Based on the alternative strategy chosen, it can reduce the cycle time in the filling process to 27839 seconds. This research can be a starting point for implementing Green Manufacturing in other industries.

Keywords: AHP, pharmaceutical industry, lean manufacturing, strategy, waste, VSM

13th-ISIEM-Paper 074 – SCM
A Conceptual Modelling of Digital Contract for Independent Palm Oil Supply Chain Systems
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Abstract. This study aims to develop conceptual models of digital contract management for the independent smallholder oil palm agro-industrial supply chain performance system. Current limitations on price transparency among the palm agro-industry supply chain actors result in large disparities in the profits of the actors in the independent supply chain network. Another problem is the significant difference between the prices set bi-weekly by the government and those received by independent smallholders which range from 15% up to 50% during last two years observation. The method for this study (1) starts with a gap analysis, (2) develops business process analysis using BPMN and (3) designs system requirements using UML. The results obtained from this research will (1) bridge the price transparency between the actors in the independent palm oil supply chain, (2) make contract management more transparent, (3) increase the partnership of farmers, cooperatives and palm oil mills to ensure equality of independent palm oil supply chain actors from upstream to downstream.

Keywords: System Modelling, Digital Contracts, Business Process, Independent Palm Oil Supply Chains

13th-ISIEM-Paper 075 – SCM
Data Mining Based Framework For Identification and Disaster Risk Assessment in The Supply Chain
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Abstract. This paper discusses the identification of disaster risks that occur in Jambi Province based on disaster data and various types of disasters. The disaster risk index is obtained from the potential hazard, vulnerability, and risk capacity of the area. From the distribution of the risk index, each region can be linked with supply chain activities so that it can be identified and mitigated so as to reduce the impact on supply chain activities. The identified risk index is then integrated with the framework so that evaluation and mitigation be carried out properly. In analyzing and mapping disaster risk in this paper the Data Mining method is used. It was found that from the 10 types of disasters, there are 8 (80%) who have a high-risk index, namely (1) floods, (2) flash floods, (3) extreme weather, (4) earthquake, (5) forest and land fires, (6) drought, (7) volcano eruption, and (8) landslide, and there are 2 (20%) that have a medium risk index, namely (9) epidemic
and disease outbreaks and (10) extreme and abrasion waves. This paper aims to improve the performance of a data mining-based framework for identifying, assessing, and mitigating various forms of disaster hazards in the supply chain activities.

**Keywords:** Data Mining, Mitigation, Risks, Supply Chain

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**13th-ISIEM-Paper 076 – IS**

**Brand Awareness Building Through Social Media (Facebook and Instagram) (case study: GianTree Startup)**

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**Abstract.** Building brand awareness is a fundamental step in introducing a new product to gain customers. GianTree – a newly founded startup in 2019 produces poultry and fish feed by using sustainable products such as coconut pulp, tofu dregs, and fish flour through fermentation process. As a new product in the market, GianTree aim to build brand awareness in order to reach customers, however in creating brand awareness, they to make one-by-one visits to farmers and fisheries. Therefore, GianTree have not reach their market widely. Today, spreading awareness through marketing on social media is more effective. Thereby, the purpose of this study is to build GianTree brand awareness by doing marketing on social media. This study utilizes Facebook advertisement and by uploading free contents on Instagram. The result of this study showed GianTree brand awareness was successfully built by utilizing social media and also can be known few important things that need to be considered in building brand awareness through Facebook and Instagram.

**Keywords:** brand awareness, Facebook, Instagram, marketing

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**13th-ISIEM-Paper 077 – EPD**

**Usability Testing and Heuristic Evaluation for Improving Usability Registration of Website Hospital**

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**Abstract.** The hospital website is one of the facilities provided by the hospital to make it easier for prospective patients to find information about the hospital. The preliminary research results indicated that the display of the hospital website made users hard to find a doctor's practice schedule. Therefore, this study aimed to measure the usability of the registration of website hospital and provide suggestions for improvements of the website. The analysis and evaluation methods used in this study were usability testing and heuristic evaluation. The results showed that the aspects of usefulness, ease of use and satisfaction were still low. In addition, errors made by users were still high. The results of the heuristic evaluation showed that many aspects had a significant error rate. Suggestions for improvements are to change the website's display, shorten the stages of finding a doctor's practice schedule, and provide a help feature to users. After conducting improvements, the results for the usability testing indicated that users did not make errors at all in looking for a doctor’s practice schedule and task-processing time became shorter than before. Meanwhile, the results for heuristic evaluation indicated that the major error from website after conducting improvements turned into a minor error.

**Keywords:** Usability Testing, Heuristic Evaluation, Registration of Hospital, Website

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**13th-ISIEM-Paper 078 – SCM**

**Optimization Hand Sanitizer Distribution Route to Public Facilities in Palembang City**

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**Abstract.** Since the Covid-19 pandemic was started in Indonesia in March 2020, huge action has been done by the Government including constitutes policies on handling the Coronavirus. One of the important things to prevent being infected with the Coronavirus is to keep the hands sanitized. It can be done either wash using soap or sanitized using hand sanitizer. However, some problems may occur in the distribution of hand sanitizers, such as undirected delivery or waste of transportation distribution costs for delivery. This research aims to determine an optimal distribution route for hand sanitizer to some public facilities in Palembang City, Indonesia as input for the Government in preventing the spread of the virus. The Nearest Neighbour and Sweep algorithm was applied to fulfill the objective of the study. For this study, two public services were set as origin points and 30 public facilities as destination points. The optimal distribution route
result is based on the Nearest Neighbor method with a total distance of 136.56 Km and a total time of 423 minutes, compared to the Sweep algorithm method. By applying the suggested route based on the Nearest Neighbor methods, the total cost is estimated 2.1% less compared to the distribution route on the Sweep algorithm.

Keywords: Distribution problem, Nearest Neighbor, Sweep Algorithm, optimal route.

13th-ISIEM-Paper 079 – QM
Capability Process on Shewhart \( p \) Control Chart and ISRT \( p \) EWMA Control Chart on Shift Drum Production
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Abstract. The common often used control chart on the quality control process is Shewhart Control Chart. However, the Shewhart Control Chart seems to be less sensitive in small shifting on process control. The ISRT \( p \) EWMA Control Chart is proposed to detecting a small shifting, which can be used on the condition for the value of \( np \geq 5 \). The data have been processed and calculated using the Shewhart \( p \) control chart and the ISRT \( p \) EWMA Control Chart using defects on shift drums. When the process has been controlled, then start to calculate the capability process for each control chart. There are two parameters on the ISRT \( p \) EWMA Control Chart, which are \( \lambda \) and \( L \), and the weighted value was given will significantly affect shift detection. From the calculation, it was known that the ISRT \( p \) EWMA Control Chart was better at detecting out-of-control data. The smaller parameter value is given, then the ISRT \( p \) EWMA Control Chart was more sensitive on shifting detection, and the smaller parameter value, then the capability process will decrease. The parameter value of \( \lambda \) is 0.20 and \( L = 2.962 \) is the lowest value to find the capability process larger than 1.00.

Keywords: Shewhart Control Chart, ISRT \( p \) EWMA Control Chart, shifting, capability process

13th-ISIEM-Paper 080 – IS
Key Drivers of Sustainable Maintenance Practices for Automotive Industry
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Abstract. National Automotive Policy (NAP) 2020 has guided Malaysian automotive companies to take into account sustainability initiatives in determining their business strategies. These strategies need to be aligned with the entire organization’s business functions, including maintenance as a critical function to be a sustainable company. This study aimed to investigate what are the main factors that drive Malaysian automotive companies to embed sustainability initiatives in their daily maintenance activities. Seven preliminary key drivers were identified based on previous studies. A survey approach was conducted to validate these drivers by sending the questionnaires to 200 companies with 50.5% complete responses. The results indicated that the corporate’s image was considered as the main driver in implementing Sustainable Maintenance Practices (SMP) for Malaysian automotive companies.

Keywords: key drivers, sustainable maintenance, Malaysian automotive industry, sustainable company

13th-ISIEM-Paper 082 – IECS
Basic Model Simulation for Disaster Evacuation Routes Evaluation using Agent Based Modeling (ABM)
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Abstract. Evaluation of disaster evacuation routes is a key to success in disaster management efforts and strategies, especially in disaster-prone areas such as Indonesia. Ability to evacuate many people in a short time is needed to minimize casualties. Thus, a computational simulation method is needed to assist in making a rescue strategy. Agent-based modelling (ABM) approach makes it possible to know what interactions occur during the evacuation process, both in the form of interactions between individuals and individual interactions with their environment. This study examines the
Abstract. PT.XYZ engages in tire retreating and producing rubber mats. The company operates several machines, i.e., tire crusher and used EPDM Rubber. PT.XYZ has a quality problem, precisely the output of the crusher machine. The crusher machine failed to produce granules in standard size. Crusher machine might need to alter to support optimal production process. The rational product design method used to modify the crusher machine. We proposed to noble granule separator machine (2,7m x 1,5m x 1,25m). The separator will adopt a special filter to confirm the size of granule with the standard.

Keywords: Granule, Crusher Machine, Rational Design Method
Sustainable Product and Service Systems Engineering; this paper elaborates Quantitative Approach, and to some extent ready for the Mixed Methods; in order to arrive at decision making on the best strategy in strategic marketing toward Asians’ Stakeholder. As Conclusion, specific attention is focused on the Strategic Marketing on particular Promotion Table. In addition to that, the conclusion that Future Research is suggested to be constantly updated, in order to adapt to continual Anthropometric of Asians Characteristics. Ultimately, The aforementioned Sustainability is intertwined with multidisciplinary Industrial Engineering (IE), Architecture (ARC) and Product Design Engineering (PDE) on Strategic Marketing (SM).

**Keywords:** Product/Service Systems, Systems Engineering, Strategic Marketing

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**13th-ISIEM-Paper 086 – SCM**

**Analysis of Mercury Lamp Recycling to Implement the Circular Supply Chain**

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**Abstract.** Technological advances have led to an increase in the quantity of waste electrical and electronic devices. Both problems are related to LED bulbs, which are made of glass, metal, plastic, fluorescent powder, and mercury. E-waste is one of the fastest increasing sources of waste, so it is important that the material loop is closed. In the lamp recycling process, a typical 80-90% fraction is in the form of broken glass. In this case, a circular economy aims to involve designing products that are durable and can be reused, repaired, and reproduced; therefore, the transition from a linear to circular economy is essential for a sustainable world. This paper analyzes the mercury-containing lamp recycling process in its result to a circular supply chain. As a result, new layout of mercury lamp production was proposed to increase sustainability and profit.

**Keywords:** lamps recycle, circular economy, closed-loop supply chain, layout.

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**13th-ISIEM-Paper 087 – PS**

**The Mushroom Media Cultivation using Green Productivity Methodology**

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**Abstract.** Industrial development is growing rapidly every year. This requires companies to increase the productivity of the company, especially for mushroom factories. Green productivity is a strategy to increase productivity and preserve the environment and impact social economic development. This research was conducted using the application of the green productivity method to increase the production of mushroom media factories. The main discussion in the mushroom media factory is to accelerate and increase the production of mushrooms. This study aims to apply and implement green productivity methodologies in the mushroom factory industry to overcome and improve existing problems. Green Productivity uses 3 tools related to green productivity, namely material balance, eco mapping. Through the results of material analysis, most of the production waste is wood dust which cannot be reused and also plastic if the mushroom media fails to produce. The production waste is better collected and sold than burned. Through the eco mapping analysis, it is figured out that the area of the milling machine was identified the area of producing the most pieces of wood powder residue. The proposed plant layout using the eco mapping method by considering the factory workflow scheme and the distance between stations. As a result, new lay out design has significantly improved as travel distance decreased if compared with the existing lay out.

**Keywords:** Green Productivity, Material Balance, Plant layout, Mapping

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**13th-ISIEM-Paper 088 – DAIS**

**Decision Support System for Business Location Selection and Economic Feasibility**

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**Abstract.** This study aims to apply and implement green productivity methodologies in the mushroom factory industry to overcome and improve existing problems. Green Productivity uses 3 tools related to green productivity, namely material balance, eco mapping. Through the results of material analysis, most of the production waste is wood dust which cannot be reused and also plastic if the mushroom media fails to produce. The production waste is better collected and sold than burned. Through the eco mapping analysis, it is figured out that the area of the milling machine was identified the area of producing the most pieces of wood powder residue. The proposed plant layout using the eco mapping method by considering the factory workflow scheme and the distance between stations. As a result, new lay out design has significantly improved as travel distance decreased if compared with the existing lay out.

**Keywords:** Green Productivity, Material Balance, Plant layout, Mapping
Abstract. The Decision-making process in the industry holds an important role to maintain an efficient business process and management. This research aims to develop a Decision Support System (DSS) for determining the potential area and analysing the economic feasibility. The DSS was designed using Data Flow Diagram and applied the Analytical Hierarchy Process (AHP), Composite Performance Index (CPI) and economic feasibility analysis (NPV and IRR) to analysed potential business area. The result showed that the DSS has been succeeded to developed and provide an interactive interface and it was verified. The DSS was very useful in the decision-making process for the industry. For further research, it required system implementation and evaluation in the real industry case.

Keywords: Analytical hierarchy process, Composite performance index, Decision support system, Economic feasibility

13th-ISIEM-Paper 089 – IECS

Structural Equation Modelling for IoT and Big Data Implementation in Business Performance
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Abstract. Many arising advancements have been developed and used to promote business performance. This study proposed an IoT (Internet of Things) and Big Data Implementation Model for Business Performance. Past research indicated lack of knowledge on their application impact on business outcomes. From those studies, several factors needed to be considered such 1) Business Process Improvement (BPI), 2) Marketing Strategies (MS), 3) Business Management Innovation (BMI), 4) Business Models and Organizational Culture (BMOC) and 5) Privacy and Ethics (PE). In this paper, a model for applying IoT and Big Data Model to achieve business performance is developed. After conducting a purposive questionnaire to managerial respondents, the PLS-SEM method was conducted using SmartPLS 3 to see whether the model is fit or not. As a result, Goodness of Fit (GoF) is 0.73 larger than required 0.67 then it is confirmed to be robust and accurate. In this model, it found that BMOC influences BPI, BPI influences MS, BMI, and BP. However, it is also interesting to find that PE does not influence BPI and BMI does not influence BP. Therefore, the model can be used as a guidance when implementing IoT and Big Data.

Keywords: IoT, Big Data, PLS-SEM

13th-ISIEM-Paper 091 – SCM

Structure Analysis and Supply Chain Strategy Development for Natural Rubber Production in West Aceh District
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Abstract. Rubber is one of the important commodities in West Aceh. But unfortunately, the rubber harvest has not been handled optimally so that it is often difficult for farmers to earn adequate income. This study was carried out to analyze the structure of supply chain management (SCM) and develop a strategy for developing a sustainable supply chain for natural rubber production in West Aceh District. In general, the problems with rubber SCM in Aceh Barat include that farmers have not experienced adequate benefits and low rubber quality due to un-optimal post-harvest handling. The quality of rubber lump produced by farmers is considered low, so that the price is also low. The age of the plant is also quite old (above 30 years), so that production tend to decreases. The purpose of this study is to analyze the structure of the rubber supply chain, and develop a strategy for developing a sustainable rubber production supply chain. The research conducted is a field survey in West Aceh Regency. The method used for data collection is SWOT analysis by distributing questionnaires, and involving experts from universities and government agency. This research uses descriptive method based on primary and secondary data. Primary data obtained from supply chain conditions and development of rubber production. Secondary data were obtained from related agencies and previous research literature studies. Data analysis was carried out qualitatively using a supply chain management (SCM) approach. The results show that the current supply chain management (SCM) of rubber is in relatively good condition, with several weaknesses. Among strategies that can be used for the development of sustainable rubber production based on a priority scale are establishing a joint pricing mechanism, improving the quality of farmers’ rubber through cultivation training and post-
harvest handling, exploring (mutually beneficial) cooperation between supply chain actors, and (in the long term) rejuvenation of farmers' rubber plants.

**Keywords**: Supply Chain Management (SCM), Natural Rubber, SWOT Method

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**13th-ISIEM-Paper 092 – QM**

**Investigating the Effect of Room Air-Conditioning Temperature on Force Resistance of 3D Printer Hook Using Taguchi Method**

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**Abstract**: With the development of 3D printer technology, industrial zones now can produce much product through the connection of each layer of the material by using a 3D printer. But the lack of interest in the study of the room temperature with the air-conditioning effect on the quality of the product still not receive the attention of scientists especially industrial system engineers. In the present study, the 3D printer hook was used as the imitated object, and the effect of the temperature on the hook was analyzed on force resistance. The setup of the experiments and parameters of the hook was then progressed by Taguchi. Also, based on the experiment results, the Minitab17 software was used to analyze the data. By an inspection of the trend of the force resistance on the hook, indicating that the Nozzle temperature had the most significant effect besides the AC room temperature. The results for the optimal design parameters show a good agreement with the achievement for the best combination of the model on force resistance is P\(_1\) P\(_2\) P\(_3\) P\(_4\) P\(_5\). With the AC room temperature P\(_1\) 1 (18°C), nozzle temperature P\(_2\) 21 (195°C), fan speed P\(_3\) 31 (30%) and the maximum force the hook can be resisted is 85.35 N. The conclusion is drawn about the effects of AC room temperature on force resistance of 3D printing hook then promote the new way for developing the method to apply for controlling the quality of 3D products.

**Keywords**: Taguchi method, 3D printer, Daikin VRV IV, Force resistance.

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**13th-ISIEM-Paper 095 – IECS**

**Exploration of Data Science Expertise in Indonesia: Study Case of Industry in Jakarta Metropolitan Area**

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**Abstract**: The term of “data is the new gold” is commonly used nowadays. To remain competitive in a tight economy, data processing is one of the core elements allowing businesses or organizations to innovate. Consequently, data scientist is nowadays enhanced the most in-demand profession in the industry around the world. Nevertheless, contradict with the high-demand data science careers, in Indonesia there is a shortage of talent in the field. Therefore, the purpose of this research study is to identify the actual condition of qualifications of data scientist in Indonesia. This research was conducted using qualitative method with 15 respondents consist of data scientist in the Jakarta metropolitan area (Jabodetabek). The findings of this study suggest that there are some inadequate qualifications of data scientist in Indonesia. To further our research, we are currently now in the progress of investigating the gap of data scientist qualifications in Indonesia using quantitative research method.

**Keywords**: Data Science, Data scientist, Qualifications.

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**13th-ISIEM-Paper 097 - DAIS**


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**Abstract**: The growth of Information Technology has contributed to the rise in how important it in improving business processes. The increased attention of the IT has an impact also on libraries. The growth of IT has made a significant improvement in library management, especially for the academic library such as school library. Library information system is one of the information systems that can help the library maintain the service level and support the library's accreditation
process. As with any other information system, the problem arises when the LIS is implemented. If the requirement is not met, then the system’s objective is biased. This research implement the user centered requirement engineering in defining the requirements for the library information system. From 5 respondents, it is known that 3 of 5 people find the feature of the library information system is useful. The requirement prioritization is conduct by using the Delphi method. The result shows that after six iterations/rounds, the consensus is obtained. The consensus coefficient is 0.701 means the consensus is high. The validation of the requirement in this research only uses the validation through prototypes. Future research can be done to enhance the process of validation using the approach more quantitative.

**Keywords:** Delphi, High School, Library Information System, Requirement Engineering, User Centered

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**13th-ISIEM-Paper 098 – SCM**

**Reduction of the Bullwhip Effect Using Vendor Managed Inventory Case Study Bottled Drinking Water**

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**Abstract.** OPQ is a producer of bottled drinking water (AMDK) products. One of the obstacles in the OPQ is the significant difference in the amount of demand from existing stock at the distributor and retail level, with changes in orders from the downstream, causing the Bullwhip Effect phenomenon. This study aims (1) to calculate the value of the Bullwhip Effect before and after applying the vendor-managed inventory (VMI) method and (2) to determine the optimal amount of inventory at the distributor and retail level. The research method used is to calculate the value of the bullwhip effect at the distributor and retail levels, and then forecasts the results used to calculate the safety stock, ROP, and the maximum distributor stock. The results showed a bullwhip effect at the distributor and retail levels, and after repairs were made by applying the VMI method, the Bullwhip Effect significantly decreased.

**Keywords:** Bottled Drinking Water, Supply Chain, Vendor Managed Inventory, Bullwhip Effect

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**13th-ISIEM-Paper 099 – IS**

**Analytical Study on Power Supply Company Productivity: A Case Study in Indonesia**

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**Abstract.** Power supply company is a company engaged in electricity and produces electricity. This study aimed to determine the level of productivity index in the company and the ratio that affects. The method used are Analytical Hierarchy Process (AHP), Objective Matrix (OMAX), Traffic light system and Fishbone Diagram. Based on processing, the highest productivity index value was recorded in April 2018 and the lowest value in August 2018. In the analysis with the Traffic light system, it was found that the month was included in the red indicator, the 1st ratio in May and August 2018, while the 2nd ratio occurred in May, August, and October 2018 also March and November 2019. For the 3rd ratio occurred in November and December 2018 and July 2019. And the 4th ratio occurred in August 2018. The combination of the analytical method could elevate the function of decision making in productivity.

**Keywords:** Productivity, Analytical Hierarchy Process (AHP), Objective Matrix (OMAX), Traffic Light System, Fishbone Diagram.

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**13th-ISIEM-Paper 100 – PS**

**Forecasting Product Returns using Artificial Neural Network for Remanufacturing Processes**

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**Abstract.** Driven by resource scarcity, a number of manufacturing industries are implementing remanufacturing processes. The accuracy of forecasting the product returns will affects the decision maker in production planning. This study was conducted in the heavy equipment remanufacturing industry. The product returns observed are the piston pump motor, one of the components of the excavator, as the core to be remanufactured. The Artificial Neural Network (ANN) is used to minimize errors in forecasting core gain. Observations were made based on 30 historical data from the last 30 periods to forecast the acquisition of cores for the next seven periods. Backpropagation is ANN approach used for forecasting. The network architecture consists of 15 network layers, of which layers 2,4,6 and 8 are used for the training processes. The activation function in the hidden layers uses tansig as input and purelin as output. MATLAB is
used to support decision makers in forecasting with the ANN approach. The result shows that the forecasting of core acquisitions for the next seven periods is 10, 16, 17, 10, 9, 16 and 14 respectively. After being compared with the actual core acquisitions, the error rate given by MAPE is 35.65%.

**Keywords:** remanufacturing, forecasting, core, artificial neural network

**13th-ISIEM-Paper 101 – EPD**
Mental Workload Analysis of Workers in the Textile Manufacturing Company during the Covid-19 Pandemic using NASA-TLX
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**Abstract.** The textile industry is one of the sectors affected by the Covid-19 pandemic. Both companies and workers experience uncertainty in their work. Research on workloads in the textile industry needs to be done because the textile industry is a labor-intensive industry that involves many workers in their work activities. However, research on the mental workload of workers during the Covid-19 pandemic has not been carried out. This study aims to evaluate the mental workload of textile industry workers during the pandemic. A state-owned company engaged in the textile industry in Yogyakarta Province is used as a case study. This research uses the Nasa TLX method, which measures six workload dimensions: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration Level. The results show that operators and mechanics have high mental workloads, indicated by an average WWL value of more than 50. The most influential indicator for weaving operators is the OP (Own Performance), with an average WWL of 283.33. In contrast, the indicator for mechanics is the EF (Effort) with a WWL mean of 278.67. The regression and correlation test results show that the length of work for operators and mechanics has a positive effect on the average WWL, while the workers' age has a negative effect on the average WWL. Meanwhile, the one-way ANOVA test shows no significant difference in the average WWL between work shifts.

**Keywords:** mental workload, NASA-TLX, textile manufacturing, Covid-19 Pandemic

**13th-ISIEM-Paper 102 – OR**
Simulation of Two Channels, Single-Phase Queuing System Using Monte Carlo Model in A Government Office
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**Abstract.** Queuing is an activity that must be minimized because it is one factor that affects customer satisfaction. One government office in Yogyakarta that is always visited by the public also has problems related to the queuing system. Many people complain that the queues and the service are too long, even those who have come sometimes cannot be served. The government office then makes a policy to limit the number of services, but without further analysis, whether the system has already optimal or not. A study to evaluate and optimize the queuing system in this government office need to be implemented. The queuing theory with the Monte Carlo simulation model is used in this current study to overcome this problem. Verification and validation tests show that the model made is following the existing system. The results show that the single phase-multi-channel queue system for the operators still has idle time. So, the single phase-single channel queue system is used as the proposed scenario. From the results of the Bonferroni test, it is stated that there is no difference in the average output, which the initial model and proposed scenario influence. Therefore, the results are not significantly different for the single phase-single channel or single phase-multi channel system. Based on these results, it is better to use one server to save costs.

**Keywords:** Queueing system, Simulation, Monte Carlo, Government Office.

**13th-ISIEM-Paper 103 – IECS**
Increasing Utilization of Production Facility Based on Simulation Model Approach at PT.XAX
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**Abstract.** PT. XAX is a company engaged in the production of secondary ingots in the form of aluminum bars. The main problem faced by the company is the low utilization of production facilities, especially for crucible production facilities. The purpose of this research is to find a strategy that can increase the utilization of production facilities based on a system
simulation approach. The method used in this research is discrete simulation using Pro Model software. Based on the simulation, it is known that in order to maximize the utilization of the furnace production facility, the company must increase the utilization of the crucible production facility according to the input requirements for the furnace production facility. Based on the simulation results, it was found that the strategy can increase the utilization of crucible production facilities from 47,16% to 70,71%.

**Keywords:** simulation, Pro Model, utilization of production facility, aluminum bars

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**Abstract.** Due to the limited availability of fossil fuels, it is necessary to look for renewable-based energy sources, as an alternative. One of them, is a bio-briquette made from corn cob. The purpose of this research is to determine the location of bio-briquette plant in Majalengka Regency. This problem needs to be considered carefully, because it will require considerable costs, and because the establishment of the plant is generally planned for a long period of time. Since the selection involving 26 sub-districts as candidates, where each sub-district has different infrastructure and physical environmental conditions, in this study the selection process was conducted using Cluster Analysis Algorithm. The clustering method used in the study was Agglomerative Hierarchical Clustering, and the result shows that the selected sub-districts is Majalengka.

**Keywords:** Majalengka, Bio-briquette, Plant-location, Agglomerative Hierarchical Clustering

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**Abstract.** This paper presents an application of the Eye-Tracking approach to evaluate some kinds of Sports Drinks Advertisement with using a bottle packaging. It is significant because a lot of advertisements involving mankind especially females for attracting customers to buy the drink. The fact brings out an impression to exploit them and not focusing on the product such that occasionally some customer is dissatisfied with the real product. In order to reveal how attractive advertising model should be, five models of advertisements were analyzed are 'Text and the Sports Drink Product' model, 'One Sports Drink and Other Products' model, 'A Lot of Sports Drink Products' model, 'One Sports Drink and One Different Product' model, and 'Single Sports Drink Product' model on basis fixation time and heat map parameter through Eye-Tracking. Forty experienced respondents in consuming the drink have participated with ages between 19-25 years old. Statistical analysis was conducted to test the hypothesis. The result of this study shows the 'Single Sports Drink Product' advertisement has the highest average fixation time (5.08 seconds) and the heat map is a red spot as the area of the primary interest to the user. This model is valid to be the best attractive advertisement.

**Keywords:** Eye Tracking, Fixation Time, Heat Map, Sports Drink, Advertisement

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**Abstract.** Machinery is one form of the physical assets of the company PT. Hamdan Jaya Makmur that must be properly maintained in order to always full-fill its function in carrying out operational activities. Some of the aims of this research are to determine the value of performance maintenance, evaluating machines that are experiencing poor maintenance performance, and creating maintenance intervals using Reliability Centered Maintenance (RCM) II method. The research results found that the Miyano CNC Lathe Machine has the lowest performance maintenance, with MTTF 20669.93 minutes and MTTR 56.30 minutes. The inspection time interval for the automatic tool changer component was carried
out every 0.554 times/month with time interval 955 hours after the last examination with MTTF 2820.01 minutes and MTTR 10.76 minutes with a maintenance time of 30 minutes. The memory component is carried out every 0.905 times/month with an interval 519 hours after the last examination with MTTF 6614.72 minutes and MTTR 10.24 minutes with an average maintenance time of 25 minutes. The relay unit component is carried out every 1,116 times/month with an interval 401 hours after the last examination with MTTF 6899.4 minutes and MTTR 18.66 minutes with an average maintenance time of 35 minutes.

**Keywords:** maintenance, performance maintenance, reliability centered maintenance, RCM II, MTTF, MTTR.

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### 13th-ISIEM-Paper 108 – QM

**Quality Improvement on Pipe Production Using Six Sigma and Data Mining in PT. FIP**

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**Abstract.** PT.FIP is an industrial company engaged in manufacturing oil and gas pipelines. PT FIP wants to reduce the product defect percentage by more than 6% in the welding process. This research aims to improve the product quality using Six Sigma and Data Mining also DMAIC (Define, Measure, Analyze, Improve, and Control) approach. At the Define stage, SIPOC (Supplier-Input-Process-Output-Customer) diagram was used to determine CTQ (Critical to Quality) resulted 4 CTQs, namely porosity, hot crack, undercut, distortion. At the measuring stage, the sigma level is 3.54, still, needs to be improved. At the analysis stage, 80% of product defects are dominated by porosity and undercut. Another defect, the hot crack was identified using Ishikawa Diagram and FMEA (Failure Mode and Effect Analysis). The highest Risk Priority Number (RPN) is porosity caused by a failure in welding conditions and humid pipes, and hot crack is the most significant defect. There is a QC PASS decision standardization with the IF-THEN Rule function from Classification and Regression Tree (CART) at the Improve stage. The improvement was made by applying the welding area cleaning form. After the improvement, the sigma level increase to 3.60.

**Keywords:** DMAIC (Define, Measure, Analyze, Improve, Control), FMEA (Failure Mode and Effect Analysis), CART (Classification and Regression Tree), six sigma, data mining

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### 13th-ISIEM-Paper 109 – DAIS

**Hospitality Food and Beverage Production with ERP System Using Odoo and Rapid Application Development (RAD) Method**

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**Abstract.** The development of the hospitality tourism sector in Indonesia requires the hotel business, especially in XYZ hotels, to improve, apart from managing the existing hotel's lodging service provision system. The need for a planning system to support food and beverage production in hotels is one of the important things to provide satisfaction to customers, both hotel guests and customers outside of hotel guests. The Food and Beverage Department (FnB) is a department that supports operations in processing to serving food and beverages. They have complete responsibility for production activities based on ordering menus and events at the hotel, namely ala-carte and table de'hote. This research focuses on designing a food and beverage production system for managing ala-carte and table de'hote in ERP-based hotels with the Odoo module manufacturing system using the Rapid Application Development (RAD) method. The results of this research are in the form of a system design as a solution needed to support the smooth operation of the FnB department to automate the production planning of table de'hote and production on ala-carte sales. The scheduling, monitoring of production materials selects quality raw materials for star hotels in stores, purchases requests, and produces reports for XYZ hotels.

**Keywords:** Information Systems, ERP Odoo, Food and Beverage Hospitality System. Manufacturing System, Rapid Application Development (RAD).
13th-ISIEM-Paper 110 – IECS
Sustainable Product Design Engineering in Industry 4.0: Civilian and Military Drones vis-à-vis Digital Transformation
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Abstract. This research elaborates outcome of both theoretical and empirical implementation of Sustainable Product Design Engineering vis-à-vis Drones within Civilian and Military Scopes. As background information, the common aspects consist of 3D Printing Technology and Big Data. The principal purpose of the study is to articulate the role of Product Design Engineering on Drones in Digital Transformation. The Scope of this research refers to drones with remote sensing technology, known as unmanned robots of unmanned aerial vehicle (UAV) and unmanned surface vehicle (USV). In term of methodology, this research capitalizes quantitative approach. This study emphasizes the most important study result in term on the wide spectrum of drones using Vertical Take Off Landing (VTOL), in which Product Design Engineering (PDE) is its centre stage of this study. Precisely, the most important study result of this research refers to the Digital Transformation using simulation strategy based upon simulation software. Nowadays, The Digital Era has opened wider implementation of Drones in both Civilian and Military Perspectives. Precisely, as conclusion from last decade and incoming years, drones are not merely used in military warfare and military defense, but also in wide array of civilian for the benefit of humankind, in the following, but not limited vis-à-vis individual hobby, community purpose, company’s delivery ways, disaster prevention and aid, including medical purpose and surveillance.

Keywords: Product Design Engineering, Drones, Digital Transformation, Industry 4.0

13th-ISIEM-Paper 111 – IECS
Application of Machine Learning Algorithms on the Multi-feature Multi-classification Problem - in the Case of a Hydraulic System
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Abstract. Nowadays, the complex machinery system is getting more complex due to its structure and components. Identifying the status of components so that the proper maintenance can be arranged in advance has become an essential and challenging issue. In order to find a more suitable algorithm to solve the multi-feature multi-classification problem, this paper takes the fault diagnosis of a complex hydraulic system as an example. Three Machine Learning algorithms, such as Decision Tree (DT), Support Vector Machine (SVM) and Artificial Neural Network (ANN), are used for fault diagnosis, and the results are compared and analyzed. There are many kinds of fault diagnosis problems in this cooling and filtering hydraulic system. The minimum characteristic number is 17, the maximum characteristic number is 1,326, the minimum classification number is 3, and the maximum classification number is 144. Among the three algorithms, the DT algorithm has the best overall performance and the most stable performance. In addition, artificial neural networks provide an excellent performance when fewer features are used.

Keywords: Machine Learning Algorithm, Complex Hydraulic System, Fault Diagnosis, Multi classification problem.

13th-ISIEM-Paper 112 – EPD
Designing Persuasive Technology Applications to Solve Human Behavior Problems: Enhancing Better Lifestyle On Millennials
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Abstract. Diverse and dynamic human behavior makes us often encounter behavior problems that can have negative impacts on ourselves and the environment. Sometimes people have to change their behavior in order to avoid or anticipate a problem caused by their behavior. An effective and efficient persuasion with the assistance of technology would facilitate this behavior change. Therefore, this study aims to develop and apply a persuasive technology approach to facilitate users in changing their behavior from current behavior problems into behavior goals. This study uses a persuasive design approach to facilitate behavior change and a rich experience design approach that can generate a positive UX by harnessing negative emotion. The design method of this study consists of project planning, data gathering, developing
design alternatives, design prototyping, and design evaluation. This study applies the method to address two behavior problems related to the millennials lifestyle. The first behavior problem is poor patterns of diet, sleep, and physical activity that cause the high number of obese millennials. To solve the problem, this study produces an app design that aims to monitor and provide personalized recommendations for the user's diet, sleep, and physical activity patterns according to their historical data and preferences in order to increase their motivation and ability to have a healthy lifestyle. The second behavior problem is poor financial management and literacy of millennials that cause the financial failures. To solve the second problem, this study produces an app design that aims to provide personalized suggestions and challenges for individual financial management and education. This study contributes to developing a design method to solve behavior problems and some apps to solve relevant lifestyle problems on millennials.

**Keywords:** Behavior Change, Mobile Application, Persuasive Technology, Product Design, User Experience

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**Ergonomic Risk Analysis of Tofu Cutting Process at Raimin's Small and Medium Enterprise**

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**Abstract.** The food industry is one of the industries that will continue to exist because it is related to basic human needs. UMKM Raimin is one of the food processing industries, namely tofu production. Currently the tofu production process is carried out manually by relying on the abilities and skills of workers, from the beginning to the end of production. Thus, the most dominant factor affecting work performance is the workers themselves. The aim of this study was to analyze the working conditions from an ergonomic point of view. Initial research using the Nordic Body Map found several complaints on several parts of the worker's body after carrying out activities on the production floor. The highest complaints were on the left shoulder, waist, back, upper and lower arms, lower neck, and left and right wrists. The purpose of this study is to determine the ergonomic risks to the work system and what recommendations are needed for improvement. The analytical tools used are the Nordic Body Map (NBM), Rapid Whole Body Assessment (REBA), Workplace Ergonomic Risk Assessment (WERA) and Heart Rate (HR). The REBA calculation result of the tofu cutting process is 12 (very high risk). The WERA score is 37 (moderate risk). The results of energy calculations based on HR measurements show that the energy required is 6.34 kcal / minute (classified as moderate work). Thus it can be concluded that corrective action needs to be done as soon as possible, so that workers are safer and more comfortable. The end goal is to improve the performance of the tofu production process.

**Keywords:** ergonomic, risk factor, tofu, REBA, WERA, HR

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**Simulation based Facility Location Modelling in A Sustainable Closed-Loop Supply Chain Network**

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**Abstract.** This paper studies a facility location problem within a closed-loop supply chain framework using discrete-event simulation. The growing pressure on the environmental impact from consumers, governments, and non-governmental organisations has led companies to take responsibility in product recovery processes. This paper integrates CO2 emission as one of the environment considerations into the simulation model. The aim of this paper is to find the best configurations of locating collection centres that will minimise both total logistical costs and total emissions. Three scenarios were proposed to simulate on finding the best collection centres' location. Preliminary experiments were conducted using Exeter city geographical area. The results show that Scenario Two produces the lowest total costs as well as total emissions. Future research directions are also highlighted.

**Keywords:** simulation, location problems, closed-loop supply chain, CO2 emissions.
13th-ISIEM-Paper 115 – OR
Multiobjective Heterogeneous Vehicle Routing Problem with Multi-Trips in Urban Logistics Context
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Abstract. Urbanization level is predicted will be increase to 68% by 2050. This lead many business opportunities and opening of potential market. However, this demand growth may cause an additional problem on current and future urban freight transportation. There are many problems related to urban freight transportation. Various city logistics scheme has been promoted and implemented to cope with these problems. The vehicle routing problem can be used as primary tools for assessing various kinds of city logistics initiatives. One of the objectives to optimize the route of vehicles in the city is to reduce congestion. Vehicle routing problem with multi-trip is appropriate in city logistics because it can make the higher utilization of the small vehicle usage. Many vehicle routing problems with multi-trip in the literature do not explicitly tackling the congestion. In this paper, we develop multiobjective vehicle routing problem with multi-trips in urban logistics context where the objectives are to minimize the total transportation cost and the total congestion cost. We use the Volume-to-Capacity Ratio to express the congestion level of customer location. The result shows that model can assign small vehicle to more congested customer location while large vehicle is assigned to deliver to less congested customer.  
Keywords: Vehicle Routing Problem, Multi-Trips, V/C Ratio, Urban Logistics

13th-ISIEM-Paper 116 – QM
Utilizing Integrated Performance Measurement System and Analytical Hierarchy Process for Competitive Advantage
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Abstract. The business unit strategy's design with a performance measuring approach is a study that is motivated by a decrease in turnover from 2015 to the present. Therefore, the researcher wants to make the basis of developing the problem to be examined with the desired achievement in the form of a performance measurement plan and business strategy by looking for strengths, weaknesses, opportunities, and threats. In this case, the performance measurement uses the Integrated Performance Measurement System method so that internal and external factors of the company will be obtained by accessing company performance, company finance, human resources, market segmentation, regional economic factors, technology, demographics, and political and government law to obtain SWOT matrix which is useful for design strategy. From the performance measurements obtained, the performance measurements with the leadership value are 2.02, and employees are 6.79, and customers are 2.01 at scale 10.  
Keywords: Analytical Hierarchy Process, External Internal Matrix, Integrated Performance Measurement System, Objective Matrix.

13th-ISIEM-Paper 117 – IECS
Designing Marketing Information System for Coconut Derivative Products in Padang Pariaman
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Abstract. Coconut is one of the commodities to focus on for national strategic advantage commodities. In West Sumatera, the coconut plantations are centered in Padang Pariaman, which later supports the growth of the coconut agroindustry in this area. However, the coconut farmers faced several challenges: the price and profit disparity between farmers and other business actors due to the long value chain and the insufficient marketing effort. To solve those problems, we used E-Commerce, a modern marketing strategy that utilizes the internet and connects the farmers directly to the consumers. In this study, we created E-Commerce for coconut commodities using the System Development Life Cycle (SDLC) method and PHP programming language. We designed a B2B and B2C marketplace for coconut and coconut commodities that let the farmers and Small Medium Enterprises (SMEs) sell their products directly to consumers and boost their marketing with online promotion. Using this system will shorten the value chain and increase the farmers’ marketing effort.  
Keywords: marketing information system, coconut products, e-commerce
13th-ISIEM-Paper 118 – SCM

Supply Chain Design by Developing Causal Loop Diagram for Patchouli Oil Business
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Abstract. Currently, Indonesia has not met the demand for patchouli oil globally, while patchouli oil is produced from various regions in Indonesia. For this reason, it is necessary to identify the problems that occur. Supply chain identification is an initial step that can be done to find issues that arise from the whole system. This study aims to identify the activities of the patchouli oil business by using Causal Loop Diagram. Furthermore, building a supply chain based on the activities carried out by the patchouli oil business. Based on the actors involved in the patchouli oil supply, the system will be divided into five subsystems. The supply chain model for patchouli oil is divided into three models. The third model is considered to be more effective and efficient because it only involves two actors. However, this supply chain model has problems because farmers' patchouli oil often does not meet exporters' quality. From this research, the unfulfilled demand is due to the low quality of the patchouli oil produced. For the exporters' demand to be fulfilled, the supply of patchouli oil quality and quantity from farmers must be sufficient.

Keywords: patchouli oil, supply chain, causal loop diagram.

13th-ISIEM-Paper 120 – DAIS

Clustering on Small and Medium Scale Manufacturing Industry in Jakarta using Fuzzy Cluster Means
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Abstract. As the backbone of the national economy, the competitiveness of small and medium scale industries (SMI) needs to be continuously improved. The purpose of this research is to determine industrial clusters and their locations to optimize optimal competitiveness. Industrial clusters were defined using the Fuzzy Cluster means (FCM) method, which involves eight criteria. Meanwhile, the right location for each type of industry was determined by using the zero-one integer programming method that considering ten criteria. The results indicate an increase in the competitiveness of SMIs from the previous low category to the medium category.

Keywords: Small and medium scale industries, clustering, competitiveness, Fuzzy Cluster Means, optimizing

13th-ISIEM-Paper 121 – SCM

Sustainable Supply Chain Analysis and Risk Prevention Business Process Using House of Risk Model
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Abstract. Establishing a sustainable industry is a very important goal for leather tanning companies in Indonesia. The production of leather products has continued to increase over the past five years and the government regulations for the industry to use resources sustainably requires companies to improve their achievements in implementing environmentally friendly systems and measuring the risk of waste that has been generated so that the system will be sustainable for all aspects of all business activities. Therefore, leather tanning companies need to pay attention to the risks that can impact the continuity of their sustainable production systems. The objectives of this study are to identify risks, develop prevention strategies, and monitor the risks in the supply chain for leather production. This study uses the SCOR method to describe the activities in the supply chain for leather production and also to identify risk events and risk agents. Then, using the HOR method, risk events are prioritized and a prevention strategy is developed. In this study, 22 risk agents were selected which is formulated and produces 7 possible preventive actions. And a monitoring system is also designed to facilitate monitoring, so it would be easier to supervise the risks.

Keywords: SCOR, HOR, Risk, Prevention, Monitoring.
Proposed Development Process to Improve Customer Quality of Service with Fuzzy-Servqual and Data Mining Methods in Insurance Agency

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Abstract. This study aims to measure and analyze customer satisfaction with the services provided by OV Agency agents. The data used in the study are questionnaires filled by 100 random customers from OV Agency. The data mining with the Classification-Decision Tree algorithm was used to determine hidden patterns by a decision tree. The results of the calculation of the overall GAP value on the Fuzzy-ServQual method are -0.008 and there are 10 attributes that require improvement. Decision trees are used to assess the environmental impact change from each transformation, Indonesia.

Keywords: Service Quality, Fuzzy-ServQual, Data Mining, Classification-Decision Tree

Optimization of Capacitated Vehicle Routing Problems for Basic Needs of Urban Logistics - The Case of The City of Bandung

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Abstract. The increasing number of residents of the city of Bandung Indonesia will also increase the household needs of the population. XYZ is a private company that supplies the basic needs of city residents through 68 retail outlets spread throughout the city. To meet the needs of all retailers, vehicle assignments are carried out randomly where vehicle capacity, departure schedules and routes are still ignored. As a result, the total distribution costs increase and attention to the urban logistics environment is neglected. The first step to solve this problem is to perform retail clustering using the sweep algorithm. This step tries to find the shortest distance for the vehicle routing problem. The second, the placement of satellite warehouses in each cluster uses the Covering Problems approach which considers the demand in each cluster and the capacity of vehicles allowed in the city. So that the density of goods transportation can be reduced. The third is to choose the shortest route in each cluster. The approach used in the last step is the nearest neighbor and the Genetic Algorithm, respectively. This study resulted in 10 retail groups supported by 10 vehicles with a total mileage of 244.6 km where these results provide an efficiency of 74% from the existing conditions. Meanwhile, total distribution costs can be saved by 65%.

Keywords: retail, covering problem, nearest neighbor, genetic algorithm

Evaluation of Service Transformation during COVID-19 Pandemic: A Case Study at DISPENDUKCAPIL Surabaya

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Abstract. COVID-19 pandemic causes devastating impacts globally, including Surabaya. One of the significant impacts is that the increasing number of death cases, forcing every activity to comply with the health protocol for people safety. DISPENDUKCAPIL Surabaya (City Council for Civil Registration) faces the condition of increasing demand for the death certificate while the health protocol is obliged. To overcome this condition, DISPENDUKCAPIL transforms their service system from KLAMPID to KLAMPID COVID and the latest one into KLAMPID ONLINE. These transformations intend to reduce the crowd and direct human contact by shifting the activity into online activity. These transformations are proven in reducing transportation and human contact, however, increasing electricity and internet consumption. This study tries to assess the environmental impact change from each transformation. The SimaPro software calculation results for KLAMPID, KLAMPID COVID-offline submission, KLAMPID COVID-online submission, KLAMPID ONLINE-offline submission, and KLAMPID ONLINE-online submission generate 77.67 mPt, 169.31 mPt, 153.69 mPt, 61.74 mPt, and
54.53 mPt of environmental impact. It shows that there’s an environmental impact jump during the KLAMPIID COVID system because of the COVID-19 pandemic even though there is a reduction in transportation and paper use.

**Keywords:** COVID-19, health protocol, DISPENDUKCAPIL Surabaya, death certificate, system transformation, environmental impact

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### 13th-ISIEM-Paper 125 – DAIS

**Deep Walk and PCA Based Conceptual Model of Sustainable Packaging Design**

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**Abstract.** One of the issues that are closely related to packaging is the issue of sustainability. The sustainability of packaging design is associated with the visual design and packaging materials that designers will choose in designing packaging functions and properties. The inexpensive nature of sustainable packaging makes designers one of the entities that act as decision-makers regarding the cost of packaging innovation must have a broad perspective on creativity for design and have a visionary focus in optimizing the sustainable packaging industry. Therefore, this paper aims to analyze the design of a knowledge-based sustainable packaging development system by predicting terms of packaging design concept using the Deepwalk and PCA methods. The knowledge framework is explored by analyzing the word selection recommendation process from consumer opinion as an alternative word prediction model for sustainable packaging design. The breadth and depth of knowledge of packaging designers are obtained by knowing how to extract consumer opinion sentences for the concept of sustainable packaging. The method of developing knowledge graph, and the embedding and classification of words using Deepwalk, is described by a case study of the term "packaging." The words obtained are then visualized with a semantic map based on eigenvectors. Principal component analysis by PCA is then used as a method of determining the single term from the case study term "packaging." Based on the knowledge graph and the method stages that the author compiled, it can be concluded that the words that can represent the target path for identity development or the concept of the term "packaging" are the terms "recycling," and "sustainable."

**Keywords:** Sustainable packaging, Conceptual-model, knowledge graph, Deepwalk, PCA

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### 13th-ISIEM-Paper 126 – IS

**Evaluation Performance of Online Learning in Indonesian Higher Education Institution During Pandemic Covid-19**

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**Abstract.** Related to the Covid-19 pandemic in Indonesia which was an impact on the transformation of learning methods in higher education institutions (HEI) from conventional learning methods to online learning methods. The transformation process will be able to affect the performance. The purpose of this study is to evaluate the performance of online learning during the Covid-19 pandemic which is determined from the student satisfaction of the performance of educational institutions, especially in the industrial engineering master program. HEISQUAL and IPA methods are used to measure the level of service quality and to find out the dimensions that need to improve. The gap between importance and performance is reflected in students' satisfaction. A survey was distributed to 1760 student populations all around the Indonesia area. The survey was conducted over one month and received 114 responses. All of the items in this questionnaire had determined by SPSS. The result shows that one item on the competence dimension and two items support facilities dimension are perceived to be quite low. One item on the competence dimension is students do not understand the material presented by the lecturer during online learning. While two items on support facilities related to the e-learning program still experienced problems during the exam and the speed in overcoming the problems of the e-learning program. Conclusions and recommendations are then made to improve the service quality of HEI in the transformation of digital education

**Keywords:** HEISQUAL, Importance Performance Analysis, Service Quality, Higher Education Institution.
13th-ISIEM-Paper 127 – IS
Opportunity and Challenge for Small Wind Power Project in Indonesia
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Abstract. This paper address the opportunity and challenge of small grid projects, especially in funding and convincing investors. The investment in wind turbines is significant and requires funding from financial institutions. The problem for conventional financial institutions is the risk of repayment, so they need collateral for the loans given. The aims of this paper is an endeavor to uncover the opportunity and challenge of small grid wind turbine. Most of the wind turbine installations are in remote areas spread along the north and south coast of Java, eastern Madura, northern and southern Sulawesi and parts of Nusa Tenggara. SWOT Analysis is used to define the situation for small wind power project. This paper highlight the result of the analysis: (Strength) Wind energy is a clean energy source that is widely available, especially in islands and offshore areas. (Weakness) Funding difficulties for wind turbine projects, especially for small-scale. (Opportunity) New technologies to increase efficiency in Small Scale Wind Turbines. (Threat) Future policy regarding incentives and support for IPP and small-scale wind turbine installations. It is recommended to search alternative funding scheme beside the conventional including Peer-to-Peer Lending with its various forms. In addition the new technology for Turbines efficiency should be adopted in order to reach the economy feasibility.

Keywords: Micro Generators; Financing; SMEs Project Planning; Wind Energy; Small Turbines.

13th-ISIEM-Paper 128 – IS
Investigating Student Anxiety Factors among International Student (Case Study: Indonesian Private University)
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Abstract. Anxiety and depression rate for undergraduate student increase every year in Indonesia. Indonesian citizen was charged to be included as Government National Insurance (BPJS) however they don’t cover for any mental problem tuition. They assume the mental issue is not important thing that need to be fixed or rather to see a professional help. This problem which occurred in the university level should be placed as the highest note for top level. However the severe anxiety will lead to worse academic performance and it will open the young generation mental health problem for instance depression and suicide. In this research, the factors that trigger anxiety will be explored especially in International student from Indonesian University. The method is distributing a questionnaire taken from Vitasari works about student anxiety. The findings are most of the student feel anxious in taking exam, understanding math subjects, facing too many different roommates at dormitory, and parent’s disappointment related to academic performance. After investigating the factor, the university will explore the suitable treatment or policy to reduce the anxiety.

Keywords: PBL, covid-19, online learning, problem-based learning, pandemic

13th-ISIEM-Paper 129 – IS
Designing Risk Response from Qualitative Analysis, A Strategy to Avoid the Project Failure (Case Study: Coffee Plant Construction Project)
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Abstract. Risks has an impact on the project's productivity, performance, quality and cost limits. Therefore, risk needs to be managed with risk management plan. The objective of risk management is to recognize risks in a project and develop strategies to reduce or even avoid them, on the other hand to find ways to maximize opportunities. Due to uncover the previous business process, Company X is going to build the new factory to coffee processing. Since the project has not been started, it is recommended to produce risk management plan in earlier stage of project. The process used in this research is identifying risk, performance qualitative risk analysis, and risk response plan, according to PMBOK 6 edition. In this research, WBS is used as input to identify risk which is processed into risk register and thereafter becomes probability and impact matrix. It is necessary to know the response or action that can be done. The result obtained from this research is risk register for coffee plant construction project which earned more than 43 risk. There are only 2 risks which sit on red level (high risk) and 3 risk which sit on orange level (medium risk). The most dangerous risk within this project is Project permit to start the work order has not been issued yet, wrong estimation on project budgeting. The first
dangerous risk is triggered by poor stakeholder management plan while the second risk is triggered by poor site survey. 
The medium risks are commonly triggered by quality issue thus quality metric is suggested as risk response.

**Keywords:** PBL, covid-19, online learning, problem-based learning, pandemic

**13th-ISIEM-Paper 130 – IS**

*Risk Assessment Design and Risk Mitigation in The Telecommunication Network Infrastructure Project (Case Study of Migration Project)*

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**Abstract.** PT. HIJ is one of the partners of the company of a one telco company in Indonesia, that is engaged in network construction as a service and material provider. As a company that has been handling network construction projects for 17 years, one of the projects handled by PT. HIJ is a Copper to Fiber Migration Project in the West Java area network.

Such that, it is known, in a network construction project has several risks that cause an impact on the completion of the project. Qualitative risk analysis is used in the research, with two main activities; risk assessment and risk mitigation. The process of knowing what risks are faced certainly requires a process risk assessment. The results of the risk assessment that has been identified further will be developed into risk mitigation, namely actions that can reduce the risk that has been identified. As the result, the research found 7 risk aspects, namely: Sales Aspects, Financial and Accountig Aspects, Human Resource Aspects, Law Aspects, Information System Aspects, Operational Aspects, and Engineering Aspects. From the risk assessment, then found out that from 7 aspects, there is 15 risk profile, that can be categorized based on risk level, there are 2 in a low level of risk, 2 in a moderate level of risk, 5 in a high level of risk, and 6 in an extreme level of risk.

As the final result, the research suggests the risk mitigation be implemented for 5 risks in a high level of risk and 6 risks in an extreme level of risk.

**Keywords:** network construction project, risk assessment, risk mitigation, risk level

**13th-ISIEM-Paper 131 – EPD**

*New Area of Food Packaging Design Research: A Systematic Review*

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**Abstract.** Packaging is a means of marketing communication used to attract consumer attention and influence the product selection process. Packaging design has become critical in recent decades due to many packaging options available that offer various cost and time reduction. Until now, research on the packaging is quite popular among researchers. Mapping was carried out to determine the research results on packaging design using Bibliometric analysis by looking at related topics among the 82 papers. The systematic review found that, first, in terms of research themes regarding packaging design, packaging design based on materials design is the most widely used theme for packaging design research. Second, the choice of quantitative method dominates empirical papers on packaging design studies. Third, most packaging design studies are conducted in developed countries, with the main study’s food industry. Fourth, based on the results of social network analysis using bibliometric techniques, they can be grouped into four research themes: packaging design development, packaging design issue, package design influence, and package design analysis. This study suggests a future research agenda such as elaborating on the theoretical and methodological aspects of the research

**Keywords:** Package Design, bibliometric technique, network analysis, systematic review.

**13th-ISIEM-Paper 132**

*Effect of Exposure Time And Elevated Temperature On Plain Concrete*

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**Abstract.** Fires are always known for seriously deteriorating concrete in structures; the concrete material in structures is likely to be exposed to elevated temperatures during fires. The objective of this study is to determine the effect of different
exposure temperatures and times on normal concrete. The research described in this paper was to evaluate the changes in the physical and mechanical properties of concrete exposed to the effect of high temperature. The same design formula was used for all the samples; water-cement ratio w/c = 0.55, and the slump value = 130 mm. Cylinders with a diameter of 100 mm and a height of 200 mm were used as concrete specimens, which were tested at the four elevated temperatures of 150, 300, 450, and 600°C for times 3 and 4 h. It was found from the experimental results that the temperature of exposure is the main contributor to the decrease in the weight and compressive strength of concrete and the exposure time has little effect. The predicted temperature distributions agree well with the experimental results. Finally, the compressive behaviors of concrete after high temperatures were established.

**Keywords:** Temperature; Concrete; Compressive Strength; Mode of failure.

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**13th-ISIEM-Paper 133**

**Strengthening of Cylinders Concrete Confined with Glass-Reinforced Polymer**

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**Abstract.** External strengthening with Fibre Reinforced Polymers (FRP) has been growing in recent years for strengthening and retrofitting of concrete and steel structures. Most of the studies focused on high-strength concretes, and research on FRP-confined low-strength concrete has been extremely limited. Hence, an endeavor has been made to examine the compressive behavior of concrete specimens (cylinders) strengthened with FRP. This study exemplifies the results of an experimental investigation on the behavior of axially loaded concrete wrapped with glass fiber reinforced polymer (GFRP) compared with unconfined concrete strength in the range of 25 MPa. Totally ten cylinders specimens were fabricated and tested under axial compression load. Two specimens were retained as control specimens and the remaining eight specimens were wrapping used GFRP fabrics strips. This study investigated three variables included full confined wrapped, spacing, and orientation of GFRP strips was examined. The result of this investigation indicates that the gain in compressive strength varied between 30.80 % and 41.40 %. In addition to ease of application, the compressive strength of GFRP-confined concrete was enhanced in all strengthening parameters indicating that strengthening of concrete using GFRP strips is an effective process, thus helping to reduce life cycle costs.

**Keywords:** Glass, Fibre Reinforced Polymer, Ultimate load, Confined, Strengthening

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**13th-ISIEM-Paper 134**

**Glass Fiber as Reinforcement In Cement Mortar for The Repair of Plain Concrete Members**

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**Abstract.** Maintenance and rehabilitation of concrete structures have become a very significant section of the activities of concrete manufacture. Concrete structures, such as beams, slabs, and columns may require maintenance or repair during their service life. Different repair materials are available, and it is usually difficult to choose the best ones, especially when considering the cost of such materials. This paper presents information that arises from a large project on the evaluation of the performance and durability of repair materials being carried out at the civil engineering materials unit, University of Bani Waleed. Because proprietary compounds are relatively expensive and because the life cost of a repaired structure is also potentially very high, there is much need to provide engineers and specifiers with independent data with which to make appropriate decisions in this field. The results of an experimental investigation of patch repair materials on plain concrete prisms were presented in this paper. Glass fiber-reinforced mortar with different mechanical properties mix produced in the lab was used in the study. Prisms were repaired using different glass fiber reinforcement percentages. The experimental work included assessment of the flexural strength of the repaired plain concrete prisms; the test results showed that all the fiber-reinforced mortar performed well in restoring the strength of the repaired plain concrete. The compatibility of the repaired reinforced mortar with substrate concrete was also found to be significant.

**Keywords:** Repair materials, Rehabilitation, Retrofitting, Glass fiber.
13th-ISIEM-Paper 135
Construction Waste Quantification and Benchmarking in Libya
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Abstract. One of the main sources of environmental pollution is the construction industry. The implementation of waste minimization program relies heavily on estimates of amount of construction waste. In the assessment of potential for waste reduction, it is important to have projection of construction waste amount. Quantified measurements expressed in numerical terms provide the foundation for decision-making in minimizing waste generated. It is thus possible to attain a better comprehension of generation of construction waste, in terms of sources and causes. Insufficient benchmarking would challenge the implantation of environmental-friendly practices in the industry. This research’s aim is to set up benchmarks on construction waste generation rate in Bani Walid city, Libya based on suitable approach of waste quantification. For the purpose of this investigation, six projects in Bani Walid that was constructed between the years 2010 to 2020 were chosen. This includes commercial and residential building projects that were carried out by a wide range of contractors using conventional systems. In this investigation, waste index and level of wastage methods have been used as a means of quantifying waste and aiding assessment of environment. At present, there is still insufficient awareness among construction parties in Libya in terms of minimizing waste. This is seen in the lack of sorting of wastage and recycling practices, inefficient record-keeping of wastes, and insufficient support from clients, authorities, and top management. Attainment of desired levels in waste generation rate in the context of Libya relies heavily on the role of construction authorities. As the policy-maker and enforcer, construction authorities play a role in developing and issuing incentives or regulations to promote waste management practices and the usage of environmental-friendly technology, introduce beneficial measures and guidelines, set up standardized systems for record-keeping of quantitative information, carry out training and education in order to promote sustainability and better environmental awareness among the construction parties of Libya.

Keywords: Construction waste, waste quantification, waste generation, benchmarking, Libya.

13th-ISIEM-Paper 136 – QM
Improving Workflow of Aircraft Maintenance for Reduce Lead-time on Nine-Passenger Aircraft
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Abstract. Aircraft maintenance is an important factor in aviation safety. In carrying out aircraft maintenance, sometimes there is waste in maintenance. This article conducts a case study on a leading maintenance, repair, and overhaul (MRO) in Indonesia, which has a standard maintenance time of 90 hours for periodic inspections every 200-hours of flights for nine-passenger aircraft. In fact, the actual time spent on the workflow was 120 hours. MRO costs are accounting for an average of 14 percent of total expenditure. Therefore, the maintenance period time must meet the predetermined time target to maintain productivity. This study aims to identify waste that occurs using the value stream mapping (VSM) method and determine the criticality level of waste presented in the calculation of risk priority figures using failure mode effect analysis (FMEA), using tools to minimize lead time maintenance services. To reduce lead time in the maintenance process requires the preparation stage for general and special tools, equipment, consumables, and training manuals, as well as additional personnel, there was an increase in the decrease in maintenance time from 120 hours to 103 hours (14.16%). Using lean methods with proposed design improvements to minimize the possibility of waste.

Keywords: workflow, aircraft, maintenance, value stream mapping, failure mode effect analysis, waste.

13th-ISIEM-Paper 137 – IS
Comparing the Effect of Electronic Word of Mouth (eWOM) in Facebook and Instagram on Donation Intention during Earthquakes in Indonesia
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**Abstract.** The purpose of this study was to compare the effect of electronic word of mouth in Facebook and Instagram to electronic word of mouth intention (eWOMI) and eventually to donation intention during Indonesian earthquakes. In particular, the techniques used in this study was the MGA-PLS. The findings showed that both social media channels—Facebook and Instagram—significantly affected electronic word of mouth intention (eWOMI) and intention to donate. However, Facebook had a greater influence than Instagram on the relationship between electronic word of mouth (eWOM) affecting intention to donate. On other hand, Instagram had a greater influence than Facebook on the relationship between electronic word of mouth (eWOMI) Intention and Intention to donate.

**Keywords:** Donation Intention, Social Media eWOM, MGA-PLS, MICOM

**13th-ISEIM-Paper 138 – EPD**

*Mapping of Noise Contours due to the Production Process of Bolts and Nuts in the Production Department and Residences Environment of Pasir Angin Village, Cileungsi, Bogor Regency*

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**Abstract.** The physical work environment is an environmental situation that can affect the physicality of the worker. One of the disturbances in the physical work environment is noise. Noise can cause hearing damage if the duration of exposure and the noise level has passed the threshold value. One of the poor effects of noise received by workers is hearing health problems. The research location is in a manufacturing company that produces nuts and bolts, where their production activities cause noise, especially in the manufacturing process of the head of the bolt. The noise generated is heard in the production area and has spread to the community around the company. Therefore, it is necessary to conduct noise mapping to determine the propagation of noise in the production area and the community around the company. The results showed that the noise propagation in the production area is minimum 90.2 dB and maximum of 92.3 dB. Indicates that the noise generated by production activities at the company exceeds the threshold value (85 dB). Meanwhile, the noise propagation in the residents around the factory is minimum 66.5 dB and maximum of 78.5 dB. So, it shows that the noise received by residents exceeds the threshold value (55 dB).

**Keywords:** Noise, Contour Zone, Environment

**13th-ISEIM-Paper 139 – IS**

*Selection Decoration Services Business Development Strategy to Elevate Sustainable Competitive Advantages: A Case Study of Mau Dekorin*

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**Abstract.** One of service business called Mau Dekorin has been affected by pandemic covid-19, proven by January till May 2020 also the company did not have orders for decoration services due to the intense competition in the decoration industry and lockdown regulation imposed by government forces Mau Dekorin to lose some target sales market areas, especially in Jakarta. In responding to this business competition, Mau Dekorin must be able to become a superior business among its competitors by developing a new business development strategy in order to adapt new normal era. There is several steps used in this research: VRIO Framework to analyze company competitiveness level, TOWS matrix the company's internal and external factors, Business Model Canvas (BMC) to provide current business process solution. And last 5W 1H to provide suggestions for improvement. This Research conclude there is 3 dominant factors need to be adapted by Mau Dekorin; Human Resource by Opening Job Vacancies and recruit employee that meets criteria, Management with Creating a new work place environment and Training Employee, Work Ethic Mechanism so they need to do a Renewel of company policies and employee contract by creating a clear new job description.

**Keywords:** TOWS, BMC, 5W 1H, VRIO, Services Business, Business, Business Strategy Selection

**13th-ISEIM-Paper 140 – IS**

*Designing Master Plan for Website and Information System Project of Smart Campus ABC University in PT. XYZ*

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**Abstract.** Increasing use of information and communication technology in Indonesia make information technology become a basic requirement in every organization. PT. XYZ is one of the companies working on information technology
projects in Indonesia. This year, PT XYZ has website and Information System Project of Smart Campus ABC. In completing the project, PT. XYZ requires good planning, so they need a master plan as a reference used in the project. Designing a master plan requires input such as project charter, project documents, enterprise environmental factors and organizational process assets. These inputs are processed to produce plan scope management, plan schedule management, plan resource management, plan stakeholder management. The processing produces an output in the form of information technology project master plan in 4 knowledge such as scope, stakeholder, resource and schedule. This master plan consist scope which include product scope description, deliverables and acceptance criteria. Then consist stakeholder register that is used to identify the power and interest of the project. Resource to estimate the resource requirements of the project, and schedule baseline aims to plan project schedule control based on the activities that have been made in the Work Breakdown Structure of website and information system project of smart campus ABC University.

**Keywords**: Master Plan, Project, Project Management, Planning, Information Technology

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**13th-ISIEM-Paper 141 – QM**

**Improvement of Process Quality Using Taguchi Method on Solvent Production**

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**Abstract.** Taguchi method is one of a design of experimental by using statistical approach to optimize the process parameters and minimum variability of product. This study aim to improve the process quality of solvent production at PT. HF that produces adhesive products used for the footwear industry. The problem is how to make solvent production with one process and produce that has good quality in one check, and does not need for adjustments. Based on measurement processed with X-bar and R-bar control charts and the Cp and Cpk process capabilities, it is known that these processes still uncontrolled and the process uncapable with the value of Cp as 0.64 and Cpk as 0.04. The Taguchi and ANOVA methods were used in this study to improve the process design. The experiment will conducted after determination the factors can affect the quality of viscosity. The result is shown by orthogonal array, Signal-to-Noise (S/N) Ratio and analysis of variances (ANOVA). The experiment obtained the optimum levels are addition of solvent (70%), TPU material (2.3%), middle product material 27.85% and mixing time (7 hours). This experiment verification was the the Taguchi method can improve the process capability at the value of Cp as 2.0 and Cpk as 1.98, its shown that the process parameter can meet the process specification.

**Keywords**: Taguchi, Solvent Production, ANOVA, Process Quality

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**13th-ISIEM-Paper 142 – IS**

**Age Replacement Scheduling On Total Organic Carbon Analyzer Instrument (TOC) at XYZ Pharmaceutical, Ltd**

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**Abstract.** XYZ Pharmaceutical, Ltd is a company engaged in pharmaceutical industry. One of problems arising in this company is a delayed production process caused by damage on a Total Organic Carbon Analyzer instrument (TOC). This research was aimed to determine a time interval for replacing critical components of the TOC and to reduce cost of replacing components. Method used to deal with the damage of this instruments is an age replacement. It was found that the optimal replacement time interval is 23 days for filter components and 34 days for a Restrictor tubing component. Furthermore, the use of age replacement could provide enormous benefits for the company through maintenance cost savings, i.e. approximately 4.01% or IDR 907,213 for filter components and approximately 6.04% or IDR 650,436 for a restrictor tubing component.

**Keywords**: cost savings, TOC, cost, age replacement.

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**13th-ISIEM-Paper 143 – IS**

**The Utilization of Information Technology: Live Stream Shopping as an Innovation Strategy to Increase Online Store Sales in the Pandemic Period**

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Abstract. The COVID-19 pandemic has caused the modern retail market in Indonesia continue to decline. One solution for the retail industry to survive and grow continuously is to maximize sales through online platforms. The rapid growth of the online market has started in 2018 and continues to grow in Indonesia. One of the factors of physical retail closures in Indonesia is not only due to the lack of consumer buying power, but also a shift from physical shopping to online shopping. The online live stream shopping feature is an innovation that utilizes information technology for customer experience improvement in shopping that allows high engagement from targeted customers. This article focuses on discovering factors of live stream shopping features as an effective channel for sales improvement. From this literature research, the result found three types of shopping values that must be improved such as utilitarian values, hedonic values, and symbolic values, which are expected to increase the customer trusts towards the seller and the products offered. The built trust will automatically increase the engagement, and the customers' desire to buy will be higher. Further research is needed to identify each factor that will be one of the solutions in increasing online store sales during the pandemic.

Keywords: Shopping Value, Customer Trust, Pandemic COVID 19, Consumer Behaviour

13th-ISIEM-Paper 144 – EPD
Utility of Reaction Time in Measuring Fatigue Associated with Short-Period, High-Cognitive Load Task
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Abstract. Fatigue while doing electronic screen tasks for a relatively long period is often measured by reaction time. However, it is unknown whether this method is sensitive enough to detect increased fatigue conditions on e-display tasks performed over a short period, especially on high cognitive load tasks. This study aims to examine changes in reaction time associated with short period high cognitive load task. Ten healthy participants performed a two-stage math test with a short period (5-10 minutes per stage). Fatigue, sleepiness, and reaction times were measured at the beginning and immediately after the end of each stage. The Samn-Perelli scale was used to assess mental fatigue. The 5-minute Psychomotoric Vigilance Task (PVT) was administered to measure the reaction time. Next, the relationships among cognitive load, fatigue, and reaction time were assessed using Paired t-test, Pearson correlation, and four utility criteria (precision, sensitivity, accuracy, and specificity). The results show that fatigue scores and reaction times significantly increased during the experiment. It is also found that these two variables have significant positive correlation (p-value = 0.024 < 0.05). Reaction time has a very good sensitivity in detecting increased fatigue. However, the reaction time tend to increase more frequent than the subjective scale. Moreover, there is no significant evidence that the condition decreased the performance. In conclusion, the findings suggest that the reaction time can be used to indicate the development of mental fatigue during short-time e-display work with a high cognitive load.

Keywords:fatigue, short-period cognitive task, Psychomotor Vigilance Task, Samn-Perelli Scale

13th-ISIEM-Paper 145 – IECs
Binary Coding Enumeration for Multi-dimensional Problem in Sculptured Dies Cavity Roughing Optimization
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13th-ISIEM-Paper 145 – IECs

Abstract. Sculptured dies cavity roughing (SDCR) is a multi-dimensional optimization problem that requires the simultaneous decision of several variables. The most frequent discussion in SDCR is the simultaneous decision on tool selection and cutting plane determination in order to minimize machining (roughing) time. This study consider the trade-off between roughing and finishing time which represented by residual volume in roughing process by applying machining efficiency as the objective of the proposed algorithm. The machining efficiency for each set of tool selection depend on the determination of cutting plane. Therefore this multi-dimensional problem is classified as a complex combinatorial problem and there is need for 2 dimensional problems formulation. This study proposed binary coding to represent the problem, by which enumeration of the problem could be well structured and the coding and decoding process of 2 dimensional problem could be simplified in order to search and identify the optimum result. The algorithm has produced the optimum result and empirically shown 10% of improvement of machining efficiency when compared to result from the simulator and better machining efficiency when compared to smallest-tool-possible (STP) and smallest residual possible (SRP).

Keywords: Sculptured dies cavity roughing, enumeration, binary coding, Fibonacci, climbing stairs problem
Three-Dimensional Object Measurement Model Image Processing System Based to Calculate Logistics Cargo Rates

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Abstract. Lack of use of modern technology in the operational processes of conventional land transportation service industry companies for the process of determining logistic cargo rates based on volumetric weight. This has resulted in unclear volume measuring instruments, resulting in losses between the consumer and the service provider on the weight of the cargo to be paid. Algorithm designs and image processing programs to calculate volume and classify 3-dimensional objects are used to solve these problems. Algorithm design consists of input, process, and output. The input consists of the shooting distance and the projected image from the front and side of the object. The process consists of image processing in which there is an active contour method, measuring object dimensions, grouping 3-dimensional object shapes using the circularity algorithm, and measuring the volume of 3-dimensional objects that are processed using MATLAB. The resulting test error average value of each experimental object is below 5% with the percentage standard deviation value below 2% with various measurement distances. The results of this algorithm design are expected to be applied to technologies that are affordable, efficient, economical, and easy to use with high mobility tools.

Keywords: Logistics cargo rates, image processing, 3-D object shapes, Circularity Algorithm.

The Use of QR Code in Restaurant Service: the Consumer Readiness

Edvi Gracia Ardani$^{1, a)}$ and Anton Harianto$^{2, b)}$

$^1$Agung Podomoro University, APL Tower 5th Fl, Jl. Letjen S. Parman Kav 28, Jakarta Barat 11470, Indonesia.
$^2$Multimedia Nusantara University, Jl. Scientia Boulevard, Gading Serpong 15810, Tangerang Banten, Indonesia

Abstract. In all aspects of the human life, people have been trying to advantage technology. Pandemic in this 21st century makes a big contribution as well as the use of technology due to minimizing human interactions. Food and beverage business has tried hard to think on how their service could be delivered in this pandemic situation. Restaurants in Indonesia more particularly in Jakarta and surrounding areas started to use online menu retrievable through different ways, but mostly using a Japanese matrix barcode invention known as QR code. However, the practice in restaurants is not as easy as it seemed to be. Consumers seemed disturbed and forced to using the barcode. This research has the objectives to identify the consumer behaviors in restaurants business in Indonesia using online menu through their staff. A qualitative methodology is used to describe the findings with observation and in-depth interview with restaurant staff. It was stated that certain consumers have no problem in using online menu, but human interactions cannot be avoided neither. The characteristics of service industry promote the moment of truth that is still needed for the consumers satisfaction.

Keywords: QR code, restaurant service, consumer behavior, online menu

Strategy Analysis of Fire Victims Evacuation Queues on Building Areas in Compliance with SMK3 Regulations in order to Green Campus (Case Study of the Faculty of Engineering, Pancasila University (FTUP))

M Y M Sholihiin$^{1, a)}$, R Prasetyani$^{1, b)}$ and Anton Harianto$^{2, b)}$

$^1$Fakultas Teknik Universitas Pancasila, Jl. Srengseng Sawang, Jagakarsa, Jakarta Selatan

Abstract: Law No. 13 of 2003 article 87 paragraph 2 concerning Manpower, stipulates that a Government Regulation concerning the Implementation of an Occupational Health and Safety Management System (SMK3) is required. in accordance with PP No. 50 of 2012 concerning SMK3, every institution it is necessary to have this system and its implementation in the context of controlling risks related to activities in order to create a safe, efficient and productive workplace. The construction of a building requires precise calculation and accuracy, especially for the safety of everyone in the building. This study uses the Togawa queuing method and simple non-linear regression. The results of the calculation of the queue in the FTUP building where the time to go down from the 2nd floor to the 1st floor is 184.5 seconds or 3.075 minutes, the time to go down from the 3rd floor to the 1st floor is 224.8 seconds or 3.75 minutes, and the time to go down from the 4th floor to the 1st floor is 304 seconds 5.067 minutes. The total time to evacuate everyone from each
floor in the FTUP Building to the 1st floor is 613.3 seconds or 11.892 minutes. The time to evacuate everyone from the 1st floor to a safe gathering place is 270.91 seconds or 4.51 minutes. The results of the queue analysis are used as material for consideration and follow-up to be taken in the design of the emergency staircase for the evacuation of victims of fires. The results of this study indicate the influence between the area of the FTUP building (A) and the evacuation time every person (Te) is 88.375% and the remaining 11.625% is influenced by other factors, as evidenced in the non-linear polynomial model \( A = 522 \text{ (Te)}^2 - 1825.3 \text{ (Te)} + 2512.8 \), where the determinant coefficient is \( R^2 = 0.88375 \), and the relationship between A and Te is very high, it is proven that the correlation coefficient R is 0.940079784. This corresponds to element No. 5 SMK3 regulations, namely work safety based on SMK3, in order in campus implementation requirement.

Keywords: Safety, Queue, Fire, green Campus

13th-ISIEM-Paper 149 – QM
Reduction of Bolt Product Defects at PT. GIP Using Six Sigma Method
Arief Suwandi\textsuperscript{1,a)}, M. Derajat Amperajaya\textsuperscript{1,b)}, and Septian Hadi Cahyo\textsuperscript{1,c)}
\textsuperscript{1}Esa_Unggul_University, West_Jakarta, Indonesia

**Abstract.** PT. GIP is a company that produces fastening products, including: Self Drilling Screw, Drywall Screw, Rivet, Furniture Screw, Tapping Screw, Bicycle Part, Euro Screw, Special Screw, Furniture Hi Lo Screw, Bolts, Chipboard Screw, Automotive Screw with a production system. by order. Currently, there are still many customer complaints about Bolt products. Production data shows defective products during the last 2 months amounted to 7 percent of the total production. The research objective is to improve the quality of production in order to reduce the defect rate of Bolt products. Research using the Six Sigma method consists of DMAIC stages (Define, Measure, Analyze, Improve, Control). The calculation results show that the biggest product defect in the Bolts production process is a dimensional defect with a number of defects of 442 pcs with a percentage of 59.5% of the total defects that occurred in the last 2 months. The overall average sigma level is 3.6993, this indicates that the company has not optimally implemented good quality control. After implementing the priority implementation of increasing production, there was an increase in the sigma level to 3.8457, this shows that there is an increase in the quality and performance of the company.

Keywords: Bolts, SIPOC, Six sigma, Quality.

13th-ISIEM-Paper 150 – OR
Applying Genetic Algorithm for Capacitated Vehicle Routing Problem and Vehicle Selection- Case Study of Vietnam Logistics Company
Nguyen Thi Xuan Hoa \textsuperscript{1)}, Vu Hai Anh, Nguyen Quang Anh, Nguyen Dac Viet Ha
\textsuperscript{1}Hanoi University of Science and Technology, 1 Dai Co Viet, Hai Ba Trung, Ha Noi, Viet Nam

**Abstract.** Logistics is becoming an important field which is spearheading the economic development of Vietnam. However, the current logistics status in Vietnam still has a number of issues, such as high costs and low competitiveness in comparison with other countries in the world. Specifically, transportation costs account for a very large share of total logistical costs. Therefore, in today's world, the improvement of the transportation network and the optimization of the distribution of goods are key priorities. In this article, we focus on the development of a transportation optimization algorithm for logistics companies in order to minimize the total travel distance. In particular, by using a genetic algorithm (GA) to solve the vehicle routing problem (VRP), which is the ideal method to enhance transport performance. This research also modifies the basic capacitated vehicle routing problem (CVRP) with a vehicle selection algorithm to improve the flexibility and accuracy of the model. The results of research show that the total travel distance is reduced by 39.5% and consequently, overall CO2 emission rates is decreased of about 27.1%. In addition, using the vehicle selection algorithm in the CVRP issue, the average fill rate of the vehicle’s capacity increases from 56.38% to 97.14%. As a result, logistics companies can establish a plan to optimize transportation, reduce transportation costs and improve competitiveness, reducing national logistics costs as a whole.

Risk analysis of the Madura-3 corn supply chain using the FMEA Method
Abdul Azis Jafkar 1,a) Hery Purwanto 2,b) and Norita Vibriyanto 2.c)
1Departement of Agroindustrial Technology, Faculty of Agriculture, University of Trunojoyo Madura, Indonesia
2Departement of Economics, Faculty of Economics and Business, University of Trunojoyo Madura, Indonesia

Abstract. The objectives of this study were: 1. Identify risks at each level of the Madura-3 maize supply chain, 2. Evaluate and mitigate the risks of the Madura-3 maize supply chain. The type of research is survey and literature study. The research location is in Dukotambin and Banyubesi Villages, Tragah District, Bangkalan Regency, as well as in PT. Giri Agro Raya Sejahtera in Pamekasan Regency. The data used are primary data and secondary data. The research method used is a descriptive method that describes the facts that exist in the research location. The results of the description of the Madura-3 corn supply chain risk were then evaluated using FMEA method. The results showed that: 1. Risk occurs at every level of the Madura-3 corn supply chain; and 2. Efforts to mitigate the risk of the Madura-3 corn supply chain need to be carried out by utilizing technology to facilitate work and monitor market developments and facilitate business development, for example by online marketing.

Keywords: risk, supply chain, FMEA method.

Environmental, Social and Governance (ESG) Strategy Implementation Plan During the Covid-19 Pandemic at Retail Company “X” in Jakarta
Yenita 1,a), L Widodo 2,b)
1Management Department, Faculty of Economic and Businessness, Tarumanagara University
2Industrial Engineering Department, Tarumanagara University

Abstract. Covid-19 affects most of the retail industry in Indonesia, including PT “X”. With 99% of sales coming from offline store channels, PT “X” needs to analyze a systematic framework to integrate ESG into its business in order to improve its ESG ranking. For this reason, PT “X” needs to reformulate its business strategy in order to survive and even win retail competition during the Covid-19 pandemic. Considering that ESG is an important factor for a public company such as PT “X”, it is very important for PT “X” to raise its ESG rating in order to increase its competitive advantage and competitiveness in the global retail industry. This study analyzes ESG integration strategies during the pandemic within the scope of retail management to maximize value and minimize company risk. Therefore, PT “X” created a framework to integrate ESG into the business and then communicated that framework internally and externally to the organization. This qualitative research uses primary data through Focus Group Discussions to the company's top management, as well as secondary data obtained through literature studies, journals, and company internal data. The ESG integration steps undertaken by PT “X” are setting overall goals, budgeting, evaluating opportunities, building an ESG framework, building a sustainability team, checking progress, and improving performance. PT “X” then analyzes the steps for implementing ESG in order to increase competitive advantage and competitiveness in the global retail market that leads to company sustainability. For companies looking to strengthen environmental, social and corporate governance (ESG) practices, it is necessary to fully review the business and reorganize it responsibly through a holistic, top-down approach to implementing an ESG strategy, implementing elements of objectives, and sustainability at the core towards successful ESG implementation.

Keywords: ESG, Strategy, Retail, Pandemic, Sustainability, Integration
KEYNOTE SPEAKER PRESENTATION

Prof. YUNG-TSAN JOU, Ph.D.
Professor and Chair, Department of Industrial and Systems Engineering, Chung Yuan Christian University – Taiwan.

Practice Sharing of The Introduction of Smart Manufacturing into Traditional Industries
Practice sharing of the introduction of smart manufacturing into traditional industries

Professor Yung-Tsan Jou
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Chung Yuan Christian University, Taiwan
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+886911027083

2021/07/28
Yung-Tsan Jou, Ph.D

Associate Professor & Chair in the Dept. of Industrial & Systems Engineering, Chung Yuan Christian University, Taiwan.

Dr. Jou has published over 100 technical papers and reports, and 3 patents, and has translated 2 books. He has been involved in many research projects since he joined the Department in 2004 and has received significant amount of research grant from various sources, including the National Science Council, Chung-Shan Institute of Science & Technology, Industry Technology Research Institute, Chung-Yuan Christian University, and companies from the Industry.

Education:
- Ph.D. in Integrate(ME, IE) Engineering, Ohio University, USA
- Master of Mechanical Engineering, Ohio University, USA

Research Interest:
Virtual Reality and Ergonomics, Design of Innovative Human-Machine Interfaces, New Product Design, Smart Manufacturing, Machine Learning, Data Analysis

- New Focus Inc., San Jose, CA, U.S.A., Manufacturing & Mechanical Engineer.
Outline

01 Background & Foreword

02 AI automatic optical defect detection system

03 Casting quality characteristics prediction system

04 Concluding remarks
Background

- Industrial 4.0
- See the situation clearly
- Changing world
- New economy
Is each traditional industry suitable for the conduction of smart manufacturing?

How to start conducting smart manufacturing?

The construction of smart manufacturing feels impossible at the beginning.

It needs to be defined, planned and executed at a speed which is suitable for the company to face the challenge or opportunity.
Industry 4.0 describes the growing trend towards automation and data exchange in technology and processes within the manufacturing industry, including:

- The internet of things (IoT)
- The industrial internet of things (IIoT)
- Cyber-physical systems (CPS)
- Smart manufacture
- Smart factories
- Cloud computing
- Cognitive computing
- Artificial intelligence
Make an inventory

Fig. 1 Example of an automation pyramid

source: https://www.ksb.com/centrifugal-pump-lexicon/field-level/192584/
Case Study: Intelligent inspection of the appearance of aluminum die-casting
This project created two subsystems:
1. Automatic optical defect detection system—Use AI automatic image inspection technology to interpret defects in aluminum die casting images.
2. Casting quality characteristics prediction model system—collect production parameters and predict the pros and cons of castings during die casting.

- Collect manufacturing parameter data in the die casting process
- Filming of finished aluminum die-casting images
- Analyze the correlation between manufacturing parameters and casting quality
- Build an AI automatic optical inspection system for defect detection
- Build a predictive model system for die-casting quality characteristics
- System integration
CONFUSION MATRIX

• It uses the form of a matrix to show the four results derived from the actual and the predicted, and can calculate the actual results from them, and explain them based on the output results of this research.

• The casting results there are two types: OK and NG, where OK castings are represented by 0, and NG castings are represented by 1.
1. AI automatic optical inspection system

**Image processing**
- Collect images of die castings
- Manually frame the feature of the defect
- Mark the framed part
- Generate mark file

**Model building**
- Build a predictive model (initial)
- Train a predictive model
- Test prediction model
- Build a predictive model (final)

**Predictive model algorithm selection:** Support Vector Machine, YOLOv4

**Evaluation model method:** use accuracy as an indicator
Schematic diagram of the camera's field of view position.
Model Training Results

- **Support Vector Machine, SVM**
  - All images are randomly selected and verified by cross-training to check the accuracy of the model and test whether the SVM model can accurately identify normal and defect.

Confusion matrix of five positions
- 400 normal images
- 256 defective images

<table>
<thead>
<tr>
<th></th>
<th>NG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG</td>
<td>200 (30%)</td>
<td>12 (2%)</td>
</tr>
<tr>
<td>OK</td>
<td>56 (9%)</td>
<td>388 (59%)</td>
</tr>
</tbody>
</table>

Average of five positions Accuracy rate **89%**
Model Training Results

- **YOLOv4 (You Only Look Once) Model**
  - If the more data is used, the more the model can master the data, it can improve the accuracy rate, and can also deal with more diverse defects.

For training: 405 images
For testing: 428 images
**Accuracy: 78%**

<table>
<thead>
<tr>
<th>A</th>
<th>NG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG</td>
<td>170  (40%)</td>
<td>50   (12%)</td>
</tr>
<tr>
<td>OK</td>
<td>44   (10%)</td>
<td>164  (38%)</td>
</tr>
</tbody>
</table>

For training: 1214 images
For testing: 428 images
**Accuracy: 78%**

<table>
<thead>
<tr>
<th>A</th>
<th>NG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG</td>
<td>183  (43%)</td>
<td>4    (1%)</td>
</tr>
<tr>
<td>OK</td>
<td>31   (7%)</td>
<td>210  (49%)</td>
</tr>
</tbody>
</table>
2. Casting quality characteristics prediction system

Forecast model algorithm selection:
- Random forest, support vector machine, neural network

Validation model method:
- Confusion matrix
Prediction Results

➢ The characteristics of the data are binary classification (NG/OK), so three algorithms, random forest, support vector machine, and neural network, which are better for handling classification problems, are selected.

➢ The first stage-use 35 OK products and 35 NG products into model for training.

➢ The second stage-use 50 OK products and 50 NG products into model for training.

• Model Accuracy:

<table>
<thead>
<tr>
<th></th>
<th>Random Forest, RF</th>
<th>Support Vector Machine, SVM</th>
<th>Artificial Neural Network, ANN</th>
<th>Total number of data sets(OK : NG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 1st stage</td>
<td>82%</td>
<td>82%</td>
<td>71%</td>
<td>70 items in total (35 : 35)</td>
</tr>
<tr>
<td>The 2nd stage</td>
<td>86%</td>
<td>90%</td>
<td>74%</td>
<td>100 items in total (50 : 50)</td>
</tr>
</tbody>
</table>
The robot arm displaces the die-casting part into the black box for shooting.
On-site operators can know the results of system prediction and interpretation of aluminum die-casting parts by the two-color lights and buzzer prompts.

The results of system prediction and identification will also be sent back to the on-site computer to facilitate subsequent data viewing.
The two subsystems predict that the die casting production parameters and the image detection results are both good, and then shows **Green light**. If the result of one of the systems is defective, it shows **Red light**.
Achievement
The stability of quality and yield is the primary condition for the construction of smart manufacturing.

Domain knowledge is the foundation of quality and yield.

Industrial engineering is the foundation of Industry 4.0.

Think big, start small, and scale fast but stay grounded in the specific needs of the factory.
KEYNOTE SPEAKER PRESENTATION

NARAPHORN PAOPRASERT, Ph.D
Researcher, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University – Thailand.

A Signaling Game for Research Fund Allocation in Thailand
Modelling
Research Fund
Allocation

THITI DUANGSONG
NARAPHORN PAOPRASERT
SUWITCHAPHON WITCHAKUL
SASAROSE JAIJIT

DEPARTMENT OF INDUSTRIAL ENGINEERING,
KASETSART UNIVERSITY, BANGKOK, THAILAND
A LITTLE BIT ABOUT ME

Naraphorn PAOPRASERT
Department of Industrial Engineering, Faculty of Engineering, Kasetsart University, Bangkok, Thailand

Decision analysis and game theory, Operations research, Data analytics, Statistical analysis

- Optimal resource allocation for defense of targets based on differing measure of attractiveness
  VM Bier, N. Haphanuwat, J. Memego, R. Zimmerman, AM Culpan
  Risk Analysis. An International Journal 29 (3), 762-770

- Methodology for identifying near-optimal interdicting strategies for a power transmission system
  VM Bier, ER Gratz, NJ Haphanuwat, W. Mangua, KR Wierzbicki
  Reliability Engineering & System Safety 52 (9), 1155-1161

- Track-offs between target hardening and overarching protection
  N. Haphanuwat, VM Bier
  European Journal of Operational Research 213 (1), 320-328

- Analytical method to identify the number of containers to inspect at US ports to deter terrorist attacks
  VM Bier, N. Haphanuwat
  Annals of Operations Research 187 (1), 137-158

- Deterring the smuggling of nuclear weapons in container freight through detection and retaliation
  N. Haphanuwat, VM Bier, HH Willis
  Decision Analysis 8 (2), 88-102

- The impact of rice research expenditure policy in Thailand
  S. Jaik, N. Paoprasert, J. Plichtamkin
  Journal of Policy Modeling 41 (1), 156-167

- Analyzing local perceptions toward the new nuclear research reactor in Thailand
  R. Teekawechcharoen, N. Paoprasert, K. Srin
  Nuclear Engineering and Technology 52 (12), 2958-2968

Researcher, National Metal and Materials Technology Center, Thailand
POSITIONS AT MY WORK

• Full-time faculty member at the Department of Industrial Engineering, Kasetsart University
• Classes responsible:
  ○ Game and Decision Theory
  ○ Reliability Theory
  ○ Applied Mathematical for Industrial Engineering
  ○ Financial Accounting and Cost Analysis
• Director of the International Graduate Program under the Department of Industrial Engineering
• Programs offered consisted of:
  ○ Master Program in Industrial Engineering and Engineering Management
  ○ Ph.D. Program in Industrial Engineering

KASET SART UNIVERSITY
Graduate Admission
Master & Ph.D. Degrees
(International Program)

MASTER DEGREE
In Industrial Engineering and Engineering Management
* Applicants are required to hold a Bachelor’s degree in Engineering or related subject with a GPA of at least 2.50 and Test of English as a Foreign Language.

Coursework for master program:
- Data engineering and analytics
- Operations modelling in supply chain
- Service operations management
- Design and analysis of manufacturing systems
- Systems engineering and product development
- Production planning and inventory management
- Leadership and entrepreneurship for engineers

Ph.D. Industrial Engineering
* Applicants are required to hold a Master’s degree in Engineering or related subject with a GPA of at least 3.09 and Test of English as a Foreign Language.

Coursework for doctoral program:
- Advanced optimization
- Advanced statistics
- Game theory
- Stochastic processes
- Advanced inventory management
- Machine learning

Scholarships:
- Monthly 10,000+ baht (Master)
- Monthly 16,000+ baht (Ph.D.)
- Tuition fee reduced by 50% (Ph.D.)

Scan for more information

fengdp@ku.ac.th. IGP by IE, Kasetsart University
A SIGNALING GAME FOR RESEARCH FUND ALLOCATION IN THAILAND
INTRODUCTION

- Funding decisions have been made by peer-reviewed process or the committee group meeting.
- The largest expenditure for research studies was on private sector (80%) followed by higher education sector (14%).
- Out of this total amount to the National Research Council of Thailand, more than 50% of research studies was categorized as applied research.
- The allocation of Thailand’s research funding seemed to be mainly a top-down system that the government allocated fund to the major research funding management agencies, then the funding in each agency was further allocated to subunits and eventually was distributed to individual projects.
PAST STUDIES

- Many studies focus on assessment of research impact
  - But this is very costly!

- Many other studies also considered portfolio analysis
  - Some studies applied the multi-objective techniques

- One study found:
  - Heidenberger and Stummer (1999) were the only one study that focused on strategic R&D expenditure when firms were racing in patent competition.

- There have been attempts to investigate strategic decision making in fund allocation
  - But has not yet in the field of research funding allocation!
MODEL FORMULATION

• We modelled the interaction in an extensive-form game between a national funding agency and a researcher.
• The funding agency could not truly know the type of researcher, categorized as “good” or “bad”.
  ◦ The terminologies of “good” and “bad” came from a typical signaling game to easily refer to the type but they did not imply that the researcher was actually good or bad.
• Both types of researchers were allowed to send a signal to the funding agency.
  ◦ The signal could be viewed as the effort each type put into composing their proposal.
• The governmental funding agency would then observed the signal and decided about the amount of funding to grant to the researcher.
• In this model, the researcher was assumed to accept any amount provided by the government.
The Game Theoretic Model

- The diagram illustrates a decision-making process involving the Government and a Researcher.
- The Government can either grant or not grant a small grant.
- The Researcher can either apply for a small or large grant.
- The outcomes involve probabilities and payoffs, indicated by the equations involving $F, e, g, r,$ and $p$.

Mathematical Formulas:

\[
(F - e_g - (1-P_{g,a})*e_{g,a} + r_{g,a} - p_{g,a} - F_{a})
\]

\[
(-e_{g,a} + r_{g,a} - p_{g,a})
\]

\[
(F - e_g - (1-P_{g,l})*e_{g,l} + r_{g,l} - p_{g,l} - F_{l})
\]

\[
(-e_{g,l} + r_{g,l} - p_{g,l})
\]

\[
(F - e_b - (1-P_{b,a})*e_{b,a} + r_{b,a} - p_{b,a} - F_{a})
\]

\[
(-e_{b,a} + r_{b,a} - p_{b,a})
\]

\[
(F - e_b - (1-P_{b,l})*e_{b,l} + r_{b,l} - p_{b,l} - F_{l})
\]

\[
(-e_{b,l} + r_{b,l} - p_{b,l})
\]

\[
(F - e_r - (1-P_{r,a})*e_{r,a} + r_{r,a} - p_{r,a} - F_{a})
\]

\[
(-e_{r,a} + r_{r,a} - p_{r,a})
\]

\[
(F - e_r - (1-P_{r,l})*e_{r,l} + r_{r,l} - p_{r,l} - F_{l})
\]

\[
(-e_{r,l} + r_{r,l} - p_{r,l})
\]
THE EXPECTED PAYOFF TO THE GOVERNMENT:

\[ E(UG_{s,k}) = p(r_{G,k}P_{G,s,k} - F_{s,k} - r_{G,s}P_{G,s,s}x) + (1-p)(r_{B,k}P_{B,s,k} - F_{s,k} - r_{B,s}P_{B,s,s}x), \forall k \]

\[ E(UG_{l,k}) = p(r_{G,k}P_{G,l,k} - F_{l,k} - r_{G,l}P_{G,l,l}x) + (1-p)(r_{B,k}P_{B,l,k} - F_{l,k} - r_{B,l}P_{B,l,l}x), \forall k \]

THE EXPECTED PAYOFF TO THE RESEARCHER:

\[ E(UR_{i,j,k}) = F_{j,k} - e_{i,j} - (1-P_{i,j,k})c_{i,k}, \forall i, j, k \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Good researcher</td>
</tr>
<tr>
<td>B</td>
<td>Bad researcher</td>
</tr>
<tr>
<td>s</td>
<td>Small grant</td>
</tr>
<tr>
<td>l</td>
<td>Large grant</td>
</tr>
<tr>
<td>j</td>
<td>Grant amount j proposed by the researcher, ( j, j \in J = {s, l} )</td>
</tr>
<tr>
<td>k</td>
<td>Grant amount k decided by the governmental funding agency, ( k \in K = {0, s, l} ) (0 means the proposal was rejected)</td>
</tr>
<tr>
<td>a_{i}</td>
<td>The action of a researcher type i, ( i \in I )</td>
</tr>
<tr>
<td>g(a_{i} = j)</td>
<td>The government funding agency action as a function of researcher type i, ( i \in I ) asking for the fund size ( j, j \in J )</td>
</tr>
<tr>
<td>F_{j,k}</td>
<td>Amount of research fund size k that the governmental agency granted to a proposal asking for a fund of size ( f(j \in J \text{ and } k \in K) )</td>
</tr>
</tbody>
</table>

\( P_{i,j,k} \) The probability of successfully achieving the project goal when granted with fund of size \( k, k \in K = \{0\} \), by the researcher of type \( i, i \in I \) asking for the fund size \( j, j \in J \)

\( p \) The probability believed by the governmental funding agency that the researcher is of a good type

\( c_{i,k} \) Penalty cost of having a bad reputation to the researcher type \( i \) obtained the fund size \( k \) whose research study was unsuccessful \( (i \in I \text{ and } k \in K = \{0\}) \)

\( r_{i,k} \) The impact (benefit) of the research study from a researcher of type \( i \) obtained a grant size \( k, (i \in I \text{ and } k \in K = \{0\}) \)

\( e_{i,j} \) Cost/effort that a researcher of type \( i \) inserted to write and present a proposal asking for a grant of size \( f_j, (i \in I \text{ and } j \in J) \)
MODEL ASSUMPTIONS

\[ F_{*,i} \geq F_{*,s} \]

\[ P_{G,**,k} \geq P_{B,**,k}, \forall k \]

\[ P_{i,**,s} \geq P_{i,**,l}, \forall i \]

\[ r_{G,k} \geq r_{B,k}, \forall k \]

\[ r_{i,l} \geq r_{i,s} \forall i \]

\[ c_{G,k} \geq c_{B,k} \forall k \]

\[ c_{i,l} \geq c_{i,s}, \forall i \]

\[ e_{i,l} \geq e_{i,s}, \forall i \]

\[ r_{i,l} P_{l,l,i} \geq r_{i,s} P_{l,s,i}, \forall i \]

\[ r_{B,s} P_{B,**,k} \geq F_{*,k}, \forall k \]
RESULTS: POOLING EQUILIBRIUM

**Proposition 1:** There exists a pooling equilibrium: $a_i^* = 1$, $\forall i$, $g^*(a_i^* = 1) = 1$, $\forall i$ and $a_i^* = s$, $\forall i$, $g^*(a_i^* = s) = s$, $\forall i$, if and only if

$$F_{i^*} - F_{s^*} \geq (1 - P_{i,i})c_{i,i} - (1 - P_{i^*,s})c_{i,s} + (e_{i,i} - e_{i,s}), \forall i$$

Additionally, if both types of researchers ask for a small fund, the government is always better off granting a small fund.

**Lemma:** The pooling equilibrium $a_i^* = 1$, $\forall i$, $g^*(a_i^* = 1) = s$, $\forall i$ and $a_i^* = s$, $\forall i$, $g^*(a_i^* = s) = s$, $\forall i$, does not exist.

**Lemma:** The pooling equilibrium of $a_i^* = 1$, $\forall i$, $g^*(a_i^* = 1) = 0$, $\forall i$ and $a_i^* = s$, $\forall i$, $g^*(a_i^* = s) = s$, $\forall i$, does not exist.
RESULTS: SEPARATING EQUILIBRIUM

**Proposition 2:** There exists a separating equilibrium: $a^*_G = l$, $a^*_B = s$, $g^*(a^*_G = l) = l$, $g^*(a^*_B = s) = s$, if and only if

$$F_{i,l} - F_{*,s} \geq (1 - P_{G,i,l})c_{G,l} - (1 - P_{G^*,s})c_{G,s} + (e_{G,l} - e_{G,s})$$

$$F_{i,l} - F_{*,s} \leq (1 - P_{R,i,l})c_{R,l} - (1 - P_{R^*,s})c_{R,s} + (e_{R,l} - e_{R,s})$$

$$P_{G^*,l}c_{G,l} - P_{B^*,l}c_{B,l} > P_{G^*,s}c_{G,s} - P_{B^*,s}c_{B,s}$$

**Lemma:** There exists a second separating equilibrium: $a^*_G = s$, $a^*_B = l$, $g^*(a^*_G = s) = s$, $g^*(a^*_B = l) = l$, if and only if

$$F_{i,l} - F_{*,s} \leq (1 - P_{G,i,l})c_{G,l} - (1 - P_{G^*,s})c_{G,s} + (e_{G,l} - e_{G,s})$$

$$F_{i,l} - F_{*,s} \geq (1 - P_{B,i,l})c_{B,l} - (1 - P_{B^*,s})c_{B,s} + (e_{B,l} - e_{B,s})$$

$$P_{G^*,l}c_{G,l} - P_{B^*,l}c_{B,l} \leq P_{G^*,s}c_{G,s} - P_{B^*,s}c_{B,s}$$
DISCUSSIONS: POOLING EQUILIBRIUM

- Only one pooling equilibrium in which both types of researchers asked for a large fund existed.
  - This was due to the assumption that the expected benefit from a research study for a large fund was large for both types of researchers.
  - Another assumption that the expected benefit from a research study was greater than the funding cost was also needed to guarantee the unique pooling equilibrium.
DISCUSSIONS: SEPARATING EQUILIBRIUM

- The criteria that we used to separate a pooling equilibrium from a separating equilibrium in this current study was the difference between the large fund and the small fund. There were two cases to consider the equilibria as shown in figures below. In these figures, case 1 is when:

\[(1 - P_{B,i,l})c_{B,i} - (1 - P_{B,l,s})c_{B,s} + (e_{B,i} - e_{B,s}) \geq (1 - P_{G,i,l})c_{G,i} - (1 - P_{G,l,s})c_{G,s} + (e_{G,i} - e_{G,s})\]

while case 2 is the reverse relationship.
DISCUSSIONS: SEPARATING EQUILIBRIUM (CONT'D)

- A reasonable separating equilibrium (the good researcher asked for a large fund and the bad researcher asked for a small fund) occurred when the expected cost of failing the large-fund project for the bad researcher was sufficiently large while the expected cost of failing the large-fund project for the good researcher was sufficiently small.

- The relationship was vice versa for a small-fund project. Also, the difference of the cost of composing a proposal between a large fund project and a small fund project should also be small for a good researcher while this should be large for a bad researcher. The separating equilibrium when a good researcher asked for a small fund project and a bad researcher asked for a large fund project required just the opposite relationships to what was explained.
CASE STUDY: SETUP

- We adopted the case study of rice research studies in Thailand as explained in Jaijit, Paoprasert, and Pichitlamken (2017) and Jaijit, Paoprasert, and Pichitlamken (2019).
- Jaijit et al. (2017) attempted to assess the research impact of three selected rice research studies in the areas of breeding, production, and processing, respectively, while Jaijit et al. (2019) further investigated the relationships between research funding and research outcomes (e.g., crop productivity, farmers’ income, plantation cost). The funding amounts for these three projects were 38 million Baht, 36 million Baht, and 25 million Baht, respectively.
- In our context, we assumed that a large-fund project costed approximately 30 million Baht. For a small-fund project, we assumed that the upper bound was approximately 5 million Baht.
  - In fact, typically, there have been a number of funding sources that have funded the amount of 0.2-0.5 million Baht for small basic research studies. However, in our context, small fund should also yield tangible impact that would require a little bit larger fund than the typical small basic research studies.
CASE STUDY: SETUP

- From Jaijit et al. (2017), the ex-ante impact assessment for the three areas of rice research studies yielded net present values of 1,251 million Baht, 289 million Baht and 1,356 million Baht, respectively.
- These assessments could be used as the impact from a good researcher obtaining a large fund in this current study.
- The differences between the effort of composing project proposal between a large-fund project and a small-fund project for all types of researchers was negligibly small, we could omit these differences from the calculation.
- In additions, if the probability of successfully achieving the project goals for small-fund projects for both types were assumed to be 1, this term could also be omitted from the calculation.
- Presumably, a good researcher was assumed to earn 5 million Baht a year. If for some reasons, the current large-fund project failed, the good researcher’s future proposals were assumed to be rejected for approximately 5 years, then = 25 million Baht. Similarly, a bad researcher was assumed to earn 1 million Baht a year, with the same duration of penalty, = 5 million Baht.
RESULTS IN THE CASE STUDY

- From figures in slide #14, we concluded that with the assessment in this case study, both types of researchers preferred to ask for large funds and the government would also grant a large fund.
- However, if the estimated cost of penalty to the bad researcher was increased such that was larger than 25 million Baht, then we began to have the separating equilibrium in which a good researcher asked for a large fund and a bad researcher asked for a small fund.
- Similarly, if the difference between the large and the small funds was decreased, the reasonable separating equilibrium could be observed.
CONCLUSIONS

- The results in the case study implied that research funding allocation was at the pooling equilibrium in Thailand in which both types of researchers asked for large fund.
- This result was not surprising since first of all the gap between a large and a small fund could be very large.
- Moreover, the expected penalty cost of failing a large-fund project for any type of researcher must also be sufficiently high, while the expected penalty cost of failing a small-fund project should be fairly small.

- It is still challenging to assess all model parameters.
  - However, to make a better decision, basic assessment such as the ex-ante technique to assess the impact of a research study should be applied.

- Beliefs about the types of researcher could be inferred by a government funding agency based generally on the past historical research study performances, researcher’s age, or interests, etc.

- Studies such as Haruechaiyasak, Kongthon, and Thaiprayoon (2009), Sense (2012) proposed methodologies to build a researcher networks that could be integrated in this study for the assessment of the success probability based on the researcher network.
- Haruechaiyasak et al. (2009) explored research networks from the bibliographic dataset for Thai researchers.
CONCLUSIONS

- The study could be one of the stepping stones to model strategic research funding allocation. Model assumptions could be further relaxed to capture additional realistic applicable cases.
- Since researchers continuously asked for research funding over the years, repeated game could also be adopted, especially, to capture the effect of the failure percentage on achieving the project goals.
  - On the other hand, repeated game could capture the effect on the researcher when the project was successfully carried on. Bias that may arise during the decision making process for research funding allocation is also interesting to further investigate.
Thank you!!
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Prof. YUN-CHIA LIANG, Ph.D.
Professor and Chair, Department of Industrial Engineering and Management, Yuan Ze University – Taiwan.
How to Make Our Lives Better?

Yun-Chia Liang
Department of Industrial Engineering and Management
Yuan Ze University
Speaker

Yun-Chia Liang

• Education
  ➢ Ph.D., Industrial and Systems Engineering, Auburn University
  ➢ M.S., Industrial Engineering, University of Pittsburgh
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• Professional Experience
  ➢ Professor and Dept. Chair, Industrial Engineering and Management, Yuan Ze University
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  ➢ Associate Editor, Journal of Industrial and Production Engineering (JIPE)
  ➢ Planning Committee, IEM Division, Ministry of Science and Technology (MOST), Taiwan
  ➢ Director, Operations Research Society of Taiwan (ORSTW)
  ➢ Technical Committee, IEEE Computational Intelligence Society
  ➢ Two-time Awardee for Outstanding Young Scholar Research Project by MOST, Taiwan

• Contact Information
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Outlines

Smart Life
- Infant Cry Recognition
- Smart Street Lighting
- Smart Coffee Bean Selector
Infant Monitoring

- Record the sound and/or video of the infant
- Caretakers can watch the video/hear the audio from digital devices
- No screening mechanism to distinguish among physiological and emotional needs or health conditions
Infant Cry Reasons

- Hungry
- Diaper Change
- Medical Treatment
- Emotional Need
- etc.

Infant Cry

Needs

Health

- Healthy
- Sick
Coffee Bean Processing – Manpower

- Exhaustive and repetitive process
- Operators’ performance degrades over time
Coffee Bean Processing – Sorting M/C

- Current sorting machine based on colors only
- Binary classification for coffee beans
Coffee Bean Defects

- Over 13 major defect types
- Color discrimination unable to classify certain types of defects

### Standard Method of Classification

| Full Black Bean | Predominately opaque black. |
| Full Sour Bean  | Predominately reddish or yellowish brown. |
| Dried Cherry/Pod | Bean partially or fully enclosed in dark outer husk |
| Fungal Damaged Bean | Exhibiting yellowish or brownish fungal attack |
| Foreign Matter   | Any non-coffee item, such as stones or stones |

### Table of Defect Equivalents

<table>
<thead>
<tr>
<th>Category 1 Defect</th>
<th>Full Black</th>
<th>Full Sour</th>
<th>Dried Cherry/Pod</th>
<th>Fungal Damaged Foreign Matter</th>
<th>Severe InsectDamage</th>
<th>Category 2 Defect</th>
<th>Partial Black</th>
<th>Partial Sour</th>
<th>Patchouli/Pergamino</th>
<th>Fister</th>
<th>Immaturity/Unripe</th>
<th>Withered</th>
<th>Shell</th>
<th>Broken/Chipped/Cut</th>
<th>Hull/Shell</th>
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<th>Shell</th>
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<th>Hull/Shell</th>
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<tr>
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<td>Partial Black</td>
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<tr>
<td>Full Sour</td>
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<td>1</td>
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<td>Partial Sour</td>
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<tr>
<td>Dried Cherry/Pod</td>
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<td>Patchouli/Pergamino</td>
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<td>Foreign Matter</td>
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<td>Withered</td>
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<tr>
<td>Severe Insect</td>
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<td>Shell</td>
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### CUPPING METHODOLOGY
Cupping is a professional technique for evaluating coffee’s fragrance, aroma, taste, body and aftertaste. 150 milliliters of hot water are poured directly onto 8.35 grams of moist and ground coffee and allowed to steep. Using a large spoon, the coffee is stirred, agitated, allowed to settle, then vigorously stired at various temperatures to reveal its flavor characteristics.

### FLAVOR CHARACTERISTICS
Upon cupping, sample must exhibit distinctive attributes in the area of taste, acidity, body and aroma as determined between buyer and seller. Must be free from faults and tastes.
Light Controller

- Easy to implement
- Less efficient to respond to the real climate change
- Sensitive to particles in environment

Most common approach to control street lights

Timer + Photoelectric Switch
Highlights of the System

- Integrate the Solar Power Generation and the Street Light Systems
- Enhance the Street and Traffic Safety
- More Effective Energy Use
- Light Control Considering Season and Weather Conditions
Thank you
ELISA LUMBANTORUAN
President Director & CEO at ISS Indonesia, Independent Commissioner at PT Indosat Tbk, and Independent Commissioner at Garuda Indonesia

Production and Service System in the New Normal Era
Connecting people and places to make the world work better.

“Production and Service System in the New Normal Era”

Elisa Lumbantoruan
ISS Indonesia, CEO & President Director
...Our way back to work
Our Way Back to Work

Prepare to Work
- These are the very practical and operational things we can do to help prepare our customers, their employees and their workplaces before they return to work

Return to Work
- These are the tactical changes and recommendations we foresee will make a difference when people return to work

Get Better at Work
- These are the more strategic opportunities to reposition our brand and in particular reposition cleaning services as a critical service creating safe, hygienic places
Top 10 focus areas for employees

#1 What are the new behavioral guidelines?
#2 Are we all healthy?
#3 How will we return to work?
#4 How will we feel assured that it is safe?
#5 How will I know that the office and specifically my desk is clean?
#6 What has changed since I was last in the office?
#7 How will I be welcomed back?
#8 What does the new office layout look like?
#9 What are my possibilities to work from home going forward?
#10 What is the new process for lunch?
Key messages to be delivered

**Workplace**
- Are new office behavior and personal hygiene guidelines communicated?
- Do the touchpoints in the building feel safe and secure post COVID-19?
- Is visible communication of guidelines in place e.g. signage, posters, etc.?

**Food services**
- Are new guidelines related to the areas of food consumption clearly communicated e.g. restaurant, meeting rooms, cafés and coffee machines?
- Have physical measures and design been put in place to ensure safe environment in food consumption areas?

**Cleaning services**
- Are all touchpoints assessed from a hygiene perspective?
- Is there a need for additional cleaning services to provide the experience of a safe and secure working environment e.g. decontamination and disinfection?
- Should the cleaning service be more visible for employees in the building?
Recommendations for Each Touchpoint

New hygiene standards and cleaning awareness for all touchpoints

<table>
<thead>
<tr>
<th>All touchpoints</th>
<th>Focus area</th>
<th>ISS recommendation to stay safe and secure (minimum requirements)</th>
</tr>
</thead>
</table>
| New hygiene, behavior and office standards for employees | 1. Basic rules | 1. Send communication e-mail to all employees before returning to work with new guidelines and behavior standards, e.g., hygiene, social distancing, sneezing and coughing, work hours, shifts etc.  
2. Lay out on floor in the building (e.g., employees who sit in offices) reminders with the new hygiene guidelines for the building. Reminders should be related to restorations, food areas, coffee stations, restrooms and meeting rooms – Numerous communication channels can be used: info-screens, physical signage, social media, internal webpage, work apps, newsletters etc.  
3. Keep physical interaction at recommended 2m safety distance (refer diagram)  
4. Place accessible hand sanitizer at all touchpoints and other relevant places  
5. Fix mandatory to sanitize hands when arriving at a new touchpoint  
6. Place visible tissue boxes in work areas  
7. Wipe all workstations and keyboards with tissue before and after use |

| Cleaning awareness / Cleaning Inception Management | 1. Cleaning Perception management | 1. Introduce visible hygiene stewards in workplaces. Numbers should be proportioned so that they minimum are visible to all employees every second hour when seated in the same place  
2. Provide posters and stickers that provide overview of what hygiene stewards do and how clean their frequency  
3. Ensure hygiene stewards are properly protected and visible in workplace environment with name tags, stand out uniforms and PPE (e.g., gloves, eyewear, masks)  
4. The following frequent touch areas should be cleaned continuously and visually as part of the hygiene stewards routine:  
   a) All door handles  
   b) All light switches  
   c) All computer mice  
   d) Any hands-on keyboard  
   e) Any tables  
   f) Snaps and handshakes  
   g) Tables surfaces in canteens and break areas  
   h) Coffee machines and coffee areas  
   i) Desks and countertops in office areas  
   j) Touchscreen computers and monitors in copy rooms  
   k) Reception counters and surfaces in lobby areas  
   l) Hygiene stewards should be visible in canteens during lunch hours, following hygiene standards for canteens  
2. Posters should be visible to describe the purpose of the hygiene stewards’ visible cleaners and their focus of work  
3. Visible markers should be put up so that users can see surfaces have been cleaned, e.g., green cards red cards, smiley indicators, or the like  
4. Hygiene stewards should keep evidence of routines performed in sharable report format with time and responsible |

| Cleaning awareness / Cleaning Inception Management | 2. Evidence and communication |  | |
| Cleaning awareness / Cleaning Inception Management | 3. Deep cleaning |  | |

3.1 Make documentation of service visible in reception and main areas
Recommendations – Other Touchpoints to Consider

- Arriving at work
- Entering the building
- Receiving & sending mail & packages
- Well-being
- Leaving work
Covid-19:
Our Way Back
To Work
Safe Circulation

- Control people flow in a single direction where possible to avoid crossing in corridors or open space
- Use 2M interval markings on the floor or walls along corridors to guide people movement and timing
Safe Workstations – Option 1

- Alternate desks are left unoccupied by removing every other seat
- Avoid face to face seating unless a 2M distance can be achieved
Safe Workstations – Option 2

- Rearrange desk positions so that a 2M separation can be achieved
- Avoid face to face seating unless a 2M distance can be achieved
Safe Break-Out Areas

- Reduce or remove furniture from break-out areas and reposition items to achieve the minimum 2 M social separation requirements.
Safe Meetings

- Reduce meeting room capacity to 50%
- Avoid face to face seating unless a 2M distance can be achieved
Safe Queuing

- Use floor stickers to mark 2m safe distance intervals at queuing locations (canteen, coffee points etc.)
COVID-19

Delivering ‘new hygiene’ standard with ISS Pure Space product

- Certified cleaning methodology with focus on hygiene
- Provide evidence through ATP tool testing & monitoring to measure levels of contamination
- Delivered by well trained ISS employee, certified specifically for Pure Space
9 Forces That Will Shape The ‘Next Normal’

Core outcomes will not change, but we will see differences in the way those outcomes materialize.

<table>
<thead>
<tr>
<th>Workforce</th>
<th>Workplace</th>
<th>Workflows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talent attraction and retention</td>
<td>Employee engagement</td>
<td>Consistency</td>
</tr>
<tr>
<td>Remote working…</td>
<td>From real estate</td>
<td>From digital for end-user experience...</td>
</tr>
<tr>
<td>…but for how long</td>
<td>From ‘Great Places to work’…</td>
<td>…to digital for health and safety</td>
</tr>
<tr>
<td>From cost-efficient cleaning…</td>
<td>From on-site workplace experiences…</td>
<td>…to automated</td>
</tr>
<tr>
<td>…to visible cleaning, hygiene and wellness</td>
<td>From preaching sustainability…</td>
<td>…to data-enabled health monitoring</td>
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<tr>
<td>From blended workplace experiences</td>
<td>From digital for health and safety</td>
<td></td>
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<tr>
<td>…to practicing sustainability</td>
<td>From touch…</td>
<td></td>
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<td></td>
<td>From data privacy fears…</td>
<td></td>
</tr>
</tbody>
</table>

Source: ISS

People Make Places
THE PROGRESSION OF ECONOMIC VALUE

Differentiated

Competitive Position

Undifferentiated

Extract Commodities

Make Goods

Deliver Service

Stage Experiences

Pricing

Market

Premium
# THE EXPERIENCE ECONOMY

<table>
<thead>
<tr>
<th>Economy</th>
<th>Agrarian</th>
<th>Industrial</th>
<th>Service</th>
<th>Experience</th>
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</thead>
<tbody>
<tr>
<td>Economic Offering</td>
<td>Commodities</td>
<td>Goods</td>
<td>Service</td>
<td>Experiences</td>
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<tr>
<td>Economic Function</td>
<td>Extract</td>
<td>Make</td>
<td>Deliver</td>
<td>Stage</td>
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<td>Nature of Offering</td>
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<td>Tangible</td>
<td>Intangible</td>
<td>Memorable</td>
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<tr>
<td>Key Attribute</td>
<td>Natural</td>
<td>Standardized</td>
<td>Customized</td>
<td>Personal</td>
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<tr>
<td>Method of Supply</td>
<td>Stored in bulk</td>
<td>Inventoried after production</td>
<td>Delivered on demand</td>
<td>Revealed over a duration</td>
</tr>
<tr>
<td>Seller</td>
<td>Trader</td>
<td>Manufacturer</td>
<td>Provider</td>
<td>Stager</td>
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<tr>
<td>Buyer</td>
<td>Market</td>
<td>User</td>
<td>Client</td>
<td>Guest</td>
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<tr>
<td>Factors of Demand</td>
<td>Characteristics</td>
<td>Features</td>
<td>Benefits</td>
<td>Sensations</td>
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</tbody>
</table>
Connecting people and places to make the world work better.
13th INTERNATIONAL SEMINAR ON INDUSTRIAL ENGINEERING AND MANAGEMENT

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