

**LEMBAR HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH : PROSIDING SEMINAR INTERNASIONAL BEREPUTASI**

Judul Jurnal Ilmiah (Artikel) : Design and Manufacture of a Low-Cost Data Acquisition Based Measurement System for Dual Fuel Engine Researches

Jumlah Penulis : N Sinaga*, B Yunianto, D Purba, , Syaiful and A Nugroho

Status Pengusul : Penulis ke-1

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Baik dari ruang lingkup maupun kedalaman pembahasan sangat baik dan memadai. Artikel ini membahas tentang integrasi sensor dan akuisisi data pada pengukuran kinerja engine. Modifikasi yang dilakukan memberikan hasil yang cukup baik, sehingga berpotensi dapat diterapkan untuk mengukur performansi mesin. Meskipun demikian, pembahasan yang dilakukan masih perlu ditunjang oleh referensi yang lebih memadai, serta parameter-parameter lain yang relevan perlu diujicobakan.

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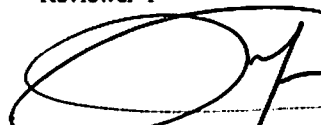
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Semarang, 25 Februari 2020

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Prof. Dr. Moh. Djaeni, ST, M.Eng.

NIP 197102071995121001

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Fakultas Teknik Universitas Diponegoro

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Isi artikel berkaitan dengan studi tentang penelitian untuk memperoleh sistem akuisisi data berbiaya rendah yang dimiliki kinerja bagus saat digunakan dalam penelitian mesin dual-fuel, dimana penelitian ini juga termasuk menseleksi variabel, komponen dan sensor, pemrograman, dan kalibrasi. Metode dan data hasil penelitian telah dibahas dan ditampilkan secara sistematis dan baik. (→ nilai 30 %)

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Reviewer-1



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Design and Manufacture of a Low-Cost Data Acquisition Based Measurement System for Dual Fuel Engine Researches (Conference Paper) (Open Access)

Sinaga, N., Yunianto, B., Purba, D., Syaiful, Nugroho, A.

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^bMechanical Engineering Department, University of Wachid Hasyim, Jl. Menoreh X/22, Sampangan, Semarang, Central Jawa, 50232, Indonesia
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Abstract

The role of data acquisition based measurement system in the researches is essential since it delivers many advantages compared to the manual arrangement. Nevertheless, its cost is comparatively high, then it becomes an obstacle, particularly for researchers in producing nations. The purpose of the study was to obtain a low-cost data acquisition system which has good performance when used in the research of dual-fuel engines. The study included a selection of variables, components and sensors, programming, and calibration. The Arduino based data acquisition system was chosen, which was relatively cheap and easy programming. The sensors/transducers consisted of three K-type thermocouples, three load cells, one proximity sensor, and one DHT-11 sensor. Programming of data acquisition systems was facilitated by using Arduino IDE software. The display and data recording were done in Microsoft Excel software, with the help of PLX-DAQ software. In this study, a low-cost data acquisition based measurement system had been successfully developed, which had low uncertainty, low hysteresis, and excellent repeatability. It is concluded that the system is very suitable to be used in dual fuel engine researches to measure engine speed, fuel discharge, gas fraction, torque, power, brake specific fuel consumption and brake thermal efficiency. © Published under licence by IOP Publishing Ltd.

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Engineering controlled terms:

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- Brake specific fuel consumption
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Conference Speaker



Prof. Chuang-Chun Chiou
Tunghai University, Taiwan

**“Challenges and Opportunities of Implementation of
Lean Manufacturing in Industry 4.0”**

About the Speaker

Dr. Chuang-Chun Chiou is a professor in the Department of Industrial Engineering and Enterprise Information at Tunghai University, Taichung, Taiwan. He received the MS in Industrial Engineering from Texas A&M University, Texas, USA and both the BS and Ph.D. degrees from Tunghai University. He served as a Deputy Secretary General for Chinese Institute of Industrial Engineering in Taiwan (2016-18). He has been appointed as an adjunct professor in the Department of Industrial and System Engineering of School of Engineering and Technology at Asia Institute of Technology, Bangkok, Thailand (2019). His research interests broadly include lean manufacturing, data analytics, modelling and optimization in manufacturing, logistics and healthcare. He has published more than 100 technical papers in journals and conferences. He also coordinated multiple academic and industrial research projects.

Abstract

In the era of Industrial 4.0 (aka, I4.0), with the advanced concepts of cyber-physical systems (CPS), internet of things (IOT), data analytics, and artificial intelligence (AI), there are numerous opportunities to make manufacturing system getting smarter. In this talk, we first review the current development of I4.0 and the implementation of lean concept in manufacturing. After examining what have been achieved in the areas of I4.0 and lean implementation. Then, we re-examine the philosophy of lean and the fundamental value generated from lean management. Especially, the experience of Taiwanese manufacturer will be discussed. We further discuss more opportunities and address the challenges that the manufacturers may encounter in implementing lean manufacturing in the future.

Conference Speaker



Prof. Hui-Ming Wee
Chung Yuan Christian University, Taiwan

“Introduction to Industry 4.0 and Logistic Networks Innovation”

About the Speaker

Hui-Ming Wee is a Distinguished Professor in the Department of Industrial and Systems Engineering, former Associate Dean at Chung Yuan Christian University (CYCU). He has received his B.S. degree (honors) in Electrical and Electronics Engineering from Strathclyde University (UK), M. Eng. from Asian Institute of Technology (AIT), and Ph.D. in Industrial Engineering from Cleveland State University, Ohio (USA). He has received an excellent research award from the Taiwan Ministry of Science & Technology, excellent life researcher award and the Medal for Distinguished Industrial Engineer Award. He has published more than 400 papers in refereed journals, international conferences and book chapters.

Abstract

Due to the advancing Internet of Thing (IoT) & Cyber-Physical Systems (CPS), the era of radically different competition is here! It is predicted in the year 2025, all of things will be connected together as a single network. In this talk, we introduce Industry 4.0 and show how it influence Logistic innovation. Today's advanced analytical tools can extract meaning from all data. Manufacturers and retailers collect data along the supply chains. New technologies grow exponentially. They are changing the world trade. And the introduction of Industry 4.0 will definitely shape the future of logistics. Based on cyber physical production system, orders will be able to steer themselves independently through the entire value chain.

Conference Speaker



Dr. I-Jan Wang
Tunghai University, Taiwan

“Application of AR/VR/MR in Smart Manufacturing”

About the Speaker

Dr. I-Jan Wang is a professor in the Department of Industrial Engineering and Enterprise Information at Tunghai University, Taichung, Taiwan. He received his B.S. and M.S. degrees in computer science and information engineering from National Central University, and National Dong Hwa University, Taiwan, in 2006 and 2008, respectively. He received his Ph.D. degree in Human Factors and Ergonomics Program of Industrial Engineering from National Tsing Hua University, Taiwan, in spring 2018. He was well-versed in interdisciplinary and integration. He had various interdisciplinary and executing experiences with industrial manufacturing, industry-university cooperative research project. In recent years, his research interests include prototyping for product design, parametric design and assistive technology. He also has experiences to integrated CAD and VR/AR/MR(XR) technologies for Industry 4.0. It enables that end-customers could evaluate industrial manufacture with functions of high usability. The interaction system provides a human- centric interactive environment with realistic visualization quality. It serves as an effective communication tool for engineers to collaborative with other resources.

Abstract

Global investors have predicted that the scale value of AR/VR/MR(XR) will hit 150 billion USD in 2020. In addition, AR requirements, technology, and developmental potential are regarded as far higher much greater than VR, at with about 4 four times the scale. Currently, the attention on VR/AR/MR(XR) is mostly focused on the gaming and entertainment industry applications. Innovative applications are still in development. Actually, XR can play an important assistive role in the typical earlier stages where optimization and enhanced productivity are more important than later stages of innovation in Smart Manufacturing.

Conference Speaker



Prof. Benny Tjahjono
Coventry University, UK

“What does Industry 4.0 mean to Supply Chain Management?”

About the Speaker

Dr Benny Tjahjono is Professor of Supply Chain Management and leader of the Sustainable Production and Consumption research cluster at the Centre of Business in Society, Coventry University. Through his 18+ years of experience in teaching and research in the UK, he has established an overarching research area in Sustainable Operations and Supply Chain Management. His research track record has been demonstrated by winning a number of research grants from the UK Engineering & Physical Research Council (EPSRC), Innovate UK, European Union and private sectors. He was a member of a consortium consisting of seven universities in Europe recently being awarded the Horizon2020 MSCA Innovative Training Network. His most recent research grant was funded by the Academy of Medical Sciences' Global Challenges Research Fund (GCRF) in the area of Circular Food Supply Chain. He has published more than 90 papers in refereed academic journals, conference proceedings, books, practitioners' journals and newspapers. He has successfully completed the supervision of 12 PhD students and over 110 Masters Students, and currently leads a team of four doctoral researchers in many areas related to Circular Economy (CE) and sustainability.

Abstract

The vision of Industry 4.0 emphasizes the global networks of machines in a smart factory setting capable of autonomously exchanging information and controlling each other. This cyber-physical system not only enables the smart factory to operate autonomously, but also opens up the virtually endless possibilities for interconnecting human beings and machines in a cyber-physical system. In order to understand the opportunities and (possibly) threats from the introduction of these new technologies, it is therefore necessary to analyse the impact of Industry 4.0 on the supply chain as a whole. The talk will discuss and demonstrate some cases on how Industry 4.0 technologies, such as virtual and augmented realities, 3D-Printing and simulation, will increase the transparency in the supply chain, and subsequently enable a greater collaboration between suppliers, manufacturers and customers throughout the life cycle of the products.

Conference Speaker



Prof. Ir. Dr. Sha'ri Mohd Yusof
Universiti Teknologi Malaysia Kuala Lumpur

“Industry 4.0 Impact on Sustainability of Lean Manufacturing in Organizations”

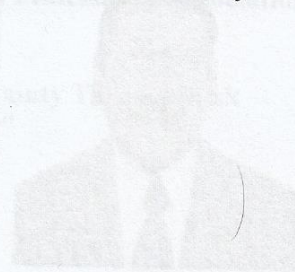
About the Speaker

Professor Sha'ri obtained his degree in Industrial Engineering from University of Miami in 1983, Master of Science in Integrated Quality Systems in 1993 and Doctor of Philosophy in 2000 both from the University of Birmingham. He is a Professor of Quality Engineering and Management in Universiti Teknologi Malaysia (UTM) since 2008. Having completed his bachelor degree, he was attached for one year training in Mitsubishi Motors Corporation, Japan. Upon completion of the training, he worked for almost six years for Proton, the Malaysian National Car, in the Body Assembling Section, and the Quality Control Department. He later joined UTM in 1990 and has since conducted and supervised various research projects at PhD and master level in topics relating to Quality Management, Toyota Production System/Lean Manufacturing, Robust Quality Engineering, and Industrial Engineering. He has extensively published in related journals and conference and possess wide experience in developing and ensuring quality of academic programs. He is a Board Member of the Asia Pacific Industrial Engineering and Management Society (APIEMS) since 2010. He is involved in national committees including SIRIM Standard Committee on Braking System and MPC Manufacturing Consultative Committee. He has also provided training for organizations including Proton, IWK, Hitachi Chemical, and Mitsubishi Electric on topics of Quality Engineering, ISO 9001, Industrial Engineering, and Project Management. He is currently conducting a research project in developing a framework for lean sustainability for Malaysian companies.

Abstract

This talk will look into impact of Industry 4.0 in sustaining lean manufacturing in organizations. It begins with a brief historical overview of the conditions resulting in the invention of TPS by its founders and champions, providing the basis of lean manufacturing. This will be followed by a description of the elements that Toyota was able to implant resulting in the building of their organizational capabilities able to sustain

and continuously challenge and improve their level of achievement and performance. One then needs to explore and look at how to integrate Industry 4.0 concepts and technologies into organizations to sustain excellence. At the same time, one also wants to look at the risks for not adopting Industry 4.0. Finally, it is suggested to use other newer concepts such as Quality 4.0 for companies to pursue the vision for Industry 4.0.



About the Speaker

Dr. Bambang Firdausy is a Chairman of National Agency for Standardization (BSN) and Head of National Accreditation Council (KAN). In 1983 graduated from Agricultural Technology Faculty at IPB Bogor and received MSc and PhD at Georg August University Göttingen, Germany. After finishing his study he worked as researcher at Indonesian Institute for Science (LIPI) at Research Center for Biomedical and 2005 appointed as head of Research Center for Biotechnology, LIPI and also promoted as Research Professor in 2006. In 2007 he got additional task as Deputy Chairman for Life Sciences. In 2018 also appointed as Head of National Committee of Bioprocess (KBN-BRC), Head of National Committee of Codex Indonesia and IEC.

Abstract

Many effort and activities in various sectors applied to make significantly contribution for Sustainable Development Goal (SDG). At the same time we recently a lot discussion out implementation of concept of supporting technology for Industry 4.0. Indonesia now has a road map for making Industry 4.0. Recently may discussion about Society 5.0 has been carried out in several moments in Indonesia. In this paper will be report the role of standardization and conformity assessment for supporting Industry 4.0 and also for Society 5.0 in relation to sustainable development goal. The standardization will provide a general platform to operate the system to make the sub-system interoperable. The consideration will include the social, environmental and economical aspects with respect to existing factual diversity.

Conference Speaker



Prof. Dr. Bambang Prasetya
**Chairman of National Agency for Standardization-
BSN/National Accreditation Council-KAN**

**“Role of Standardization and Conformity Assessment for
Supporting Industry 4.0 and Society 5.0 in relation to
Sustainable Development Goals”**

About the Speaker

Dr. Bambang Prasetya is a Chairman of National Agency for Standardization (BSN) and Head of National Accreditation Council (KAN). In 1983 graduated from Agriculture Technology Faculty at IPB Bogor and received MSC and PhD at Georg August University Gottingen, Germany. After finishing his study he worked as researcher at Indonesian Institute for Sciences (LIPI) at Research Center for Biomaterial, and 2005 appointed as head of Research Center for Biotechnology, LIPI and also promoted as Research Professor 2005. In 2007 he got additional task as Deputy Chairman for Life Sciences. In 2018 also appointed as Head of National Committee of Biosafety (KKH-PRG), Head of National Committee of Codex Indonesia and IEC.

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Conference Speaker



Dr. Antonius Alijoyo
Head of Indonesia Risk Management Professional Association (IRMAPA)

“ISO 31000: Navigating Uncertainty Through Risk Management”

About the Speaker

Dr. Antonius Alijoyo, MBA, BCCE, CCSA, CFSA, CGAP, CRMA, CGEIT, CFE, CERF, ERMCP, is a leading governance and risk management expert in Indonesia. Spending his early professional career as senior and top management in mostly multinational companies, Dr. Antonius was also a former committee member and board of commissioner's member in companies from various industries, as well as a former audit board of Indonesia Financial Services Authority (OJK). Right now, he is an independent commissioner of multinational insurance companies, chairman of technical committee 03-10 under Indonesia National Standardization Agency (BSN) for governance, risk management and compliance (GRC) and national mirror committee of ISO/TC 262 risk management and ISO/TC 309 governance and compliance management system, chairman of Indonesia Risk Management Professional Association (IRMAPA), board member of National Committee of Governance Policy (KNKG), and founder of Center for Risk Management Studies (CRMS) Indonesia. Earned a doctorate degree in governance from University of Parahyangan, Dr. Antonius does not only serve his time as a practitioner but also shares his knowledge and experiences to the younger generations by being a lecturer at his alma mater and other universities.

Abstract

Just like two sides of a coin, expecting tons of opportunity that come with interconnected world of industry 4.0 at the same time requires organizations around the world to build their readiness for a new landscape of risks. An organization needs to have the ability to understand its risk universe, and build its capacity to anticipate the risks, in order to overcome future disruptive challenges. This session will discuss the roles of business leaders in building a solid platform for effective risk management practices throughout the organization, and how ISO 31000 as an international best practice reference helps them in implementing a sound risk management system within the organization.

Conference Speaker



Dr. Aries Suanty
Diponegoro University, Indonesia

**“Supply Chain Management, Circular Economy, and
Industry 4.0: A research agenda”**

About the Speaker

Dr. Aries Suanty ST MT is a lecturer in the Department of Industrial Engineering at Diponegoro University, Semarang, Indonesia. She obtained her Doctoral in Industrial Engineering from the Bandung Institute of Technology. She served as Secretary of Master Program of Industrial Engineering and Management from 2017. Her research interests broadly include supply chain modelling, supply chain governance, supply chain policy, procurement, and logistics strategy. She has also interests in the field of management and organisation lean manufacturing, data analytics, modeling and optimization in manufacturing, logistics and healthcare. She has published more than 50 technical papers in journals and conferences. She also coordinated multiple academic and industrial research projects.

Abstract

We can't have a circular economy without the 4th industrial revolution. The circular economy requires green supply chain activities in order to function. The circular economy includes a broader set of practices and policies at multiple levels. Most of the work on the circular economy has occurred at a macroeconomic level, but practices at the organizational and supply chain level are important in the operationalization of the circular economy. The various technologies under the umbrella of Industry 4.0 serve as a major enabler of circular strategies. At the same time, this contribution to a circular economic model gives the development of Industry 4.0 purpose and momentum. The following examples show how this may occur in practice. Internet of Things (IoT) & data analytics, products that are connected to the IoT allow manufacturers to control and analyse their performance at a distance and collect usage data. Industry 4.0 technologies can minimize unreliable demand planning and overproduction. More accurate demand forecasts as enabled by Industry 4.0 applications lead to reductions in waste, because

needed input materials could be projected more accurate (which will reduce inventory) and overproduction can be reduced), Advances in robotics allow manufacturers to employ robots in an increasing number of applications, thereby increasing yield and reducing waste, as well as extending product life times. The use of 3D printing for the on-demand production of spare parts improves maintainability and extends the life cycle of products and equipment. It also affects product design in that future 3D part maintenance can be built in to the process.

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The Difference of Traditional Fishing Boats in Blimbing and Brondong Sub-districts,
Lamongan, Indonesia

Y Praharsi, M A Jami'in, G Suhardjito and H M Wee

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Integrating Importance-Performance Analysis into E-S-QUAL and E-RecS-QUAL scales
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M M Ulkhaq, M Rabbani, B A Rachmania, A T Wibowo and F Ardi

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An Assesment of Sebelas Maret University Readiness to Establish Product Certification
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S R Fauziyah, F Fahma and R Zakaria

The Difference of Traditional Fishing Boats in Blimbing and Brondong Sub-districts, Lamongan, Indonesia

Y Praharsi¹, M A Jami'in¹, G Suhardjito¹ and H M Wee²

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Abstract. There are 17 fisherman's offices in Lamongan regency whose record the data of traditional fishing boats. However, there are only two fisherman's offices whom very active, i.e.: Blimbing and Brondong sub-districts. Blimbing has the data of 394 traditional boats while Brondong has 207 ones. In this study, we compare the Gross Tonnage-Size of traditional boats, the type of fish catching tools, and the frequency distributive between the two sub-districts. The results show that the mean of GT-size in Blimbing and Brondong is 15 GT and 10 GT respectively. The Pareto charts show that more than 50% in Blimbing used trawl while more than 60% in Brondong used fishing rods. We did the hypothesis test for the mean of GT-Size. The results of hypothesis show that there are differences of mean between the two sub-districts. Subsequently, we create the frequency distributive in each district. By this study, it is expected that the data extraction of traditional boats in Blimbing and Brondong gives a comprehensive description and understanding for the standardization of traditional fishing boats.

1. Introduction

The traditional fishing boat are still used and produced by fishermen in Lamongan regency. Traditional fishing boats are made from wooden [1] [2]. The fishermen build the traditional fishing boats by a heritage technique from their ancestors [1] [4]. Most of the fishermen are registered as a membership among the seventeen fishermen offices. In each office, there is an organization structural including the chief, the secretary, the treasure, the chief of sub divisions in advocacy and law, in development of fish processing, in society service, in training and education for fishermen, in discipline, and members. However, there are only two fishermen offices whose very active organizations, i.e.: Brondong and Blimbing sub-districts. Brondong has 207 members of fishermen while Blimbing has 394 members ones. When our research team visited these two offices, we discussed about the characteristics of traditional fishing boats in both territories [5]. However, they could not explain about the mean of GT size, the majority of fish catching tools used by fishermen, and the data dispersion of their members. This study is motivated by their problem. We aim to extract the data of membership in Brondong and Blimbing sub-districts by the central tendency distribution, the hypothesis testing of mean of GT sizes in both sub-districts, and the frequency distribution table to describe the data dispersion.

In order to describe the data quantitatively, the measurements used in the central tendency distribution are mean, mode, median, quartile 1, and quartile 3. We also consider the data dispersion



Integrating Importance-Performance Analysis into E-S-QUAL and E-RecS-QUAL scales for Assessing Electronic Service Quality

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Abstract. In this globalization era, service sector has been arguably affected and influenced by the internet for doing several activities, especially in doing business. As a result, service sector nowadays has transformed from the conventional way into the electronic service (e-service). This paper tried to integrate the importance-performance analysis (IPA) model to E-S-QUAL and E-RecS-QUAL scales to assess the e-service quality. It implies that not only the performance of e-service quality is assessed, but also its importance. It is according to the fact that every service provider is believed to have limited resources. Therefore, the resources have to be best deployed based on the priorities (i.e., importance) to achieve customer satisfaction. A case study was performed in one of the largest online fashion shops in Indonesia to show the applicability of the methods. It is believed that this research could offer the service providers with valued understanding of the service attributes that manifest point of views of the customers.

1. Introduction

In this competitive global market era, the internet has developed remarkably fast to facilitate tons of people in the world. The internet users are estimated to be more than 40% of the world population [1]. The internet, over the past decades, has strengthen itself as an impressive platform that has transformed the way people behave, in this sense, to do business. With the aid of the internet, the companies have adopted new information and communication technology to help their businesses. They tried to enhance some competitive advantages to interact with their customers by using electronic transactions or electronic commerce (e-commerce). Most successful companies have realized that the vital factors for being successful or being failed in employing the e-commerce are not simply the presence of website and lower products price, but also the quality of electronic service (e-service) [2]. Consequently, they need to move from e-commerce, i.e., the transactions only, to e-service, i.e., all signals and encounters involving the transactions [3].

Contrasting with the notion of traditional service quality that has been investigated by abundant researchers (e.g., [4]–[9]), the research on the e-service quality are still at an initial phase [10]. The e-service quality is defined by Santos as “overall customer assessment and judgment of e-service delivery in the virtual marketplace” [11]. There are several assessing schemes to assess and measure the e-service quality, such as: SITEQUAL [12], WebQual 4.0. [13], WebQualTM [14], eTailQ [15], e-SERVQUAL [16], eTransQual [17], and PeSQ [18].

Although the previous research has defined the exact area of the quality construct and deliver a clear definition of the e-service, most of those do not present a wide-ranging assessment of the web-site and



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Application of Spatial Analysis for Delineating Groundwater Recharge Zone for Industrial Usage in Tanah Bumbu Regency, South Borneo/Indonesia

Traffic Accident Severity Prediction Using Naive Bayes Algorithm- A Case Study of Semarang Toll Road

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Abstract. A traffic accident was one of the leading cause of death in Indonesia. Toll Road is one of the places where traffic accidents occur. In 2007-2017 there were 501 accidents at Semarang Toll Road. Accident in Semarang Toll Road has a variety of severity. The most severe case is death. A traffic accident can lead to death. One of the ways to decrease the number of the accident was decreased the severity of the accident. This achieved by making a prediction model. The prediction model can predict the severity of the accident based on the attribute affecting the severity of the accident. In this research, Days, Type of Road, Weather, Condition of Road, Time of the accident, Sex of Driver, and Type of Vehicle were chosen as attributes to make prediction model of accident severity. Naive Bayes algorithm was used to make the model which can predict accident severity. The result was an accident prediction model with an accuracy of 39.49% to predict accident severity and the probability of an accident.

1. Introduction

Accidents are defined as an unplanned and controlled event that can be caused by humans, situations, environmental factors, or combinations of these things [1]. The causes of traffic accidents were grouped into four elements, namely human, vehicle, road, and environment [2]. Environmental factors were weather conditions (foggy and rainy). Weather conditions had a significant impact on vehicle performance, driver's visibility, driver behavior, travel demand, traffic flow characteristics, and traffic safety [3]. A traffic accident is one of the leading cause of death in Indonesia. The amount of traffic accident in Semarang Toll Road were 501 from 2007 to 2017. A traffic accident has a level of severity in which the highest was death. Based on this, any attempt to increase safety in Toll Road need to be done, and one of the ways to do this is by decreasing the level of severity in an accident.

In their research, [4] said that many factors are leading to how an accident happens namely environmental factor like weather condition, type of vehicle, driver behavior and characteristic factor like an age of driver and sex type of driver. These factors have a role in determining the severity level of the accident. In other research, [5] said that by applying the data mining technique to make a prediction model in these traffic accident data, it could help decision maker to make a decision related to the safety of a driver. So in accordance with this, we can agree that safety in Toll Road can be increased by making a prediction model of accident severity.

According to [6], *data mining* was a process to gain pieces of information from a group of data which help in making a decision. Data mining consists of Classification, Clustering, Estimation, and



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Hazard Identification, Risk Assessment, and Risk Controlling Using Hazard Identification and Risk Assessment Method

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A Simulation-Based Approach to Assess Eco-Process Innovation Performance

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Abstract. In the recent decade, eco-process innovation practice has been prioritised over other green strategies to help manufacturing firm becoming more sustainable. This paper evaluates the improvement in production cycle time as an outcome of the eco-process innovation, using the actual data of a manufacturing facility. Discrete event simulation approach was adopted to model and simulate the cycle time of previous state and current state of an eco-innovated production line. Result of cycle time per entity revealed a 6% reduction, thus proving that implementation of eco-process innovation could improve the economic performance of manufacturing firm. The study is a small part of a larger research work of which the authors are developing indicators for measuring eco-process innovation performance at firm level.

1. Introduction

Manufacturing refers to the process of transforming input resources such as material, people and machines into products to fulfill human needs and generate wealth for the manufacturer. However, manufacturing processes has indirectly resulted to degradation of the environment due to their side produces such as waste, emissions and other unfavorable outputs. Numerous approaches have been adopted by manufacturers to obtain the most optimized production operations, yet associated with minimal environmental unfavorable impacts. The incorporation of eco-innovation practice into the manufacturing processes (known as eco-process innovation) is an effective initiative to achieve the intended eco-friendly results [1][2][3]. [4] View of eco-process innovation as the changes of existing production methods or addition of new processes to minimize the environmental impacts. Moreover, it relates directly to operations activities and concerned with process upgrades or introduction of new techniques and technology into production operations [5][6] which improve resources consumptions and production efficiency, thereby leading to waste and cost reduction [4][7]. In agreement to [8], this study refers to eco-process innovation as any eco-innovation taking place in the production processes which are aimed at an improved economic, environmental and social performance of the firm. However, this study is primarily concerned with the economic aspect of eco-process innovation performance, specifically indicated by production cycle time.

Development and refinement of effective mechanisms to assess eco-process innovation performance is of vital importance for various reasons such as benchmarking [12], improvement plan design [13] and provide stakeholders with information on firms' actual eco-innovation performance [10][14]. Recently, some researchers and practitioners have developed instrument for measuring performance of eco-process innovation implemented in manufacturing firms [4]. However, such efforts are scattered and





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