PROCEEDING

ICONETSI

International Conference on Engineering and Information Technology for Sustainable Industry **2020**

28 - 29 September 2020

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MESSAGE FROM RECTOR

Swiss German University (SGU) has been established for 20 years. As a university committed to striving for quality education, SGU organizes its annual event, the International Conference on Innovation, Entrepreneurship and Technology – ICONIET to give a platform for researchers, practitioners, government officials to present and discuss their works. The ICONIET 2020 consists of two sub-conferences, namely "International Conference on Engineering and Information Technology for Sustainable Industry 2020 (ICONETSI)" on Monday & Tuesday, 28-29 September 2020 and "International Conference on Global Innovation and Trend in Economy (INCOGITE 2020)" on Thursday, 5 November 2020.

The conference has the same theme as the 20th anniversary of SGU, "Transforming Digitally, Empowering Globally". Digital transformation is a must. It connects technology specialists across all sectors and fields in order to meet business needs and market requirements. It builds innovation and high-tech know-how to assist business initiatives or to upgrade technology for future growth. SGU has also participated in education for empowering communities globally. By lifting up individuals within communities, SGU encourages and supports sustainable community and economic development. Good quality of education and research will generate technology, innovation and entrepreneurship which will eventually improve quality of life and the prosperity of societies, nations and the world as a whole.

This year, the ICONIET is conducted in the midst of pandemic Covid-19 and hence, will be fully virtual using video conferencing. I'd like to take this opportunity to welcome all honorable guests, speakers, presenters and participants, who have come not only from Indonesia, but also from different countries such as Germany, Japan, Malaysia, the United Stated, Singapore, Egypt and Taiwan.

I'd like to personally thank the Committee of ICONIET 2020, including the committee of ICONETSI and INCOGITE 2020, who have put their utmost efforts into organizing this event. I wish to express my gratitude to the Ministry of Research, Technology and BRIN for their continuous support to our research. I would also like to thank SGU's University partners, the South Westphalia University of Applied Sciences and the University of Applied Sciences Jena in Germany, as well as the International Management Institute (IMI) in Switzerland.

We do hope that the conference will be beneficial and mind-opening for all participating parties. Let us use this event to exchange ideas and to extend our networking virtually, with the aim of empowering the wider global community.

Respectfully yours,

Dr. rer. nat. Filiana Santoso
Rector of Swiss German University

MESSAGE FROM CONFERENCE CHAIR

I would like to welcome you to the 2020 1st International Conference on Engineering and Information Technology for Sustainable Industry, Tangerang, Indonesia. ICONETSI 2020 provides a scientific platform for both local and international researchers, engineers and technologists who work in all aspects of Engineering and Information Technology for Sustainable Industry to exchange their latest research results. In addition to the contributed papers, internationally well-known experts are also invited to deliver keynote and plenary speeches at ICONETSI 2020. We are honored to have the distinguished keynote speakers: Prof. Bambang PS Brodjonegoro, Ph.D of the Minister of Research and Technology – BRIN, INDONESIA; and also Prof. Dr. Engg. Koichi Murata of Nihon University, Japan; Prof. Dr. Eng. Agus Purwanto of Universitas Sebelas Maret, Indonesia; Assoc. Prof. Dr. Waseem Haider of Central Michigan University, USA; Dr. Anto Satriyo Nugroho of Agency for Assessment and Application of Technology – BPPT, Indonesia; Assoc. Prof. Yudi Fernando PhD M.LogM of Universiti Malaysia Pahang, Malaysia; and Dr. Charles Lim, BSc., MSc. of Swiss German University, Indonesia as our invited speakers.

The conference is organized as a set of tracks in Sustainable Energy and Environment, Production and Operation Management, Logistics and Supply Chain, Ergonomic and Human Factors, Automation, Mechatronics and Robotics, Cyber Security and AI, and Software Engineering.

In this first event of ICONETSI 2020, we have received 125 paper submissions from Germany, Japan, Taiwan, Singapore, Egypt and Indonesia. To ensure the high quality of papers in ICONETSI 2020, each submission is reviewed by no less than three reviewers through a blind review process. In addition, we also carefully check the similarity rating to avoid plagiarism, and the writing format according to the conference proceedings template for each submission. After a careful review process, the program committee accepted 76 high quality full papers for presentation in ICONETSI 2020.

The successful organization of ICONETSI 2020 has required strong support from Indonesia Honeynet Project, Industrial Engineering Higher Education Organizing Cooperation Agency (BKSTI), Pusat Unggulan Iptek (PUI) Baterai Lithium Universitas Sebelas Maret, and Indonesian Association for Pattern Recognition (INAPR).

Most of all, I thank you, the participants, for enriching this conference by your presence. I am thankful to the conference organizing committee members, the track chairs, the session chairs, and the numerous volunteers, without whose generous contributions, this conference would not have set a record number of presentations and number of participants, higher than our expectation, especially considering some difficulties that happened during the Covid-19 pandemic. We truly believe the participants will find the discussion fruitful, and will enjoy the opportunity of setting up future collaborations.

Warm Regards,
Assoc. Prof. Dr. Tanika D Sofianti
ICONETSI 2020 General Chair

Keynote Speaker

Prof. Bambang Permadi Soemantri Brodjonegoro, Ph.D

Minister of Research and Technology - The National Research and Innovation Agency of the Republic of Indonesia

Short Biography:

Prof. Bambang Permadi Soemantri Brodjonegoro, Ph.D is the Minister of Research and Technology and Head of the National Research and Innovation Agency of the Republic of Indonesia. Previously, he was the Minister of National Development Planning of the Republic of Indonesia from 2016 to 2019 and also the Minister of Finance from 2014 until 2016. He has also worked in various roles in the Ministry of Finance. The opportunities to contribute as the Minister of Research and Technology, Minister of National Development Planning, and Minister of Finance have established Prof. Brodjonegoro's career in integrating Indonesia's research, technology, innovation, development planning, financing, and economic stabilization. Prof. Brodjonegoro earned his Ph.D in Urban and Regional Planning from the University of Illinois at Urbana–Champaign, United States in 1997. Afterward, he started his academic career as a lecturer in Universitas Indonesia and became Dean of the faculty of economics, Universitas Indonesia from 2005 to 2009. His research mostly focuses on Economics. He has also been actively involved in various local and international organizations and Indonesian companies, including being the director-general of the Islamic Research and Training Institute (IRTI), Islamic Development Bank Group, Jeddah, The Kingdom of Saudi Arabia in 2010. He was also awarded several honor and awards, including Bintang Maha Putra Utama from President of Indonesia and Bintang Bhayangkara Utama from the Indonesian National Police.

Invited Speaker 1

On the Role of Industrial Engineering in the COVID-19 Era

Prof. Dr. Eng. Koichi Murata
Nihon University, Japan.

Abstract:

The purpose of this study is to consider the role of industrial engineering in the era of COVID-19. This paper is divided into three parts. Firstly, the history of industrial engineering is reviewed to confirm the richness and compensation of life brought by the division of labor. The second part describes the exchange that should be paired with the division of labor, and what it is likely to be, and then explains that the integration of the division of labor and its exchange is a future issue for humanity. The third part, regarding the touch strategy that is the first step of exchange, reviews the concept of visual management, which is a precedent case, and tries to systematize the three touch strategies that were tried in the early stages of the spread of COVID-19 in Japan. The results obtained from this survey show that it is important for industrial engineering, which has been trying to understand management resources from various perspectives, to engage not only in the division of labor, but also in their exchange. Also, in an era where environmental destruction and digitalization are progressing at a speed that humanity does not notice, the findings can be considered as a problem in order to produce human resource workers whose value is higher than ever.

Short Biography:

Koichi Murata is the head of operations & production management laboratory and a professor at the Department of Industrial Engineering and Management, College of Industrial Technology, Nihon University. He previously worked in industry as an industrial engineer at the flagship factory of Murata Manufacturing Co., Ltd., which is a global leader mainly in the manufacturing of electronic components. His research interests include operations & production management, kaizen, lean management, visual management, technology transfer, knowledge management, sustainable supply chain and others. Dr. Murata has published articles in international academic journals such as International Journal of Production Research, Sustainability, Journal of the Operations Research Society of Japan, and others. He was interviewed for NHK and the Associated Press (AP) about the prospects for the manufacturing industry.

Invited Speaker 2

Honeynet Threat Sharing – One step closer to Cyber Situational Awareness

Dr. Charles Lim, BSc., MSc., CTIA, CHFI, EDRP, ECSA, ECSP, ECIH, CEH, CEI
Swiss German University; Indonesia Honeynet Project

Abstract:

As organizations are digitally transforming their business, they are encountering security risks to slow down their intent. A collection of honeypots, i.e. honeynet, are often deployed in their infrastructure to detect the early cyber security attacks into the infrastructure, allowing the organization to be more aware of the emerging threats. Organizations may forge to stay relevant, timely and accurate in assessing these threats when they are willing to share these threats to the community of interest, providing the first step to cyber situational awareness.

Short Biography:

Charles Lim is a Cyber Security Researcher and Lecturer at Swiss German University, an independent researcher who works closely with Badan Siber dan Sandi Negara (BSSN) and a professional IT security related consultant and trainer. He is one of the recipients of the 2019 ISIF Asia Network Operations Research Grants and 2020 Internet Operations Research Grants. He also holds a few security professional certifications in the area of incident response, threat intelligence and security analyst, from ECCOUNCIL. He has a Doctorate degree in Electrical Engineering from Universitas Indonesia, Master of Science in Electrical Engineering from University of Hawaii, USA and his research includes Malware Analysis, Digital Forensics, Cloud Security, and IT Security Architecture. He is actively involved with many cyber security communities, such as Indonesia Honeynet Project (IHP), ACAD CSIRT (Academy Computer Security Incident Response Team), Indonesia Digital Forensics Association (AFDI), and others.

Invited Speaker 3

Recent Trends in 3D Printing

Assoc. Prof. Dr. Waseem Haider
Central Michigan University, USA

Abstract:

Additive manufacturing or 3D printing of metals is emerging and rapidly growing manufacturing technique from prototyping to large production runs. This process involves the fusion of metal powder bed by selectively melting above the melting temperature and building layers on top of each other. The imminent advantages of producing complex geometries, unprecedented manufacturing flexibility, product customization and at the same time economically viable process makes it a potentially disruptive technology for different industrial applications. The huge interest of industries for adapting this technology also brought the attention of research community to work in this area with full potential. The changed melting and solidification dynamics during additive manufacturing, results into striking differences in the microstructural evolution in comparison to the one obtained through conventional casting process. The microstructure variation strongly impacts the other structural properties of the material, e.g. mechanical, electrochemical etc. and this provides different avenues for the research community. Our group is working to elucidate the electrochemical response and the nature of passive oxide film formed on the additively manufactured 316L stainless steel for varying applications (biomedical, petrochemical and food industries).

Short Biography:

Dr. Waseem Haider is a tenured associate professor at School of Engineering and Technology, Central Michigan University, USA. He earned his PhD in Mechanical Engineering from Florida International University in 2010. He got a post-doctoral fellowship in materials science and engineering at Pennsylvania State University. Afterwards, he joined orthopedic research labs as a research scientist at State University of New York. Soon after that, he joined University of Texas as tenure track assistant professor where he served for three years. Dr. Haider's research focuses on Materials Science and Biomedical Engineering with special emphasis on Biomedical Materials Surface Chemistry, Electrochemistry, Bulk Metallic Glasses, and Nanomaterials. His research is supported by National Science Foundation and Department of Defense.

Invited Speaker 4

Engineering Design and Blockchain Technology for Sustainable Industry: A Circular Economy Perspective

Assoc. Prof. Yudi Fernando PhD M.LogM
Universiti Malaysia Pahang, Malaysia

Abstract:

The manufacturing industry is an essential sector, especially in developing countries, and significantly contributes to a nation's economy. These significant contributions are due to the availability of vendors with capabilities supporting low-cost production with quality materials. These significant contributions should not overlook other outputs from this industry as one of the largest emitters of greenhouse gasses, pollution, and waste that contribute to negative environmental impacts. These externalities are due to waste from the energy and material resources required to be processed into finished products. While the manufacturing industry has contributed enormously to wealth and job creation, thus improving quality of life, this is happening at the expense of delivering unsustainable amounts of solid waste and pollution. Due to many competing factors, the manufacturing industry is transforming from a linear economy model (make, use and discard) to a global circular economy in which the components of products are fed back to production after their service life. Yet, scanty evidence exists on how the manufacturing firms report on the success story of the remanufacturing process of leftover materials, return products and scrap. In the past, environmental concerns were mostly neglected in the manufacturing and supply chain processes. Circular economy, a term which used to be known as the remanufacturing of scrap, is an alternative method to counter this issue. The engineering redesign needs to be adopted with the proper integrity platform. Blockchain technology can be used to improve visibility, transparency and the accurate computation of the production and overall supply chain's carbon footprint. Blockchain technology has a high level of security and cannot be hacked. It can be used to support the integration of energy production, utilization, transmission, and storage so that every carbon footprint activity and carbon trading transaction can be tracked and no data can be manipulated. In regard to the importance of engineering design using circular economy concept and industrial revolution 4.0 enabler technology like blockchain, I will be presenting a remanufacturing model for sustainable industry that will assist the industry and academia to find alternative solutions to turn waste into value-added products.

Keywords: remanufacturing; design; circular economy; blockchain technology; industrial revolution 4.0; sustainability

Short Biography :

Yudi Fernando is an Associate Professor and holds a PhD. He is the Editor-in-Chief Industrial Management: An International Journal and Managing Editor of Journal of Governance and Integrity at the Faculty of Industrial Management, Universiti Malaysia Pahang. He is a Research Committee Chair and founding member of the Malaysian Association of Business and Management Scholars (MABMS). He is also a member of the Society of Logisticians, Malaysia/Pertubuhan Pakar Logistik Malaysia (LogM). Prof. Yudi is involved actively as the assessor for ABEST21 (Alliance of Business Education and Scholarship for Tomorrow) program-based accreditation system. His research interest is in the areas of sustainable supply chain; circular economy 4.0 and blockchain technology and he has supervised 9 PhDs, 11 ongoing, and more than 70 Master theses. His works can be found in the top tier journals such as: Journal of Cleaner Production, *Resources, Conservation* & Recycling, Sustainable Production and Consumption; tourism management International Journal of Information Management; Food Control, Journal of Energy Policy and others.

Invited Speaker 5

Biometrics Technology for Better Public Services

Dr. Eng. Anto Satriyo Nugroho
Center for Information and Communication Technology,
Agency for Assessment and Application of Technology (PTIK BPPT)

Abstract:

Kartu Tanda Penduduk Elektronik (KTP-el) is a National electronic ID card which is issued by the Indonesian government. The goal of KTP-el is to develop an accurate national population database, and ensure a single identity number (SIN) for the citizens. The unique identity of each citizen is verified using biometrics data: ten fingerprint scans, two iris scans and a face scan. More than 190 million citizens have had their biometrics data taken. The scale of biometrics data is the second largest biometrics data in the world after those collected by Unique Identification Authority of India (UIDAI). The data opens various applications such as biometrics authentication for banking, forensic identifications, and electronic voting. In this presentation, we will discuss several topics including biometrics testing of KTP-el Reader, the usage of KTP-el and biometrics for public services, and the future of biometrics data.

Short Biography:

Anto Satriyo Nugroho works for the Center of Information & Communication Technology, Agency for the Assessment & Application of Technology (PTIK BPPT), Indonesia. He completed his B.Eng. (1995), M.Eng. (2000) and Dr.Eng. (2003) in Electrical and Computer Engineering from Nagoya Institute of Technology, Japan. From 2003 to 2007, he was working as visiting professor at School of Life System Science & Technology, Chukyo University, Japan. His research interest is on pattern recognition and computer vision with applied field of interest in Multimodal biometrics Identification and Computer Aided Diagnosis for Malaria Detection. He is the 1st president of Indonesian Association for Pattern Recognition (INAPR), and an Indonesian Governing Board member of International Association of Pattern Recognition (IAPR). Dr. Anto Satriyo Nugroho is a member of IEEE, Indonesian Association for Pattern Recognition (INAPR), Indonesian Association for Computational Linguistics (INACL) and Indonesian Society of Soft Computing.

Invited Speaker 6

Recent Progress of Lithium Ion Battery for Electric Vehicles

Prof. Dr. Eng. Agus Purwanto, ST. MT
Lithium Battery Research and Technology Centre,
Universitas Sebelas Maret, Surakarta, Indonesia

Abstract:

At the end of 2019, the Nobel prize in chemistry was awarded for the advancement of Li-ion batteries considering its discovery promotes the current technology and lifestyle. Li-ion batteries (LIBs) are considered as a vital and predominant power source for various wireless and portable electronics, and have even been applied to high performance Electric Vehicles, especially BEV and HEV. It is predicted by 2030, the largest Li-ion Batteries market will be electric vehicles, mainly cars. As it progressed, current problems found during the development of LIBs were addressed and needed to be overcome such as performance, cost, weight and size. However, cell chemistry and thermal management became the main focus. Cell chemistry considers not only the electrochemical performance, but also its availability to avoid material shortage in the future. It appears that $LiFePO_4$ and graphite system was selected due to its safety properties. However, future trends tend to use nickel rich cathode and silicon-graphite anode for high voltage (up to 5 V) and high energy density batteries. However, high energy density results in high thermal runaway risk, thus making thermal management and failure mechanisms equally as important as cell chemistry. Failure mechanisms of LIBs have been extensively studied. From the material level, challenges such as undesired side reaction, particle breakage and passivation and metal dissolution are often found. However, the current technology of morphology control, nano-layer coatings and structural modification can be used to solve these problems. At the cell level, extensive safety tests, i.e. a mechanical test, thermal test and electrical abuse test are necessary to assure the safety of LIB cells for EVs. With good battery cell design, safety issues can still emerge due to the use of liquid electrolyte which is often flammable and unstable at elevated voltage and temperature. This phenomenon has initiated the development of solid electrolytes for high safety all-solid-state batteries (ASSB). In conclusion, LIBs bring numerous advantages for civilization, however, during worldwide EV application, intrinsic and extrinsic challenges still remain under investigation. With excellent efforts, high safety electric vehicles will undoubtedly be achieved in the near future.

Short Biography:

Agus Purwanto is recognized as an Indonesian developer of Lithium Ion Batteries (LIBs) and the leader of the Centre of Excellence for Electrical Energy Storage Technology

(CEFEEST) Universitas Sebelas Maret. His current work is developing LIBs active material and design. He is the author of over 100 scientific papers, co-inventor of 14 inventions and a Professor in Chemical Engineering.

Agus Purwanto was born in Sragen, Indonesia in 1975 and currently lives with his family in Solo. He obtained his bachelor and master degree in Chemical Engineering from Institut Teknologi 10th November 1998 and 2002 respectively, and his Doctoral degree from Hiroshima University. He is taking a faculty position in the Chemical Engineering Department of Universitas Sebelas Maret.

Agus Purwanto has collaborated with many organizations and industries such as Indonesian Endowment Fund for Education (LPDP), Indonesian Institute of Science (LIPI), the National Nuclear Energy Agency (BATAN), PT Pertamina and Toyota. Agus Purwanto has received multiple awards including: Outstanding Lecturers of Universitas Sebelas Maret (2011), Academic Leader in Technology by Ministry of Research and Technology and Higher Education (2017), and Science and Technology Award by ITSF (2020).

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(ICONETSI 2020)

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New Product Development with Kano Model to Supports Supply Chain Performance of Jewelry Industry in Indonesia

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ABSTRACT

Current consumer demands make product development and delivery's period becomes shorter so that the product life cycle is shorter, especially for fashion items that have a short lifecycle. Collaborate with customers in product development is essential to accelerate the product development's process. Combination of customer satisfaction methodologies, Kano and QFD make easier to capture customer qualifications, determine which components to develop also repair it, and helps practitioners and researchers know the life cycle every design attributes. The results of this study resulted in a framework that makes use of n integration method Kano, customer's satisfaction, and QFD.

CCS CONCEPTS

• Applied computing → Operation Research → Industry and manufacturing →Supply chain management

KEYWORDS

Supply chain management, new product development, Kano model, customer satisfaction, QFD

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1 Introduction

Supply chain is all parties are involved directly or indirectly in the delivery of goods to end customer. As a result of industrial development 4.0, the supply chain changes the way they work. They send the product faster by shortening the time of developing. This strategy gives impact on product lifecycle being shorter. The synergy between the supply chain and product development is important to produce new products faster. However, some new product innovations fail in the market because it is not proper market research and customers are not easily satisfied even if the products already meet their needs. New product ended up being wasteful and costly. It is also spending more costs on valuable goods or high value such as jewelry. Jewelry companies must prevent it by developing products that can capture needs and improve customer satisfaction. The consideration of inviting consumers in product development can help bring up a variety of new ideas and determine current and future consumer needs. However, this method is still rarely used in capturing and generating new trends in jewelry design that has a short cycle in developing countries, which rely on traditional product development methods that involve internal labor. What method is more precise in determining the attributes of jewelry design that can improve customer satisfaction and supply chain performance? Answering this question, the study was conducted review more on researches that has been done related to the new jewelry design development. The research held based on customer satisfaction in Indonesia that can encourage the jewelry supply chain performance. When it was exploring papers, Supply chain, product development, customer satisfaction, Kano, QFD, and jewelry were keywords used. This study did some literature review related to find the right methods to capture customer needs. The framework of how to discover jewelry designs that can enhance customer satisfaction and improve the supply chain of jewelry especially in Indonesia was formed as a result of this research.

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2 Literature Review

This section will discuss the theoretical basis underlying this research as well as previous studies of supply chain vs. new product development, integration of Kano model, customer satisfaction, and QFD also consumer behavior towards jewelry.

2.1 Supply Chain Industry vs. New Product Development

Supply chain is a series of integration that is involved in adding the value of the service or product directly or indirectly in satisfying customer demand [1] which aims to guarantee the products or services to get into the end-user with right quality, right quantity and on time. Customers are demanding to get products in a short time which leads to launching new products in a shorter time [2]. The integration of supply chain and

product development can meet consumer demands and [3] they are complementary activities. Additionally developing products also can support new enterprise competition [4] as well as the viability of the company [5]. Finally, the company develops and launches a new product quickly but the effect on the product life cycle is shorter.

To reduce distribution time to market, the involvement of customers and major suppliers is very important in the product development process [3]. Collaboration with suppliers supports the emergence of new technologies transfer of information [6]. However, most of these innovations failed in the market due to a lack of orientation and inappropriate market research [7]. Review of previous research exposing that consumer can contribute innovative ideas, increase the variety of products [8], and improve market performance by buy products designed consumer and gives knowledge of the needs of current and future [9]. How do companies get to grips with the needs and wants of consumers? The integration assessment of customer satisfaction and the model of Kano can become one method that can be used to classify the components of product development.

2.2 Integration of Customer Satisfaction, Kano Model and QFD

Customer satisfaction is a measure of the quality of an item. If the consumer needs and desires can be fulfilled, it can raise a customer satisfaction and a sense of customer loyalty [10]. Satisfaction can be obtained through cognitive responses that involve knowledge, meaning, and beliefs that process knowledge, also information and affective responses that involve feelings and emotions of customers [11]. Cognitive satisfaction is a comparison between expectations and perceived quality that customer receives [12]. According to Hanan, [13] there are eight qualities' attributes that form customer satisfaction in a product called "The Big Eight Factor". There are the relation value and the price, quality of products, products feature, reliability, assurance, responding and fix the problem, sales service experience, and convenience of acquisition. However, customer satisfaction is not always in positive linear but also showed a linear negative. This condition cannot be shown in satisfaction score results.

The Kano model can classify the relationship between product or service user satisfaction with providers and the life cycle of an item [14]. This model can categorize performance and prioritize gaps that need more attention [10]. There are 5 dimensions of quality; two of them can increase customer satisfaction if developed more are Attractive (A) and One-dimensional quality (O). The quality attributes in these dimensions are weighted and multiplied by the satisfaction score, which yields an important weight of what value. Values included in the Pareto in percentage and attribute that is entered in a cumulative 80% of the largest further processing in Quality Function Development.

Quality Function Development is used to change the technical requirements of a product element into the needs of customers [15]. These inputs are linked with other inputs from experts or practitioners in a matrix called the House of Quality (HOQ). Connecting "what" and "*how*", there is a relationship matrix that explains the relationships that are formed and shows the department or product components related to consumer desires. Target values show the importance of the point of how to effect compliance attributes. This method can help determine the technique and strategy in the future, reduce development time, and help the company determining strategy. Application of the integration of the product development needs to be done, especially on items of fashion that has a short life cycle

2.3 Consumer Behavior towards Jewelry

The life cycle of *fashion* products is very diverse and sells unique designs. Jewelry has its own value because the basic material for jewelry is made according to the needs and desires of consumers. This happens because jewelry has special values in economic, social, mystical, and other things that support consumers to buy and wear jewelry. Value, lifestyle, background education, environment, and others also form the habits of consumers [16] which is the basis for consumers to buy jewelry. Table 1. shows which contains a summary of the research that has been done regarding consumer behavior towards jewelry:

Figure 1. Summary of Consumer Behavior

	Country		
	Rome	Turkey	Indonesia
Background	Expensive, valuable items, beautiful accessories, and sentimental value	Expensive, usability Jewelry	Prices, trends, social
Buying considera-tions	Time value, trends, and prices	Prices, trends, excess jewelry	Investment, increase social degrees
Research source	Daniela, Roxana and Elena, 2014 [16]	Bilgili, Erci and Ünal, 2011 [4]	Amelia and Hudrasyah, 2016 [17]

3 Discussion

Supply chain and product development are two things that support each other, especially to make products that meet consumer needs. Before realizing a successful new product, collecting information from customers is very important. However, companies and designers must know and consider the differences in characteristic, behavior, background, and environment of jewelry consumers in their market.

Integration of customer satisfaction, Kano, and QFD can directly collect and filter information of customer satisfaction. But ensuring companies do not lag the changing trends and market conditions, assessment, evaluation, and improvement should not be stopped. This processes capture trend and product development continuously updated due to the influence of information from external sources and customer. Figure 1 shortly describes the information flow system that occurs in the jewelry industry.

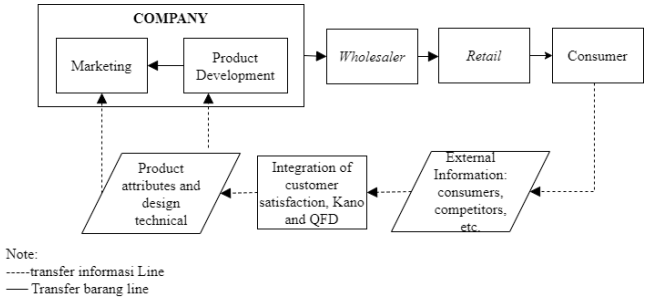

Figure 1. Integration of customer satisfaction, Kano, and QFD in the jewelry design supply chain

The integration model framework was formed in Figure 2. The most important thing is to determine the design attributes that are considered when designing jewelry. First, testing design attributes in the customer satisfaction and Kano questionnaire. Attributes that have a negative satisfaction score and included in Attractive or one-dimensional attributes are further processed. The satisfaction score is multiplied by the attribute weight of the Kano, resulting in the value of the importance of what the calculation results are accumulated and ordered in Pareto. Attributes that are included in the 80% highest cumulative score for Pareto are included in the house of quality. The "what" area contains attributes in the cumulative 80% of Pareto. "How" area filled with the voice of the engineer and can provide an alternative in the area of "what". The relationship matrix shows the relationship between "what" and "how". "How" which has the highest importance value and has a relationship with "what" becomes a solution for attribute improvement.
Consumers provide feedback regarding designs have been released. Some resources can provide input in the form of alternatives to "how". However, information comes not only from consumers, but also of benchmarking, competitor's condition, and retailer, designer, etc. who provide input on the designer new solutions or "how" that can satisfy the customer. Alternative solutions do not always become a design attribute that must be held. Solution can be a quality attribute so that need to update the latest information and catch new trends continuously based on current trends.

This framework is made theoretically. Overall, the information distribution and processing system are more structured, clear, and measurable. All improvement suggestions clearly and focus on the attributes have big impact and relevance. However, this framework has not been tested in real terms, especially in jewelry companies in Indonesia. It can show the impact on information flow and supply chain performance of jewelry companies can be seen. In further research, it is necessary to implement this framework so that its effectiveness and benefits can be seen.

4 Conclusions, Limitations, and Suggestions

Facilitating companies in gathering information from consumers, the integration of customer satisfaction, Kano, and QFD can be used. Moreover, the input from third-party are involved in the product's stream jewelry can add that information. Continuous assessment and improvement is also facilitated in this framework to capture changes and new strategies that are happening in the community.
However, this research focuses on developing new products with the integration of customer satisfaction, Kano, and QFD that support supply chain performance theoretically. The results of this study are expected to contribute to improving the workflow for jewelry design development, especially in Indonesia. The framework that is formed is only based on theoretical concepts and can be used as an opportunity to test its application so that it can support supply chain performance improvement and product development in jewelry design in Indonesia. Besides, deeper research on Indonesian consumer behavior is necessary considering the varied geographical conditions that can affect the way consumers perceive consumer behavior.

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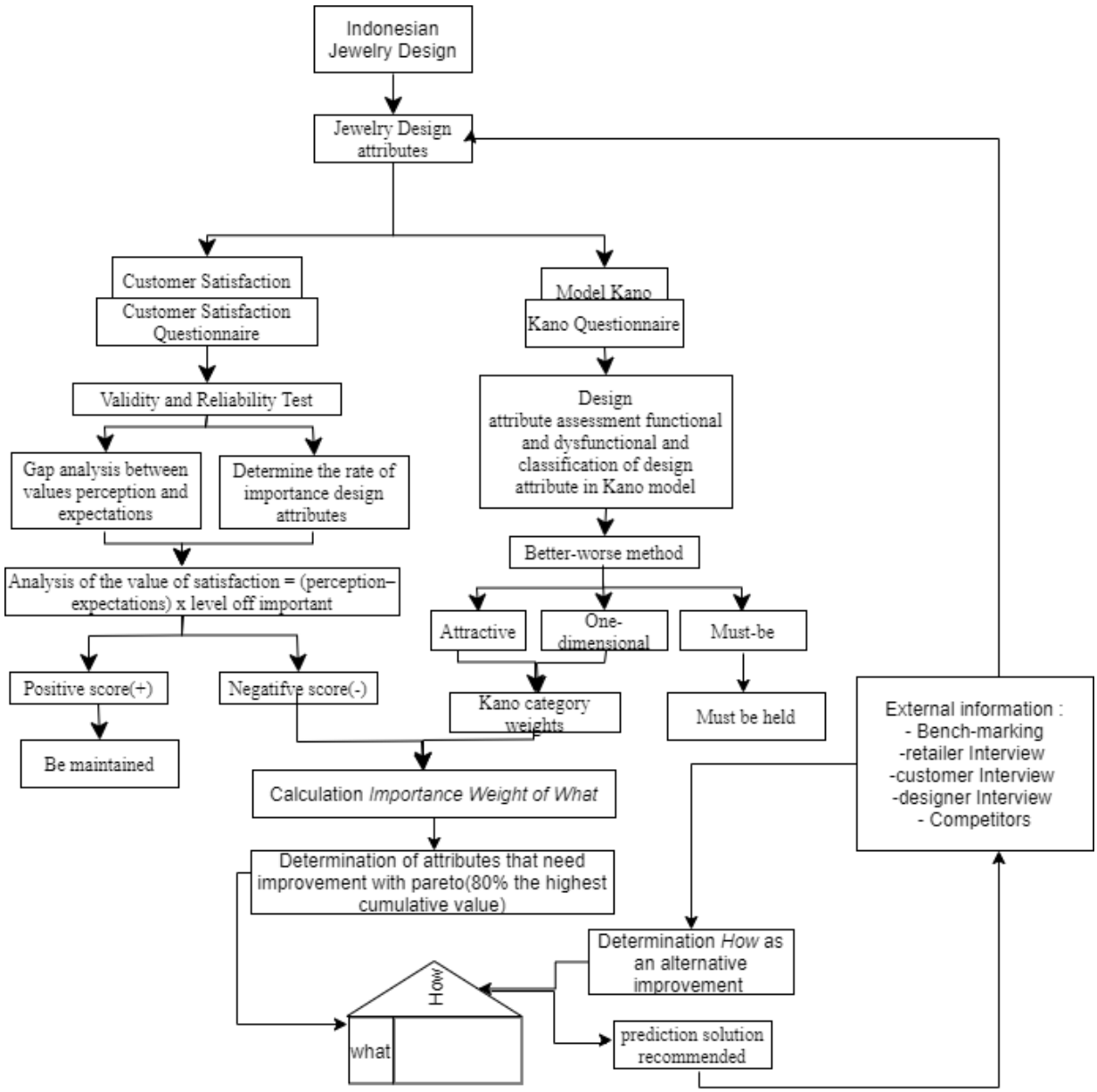

Figure 2. Product development framework with the integration of SERVQUAL and Kano