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DESIGNING AND PRODUCING BETTER PRODUCTS, PROJECTS AND SERVICES

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Innovation management begins with idea generation, and so, a theory about how to improve ideas marks a contribution to this field. The relationship between innovation management and idea generation often requires a multi-disciplinary team to develop shared understanding of the relationship between thoughts and reality. If we can improve this understanding, we can enhance our ability to create added value for products, projects, and services.

Modelling Function and Process Relationship

Many studies have focused on modeling functions in the field of technological design as an important step toward product creation and innovation. Philosophical literature divides the concept of function into two main understandings: teleological theory and etiological theory. The teleological theory of function can explain the purpose and requisite actions of an object by citing expectations of collective intentionality, such as, our collective agreement that a hammer should be used to hit nails. The starting point is to differentiate the purpose of the artefact from the way it is used by articulating the designer's intentionality. Thus, we can explain why and when an artefact (such as a chair) can be used in relation to its function; for example, whether a chair can be used to support the weight of a seated person, to hold open a door, as a step-stool, and so on. The etiological theory of function explains the prevalence and/or persistence of object types by citing the current presence of an object through causal contributions to its adaptation. Although unprotected steel can be used to form a roof in a wet climate, it will rust because of the etiological functions related to the causal account of oxidation. Thus, an etiological function of a technological artefact explains the causal relationship of why such an artefact exists by providing a historical account of its adapted/evolved form. Thus, we can see that the designers' intentionality is constrained within etiological interactions.

On other hand, a process can be a naturally occurring or designed sequence of operations or events, or possibly time, space, expertise, or some other resource, which produces a phenomenological outcome. A process may be identified by changes that it creates in the properties of one or more objects under its influence. The numbers of people in a check-out line in a store, the frequency of a train stopping at a station, or even the heat generated when a light bulb is illuminated are examples of what we recognize as 'process.' In product development, the implied functional and process theories are different in the sense that the former is conceptual and the latter phenomenological. In the design of things, both theories are used intentionally. However, other functional and process theories can also be found in causal relationships, and so, it is necessary to distinguish between intention and causality. There is a need to determine an artefact's function in terms of intentionality and how that determination can be achieved through causal relationships. Understanding in which areas we want to improve will lead us to produce better products, projects, and services.

Furthermore, creating alternative designs and developing technology through innovation can be seen as steps toward sustainable development (see my previous notes in Vol.5 and Vol.6). Having said this, many alternatives to functions and processes in products, projects, and services can improve end results. In this edition, we are pleased to present twenty selected papers that discuss various improvements in product and technology development processes in various engineering contexts.

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The first paper, written by Slamet, E. Kusrini, A.S. Afrozi, and M. Ibadurrohman, investigates the technology employed to produce renewable, clean energy by modifying TiO_2 P25 photocatalyst with both metal (Platinum (Pt) andCopper (Cu)) loading and non-metal (Nitrogen (N)) doping to produce Hydrogen (H_2) from a glycerol-water mixture. Both non-metal doping and metal loading are effective ways to improve photocatalytic H_2 production. N-TiO_2 could enhance H_2 production four times more than could undoped TiO_2. In addition, the authors argue that Pt-N-TiO2 enhances H_2 production up to 34 times higher than TiO_2, while Cu-N-TiO_2 could enhance H_2 production up to 10 times higher than TiO_2.

The second paper, written by L.D. Wilson and S.T. Mahmud, evaluates the adsorption properties of surface-modified, mesoporous silica materials containing β-cyclodextrin (CD ICS) using two types of gas-phase adsorbates (N_2 and CH_3Cl) and a dye molecule,*p*-nitrophenol (PNP), in an aqueous solution. The result shows that the surface area (SA) of the CD ICS materials decreases by *ca.* 1.5-fold as the CD loading varies from 2–6%, while the adsorption capacity (Q_e; mmol/g) of PNP increases from 61–84% as the CD loading increases and as the alkyl chain length of the surfactant template varies from C12 to C16. The authors argue that the adsorption properties of CD ICS materials with CH_3Cl in the gas phase and of PNP in aqueous solution adopt a multi-layer profile, as described by the BET isotherm model.

The third paper, written by F.S. Mehamod, K. KuBulat, N.F. Yusof, and N.A. Othman, presents develops Molecularly Imprinted Polymers (MIPs) for caffeine extraction. The Non-Imprinted Polymer (NIP) is simultaneously produced as a control polymer, with a design approach adapted from Ab Initio Molecular Orbital Studies. Experimentally, MIPs synthesized via the precipitation polymerization technique produce distributed, homogenous, spherical beads, with the complex 1:3 yielding the highest interaction energy between caffeine and MAA (-45.29 kJ/mol), followed by 1:4 (-43.52 kJ/mol), and 1:5 (-43.11 kJ/mol).

The fourth paper, written by B. Priyono, A.Z. Syahrial, A.H. Yuwono, E. Kartini, M. Marfelly, and W.M.F. Rahmatulloh, examines the use of Lithium Titanate ($Li_4Ti_5O_{12}$ or LTO) as an anode material for a high-performance lithium ion battery. The LTO is synthesized by a hydrothermal method using Titanium Dioxide (TiO_2) xerogel prepared by a sol-gel method and Lithium Hydroxide (LiOH). The sintering process is conducted at 550^{o}C, 650^{o}C, and 750^{o}C to determine the optimum characteristics of $Li_4Ti_5O_{12}$. The authors argue that the highest intensity X-ray Powder Defraction (XRD) peaks and Fourier Transform Infrared (FTIR) spectroscopy spectra of the LTO were achieved at the highest sintering temperature (750^{o}C).

The fifth paper, written by A. Sholehah and A.H. Yuwono, examines the effects of annealing temperature and seed layer on the growth of Zinc Oxide (ZnO) nanorods using the chemical bath deposition (CBD) method. The ZnO seed layers are deposited onto ITO glass using the spin-coating technique and annealed at two different temperatures: 200^{o}C and 400^{o}C. In addition, one, three, and five layers of seeds are used prior to using the CBD method. The results show that optimal ZnO nanorod growth is achieved by using three seed layers annealed at 200^{o}C. These conditions provide an average diameter of 157.58 nm, the largest crystallite size (up to 59.63 nm), and a band-gap energy of 3.27 eV.

The sixth paper, written by K.F. Liew and N. Mohd-Ghazali, describes simulated flow and temperature in a thermoacoustic resonator. The study carries out a two-dimensional, numerical simulation of the flow of inviscid fluid around the stack unit in a quarter-wavelength resonator using the continuity, Navier-Stokes, and energy and ideal gas equations. Three stack plate thicknesses are investigated: negligible, 0.4 mm, and 0.8 mm. The authors argue that the development of the velocity and temperature profiles show the existence of vortices and streaming effects and are very much dependent on the plate thickness and separation gap.

The seventh paper, written by M.I. Alhamid, Nasruddin, Senoadi, M.B. Perdana, and Ratiko, examines the effects of gas flow-rate on the adsorption capacity and temperature distribution of the adsorbent. The adsorbent is a commercially activated carbon, and methane gas is used as the adsorbate. Methane flow rates are 1 standard liter per minute (SLPM) and 20 SLPM. Temperature in the pressure vessel is maintained at 25°C, and the pressure is maintained at 3.5 MPa. The authors argue that the adsorption capacity of activated carbon is higher at a lower gas flow-rate and that the higher methane gas flow-rate causes higher temperature differences in the adsorption and desorption processes.

The eighth paper, written by Nasruddin, Lemington, and M.I. Alhamid, presents a simulation of a two-bed, silica gel-water adsorption chiller using solar energy based on maximum and minimum inputs

of solar irradiation in Indonesia during working hours. In addition, mass recovery and heat recovery are also applied in the adsorption cycle to increase the cooling capacity. The authors argue that during the maximum irradiation, the COP can reach 0.26, while during the minimum irradiation, the COP is 0.15. The cooling capacity also varies and at maximum irradiation can reach about 37.8 kW and at minimum irradiation drops to 5.3 kW.

The ninth paper, written by A.S. Baskoro and A. Fauzan, examines the effect of pressure and lap-joint length on shear load and joint clearance during joining of dissimilar metals (BJ DD2 steel and C12000 copper), using torch brazing. The authors argue that greater pressure increases the shear load on a 15-mm length of lap joint. A pressure of 0.7 MPa and a lap-joint length of 15 mm give optimal results: a shear load of 319.83 kg with a standard deviation of 42.37 kg and a joint clearance of 0.2 mm with a standard deviation of 0.03 mm.

The tenth paper, written by S. Supriadi, T.W. Sitanggang, B. Irawan, B. Suharno, G. Kiswanto, and T. Prasetyadi, presents an orthodontic bracket fabricated using the investment casting process. This process produces a wax pattern of an orthodontic bracket and then shapes it into the tree form. Geometric and surface-roughness analyses are conducted by using a digital microscope and Surfcom 2900SD3. The authors argue that an orthodontic bracket can be successfully produced with acceptable tolerances in geometrical and surface characteristics (the surface roughness value is 0.91 µm).

The eleventh paper, written by P.S. Priambodo, S. Rahardjo, G. Witjaksono, and D. Hartanto, presents an optimizing coupling region as the sensing area in optical ring resonator sensor applications. The results show that the sensed coupling value is determined by the interaction length of the coupling area and the coupling coefficient. The maximum variation can be optimized by designing the coupling interaction as an integral term. The authors argue that as a consequence of obtaining a constant optimum value, the coupling interaction length should be extended for exponential purposes and the sensing area should be expanded exponentially as well.

The twelfth paper, written by U. Darusalam, P.S. Priambodo, and E.T. Rahardjo, examines noise suppression ofthe signal spectra induced by atmospheric turbulence on free-space optical (FSO) communications. To minimize randomly fluctuating temporal noise, a cone reflector is designed to suppress beam wander and focus it into a pinhole. The pinhole governs the Fresnel diffraction to suppress spatial noise in the center of the focus spot, which undergoes fluctuation and random frequencies. The results show that the average values of the Signal-to-Noise Ratio (SNR) increase to 37.5 dB, 38.5 dB, 38.7 dB, and 39.2 dB for pinhole diameters of50 µm, 40 µm, 30 µm, and 20 µm, respectively.

The thirteenth paper, written by S. Gupta and G. Narsimha, compares the performance of NoSQL-Cassandra and MySQL when used with big data. The web crawler application was deployed in a single-node Mysql database and Cassandra, and the number of nodes was increased to monitor the scalability. The results show how big data collected from across the the Web, with billions of records generating continuously, are poorly handled by MySQL in terms of ‘write’ operations but are well-handled by NoSQL-Cassandra. The authors claim improved ‘read’ performance of the proposed architecture and configuration compared to MySQL and cost savings for organizations using NoSQL-Cassandra to manage big data for heavy loads.

The fourteenth paper, written by I. Surjandari, A. Dhini, E.W.I. Lumbantobing, A.T. Widari, and I. Prawiradinata, presents a big-data analysis of the publications of Indonesian scholars. The authors used co-word analysis to define the interrelationship among research themes in scholarly publications indexed in Scopus during the last five years (2010–2014). The results show that there are 15 main research themes in Indonesia. The results also show that more specialized and distinct research themes occur, including child well-being, genome, microbiology, urban and regional studies, economics and international relations, and waste management.

The fifteenth paper, written by A. Suzianti, S. Rengkung, B. Nurtjahyo, and H.A. Rasyid, applies cognitive-based design in developing yogurt product packaging to increase consumers’ willingness to buy the product. Initial research pursued six color schemes and font combinations and then narrowed the results to the two best options, which are combined with primary research analyzing the shape factors. Three methods, Eye-Tracking, Retrospective-Think-Aloud (RTA), and Conjoint Analysis, are used to analyze the data. The authors use the attribute values of the packaging combinations to argue that the

best yogurt product packaging has a rounded shape, a ‘Fineliner’ font type, and an ‘Analogue’ color scheme.

The sixteenth paper, written by M.A. Berawi, A.R.B. Berawi, I. Surjandari, P. Nahry, P. Miraj, Y. Abdurachman, E. Tobing, and A. Ivan, proposes a conceptual design for high-speed railways using the value engineering method to identify optimum benefits of the project. Applying the value engineering approach to development of the Jakarta-Surabaya High Speed Railway identifies additional functions that could be integrated into the project, such as bituminous ballast, transit oriented development, utility-service integration, tourism areas, electric generators, and train service facilities. Route analysis is performed based on contour analysis, economic growth, and the population potential of cities on Java Island. The results show that a train route from Jakarta to Surabaya has the lowest cost scenario, 36 trillion rupiah, with operating and maintenance costs of about 1.2 billion rupiah annually.

The seventeenth paper, written by M.L. Siregar, T. Alawiyah, and T. Tjahjono, investigates remedial safety treatment of accident-prone locations. The research combines systems theory and causal accident theory approaches to identify the causes of accidents. The results indicate that geometric features are the main risk factors, because they lack compliance with standards. Therefore, the authors argue that remedial safety treatment should focus on geometric redesign of roundabouts to comply with standards and traffic demands. In addition to this major change, other hazard-reduction schemes are proposed for roads.

The eighteenth paper, written by Sunarsih, Purwanto, and W.S. Budi, presents modeling of domestic wastewater treatment facultative stabilization ponds. The paper identifies thirteen simultaneous systems of nonlinear differential equations using the method of Runge-Kutta-Fehlberg (RKF45). Data validation is measured in a facultative stabilization pond at distances of 0 m, 25 m, 50 m, and 75 m. The authors argue that their model is appropriate for evaluating performance of Class II water quality standards in Wastewater Treatment Plants (WWTPs).

The nineteenth paper, written by S.N.R. Anwar, P. Suprobo, and E. Wahyuni, evaluates the axial and flexural performance of adhesive connections on cold-formed steel structures. The study tests six groups of single lap joints (SLJs) and flexural joints manufactured from cold-formed steel and adhesive. Screw and combination joints on cold-formed steel structures could prevent premature structural collapse. The authors argue that the rigidity of cold-formed steel structures is increased throughout the adhesively bonded joints and that the effect of local buckling can be reduced by increasing structural rigidity.

The twentieth paper, written by D. Damoerin, W.A. Prakoso, and Y. Utami, proposes improving shear strength of clay by using cement-column reinforcement under consolidated, undrained, triaxial testing. For triaxial testing, the soil samples are made by using an extruder, and the composite samples are made by boring soil sample cores and then filling the holes with cement slurry. The results show that the cohesion parameter and angle of internal friction of composite samples are higher and lower, respectively, than those of unreinforced soil samples under consolidated, undrained, triaxial testing. The authors argue that cement-column reinforcement can improve soil strength and reduce settlement under permanent load.

I hope that this edition of IJTech conveys some new insights in the way we conduct our research and I invite you to join us in this venture by sending your work for consideration.

With warmest regards from editorial desk,

Dr. Mohammed Ali Berawi
Editor in Chief