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TECHNOLOGY BREAKTHROUGH: A NEED FOR CONTINUOUS IMPROVEMENT

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Innovation is often driven by a need for continuous improvement. New technologies evolve from conceptual breakthroughs, which lead to a series of innovative processes designed to produce an end product, to succeed or to fail in commercial markets, or even to further newly discovered technological needs. Technology is a process of creation that is underpinned by scientific theory from modeling to modifying and from predicting to producing end results. Creating design breakthroughs, improving processes, and adding new features all become means for enhancing the competitive value of technology.

To achieve technological breakthroughs, needs are first translated into a list of functional requirements and design specifications. The design parameters are combined and amended to create a blueprint of end results. Prototyping and testing are often conducted through several iterations that lead to improvements in the design and process parameters. The process of choosing optimal design requirements, parameters, and measurement procedures requires a rational method that must be formulated to improve the process and/or end result. Efficiency, safety, and sustainability are often sought in order to optimize the end result of a technological process or product performance.

Creating Breakthroughs

In terms of technological development, added value can be broken down into improvements to specific attributes and features of a technology that contribute to its usefulness, usability, and desirability. The better an improvement is, the greater the resulting technology's value becomes. Creating breakthroughs for end results begins with identifying key attributes and continues with creating insightful and comprehensive approaches for generating technological improvements. Interventions related to key attributes in technology development processes should be aligned with expected values for technology contributions and outcomes.

Technology leverages specific knowledge to design series of processes and methods that are implemented in order to produce end products. This season, we are pleased to present twenty papers dedicated to technology development. Against this themed backdrop, the issue discusses design and process improvements implemented to create more effective and improved technologies in various engineering disciplines.

The first paper, written by N. Abbas, A.H. Abdullah, Z. Mohamad, and A. Altameem, investigates the splitting of clustered red blood cells via a boundary analysis of digital images of microscopically thin blood smears. The number of red blood cells depends on the mask, and it is determined by performing a double check and examining the area of the cells' convex hulls. The authors argue that the overall harmonic mean of the precision and recall achieved is 96%, suggesting high accuracy for the proposed method.

The second paper, written by A.A.N.G. Sapteka, H.N. Tan, R. Unno, D. Moraru, A. Udhiarto, S. Purwiyanti, M. Tabe, D. Hartanto, and H. Sudibyo, presents the linear region of I-V characteristics for highly doped nano-scale *p-i-n* diodes fabricated within ultra-thin silicon-on-insulator structures. The diodes have intrinsic layer lengths of 200 nm and 700 nm and are analyzed under a forward bias at temperatures ranging from 50 K to 250 K. The authors argue that highly doped *p-i-n* diodes produce higher currents because the temperature decreases under a certain bias voltage range and because nano-scale diodes with longer and wider intrinsic layers generate higher currents under a certain bias voltage range and in low temperatures.

The third paper, written by D. Thiyagarajan and R. Ganesan, proposes an efficient method for providing data security for cloud-stored data using Hyperelliptic curve cryptography (HECC) for

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encryption and decryption and a secure hash algorithm-3 for data integrity verification. The efficiency of the framework is analyzed by comparing the encryption and decryption times of HECC and ECC. The authors argue that HECC with an 80-bit operand length provides the same level of security as 160-bit ECC, thereby making 80-bit HECC more suitable for cloud environments.

The fourth paper, written by E.A. Setiawan, Kurniawan and A. Setiawan, examines maximum power outputs and fill factors under a standard test condition to determine the performance of crystalline solar panels using the Gaussian method. The experiment shows that A-180 photovoltaics (PVs) have better performance ratings than B-180 PVs with probability ratios of 27.12% and 16.09%, respectively. The authors also argue that A-180 PVs have better power ratios (81.55%, compared to 78.6% for B-180 PVs).

The next paper, written by S. Naik and P. Metkewar, proposes an efficient segmentation technique for identifying superscripts, subscripts, and main characters in offline handwritten mathematical expressions. The proposed system is implemented as an experiment with a database of 300 samples of scanned mathematical expressions, comprising 2,000 symbols and 31 different types of mathematical symbols. The classification of the elements is based on density features and conducted by a K-NN classifier. The authors claim that the overall recognition rate is 94.30%.

The sixth paper, written by H. Setiawan, evaluates the efficiency of the peak-to-average power ratio (PAPR) in the circuit design of a 20 MHz bandwidth wireless local area network's IEEE 802.11n. The authors argue that the highest probability maximum PAPR for a signal field of Legacy format 802.11n is about 29.3 dB when the data rate is 6 Mbps and the data length is 3846 octets. However, the maximum PAPR for the high throughput format is 35.6 dB, which is related to a data rate of 6.5 Mbps and a data length of 32768 octets.

The seventh paper, written by Budihardjo, Nasruddin, and M.H. Nugraha, examines the performance characteristics of a closed system cooling tower in an HVAC system using the system's effectiveness value, number of transfer units, cooling capacity, overall heat transfer, and cooling tower mass coefficient. The authors argue that an increase in the amount in water spray mass flow increases the effectiveness value, the heat transfer, and the overall mass transfer, as well as the cooling capacity of the cooling tower. The results show that waste heat utilizes up to 80% latent evaporation heat and 20% sensible air heat, while waste heat in the closed-system cooling tower utilizes 100% latent evaporation heat.

The eight paper, written by I.N. Sukanta, W.A. Prakoso, and T. Ilyas, highlights an extended Hara model for estimating seismic moment magnitudes using teleseismic waveform data of the vertical components of earthquake P-wave records: the amplitude of displacement, the epicenter distance, and the duration of high-frequency energy radiation. The authors argue that the extended Hara model provides a better estimation than the first-generation model, such that the differences between the means and the standard deviations of the extended Hara model and the global CMT catalog are 0.01 and 0.14, respectively.

The next paper, written by M.A. Berawi, T.Y.M. Zagloel, A.R.B Berawi, and Y. Abdurachman, proposes an added value for the conceptual design and route selection of the Trans-Sumatera Toll Road Infrastructure Project by showing an increasing and positive rate of return for the project. Six additional functions of the project include: motorcycle lane integration, rest area development, dry port integration, median railway integration, tourism park development, and fiber optic networking. The three scenarios of project feasibility resulting from the system dynamics indicate an estimated improvement in the project's internal rate of return of 8.28% to 13.77%.

The tenth paper, written by M. Johanes and P. Atmodiwirjo, demonstrates the use of isovists to determine the visibility of an inpatient ward by analyzing visibilities from the nurse station, during nurses' movement along the corridor, and at the ward entrance area. The authors argue that the performance and visibility of hospital inpatient wards necessitates that ward spatial configurations be carefully designed for the purposes of control, surveillance, interaction, and communication among patients and medical staff members.

The eleventh paper, written by I. Surjandari, A. Dhini, N. Wibisana, and E.W.I. Lumbantobing, uses a big data method to present an analysis of strategic research themes based on publication performance in international indexing databases. Co-word analysis is used to determine the interrelationships among

the research themes based on the co-occurrence of word and phrase pairs. The authors argue that mapping and measuring various research themes in relation to scientific publication strengths can help organizations in effectively determining their optimal strategic directions for research.

The next paper, written by M. Tukan, T. Achmadi, and S. Widjaja, evaluates the effect of seaport parameters on regional archipelagic economic zones using dynamic models, in which an econometric model is applied to the completion of the Cobb-Douglas production equation. The authors argue that increased volumes of loading/unloading cargo are correlated with local economic growth. They also argue that increased cargo loading/unloading is correlated with growth in vessel holding capacity/deadweight tonnage and that it promotes growth in the region's gross domestic product.

The thirteenth paper, written by Samuel, M. Iqbal, and I.K.A.P. Utama, examines the use of catamarans for passenger carriers and their application as fishing vessels to produce wider deck areas and smaller engine sizes. A conversion analysis of mono-hull fishing vessels into catamaran hulls is conducted using the computational fluid dynamics approach and the slender body theory. As a result, the authors argue that the modification of a mono-hull vessel into a catamaran can increase the payload capacity up to two times—and, conversely, increase resistance to by almost four times.

The fourteenth paper, written by A.H. Muhammad, M. Hasbullah, M.A. Djabbar, and Handayani, examines the influences of conventional and azimuthing podded propulsion methods on passenger ferry maneuvering, particularly in the context of turning circle and zig-zag maneuvers. In this model, the Mathematical Modelling Group (MMG) develops 4 degrees of freedom modules for the hull, the propeller-rudders, and the pod systems. The simulation involves separating the components of the hull equations, the propeller-rudders, and the pod systems, as well as their interactions. The authors argue that selecting the appropriate propulsion system for a ferry can reduce the tactical diameter of the turning circle, decrease the overshoot time of the zig-zag maneuver, and possibly increase ship safety.

The next paper, written by B. Suthep and T. Kullawong, applies the reliability-centered maintenance (RCM) approach to the development of maintenance planning in hard chrome-plating plants in order to further reduce machine downtime maintenance stemming from machine breakdowns. The approach also seeks to select preventive maintenance activities based on the engineering reliability of the machine parts using Failure Mode and Effects Analysis. The authors argue that a plant's failure rate can be reduced by 9.22% and that its machine availability rate can be simultaneously increased to 80.34%. Thus, the application of the RCM approach produces a reduction in the key time between plant equipment failures and the likelihood of abrupt equipment failures.

The sixteenth paper, written by D.M. Nurjaya, S. Astutiningsih, and A. Zulfia, examines thermal effects on the flexural strength of a geopolymer matrix composite including alumina and wollastonite as fillers. The authors argue that the addition of alumina tends to decrease the matrix's flexural strength due to the formation of a micro-porous structure and the segregation of the alumina, while the wollastonite addition slightly increases the flexural strength due to the bridging effect of the wollastonite fibers.

The seventeenth paper, written by Winarto, D. Priadi, N. Sofyan, and M.A. Anggoro, investigates the wear resistance and interlocking properties of AISI 5200 steel ball bearings coated with nanocomposites. The development of a lubrication system is accomplished through the formation of an interlocking system of a composite coating (i.e., $Zn_3(PO_4)_2$ / MoS_2 / MWCNT / nanographite / Na_2SiO_3) prepared by chemical immersion. The coating was applied using the one-mixing-layer and multi-layer techniques. The results shows that the one-mixing-layer technique had better results for the coated balls than the multi-layer technique did in terms of the distribution and uniformity of elements on the coating surface, the interlocking between the composite compounds, and the thickness of the layer formed.

The next paper, written by S. Sadighi, R.S. Mohaddecy, and Y.A. Ameri, proposes a hybrid artificial neural network (ANN) genetic algorithm for modeling and optimizing the Hall-Heroult process for aluminum extraction. The temperature and cell voltages, metal and bath heights, CaF_2 and Al_2O_3 purities, and bath ratios are input variables considered in modeling. The authors argue that setting decision variables at the optimal values can increase model outputs for metal purity, ampere efficiency, and product rate by approximately 0.007%, 0.185%, and 20 kg/h, respectively.

Thenineteenth paper, written by Yuliusman, W.W. Purwanto, and Y.S. Nugroho, evaluates the effectiveness of a smoke clearing method using adsorbents, which was measured *in situ* using a photoelectric smoke detection system. The influences of the type, size, and mass of the adsorbents are

examined in relation to the smoke clearing process. The authors argue that the best clearing process effectiveness is achieved with commercially activated carbon, followed by $ZnCl_2$-activated carbon and activated natural zeolite. A particle size of 53 microns exhibited the most effective performance, and the greater the mass of the dispersed adsorbent was, the faster the clearing process was.

The last paper, written by A. Wahid and A. Ahmad, proposes a multiple model predictive control (MMPC) approach to control a nonlinear distillation column. The setpoint tracking and disturbance rejection performances of the proposed MMPC are evaluated and compared to those of a proportional-integral (PI) controller. As a result, the authors show that the controller output configurations of the PI and single linear MPC are able to improve control performance when the process is subjected to disturbance changes (F and zF). Compared to the PI controller, the maximizing MMPC and PI controller output approaches are shown to provide better control performance with moderate disturbance sizes.

I hope that this special edition of *IJTech* conveys new insights into the ways in which we conduct our research. I am pleased to accept and respond to any comments and inquiries you may have concerning the direction and content of *IJTech,* 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