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# International Conference on Informatics, Technology and Engineering 2017 (InCITE 2017)

## Sustainable Technology and Innovation: Opportunities and Challenges

24-25 August 2017: Bali, Indonesia

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**Prof. Mats Rönnelid, Ph.D.**

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**Prof. Willy Susilo, Ph.D.**

*Director*

Center for Computer and Information Security Research  
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## ***Welcome Remarks, Chair of the Steering Committee***

Welcome to Bali! Welcome to our very first International Conference on Informatics, Technology and Engineering (InCITE) 2017 held by Faculty of Engineering Universitas Surabaya (Ubaya), in collaboration with University of Wollongong (Australia), Solar Energy Research Center – Dalarna University (Sweden), Suranaree University of Technology (Thailand), and National Taiwan University of Science and Technology (Taiwan).

This international conference will be enlivened by a series of keynote speeches and parallel sessions delivered by scholars, researchers, practitioners and academicians who are coming from 5 different countries and more. More specifically, it is hoped that InCITE may link researchers and practitioners from various branches of engineering disciplines from around the world. This year's conference theme of Sustainable Technology and Innovation – Opportunities and Challenges will bring you to the critical awareness of what we have done and what we should contribute to our sustainable environment, society and economy, through the applied technology and innovation. All participants will disseminate information on the relevant and recent research and practice in engineering-based sustainability.

We would like to say thank you to all keynote speakers, presenters, and reviewers/scientific committees for the generous supports. In addition, our thank you to the Ubaya Foundation, Rector of Ubaya, Dean of Faculty of Engineering Ubaya, OC Chairman and members, SC members, and all InCITE committees.

We wish you a very pleasant and memorable stay and research networking event in InCITE 2017 Bali. We are looking forward to seeing you again at the 2nd InCITE 2019! Thank you very much. *Matur nuwun sanget.*

Assoc. Prof. Ir. Markus Hartono, Ph.D., CHFP, IPM

## **Welcome Remarks, Chair of the Organizing Committee**

Rector of University of Surabaya: Prof. Dr. Joniarto Parung,  
Dean of Faculty of Engineering, University of Surabaya: Dr. Amelia Santoso,  
Honorary Keynote Speakers: Prof. Dr. Suksun Horpibulsuk, Prof. Dr. Nai-Wei Lo, Prof. Dr. Mats Rönnelid, and Prof. Dr. Willy Susilo,  
Fellow Participants, Distinguished Guests, Ladies and Gentlemen:

First of all, welcome to Bali, Indonesia, and welcome to the first International Conference on Informatics, Technology and Engineering (InCITE) 2017!

It is still vivid in my memory, one and a half year ago, when some colleagues and officials of our Faculty of Engineering discussed the possibility of organizing an international event, to substitute national seminars that some of our study programs held annually or bi-annually. The call for an international event is a necessity given 30 years of Faculty of Engineering's existence, and the dawn of University of Surabaya's Silver Anniversary next year. Such a level of maturity prompts us to contribute more to a larger scale. An international event will have greater exposure to international community, and consequently greater impact to us all.

The following process, however, was far from easy. We were inexperienced, but we were faithful to our mission. It took us some time until we were able to formulate the conference theme, found prominent scholars in the selected theme, and negotiated with them. We are very grateful that all four speakers whom we approached are here with us today, to deliver their insights on opportunities and challenges in sustainable technology and innovation. Let's give our big hands to them!

Sessions beyond those with our invited speakers will deliver four sub-themes, namely: *sustainable design & innovation, sustainable manufacturing & processes, sustainable energy & earth resources, and the role of IT in sustainable enterprise*. We are glad to inform you that our conference has attracted 67 papers from the first round of acceptance. After careful selection by a panel that consists of high-profile international reviewers around the world, we passed 50 papers. We are thankful to our international reviewers who worked very hard providing feedback to the submitted papers. We are indebted to such great service that they have given.

I sincerely hope that the exchange of knowledge throughout this event, be it from within the substance of academic papers or during the conference time, will enhance our professional network and benefit us in the long run. Thank you to all our speakers, reviewers, participants, and most of all my committee members who have been hand-in-hand with me in this long journey! You all have made our dream come true!

We hope you will have a wonderful conference and memorable stay in Bali this week. We are looking forward to seeing you again in the next two years!

Assoc. Prof. Eric Wibisono, Ph.D.

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# IOP Conference Series: Materials Science and Engineering

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### Preface

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<https://doi.org/10.1088/1757-899X/273/1/011002>

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## Papers

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### The Role of IT in Sustainable Enterprise

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012001

#### [Text-based CAPTCHAs over the years](#)

Y W Chow and W Susilo

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The notion of CAPTCHAs has been around for more than two decades. Since its introduction, CAPTCHAs have now become a ubiquitous part of the Internet. Over the years, research on various aspects of CAPTCHAs has evolved and different design principles have emerged. This article discusses text-based CAPTCHAs in terms of their fundamental requirements, namely, security and usability. Practicality necessitates that humans must be able to correctly solve CAPTCHA challenges, while at the same time automated computer programs should have difficulty solving the challenges. This article also presents alternative paradigms to text-based CAPTCHA design that have been examined in previous work. With the advances in techniques to defeat CAPTCHAs, the future of auto-mated Turing tests is an open question.

<https://doi.org/10.1088/1757-899X/245/1/012001>

[References](#)

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012002

#### [Computer vision system for egg volume prediction using backpropagation neural network](#)

J Siswantoro, M Y Hilman and M Widiarsi

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[PDF](#)

Volume is one of considered aspects in egg sorting process. A rapid and accurate volume measurement method is needed to develop an egg sorting system. Computer vision system (CVS) provides a promising solution for volume measurement problem. Artificial neural network (ANN) has been used to predict the volume of egg in several CVSs. However, volume prediction from ANN could have less accuracy due to inappropriate input features or inappropriate ANN structure. This paper

proposes a CVS for predicting the volume of egg using ANN. The CVS acquired an image of egg from top view and then processed the image to extract its 1D and 2 D size features. The features were used as input for ANN in predicting the volume of egg. The experiment results show that the proposed CSV can predict the volume of egg with a good accuracy and less computation time.

<https://doi.org/10.1088/1757-899X/245/1/012002> [References](#)

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012003

### [A multi-hop relay path selection algorithm considering path channel quality and coordinating with bandwidth allocation](#)

Y C Lai, R Jayadi and J N Lai

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Many multi-hop relay path selection algorithms were proposed. However, these algorithms do not consider the channel condition of the overall path and coordinate with the bandwidth allocation algorithm. In this paper, we proposed a greedy based multi-hop relay path selection algorithm considering channel quality and available bandwidth of overall path to provide high throughput in varying channel conditions. From the simulation results, our proposed algorithm actually provides higher throughput and outperforms the previous works.

<https://doi.org/10.1088/1757-899X/245/1/012003> [References](#)

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012004

### [Leaf App: Leaf recognition with deep convolutional neural networks](#)

T L I Sugata and C K Yang

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In this paper, a very deep convolutional neural network is used to do leaf recognition. In order to predict location of leaves, some pre-processing technique is adopted to extract regions in the image before doing classification. To improve the accuracy, we enlarge the dataset by data augmentation, i.e., doing several transformations such as horizontal reflection, contrast enhancement and rotations. Experimental results show that by using deep convolutional neural network with data augmentation, our system can achieve accuracy close to the state-of-the-art systems.

<https://doi.org/10.1088/1757-899X/245/1/012004> [References](#)

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## **Sustainable Energy & Earth Resources**

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012005

## Recycled asphalt pavement – fly ash geopolymer as a sustainable stabilized pavement material

S Horpibulsuk, M Hoy, P Witchayaphong, R Rachan and A Arulrajah

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Strength, durability, microstructure and leachate characteristics of Recycled Asphalt Pavement and Fly Ash (RAP-FA) geopolymers and RAP-FA blends as a sustainable pavement material are evaluated in this paper. The strength development of the stabilized materials with and without effect wetting-drying (w-d) cycles was determined by Unconfined Compression Strength (UCS) test. The mineralogical and microstructural changes of the stabilized material were analyzed by X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). The leachability of the heavy metals were measured by Toxicity Characteristic Leaching Procedure (TCLP) and compared with international standard. The results show that both RAP-FA blend and RAP-FA geopolymer increase with increasing the number of w-d cycles ( $C$ ), reaching its peak at 6 w-d cycles. The XRD and SEM analyses indicate that the strength development of RAP-FA blend occurs due to stimulation of the chemical reaction between the high amount to Calcium in RAP and the high amount of Silica and Alumina in FA leaching to production of Calcium Aluminium (Silicate) Hydrate, while the geopolymerization reaction is observed in RAP-FA geopolymer. For  $C > 6$ , the significant macro- and micro-cracks developed during w-d cycles cause strength reduction for both RAP-FA blend and geopolymer. The TCLP results demonstrate that there is no environmental risk for these stabilized materials. Furthermore, FA-geopolymer can reduce the leachability of heavy metal in RAP-FA blend. The outcome from this research confirms the viability of using RAP-FA blend and RAP-FA geopolymer as alternative sustainable pavement materials.

<https://doi.org/10.1088/1757-899X/245/1/012005>

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012006

## Effects of glass scraps powder and glass fiber on mechanical properties of polyester composites

K Sonsakul and W Boongsood

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One concern in bus manufacturing is the high cost of glass fiber reinforced in polyester composites parts. The composites of glass fiber and polyester are low elongation and high strength, and glass scraps powder displays high hardness and good chemical compatibility with the polymer matrix and glass fiber. This research aimed to study the effects of glass scraps powder and glass fiber on mechanical performance of polyester composites. Glass fiber was randomly oriented fiber and used as new. Glass scraps were obtained from a bus factory and crushed to

powder sizes of 120 and 240  $\mu\text{m}$  by a ball mill. Polyester composites were prepared using Vacuum Infusion Process (VIP). Polyester reinforced with 3 layers of glass fiber was an initial condition. Then, one layer of glass fiber was replaced with glass scraps powder. Flexural strength, tensile strength, impact strength and hardness of the polyester composites were determined. Hardness was increased with a combination of smaller size and higher volume of glass scraps powder. Pictures of specimens obtained by using scanning electron microscope (SEM) confirmed that the powder of glass scraps packed in the layers of glass fiber in polyester composites.

<https://doi.org/10.1088/1757-899X/245/1/012006> [References](#)

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012007

### Phenol hydroxylation on Al-Fe modified-bentonite: Effect of Fe loading, temperature and reaction time

R K Widi, A Budhyantoro and A Christianto

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The present work reflects the study of the phenol hydroxylation reactions to synthesize hydroquinone and catechol on Al-Fe modified-bentonite. This study started with synthesizes the catalyst material based on the modified bentonite. Natural bentonite from Pacitan, Indonesia was intercalated with Cetyl-TetramethylammoniumBromida (CTMA-Br) followed by pillarization using Alumina. The pillared bentonite was then impregnated with Fe solution (0.01 M, 0.05 M, and 0.1 M). The solid material obtained was calcined at 723 K for 4 hours. All the materials were characterized using BET  $\text{N}_2$  adsorption. Their catalytic activity and selectivity were studied for phenol hydroxylation using  $\text{H}_2\text{O}_2$  (30%). The reaction conditions of this reaction were as follows: ratio of phenol/ $\text{H}_2\text{O}_2$  = 1:1 (molar ratio), concentration of phenol = 1 M and ratio of catalyst/phenol was 1:10. Reaction temperatures were varied at 333, 343 and 353 K. The reaction time was also varied at 3, 4 and 5 hours. The result shows that the materials have potential catalyst activity.

<https://doi.org/10.1088/1757-899X/245/1/012007> [References](#)

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012008

### Equilibrium study for ternary mixtures of biodiesel

S Dounsri, T Sookkumnerd, A Wongkoblaph and A Nuchitprasittichai

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The liquid-liquid equilibrium (LLE) data for the ternary mixtures of methanol + fatty acid methyl ester (FAME) + palm oil and FAME + palm oil + glycerol at various temperatures from 35 to 55°C, the tie lines and binodial curves were also investigated and plotted in the equilibrium curve. The experimental results showed that the binodial curves of methanol + FAME + palm oil depended significantly with temperature



while the binodial curves of FAME + palm oil + glycerol illustrated insignificant change with temperatures. The interaction parameters between liquid pair obtained for NRTL (Nonrandom Two-Liquid) and UNIQUAC (Universal Quasi-Chemical Theory) models from the experimental data were also investigated. It was found that the correlated parameters of UNIQUAC model for system of FAME + palm oil + glycerol, denoted as a13 and a31, were 580.42K and -123.69K, respectively, while those for system of methanol + FAME + palm oil, denoted as a42 and a24, were 71.48 K and 965.57K, respectively. The ternary LLE data reported here would be beneficial for engineers and scientists to use for prediction of yield and purity of biodiesel for the production. The UNIQUAC model agreed well with the experimental data of ternary mixtures of biodiesel.

<https://doi.org/10.1088/1757-899X/245/1/012008>

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012009

### Identification, measurement, and assessment of water cycle of unhusked rice agricultural phases: Case study at Tangerang paddy field, Indonesia

N Hartono, Laurence and H P Johannes

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According to one of UN reports, water scarcity has happened all around the world, including Indonesia. Irrigation sector takes up 70% of world water consumption and potentially increases 20% due to the population explosion. Rice is accounted for 69% of agricultural products contributions in Indonesia's water footprint. Therefore, evaluation of water cycle was essential to raise awareness among practitioners. Data collections were conducted in the functional unit of one-hectare rice field located in Tangerang. This study used CropWat 8.0 and SimaPro software. Identification involved data such as climate, crop, and soil. Nursery became the highest water consumed phase, requiring 419 mm in height. Measurement through water footprint resulted in consumption of green water footprint for 8,183,618.5 liters (62.9%), followed by grey for 4,805,733.2 liters (36.9%) and blue for 23,902.36 liters (0.2%). The grey consumption was exceeding the average, which indicated high doses of pesticides. Life Cycle Assessment showed negative impacts of fertilizers that caused damages like fossil depletion, respiratory health, and eutrophication.

<https://doi.org/10.1088/1757-899X/245/1/012009>

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012010

### Performance test of a grid-tied PV system to power a split air conditioner system in Surabaya

E Tarigan

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Air conditioner for cooling air is one of the major needs for those who live in hot climate area such as Indonesia. This work presents the performance test of a grid-tied PV system to power air conditioner under a hot tropical climate in Surabaya, Indonesia. A 800 WP grid-tied photovoltaic (PV) system was used, and its performance was tested to power a 0.5 pk of split air conditioner system. It was found that about 3.5 kWh daily energy was consumed by the tested air conditioner system, and about 80% it could be supplied from the PV system. While the other 20% was supplied by the grid during periods of low solar irradiation, 440 Wh of energy was fed into the grid during operation out of office hours. By using the grid-tied PV system, the energy production by PV system did not need to match the consumption of the air conditioner. However, a larger capacity of PV system would mean that a higher percentage of the load would be covered by PV system.

<https://doi.org/10.1088/1757-899X/245/1/012010>

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012011

### Hydrolysis of alkaline pretreated banana peel

A Fatmawati, K Y Gunawan and F A Hadiwijaya

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Banana peel is one of food wastes that are rich in carbohydrate. This shows its potential as fermentation substrate including bio-ethanol. This paper presented banana peel alkaline pretreatment and enzymatic hydrolysis. The pretreatment was intended to prepare banana peel in order to increase hydrolysis performance. The alkaline pretreatment used 10, 20, and 30% w/v NaOH solution and was done at 60, 70 and 80°C for 1 hour. The hydrolysis reaction was conducted using two commercial cellulose enzymes. The reaction time was varied for 3, 5, and 7 days. The best condition for pretreatment process was one conducted using 30% NaOH solution and at 80°C. This condition resulted in cellulose content of 90.27% and acid insoluble lignin content of 2.88%. Seven-day hydrolysis time had exhibited the highest reducing sugar concentration, which was 7.2869 g/L.

<https://doi.org/10.1088/1757-899X/245/1/012011>

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012012

### Closed-loop simulation of decentralized control using RGA for uncertain binary distillation column

R Agustriyanto and J Zhang

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This paper presents the results of closed-loop simulation for the decentralized control of uncertain distillation column. The RGA (Relative Gain Array) RGA analysis was used as the basis for selecting the configuration of the decentralized control system. PI controller obtained was then tuned with optimization methods. The simulation results show that the RGA analysis requires accurate range for uncertain systems. In addition, closed-loop simulation results confirm the RGA analysis.

<https://doi.org/10.1088/1757-899X/245/1/012012> [References](#)

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012013

### [An efficiency improvement in warehouse operation using simulation analysis](#)

N Samattapapong

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In general, industry requires an efficient system for warehouse operation. There are many important factors that must be considered when designing an efficient warehouse system. The most important is an effective warehouse operation system that can help transfer raw material, reduce costs and support transportation. By all these factors, researchers are interested in studying about work systems and warehouse distribution. We start by collecting the important data for storage, such as the information on products, information on size and location, information on data collection and information on production, and all this information to build simulation model in Flexsim® simulation software. The result for simulation analysis found that the conveyor belt was a bottleneck in the warehouse operation. Therefore, many scenarios to improve that problem were generated and testing through simulation analysis process. The result showed that an average queuing time was reduced from 89.8% to 48.7% and the ability in transporting the product increased from 10.2% to 50.9%. Thus, it can be stated that this is the best method for increasing efficiency in the warehouse operation.

<https://doi.org/10.1088/1757-899X/245/1/012013> [References](#)

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012014

### [Modeling of the minimum variable blank holder force based on forming limit diagram \(FLD\) in deep drawing process](#)

S Candra, I M L Batan, W Berata and A S Pramono

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This paper presents the mathematical approach of minimum blank holder force to prevent wrinkling in deep drawing process of the cylindrical cup. Based on the maximum of minor-major strain ratio, the slab method was

applied to determine the modeling of minimum variable blank holder force (VBHF) and it compared to FE simulation. The Tin steel sheet of T4-CA grade, with the thickness of 0.2 mm was used in this study. The modeling of minimum VBHF can be used as a simple reference to prevent wrinkling in deep drawing.

<https://doi.org/10.1088/1757-899X/245/1/012014> [References](#)

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012015

### Single-tier city logistics model for single product

N I Saragih, S Nur Bahagia, Suprayogi and I Syabri

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This research develops single-tier city logistics model which consists of suppliers, UCCs, and retailers. The problem that will be answered in this research is how to determine the location of UCCs, to allocate retailers to opened UCCs, to assign suppliers to opened UCCs, to control inventory in the three entities involved, and to determine the route of the vehicles from opened UCCs to retailers. This model has never been developed before. All the decisions will be simultaneously optimized. Characteristic of the demand is probabilistic following a normal distribution, and the number of product is single.

<https://doi.org/10.1088/1757-899X/245/1/012015> [References](#)

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012016

### Inventory model optimization for supplier-manufacturer-retailer system with rework and waste disposal

A R Dwicahyani, E Kholisoh, W A Jauhari, C N Rosyidi and P W Laksono

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This study developed a model for a CLSC inventory system which consisted of a supplier, a manufacturer and a retailer. We applied single remanufacturing cycle and multiple manufacturing cycle,  $(1, \mathcal{P})$ , policy and performed a comparison to the previous study. We conducted an investigation of an imperfect manufacturing process whose defective items were being reworked. Other considerations were quality dependent return rate and waste disposal activity, for any returned items that did not exceed the acceptable quality level. Some parameters including demand, proportion of defect, waste and refurbished item were assumed deterministic and constant. We proposed a solution procedure and presented a numerical example to illustrate the application of the model. The results showed that  $(1, \mathcal{P})$  policy allowed higher profit for the system than  $(R, 1)$  policy presented in the previous study.

<https://doi.org/10.1088/1757-899X/245/1/012016> [References](#)

## A periodic review integrated inventory model with controllable setup cost, imperfect items, and inspection errors under service level constraint

R S Saga, W A Jauhari and P W Laksono

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This paper presents an integrated inventory model which consists of single vendor and buyer. The buyer managed its inventory periodically and orders products from the vendor to satisfy the end customer's demand, where the annual demand and the ordering cost were in the fuzzy environment. The buyer used a service level constraint instead of the stock-out cost term, so that the stock-out level per cycle was bounded. Then, the vendor produced and delivered products to the buyer. The vendor had a choice to commit an investment to reduce the setup cost. However, the vendor's production process was imperfect, thus the lot delivered contained some defective products. Moreover, the buyer's inspection process was not error-free since the inspector could be mistaken in categorizing the product's quality. The objective was to find the optimum value for the review period, the setup cost, and the number of deliveries in one production cycle which might minimize the joint total cost. Furthermore, the algorithm and numerical example were provided to illustrate the application of the model.

<https://doi.org/10.1088/1757-899X/245/1/012017>

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## A joint economic lot-sizing problem with fuzzy demand, defective items and environmental impacts

W A Jauhari and P W Laksono

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In this paper, a joint economic lot-sizing problem consisting of a vendor and a buyer was proposed. A buyer ordered products from a vendor to fulfill end customer's demand. A produced a batch of products, and delivered it to the buyer. The production process in the vendor was imperfect and produced a number of defective products. Production rate was assumed to be adjustable to control the output of vendor's production. A continuous review policy was adopted by the buyer to manage his inventory level. In addition, an average annual demand was considered to be fuzzy rather than constant. The proposed model contributed to the current inventory literature by allowing the inclusion of fuzzy annual demand, imperfect production emission cost, and adjustable production rate. The proposed model also considered carbon emission cost which was resulted from the transportation activity. A mathematical model was developed for obtaining the optimal ordering quantity, safety factor and the number of deliveries so the joint total cost

was minimized. Furthermore, an iterative procedure was suggested to determine the optimal solutions.

<https://doi.org/10.1088/1757-899X/245/1/012018>

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012019

### [Development of coordination system model on single-supplier multi-buyer for multi-item supply chain with probabilistic demand](#)

G Olivia, A Santoso and D N Prayogo

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Nowadays, the level of competition between supply chains is getting tighter and a good coordination system between supply chains members is very crucial in solving the issue. This paper focused on a model development of coordination system between single supplier and buyers in a supply chain as a solution. Proposed optimization model was designed to determine the optimal number of deliveries from a supplier to buyers in order to minimize the total cost over a planning horizon. Components of the total supply chain cost consist of transportation costs, handling costs of supplier and buyers and also stock out costs. In the proposed optimization model, the supplier can supply various types of items to retailers whose item demand patterns are probabilistic. Sensitivity analysis of the proposed model was conducted to test the effect of changes in transport costs, handling costs and production capacities of the supplier. The results of the sensitivity analysis showed a significant influence on the changes in the transportation cost, handling costs and production capacity to the decisions of the optimal numbers of product delivery for each item to the buyers.

<https://doi.org/10.1088/1757-899X/245/1/012019>

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012020

### [Using genetic algorithm to determine the optimal order quantities for multi-item multi-period under warehouse capacity constraints in kitchenware manufacturing](#)

D Saraswati, D K Sari and V Johan

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The study was conducted on a manufacturer that produced various kinds of kitchenware with kitchen sink as the main product. There were four types of steel sheets selected as the raw materials of the kitchen sink. The problem was the manufacturer wanted to determine how much steel sheets to order from a single supplier to meet the production requirements in a way to minimize the total inventory cost. In this case, the economic order quantity (EOQ) model was developed using all-unit discount as the price of steel sheets and the warehouse capacity was limited. Genetic algorithm (GA) was used to find the minimum of the

total inventory cost as a sum of purchasing cost, ordering cost, holding cost and penalty cost.

<https://doi.org/10.1088/1757-899X/245/1/012020>

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012021

## [From ISO 9001:2008 to ISO 9001:2015: Significant changes and their impacts to aspiring organizations](#)

Y Sari, E Wibisono, R D Wahyudi and Y Lio

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ISO 9001:2015 is the latest version of ISO Quality Management System standard that has been updated recently from ISO 9001:2008. It is necessary for all organizations that have implemented and been certified with ISO 9001:2008 to prepare the transition and upgrade their Quality Management System because the certification will expire by September 2018. This paper attempts to provide knowledge on the significant changes from ISO 9001:2008 to ISO 9001:2015, what new requirements are added, and how they would impact the organizations. An exploratory and applied research was chosen as the research approach and aimed to explore what transition designs are needed to anticipate the changes as well as their impacts. The research applied a methodology of Plan-Do-Check-Action (PDCA) cycle into four organizations and their results were compared and discussed to explain the transition designs. Some qualitative methods such as observation and interview were used to collect the data. By addressing the new requirements, three transition designs that should be prepared are: (i) identifying needs from interested parties, (ii) analyzing internal and external factors of the organizations to formulate relevant strategies and quality objectives, and (iii) registering risks associated to business processes as well as organizational strategies.

<https://doi.org/10.1088/1757-899X/245/1/012021>

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012022

## [Improving delivery routes using combined heuristic and optimization in a consumer goods distribution company](#)

E Wibisono, A Santoso and M A Sunaryo

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XYZ is a distributor of various consumer goods products. The company plans its delivery routes daily and in order to obtain route construction in a short amount of time, it simplifies the process by assigning drivers based on geographic regions. This approach results in inefficient use of vehicles leading to imbalance workloads. In this paper, we propose a combined method involving heuristic and optimization to obtain better solutions in acceptable computation time. The heuristic is based on a time-oriented, nearest neighbor (TONN) to form clusters if the number of locations is

higher than a certain value. The optimization part uses a mathematical modeling formulation based on vehicle routing problem that considers heterogeneous vehicles, time windows, and fixed costs (HVRPTWF) and is used to solve routing problem in clusters. A case study using data from one month of the company's operations is analyzed, and data from one day of operations are detailed in this paper. The analysis shows that the proposed method results in 24% cost savings on that month, but it can be as high as 54% in a day.

<https://doi.org/10.1088/1757-899X/245/1/012022>

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### [The effect of different concentrations of tween-20 combined with rice husk silica on the stability of o/w emulsion: A kinetic study](#)

L Sapei, I G Y H Sandy, I M K D Suputra and M Ray

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Emulsion is a thermodynamically unstable system which undergoes destabilization with time. The destabilization kinetics of "food grade" oil-in-water (O/W) emulsions in the presence of both tween-20 and rice husk silica as emulsifiers were studied. Rice husk silica concentration of 2.5% was combined with various concentrations of tween-20 from 0.1 to 1%. Oil phase fraction was 20% relative to the aqueous phase. Emulsification was conducted using a rotor-stator homogenizer at 20,000 rpm. The emulsions tended to destabilize with time. Their destabilization rates were studied using zero order and first order kinetic models. In general, the kinetics of O/W emulsion destabilization followed first order model. Different concentrations of tween-20 combined with rice husk silica influenced the destabilization rate of o/w emulsions. Destabilization rates of emulsions stabilized using mixed emulsifiers of 1% tween-20 and 2.5% silica were ~50 times and ~3 times lower compared to those stabilized using silica alone and tween-20 alone, respectively.

<https://doi.org/10.1088/1757-899X/245/1/012023>

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012024

### [Constrained optimization via simulation models for new product innovation](#)

Nugroho A Pujowidianto

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We consider the problem of constrained optimization where the decision makers aim to optimize the primary performance measure while constraining the secondary performance measures. This paper provides a brief overview of stochastically constrained optimization via discrete event simulation. Most review papers tend to be methodology-based. This review attempts to be problem-based as decision makers may have already



decided on the problem formulation. We consider constrained optimization models as there are usually constraints on secondary performance measures as trade-off in new product development. It starts by laying out different possible methods and the reasons using constrained optimization via simulation models. It is then followed by the review of different simulation optimization approach to address constrained optimization depending on the number of decision variables, the type of constraints, and the risk preferences of the decision makers in handling uncertainties.

<https://doi.org/10.1088/1757-899X/245/1/012024>

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### Affective design identification on the development of batik convection product

H Prastawa and R Purwaningsih

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The affective design is increasingly applied to product development in order to meet the desires and preferences of customers. Batik is a traditional Indonesian culture containing historical and cultural values. The development of batik design is one of the efforts to strengthen the identity and superiority of Indonesia's creative industries as well as to preserve batik as the cultural heritage of the nation. Batik product designs offered by the manufacturers do not necessarily correspond with the wishes of consumers, especially the affective values involved. Therefore it is necessary to identify consumer perceptions of convection-based batik product in the form of clothing and fabrics, especially the affective value as the consideration for the designer or manufacturer to develop design alternatives to batik convection products. This research aims to obtain information on consumer affective value, to identify the affective value perception differences among X and Y Generation and to classify affective value in the corresponding cluster of the batik products convection. This study uses Kansei engineering to determine the perception of affective design in the form of Kansei word. Cluster Analysis was used to form clusters that classify affective value of the same class. The results showed that there were 16 pairs of Kansei word which was worth as an affective consumer desire, the 3 indicators that had significant differences among X and Y Generation and 4 clusters with different characteristics.

<https://doi.org/10.1088/1757-899X/245/1/012025>

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012026

### Estimating life cycle cost for a product family design: The

## challenges

T J Suteja, A Karim, P K D V Yarlagadda and C Yan

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A cost estimation system is required to assist in designing a product family. The aim of this paper is to identify the requirements and the problems in estimating the life cycle cost of a product family. Then, this paper also presents the state-of-the-art and the research challenges in developing a life cycle cost estimation system for a product family design. As the conclusion, the life cycle cost estimation process for a product family still needs to face the challenges to determine the end of life strategy of each sub module of a product family, to integrate the end of life strategy to estimate the life cycle cost of a product family, to estimate the life cycle cost of each component level of a product family for design purposes and for different technologies and approaches, to reduce the required time and effort for updating process in estimating the life cycle cost for different structures of different product families, and to transform the available information into the required information in order to estimate the life cycle cost of a product family at the early stage of product development.

<https://doi.org/10.1088/1757-899X/245/1/012026>

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012027

## An integrative fuzzy Kansei engineering and Kano model for logistics services

M Hartono, T K Chuan, D N Prayogo and A Santoso

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Nowadays, customer emotional needs (known as Kansei) in product and especially in services become a major concern. One of the emerging services is the logistics services. In obtaining a global competitive advantage, logistics services should understand and satisfy their customer affective impressions (Kansei). How to capture, model and analyze the customer emotions has been well structured by Kansei Engineering, equipped with Kano model to strengthen its methodology. However, its methodology lacks of the dynamics of customer perception. More specifically, there is a criticism of perceived scores on user preferences, in both perceived service quality and Kansei response, whether they represent an exact numerical value. Thus, this paper is proposed to discuss an approach of fuzzy Kansei in logistics service experiences. A case study in IT-based logistics services involving 100 subjects has been conducted. Its findings including the service gaps accompanied with prioritized improvement initiatives are discussed.

<https://doi.org/10.1088/1757-899X/245/1/012027>

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## The impact of expatriates directors on the Indonesian company's performance

I M Ronyastra

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This research examined the impact of employing expatriates as board of directors (BOD) to the financial performance of Indonesian companies. Using samples from Kompas 100 index in Indonesian Stock Exchange, the research performed analyses on three performance indicators i.e. Return on Asset (ROA), Return on Equity (ROE), and Tobin's Q. Binary variable of whether a company employing expatriate and the proportion of expatriate in the BOD were used as the proxy for the independent variable. The research did not find enough evidence to support the hypothesis that employing expatriate in the BOD would make the financial performance different.

<https://doi.org/10.1088/1757-899X/245/1/012028>

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## Survival analysis for customer satisfaction: A case study

M A Hadiyat, R D Wahyudi and Y Sari

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Most customer satisfaction surveys are conducted periodically to track their dynamics. One of the goals of this survey was to evaluate the service design by recognizing the trend of satisfaction score. Many researchers recommended in redesigning the service when the satisfaction scores were decreasing, so that the service life cycle could be predicted qualitatively. However, these scores were usually set in Likert scale and had quantitative properties. Thus, they should also be analyzed in quantitative model so that the predicted service life cycle would be done by applying the survival analysis. This paper discussed a starting point for customer satisfaction survival analysis with a case study in healthcare service.

<https://doi.org/10.1088/1757-899X/245/1/012029>

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## Pattern analysis of fraud case in Taiwan, China and Indonesia

A H Kusumo, C-F Chi and R S Dewi

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The current study analyzed 125 successful fraud cases happened in Taiwan, China, and Indonesia from 2008 to 2012 published in the English online newspapers. Each of the case report was coded in terms of scam principle, information media (information exchange between fraudsters and victim), money media (media used by fraudsters to obtain

unauthorized financial benefit) and other additional information which was judged to be relevant. The Chi-square Automatic Interaction Detector (CHAID) was applied to the coded data of information, scam principle and money media to find a subset of predictors that might derive meaningful classifications. A series of flow diagrams was constructed based on CHAID result to illustrate the flow of information (scam) travelling from information media to money media.

<https://doi.org/10.1088/1757-899X/245/1/012030> [References](#)

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012031

## Outdoor altitude stabilization of QuadRotor based on type-2 fuzzy and fuzzy PID

H Wicaksono, Y G Yusuf, C Kristanto and L Haryanto

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This paper presents a design of altitude stabilization of QuadRotor based on type-2 fuzzy and fuzzy PID. This practical design is implemented outdoor. Barometric and sonar sensor were used in this experiment as an input for the controller YoHe. The throttle signal as a control input was provided by the controller to leveling QuadRotor in particular altitude and known well as altitude stabilization. The parameter of type-2 fuzzy and fuzzy PID was tuned in several heights to get the best control parameter for any height. Type-2 fuzzy produced better result than fuzzy PID but had a slow response in the beginning.

<https://doi.org/10.1088/1757-899X/245/1/012031> [References](#)

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012032

## Investigating the role of Fuzzy as confirmatory tool for service quality assessment (Case study: Comparison of Fuzzy SERVQUAL and SERVQUAL in hotel service evaluation)

R D Wahyudi

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The problem was because of some indicators qualitatively assessed had been discussed in engineering field. Whereas, qualitative assessment was presently used in certain occasion including in engineering field, for instance, the assessment of service satisfaction. Probably, understanding of satisfaction definition caused bias if customers had their own definition of satisfactory level of service. Therefore, the use of fuzzy logic in SERVQUAL as service satisfaction measurement tool would probably be useful. This paper aimed to investigate the role of fuzzy in SERVQUAL by comparing result measurement of SERVQUAL and fuzzy SERVQUAL for study case of hotel service evaluation. Based on data processing, initial result showed that there was no significant different between them. Thus, either implementation of fuzzy SERVQUAL in different case or study

about the role of fuzzy logic in SERVQUAL would be interesting further discussed topic.

<https://doi.org/10.1088/1757-899X/245/1/012032>

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## Modeling of the minimum variable blank holder force based on forming limit diagram (FLD) in deep drawing process

To cite this article: S Candra *et al* 2017 *IOP Conf. Ser.: Mater. Sci. Eng.* **273** 012014

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# Modeling of the minimum variable blank holder force based on forming limit diagram (FLD) in deep drawing process

S Candra<sup>1</sup>, I M L Batan<sup>2</sup>, W Berata<sup>2</sup> and A S Pramono<sup>2</sup>

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**Abstract.** This paper presents the mathematical approach of minimum blank holder force to prevent wrinkling in deep drawing process of the cylindrical cup. Based on the maximum of minor-major strain ratio, the slab method was applied to determine the modeling of minimum variable blank holder force (VBHF) and it compared to FE simulation. The Tin steel sheet of T4-CA grade, with the thickness of 0.2 mm was used in this study. The modeling of minimum VBHF can be used as a simple reference to prevent wrinkling in deep drawing.

## 1. Introduction

The wrinkle is a type of product defect that often occurs in deep drawing. One thing that can be pursued to prevent product defects is determining the magnitude of the blank holder force (BHF) accurately. To solve this problem, the magnitude of BHF should be set by safe value. Some research related to the determination of blank holder force for prevention product defect is still widely performed. Reddy et al. [1], Agrawal et al. [2], Wang et al. [3], and Qin et al. [4] conducted the research to obtain the linear BHF distribution magnitude for reducing wrinkling. Based on restraining energy calculating and buckling criterion, Agrawal et al. [2], Wang et al. [3] and Qin et al. [4] developed the mathematical modeling of minimum constant BHF to avoid wrinkling. The wrinkling would occur when the buckling strain as the tangential strain is excessive. Furthermore, they have developed the buckling analysis to predict the onset of wrinkling and determined the BHF magnitude by using the theory of strain energy.

Kadkhodaya et al. [5], Chu et al. [6], Correia et al. [7], and Shafaat et al. [8, 9] have proposed the mathematical model of wrinkling by using the approach of bifurcation function and Tresca criterion. Furthermore, these models are used to predict the minimum constant BHF without wrinkling, during the punch stroke. Candra et al. [10] continued these researches to estimate the variable blank holder force by using the maximum gap criterion.

Based on the researches above, this paper develops a different approach to determine the minimum VBHF by using the forming limit diagram (FLD) criterion to prevent wrinkling. Modeling of the minimum VBHF would also be verified by FE simulation.



## 2. Mathematical modeling of minimum variable blank holder force

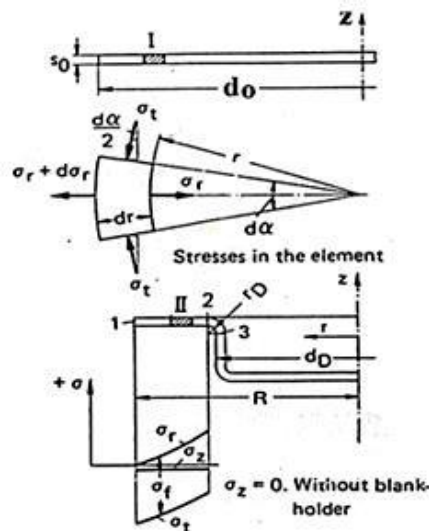
Based on the equilibrium force diagrams in a small element and considering the friction on the flange surface, as shown in Figure 1, the tangential stress equation is obtained as follows [10, 11].

$$\sigma_{t,i} = \sigma_{r,i} - \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}}(\sigma_f) \quad (1)$$

And

$$\sigma_{t,i} = \left\{ \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} (\sigma_{fmp1-2,i}) \left( \ln \frac{d_{1,i}}{d_m} \right) \right\} + \left\{ \frac{2\mu F_{bh,i}}{\pi d_{1,i} s_0} \right\} - \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}}(\sigma_f) \quad (2)$$

Where  $\sigma_{r,i}$  is the stress in radial direction,  $\bar{R}_n$  is average of material anisotropic value,  $\sigma_{fmp1-2,i}$  is the mean flow stress on flange over punch stroke,  $d_{1,i}$  is the outer local diameter of flange - function of punch stroke,  $d_m$  is the average radius of cylindrical cup deep drawing,  $\mu$  is the coefficient of friction,  $F_{bh,i}$  is the variable blank holder force (VBHF),  $s_0$  is the initial thickness of material and  $\sigma_f$  is the flow stress a moment on *flange*.



**Figure 1.** The equilibrium force diagram in a small element on flange [10, 11].

The mean flow stress on flange over punch stroke ( $\sigma_{fm,p1-2,i}$ ) can be calculated by Eq. (3) [10].

$$\sigma_{fm,p1-2,i} = \left( \frac{1}{2} \right) \left( \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} \right)^n K \left[ \left( \ln \frac{d_0}{d_{1,i}} \right)^n + \left( \ln \frac{d_{int,i}}{d_D + 2r_d} \right)^n \right] \quad (3)$$

Where  $d_D$  is the die diameter and  $r_d$  is the die edge radius and  $d_{int,i}$  is the inside diameter.

To determine the changing of diameter should be calculated under the condition a constant volume. The outer local diameter of flange and inside diameter each step could be determined by equation as follows [10, 11].

$$d_{1,i} = f(d_0, d_D, r_p, r_d, i=h) = \sqrt{(d_0)^2 + 4d_D \{h - (0,43r_p - 0,43r_d)\}} \quad (4)$$

Where  $r_p$  is the punch edge radius,  $i=h$  is the punch stroke and  $d_{int,i}$  can be calculated by Eq. (5),

$$d_{int,i} = f(d_0, d_D, r_p, h, d_{1,i}) = \sqrt{(d_0)^2 + (d_D + 2r_d)^2 - (d_{1,i})^2} \quad (5)$$



The deformation of deep drawing process can be represented by a minor strain (strain tangential) and major (tensile strain). The safe value of the radial and tangential strain ratio in the flange area could be determined by the forming limit diagram (FLD) as shown in Fig. 2. The force and stress tangential equation each punch stroke with considering the friction and no differences of the cross section area (see Figure 3) can be determined by Eqs.  $F_{t,i} = F_{t\text{minor},i} - F_{\text{friction},i}$  and  $\sigma_{t,i} = \sigma_{t\text{minor},i} - \sigma_{\text{friction},i}$ , respectively. Where,  $F_{t,i}$  is the tangential force,  $F_{t\text{minor},i}$  is the ideal tangential force,  $F_{\text{friction},i}$  is the tangential friction force,  $\sigma_{t\text{minor},i}$  is the ideal tangential stress and  $\sigma_{\text{friction},i}$  is the tangential friction stress.

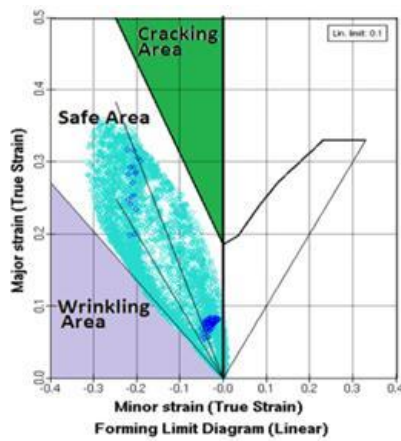


Figure 2. Forming limit diagram [19].

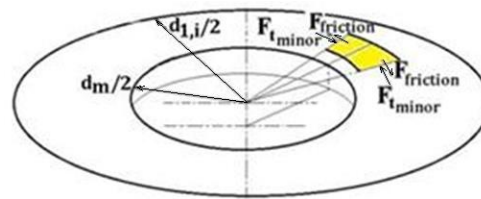


Figure 3. Equilibrium of the force diagram in tangential direction.

Based on defect criterion and the forming limit diagram (FLD), the wrinkling will be predicted when the ratio of minor and major strain around 1.3. In order to achieve these conditions, the equation of tangential stress of each punch stroke also becomes,

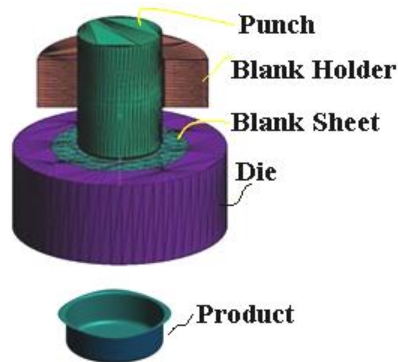
$$\sigma_{t,i} = \left(\frac{1}{2}\right) \left( \left( 1.3 \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} \right)^n K \left( \left( \ln \frac{d_0}{d_{1,i}} \right)^n + \left( \ln \frac{d_{\text{int},i}}{d_m} \right)^n \right) - \left( \frac{2\mu F_{bh,i}}{s_0 \left( \frac{d_{1,i} - (d_D + r_d)}{2} \right)} \right) \right) \quad (6)$$

Combining Eqs. (2) and (8), the minimum VBHF ( $F_{bh,i}$ ) could be determined with the equation,

$$F_{bh,i} = \text{VBHF} = \frac{\left(\frac{1}{2}\right) \left( \left( 1.3 \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} \right)^n K \left( \left( \ln \frac{d_0}{d_{1,i}} \right)^n + \left( \ln \frac{d_{\text{int},i}}{d_m} \right)^n \right) - \left( \left\{ \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} (\sigma_{fmp1-2,i}) \left( \ln \frac{d_{1,i}}{d_m} \right) \right\} - \left( \sqrt{\frac{2(\bar{R}_n+1)}{1+2\bar{R}_n}} \sigma_f \right) \right) \right)}{\left( 2\mu/\pi d_{1,i} s_0 + \left( 2\mu/s_0 \left( \frac{\left( \frac{d_{1,i} + d_{\text{int},i}}{2} \right) - \left( \frac{d_D + r_d}{2} \right)}{2} \right) \right) \right)} \quad (7)$$

### 3. FE modeling

In this study, the analytical solution provided was compared to FE Modeling. Forming simulation used the implicit Auto form FE solver as shown a virtual image in Fig. 4. The FE simulation was utilized element formation using elastic-plastic deformation approach and ignore the effects of spring back. The number and shape of meshing were done automatically by FE software. The number of meshing was determined based on deformation conditions. Meanwhile, the shape of meshing is defined as a triangle, which is often used for sheet metal forming simulations.



**Figure 4.** Finite Element modeling.

The analytical approach and FE simulation used the detail value of the punch-die dimension, the steel sheet and process parameters, as shown in Table 1.

**Table 1.** Dimension of tools, mechanical properties and variables of processes.

Dimension of tools		Mech. properties Tin plate T4 CA		Processes parameters	
$d_0$	64 mm	K	559 N/mm <sup>2</sup>	$\mu$	0,45 (dry)
$d_D$	40 mm	n	0.176		
$d_p$	39.576 mm	$\bar{R}$	2	BHF	Not constant
Clearance	0.288 mm	UTS	355 N/mm <sup>2</sup>		
$s_0$	0.2 mm	c	1.125		
$r_d$	1 mm				
$r_p$	2 mm				
H	15 mm				

#### 4. Results and discussion: analytical and FE simulation of minimum VBHF

Table 2 shows the magnitude of tangential-radial stress and minimum VBHF by using the equations 1 to 7, based on the minor and major limiting strain ratio, during the punch stroke. A minimum VBHF application under maintaining the strain ratio was effective for controlling the equilibrium of stress deformation. The profile of minimum VBHF increases with an average of gradient slopes around 39.6 to prevent wrinkling.

**Table 2.** Minimum  $F_{bh,i}$ (VBHF) from analytical based on the limiting strain ratio.

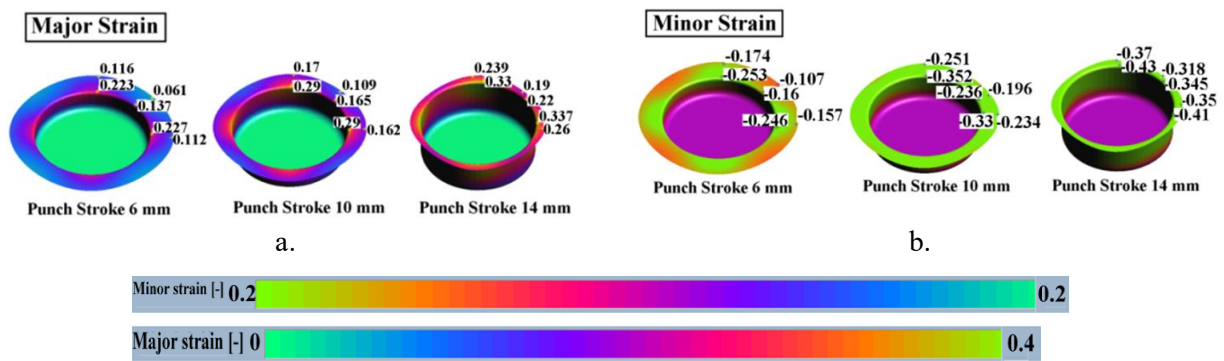
i=h Punch stroke (mm)	The absolute of minor strain and major strain ratio	$\sigma_{t,i}$	$\sigma_{r,i}$	Min. $F_{bh,i}$ (Minimum VBHF)
6	1.3	418.35	399.47	682.40
8	1.3	444.43	424.37	739.38
10	1.3	464.92	443.94	788.80
12	1.3	482.21	460.45	831.00
14	1.3	497.55	475.10	865.13
Etc.				

Table 3 shows the details of the FE simulation result, related to tangential stress, radial stress and minimum blank holder force, based on the minor and major strain ratio and the forming limit diagram (FLD). The simulation was conducted to present an application of the minimum VBHF, should be applied slightly increase. The virtual image of minimum VBHF application leads to the major strain

and minor strain at punch stroke 6, 10 and 14 mm, as shown in Fig. 5. In addition, the minor and major strain ratio can be maintained around 1.3 without excessive wrinkling product. FE simulations prove that the modeling of minimum VBHF could be applied as a reference in deep drawing process without excessive wrinkling. Results of FE simulation have no different significantly compared to the analytical results before.

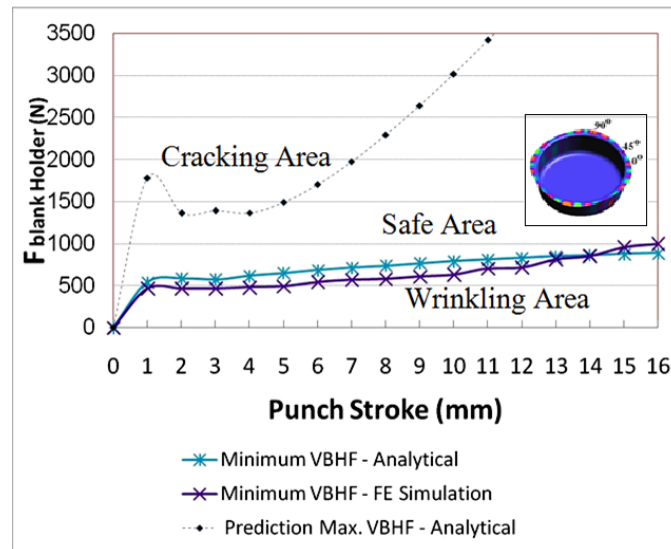
**Table 3.** Minimum  $F_{bh,i}$  (VBHF) from FE simulation.

i=h Punch stroke (mm)	The absolute of minor strain and major strain ratio	$\sigma_{t,i}$	$\sigma_{i,i}$	Minimum $F_{bh,i}$ (Minimum VBHF)
6	1.23	381.3	402.2	546.4
8	1.25	406.9	423.2	577.9
10	1.35	425.5	438.7	631.6
12	1.35	439.8	450.7	719.3
14	1.40	455.3	464.5	852.8
Etc.				



**Figure 5.** a. Major Strain, b. Minor Strain.

The final results of calculation and FE simulation have been displaying the minimum VBHF each punch stroke, as shown Fig. 6. To prevent wrinkling at each punch increment, the BHF should be maintained slightly above the minimum VBHF line. These conditions will keep the value of minor and major strain ratio around 1.3 and control the magnitude of the tangential stress. Finally, the process can be operated properly without excessive wrinkling product.



**Figure 6.** Minimum VBHF vs Punch Stroke.

## 5. Conclusion

The results of the minimum VBHF calculation are not much different from FE simulation. VBHF could be effective for preventing the occurrence of wrinkling, and also for improving the permeability of the process. VBHF modeling indicated a similar trend compared to FE simulation results. Mathematical modeling of VBHF can be used as a simple approach for estimating the magnitude of minimum blank holder force in every punch stroke. The minimum VBHF has provided the information about a safe area on cylindrical cup deep drawing. Therefore, the safe area must be maintained above the minimum VBHF. Modeling minimum VBHF based on the ratio of minor and major strain and FLD can be used as a reference in the process of deep drawing.

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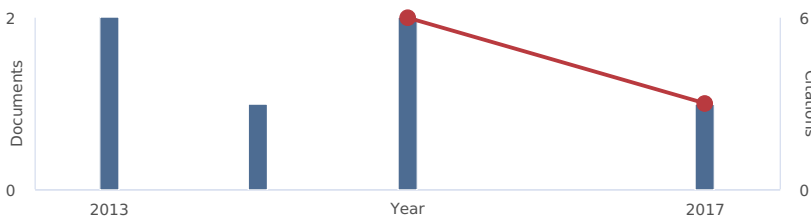
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