

# Message from the APIEMS President



Greeting and a warm welcome to the participants of the 15th Asia Pacific Industrial Engineering and Management Systems Conference. Started in 1998, APIEMS has grown to become the premier conference for industrial engineering and management systems in the region with participants from all around the world. The main theme of this year conference: “Sustainable Industrial Systems and Big Data Management”, is an attempt to address the balance among economic and technical development, social development, and environmental protection in this fast changing world.

I congratulate and thank Prof. Dr. Chi-Hyuck Jun, the conference chair, whose leadership made this APIEMS 2014 conference possible. We are also grateful for the enthusiastic support of APIEMS from the KIIE and the Korea research community.

On behalf of the Asia Pacific Industrial Engineering and Management Society, I wish you a successful conference with many thoughtful discussions and debates with old and new friends.

A handwritten signature in blue ink, which appears to read 'V. Kachitvichyanukul'. The signature is fluid and cursive.

Professor Voratas Kachitvichyanukul  
APIEMS President, (2013-2014)  
Professor of Industrial & Manufacturing Engineering  
Dean, School of Engineering and Technology  
Asian Institute of Technology, THAILAND

# Message from the General Chair



Welcome to APIEMS 2014 in Jeju City, a beautiful island located at the most south of Korea. It is our great pleasure to organize this conference, which is supported by Korean Institute of Industrial Engineers (KIIIE). APIEMS conferences have rapidly emerged as an important forum for exchange of ideas and information about latest developments in the field of industrial engineering and management systems among professionals mostly from Asia-Pacific countries. APIEMS 2014 conference encourages contributors to address the topical theme: Sustainable Industrial Systems and Big Data Management. Papers will represent the latest academic thinking and successful case examples. The wider audience will benefit from the knowledge and experience of leading practitioners and academics in this area.

The conference seeks research contributions from researchers, educators, modelers, software developers, users and practitioners. We hope that you enjoy participating in APIEMS 2014 and staying in Jeju.

A handwritten signature in black ink that reads "Chi H. Jun". The signature is written in a cursive, flowing style.

Professor Chi-Hyuck Jun  
General Chair, APIEMS 2014  
Industrial & Management Engineering  
POSTECH, Korea

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# Keynote Speech

## **Keynote Speech I** **Research Issues in Future Logistics**

***Oct 13 (Monday) 11:00-12:00***

***Room: Ramada-1***

### **Chung– Yee Lee**

Hong Kong University of Science and Technology, China



Dr. Chung-Yee Lee is Chair Professor/Cheong Ying Chan Professor of Engineering in the Department of Industrial Engineering & Logistics Management at Hong Kong University of Science and Technology. He served as Department Head for seven years (2001- 2008). He is also the Founding and Current Director of Logistics and Supply Chain Management Institute. He is a Fellow of the Institute of Industrial Engineers in U.S. and also a Fellow of Hong Kong Academy of Engineering Science. Before joining HKUST in 2001, he was Rockwell Chair Professor in the Department of Industrial Engineering at Texas A&M University. He worked as a plant manager and also had few years consulting experience in Taiwan. In the past thirty years he has engaged in more than forty research projects sponsored by NSF, RGC, ITF, IBM, Motorola, AT&T Paradyne, Harris Semiconductor, Northern Telecom, Martin Marietta, Hong Kong Air Cargo Terminal, Hongkong International Terminal, Philips Medical, ...,etc.

His search areas are in logistics and supply chain management, scheduling and inventory management. He has published more than 130 papers in refereed journals. According to an article in *Int. J. Prod. Eco.* (2009), which looked at all papers published in the 20 core journals during last 50 years in the field of production and operations management, he was ranked No. 6 among all researchers worldwide in h-index.

He received a BS degree in Electronic Engineering (1972) and a MS degree in Management Sciences (1976) both from National Chiao-Tung University in Taiwan. He also received a MS degree in Industrial Engineering from Northwestern University (1980) and PhD degree in Operations Research from Yale University (1984).

# Keynote Speech

## **Keynote Speech II Data-Driven Decision Making in Manufacturing: Lessons Learned and Future Opportunities**

*Oct 14 (Tuesday) 11:00-12:00*

*Room: Ramada-1*

### **Ronald G. Askin**

Arizona State University, USA



Ronald G. Askin, Ph.D., is a Professor of Industrial Engineering and Director of the School of Computing, Informatics, and Decision Systems Engineering at Arizona State University. Professor Askin received his B. S. in Industrial Engineering from Lehigh University followed by an M.S. in Operations Research and PhD in Industrial and Systems Engineering from the Georgia Institute of Technology. He has over 30 years of experience in the development, teaching and application of methods for systems design and analysis with particular emphasis on production and material flow systems. Other interests include quality engineering and decision analysis. He has published over 120 journal and conference proceedings papers in these areas.

Dr. Askin is a Fellow of the Institute of Industrial Engineers (IIE) and serves as Editor-in-Chief of IIE Transactions. He has served on the IIE Board of Trustees, as President of the IIE Council of Fellows, Chair of the Association of Chairs of Operations Research Departments (ACORD) Chair of the Industrial Engineering Academic Department Heads (CIEADH) and President of the INFORMS Manufacturing and Service Operations Management Society (MSOM). He was also General Chair of the 2012 INFORMS Annual Conference. His list of awards includes a National Science Foundation Presidential Young Investigator Award, the Shingo Prize for Excellence in Manufacturing Research, IIE Joint Publishers Book of the Year Award (twice), IIE Transactions on Design and Manufacturing Best Paper Award (twice), the Eugene L. Grant best paper award from The Engineering Economist, and the IIE Transactions Development and Applications Award.

# Keynote Speech

## **Keynote Speech III Big Data Management**

***Oct 14 (Tuesday) 13:00-14:00***

***Room: Ramada-1***

### **Sungzoon Cho**

Seoul National University, Korea.



Sungzoon Cho is currently professor of Industrial Engineering Department, the director of Data Mining Center at Seoul National University (SNU) and a member of Government 3.0 Committee of Korean government. He is on the editorial board of International Journal of Operations Research and Information Systems and International Journal of Cognitive Biometrics. He served as the president of Hyundai Motors, Hyundai Heavy Industries, POSCO, Daewoo Shipbuilding and Marine Engineering, LG Electronics, Doosan Infracore, SK Hynix, SK Telecommunication and CJ. He advised nine PhDs and 56 Master students. He teaches Data Mining and Computational Intelligence at SNU as well as at firms. He received BS and MS in Industrial Engineering at SNU. He won a Fulbright Scholarship to obtain Masters and PhD at University of Washington in Seattle, US, and University of Maryland in College Park, US, respectively.

# Shift-Scheduling Characteristic Identification of Non-Star Hotels Industry in Yogyakarta Indonesia

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**Abstract.** Shift arrangement in developing work schedule become classical problem faced by non-star hotel in Yogyakarta. They have to maintain their service well by keep the workforce in good performance and give competitive facilities in order to survive in increasing number of hotel in Yogyakarta. However, as well as other non-star hotel, they override the balance between the work load and the workforce well-being factor. Most of non-star hotel in Yogyakarta develop their work schedule base on subjective consideration of the officer who responsible to arrange the schedule. The objective of this research is to identify the shift scheduling characteristics of non-star hotel in Yogyakarta and the weaknesses effect of the schedule. Based on identified parameters of shift scheduling characteristic, there are 27 models of shift scheduling for Front Office Department, 19 models of shift scheduling for Housekeeping Department, and 16 models of shift scheduling for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta by considering the human factor to eliminate the weakness of the actual shift scheduling applied.

**Keywords:** shift scheduling, non-star hotel, characteristic identification

## 1. INTRODUCTION

Human resources are an important factor in hotel industry management since the workforce becomes a part of services that have direct interaction with the consumers. Requirement of operational time for 24 hours a day and 7 days a week is not in line with workforce availability in non-star hotel which limited by operational cost budget. Departments which operate for 24 hours, such as Front Office or Security, apply shift work which divided operational time into certain number of shifts. Available workforce is alternately assigned in each shift. Ideally, shift pattern assign to each workforce have to consider the balance between work load and working time duration, as well as family and social time needs. Therefore, the hotel management should be able to manage shift work schedule well in order to meet the workforce requirement according to the appointed standard, however still consider workforce

personal needs, such as between-days break time, on leave, and weekend off-day. Meeting the workforce requirement and workforce personal needs in workforce scheduling for hotel industry become important factor because it have direct impact on the service quality provided by the workforce. Workforce in hotel industry is charged always have a good performance, in both physical appearance and servicing. A bad arrangement in shift scheduling for the workforce in hotel industry may influence the workforce performance. Chiang *et al.* (2010) in their research have founded that job demands in hotel and catering industry are not necessarily stressful, particularly when employees have control over their job responsibilities and receive sufficient support from their organizations (e.g., work-life balance policies). It requires active support from the organization in utilizing human resource management strategies to increase the level of well-being at work. And one of work-life balance application in human resource management

strategies is flexible scheduling and work arrangements.

On the other hand, workforce scheduling has a significant proportion of operational cost in hotel industry. Payroll and related expenses are sometimes over 30% of the operating cost of a hotel. A reduction in this by even 1% represents considerable cost savings (Ernst *et al.*, 2004). So that staff scheduling in hotel industry become a complex problem to determine optimal solution that fulfill the staff requirement and minimize cost, meet the staff preferences, and distribute shifts equitably among staffs.

Limited financial resources and number of staffs owed by non-star hotel becomes additional constraint in developing the workforce schedule. Commonly they override the balance between working times and break time, even less family and social time needs. The resulting workforce schedule become inflexible due to limited workforce available while the workforce requirement is fixed even increasing in certain period, such as holiday or long week-end. Therefore, workforce schedule developing in non-star hotel should be compromise between workforce requirements, limited workforce available, and workforce personal needs, to obtain schedule that fulfill the workforce requirement.

However in developing the workforce schedule, non-star hotel sometimes override the balance between the work load and the workforce well-being factor, i.e. physiological, psychological, and psychosocial factor. Kroemer *et al.* (2001) stated that several researches have shown that statistically, workforce who work in shift more have health problems than workers who work in normal hours, morning to evening. They also experience negative psychosocial effects, which interfere their family activities and other social activities. Wright Jr. *et al.* (2013) have shown there are increasing evidences that indicates negative influence of shift-work schedules to worker physiology, health, and safety. Moreover, shift workers are at risk for shift work disorder (SWD), which is a circadian rhythm sleep disorder. This circumstance needs a management strategies include approaches to promote sleep, wakefulness, and adaptation of the circadian clock to the imposed work schedule. Shift work is also reported have negative effect in associated with increased work to family conflict (Halbesleben, 2009; Tuttle and Garr, 2012), as negative effect to social life (Loudoun, 2008).

Besides the negative effect for the workforce, shift work also reported has negative effect to the hotel organization itself. Lee *et al.* (2011) have found that hotel workers' overall job satisfactions are influence by their schedule flexibility satisfaction and the decreased turnover intent is a consequence of schedule flexibility satisfaction. The managerial approach offered for this circumstance is to arrange the work schedule as flexible as possible. Therefore, the work schedule developing in the form of a combination

of shift arrangements imposed on workforce who work with operating hours of 24 hours have to consider the balance of workforce physiological, psychological, and psychosocial factors.

Shift arrangement in developing work schedule also become classical problem that faced by non-star hotel in Yogyakarta. They have to maintain their service well by keep the workforce in good performance and give competitive facilities in order to survive in increasing number of hotel in Yogyakarta. As one of tourist destination in Indonesia, the tourism industry in Yogyakarta continues to develop. The tourism development in Yogyakarta also followed by the tourism supporting-facilities development, such as hotels, restaurants, souvenir shops, travel agencies, etc. One of the tourism supporting-facilities industries which are currently growing rapidly is the hotel industry. The development of hotel industry is shown by the increasing number of hotels in Yogyakarta. Data of Central Statistics Agency showed that the number of hotels in Yogyakarta increasing every year (Central Statistics Agency of Special District of Yogyakarta, 2013). Increasing number of hotels in Yogyakarta prosecute the hotels management to improve services provided as the competitiveness of their business.

Yogyakarta is famous as low cost with remain qualified tourist destinations so that there are many small scale hotel with low rates in Yogyakarta. Data of Ministry of Tourism and Creative Economy of Republic of Indonesia showed that in 2011 there are 42 star hotels and 1058 non-star hotels in Yogyakarta. The non-star hotels include the budget hotels, lodging, cottage, and other accommodation services (Ministry of Tourism and Creative Economy of Republic of Indonesia, 2013). In general, non-star hotels in Yogyakarta are professionally managed although they have limited resources, so that management must be capable in managing its limited resources to obtain quality and profit. However, as well as other non-star hotel, they override the balance between the work load and the workforce well-being factor. Most of non-star hotel in Yogyakarta develop their work schedule base on subjective consideration of the officer who responsible to arrange the schedule.

Therefore, we need a method that facilitates the management of non-star hotels in Yogyakarta for arranging work schedules of its workforce which use shift system. This scheduling method must consider the limited resources constraints, which is a major problem of the non-star hotel in Yogyakarta. The proposed scheduling methods should be easy to use and accessible by the hotel management, given its have various limitation. Hence, it is necessary to have software for helping the management in developing workforce scheduling that considering the balance between workload and the workforce well-being factor. The proposed workforce scheduling software will be

developed in on-line form (web-based), so it will be easy to be accessed and used by the non-star hotel management. The proposed web-based workforce scheduling software is expected to be a tool for the non-star hotel in Yogyakarta to manage its workforce in order to improve the quality of services provided to consumers.

This research is the first part of research in developing the web-based workforce scheduling software for the non-star hotel in Yogyakarta. The objective of this research is to identify the shift scheduling characteristics of non-star hotel in Yogyakarta and the weaknesses effect of the schedule. Hereinafter, the result of this research will be used for next research in developing the shift scheduling model which considering the balance between workload and workforce well-being and eliminate the weaknesses effect of the schedule.

## 2. RESEARCH METHODOLOGY

Data used in this research are obtained from observation using questionnaires to 35 Front Office Department, 25 House Keeping Department, and 21 Security Department of non-star hotel in Yogyakarta. The questions in the questionnaire are in form of open question, i.e.:

1. Managerial
  - a. Authority to develop the schedule
  - b. Schedule period
  - c. Starting time to develop the schedule
  - d. Dynamic or static schedule
2. Shift type
  - a. Number of shifts in 24 hours
  - b. Start and end times of each shift (overlapping or continuous)
3. Workday and off-day
  - a. Work-stretch and off-day
  - b. Consecutive day-off
  - c. Off-day allocation
  - d. Weekend-off consideration
  - e. National holiday replacement
4. Shift pattern allocation
  - a. Fixed shift pattern allocation
  - b. Cyclic shift pattern
  - c. Between-days break-time consideration
  - d. Shift allocation policy for female workforce
  - e. Workforce preference consideration
5. Managerial and technical reason in developing the schedule
6. Problem arising from the application of the schedule
  - a. Physical
  - b. Productivity
  - c. Relationship between workers
  - d. Social and family relationship

Data resulted from questionnaire then analyzed to identify the operational profile using question number 1 and 5, the parameters of the shift scheduling characteristics using question number 2 to 4, and the problem arise from the application of the schedule using question number 6. The analysis use hierarchical clustering in SPSS 15.0 to determine number of groups. In hierarchical clustering, we use between-groups linkage cluster method and squared-euclidean distance measure interval. Then we use K-means clustering in SPSS 15.0 to determine the group members. The method used is iterate and classify. As the input for number of clusters is result of hierarchical clustering in previous step.

## 3. RESULT AND DISCUSSION

### 3.1 Operational Profile

The data shows that the official worker that responsible in developing the schedule is the supervisor of the department. For a few number of workers, the supervisor of all the observed departments is given to one person, sometimes directed by the manager. The schedule period is for a week until a month and mostly the schedule is prepared 2 until 15 days in advance. The schedule is performed as static schedule, but in reality if there is incidental condition, the worker can deal with other worker to switch the shift allocated to him/her. This condition will not change the applicable schedule and should be approved by the supervisor.

### 3.2 Identification of Shift Scheduling Characteristics

The results of shift scheduling characteristic identification for non-star hotel in Yogyakarta are shown in the Table 1 to Table 3. The identified parameters of shift scheduling characteristic are:

1. Schedule period (A)
2. Number and type of shift in 24 hours (B)
3. Shift allocation (H)
4. Work-stretch and off-day pattern (F)
5. Shift allocation policy for female workforce (C)
6. Distinctive shift allocation (D)
7. Distinctive work-stretch (E)

Parameter of schedule period consists of a week (A1), 2 weeks (A2), 4 weeks (A3), or a month (A4). Number and type of shift is denoted by letter B followed 1 or 2 digit number. The first digit shows the number of shift in 24 hours, 1 for 1 shift, 2 for 2 shifts and so forth. Two digit numbers is just owned by 3 shifts, consists of continuous shift type denoted by 1 and 2 for overlapping. Continuous means that the starting time of a shift is equal to the end

time of previous shift. Overlapping shift type is for condition that starting time of a shift is a few hours before the end of the previous shift. It means there are a few hours that coincide between 2 consecutive shifts. For 3 shifts application, it may in form of continuous or overlapping, but for more than 3 shifts application, it absolutely in form of overlapping.

Table 1: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for Front Office Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter						
	A	B	H	F	C	D	E
FO1 (1)	A1	B31	H0	F3	C0	D0	E1
FO2 (1)	A1	B31	H32	F3	C2	D0	E0
FO3 (1)	A2	B32	H0	F0	C0	D0	E0
FO4 (3)	A4	B1	H11	F1	C0	D0	E0
FO5 (1)	A4	B1	H21	F5	C0	D0	E0
FO6 (1)	A4	B1	H51	F6	C0	D0	E1
FO7 (3)	A4	B2	H0	F0	C0	D0	E0
FO8 (1)	A4	B2	H0	F3	C0	D1	E0
FO9 (1)	A4	B31	H0	F0	C2	D0	E0
FO10 (1)	A4	B31	H0	F3	C2	D0	E0
FO11 (1)	A4	B31	H0	F0	C1	D0	E0
FO12 (1)	A4	B31	H0	F0	C1	D1	E0
FO13 (3)	A4	B31	H0	F0	C2	D0	E0
FO14 (2)	A4	B31	H0	F0	C2	D1	E0
FO15 (1)	A4	B31	H0	F0	C0	D0	E0
FO16 (1)	A4	B31	H0	F2	C2	D1	E0
FO17 (1)	A4	B31	H21	F2	C0	D0	E0
FO18 (1)	A4	B31	H22	F2	C2	D0	E0
FO19 (2)	A4	B31	H22	F2	C2	D1	E0
FO20 (1)	A4	B31	H22	F2	C2	D1	E1
FO21 (1)	A4	B31	H32	F3	C2	D0	E0
FO22 (1)	A4	B31	H32	F3	C0	D1	E1
FO23 (1)	A4	B32	H32	F3	C2	D1	E0
FO24 (1)	A4	B4	H0	F0	C2	D0	E0
FO25 (1)	A4	B4	H0	F3	C2	D0	E0
FO26 (1)	A4	B4	H0	F3	C2	D0	E1
FO27 (1)	A4	B4	H72	F7	C0	D0	E0

Shift allocation consists of 2 conditions, i.e. cyclic and non-cyclic. Cyclic condition means that shift allocation on the schedule forms a certain pattern that repeated for a fixed period. Inversely, there is no certain pattern of shift allocation in non-cyclic condition; the shift can differ for each worker or each period. Shift allocation parameter is denoted by letter H followed by 1 or 2 digits number. One digit number is only for non-cyclic condition using number 0. Cyclic condition uses 2 digit numbers. The first digit shows the code for the cyclic period, i.e. number 1 to 7 for

2 days, 3 days, 6 days, 7 days, 18 days, 2 weeks, 1 month, respectively. The second digit is denoted by 1 for the same shift pattern allocation for each worker, and 2 for different pattern allocation for each worker. The type of cyclic period in shift allocation should be relevant with pattern of work-stretch and off-day. In cyclic shift pattern, off-day is commonly placed at the end of period. Work-stretch and off-day pattern shows pattern of consecutive workday and off-day. This parameter is denoted by letter F followed by 1 digit number. Number 1 to 8 is for work-stretch and off-day pattern 1-1, 2-1, 5-1, 6-1, 7-1, 4-2, 13-1, 30-1, respectively. Number 0 following letter F means that no certain pattern for work-stretch and off-day.

Table 2: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for House Keeping Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter					
	A	B	H	F	C	D
HK1 (1)	A1	B4	H0	F4	C0	D1
HK2 (1)	A2	B2	H0	F0	C1	D0
HK3 (1)	A3	B31	H0	F0	C0	D1
HK4 (2)	A4	B1	H0	F0	C0	D0
HK5 (1)	A4	B1	H42	F4	C0	D0
HK6 (1)	A4	B1	H62	F7	C0	D0
HK7 (1)	A4	B2	H0	F0	C0	D0
HK8 (1)	A4	B2	H0	F5	C0	D1
HK9 (1)	A4	B2	H42	F3	C0	D0
HK10 (1)	A4	B3	H0	F3	C0	D1
HK11 (1)	A4	B3	H52	F3	C0	D0
HK12 (3)	A4	B31	H0	F0	C0	D0
HK13 (2)	A4	B31	H31	F3	C0	D0
HK14 (3)	A4	B31	H32	F3	C0	D0
HK15 (1)	A4	B32	H0	F3	C0	D1
HK16 (1)	A4	B32	H32	F3	C0	D0
HK17 (1)	A4	B32	H42	F4	C0	D0
HK18 (1)	A4	B4	H31	F6	C0	D0
HK19 (1)	A4	B5	H0	F3	C2	D0

For safety reason, hotels will apply particular shift allocation for female workforce. Shift allocation policy for female workforce parameter is denoted by letter C followed with 1 digit number. Number 1 shows that female worker is assigned for morning shift only, number 2 for female worker assigned in morning and evening shift, number 0 means there are no female worker. Distinctive shift allocation shows that for specific worker, as supervisor, senior worker, or casual worker, usually assigned in specific shift, different with other workers. It is also applies for distinctive work-stretch. Distinctive shift allocation and distinctive work-stretch parameter is denoted by letter D

and E, respectively, followed with number 0 or 1. Number 0 means there is no specific shift allocation or work-stretch for a specific worker and 1 for otherwise.

Data in the Table 1 to Table 3 shows that most of non-star hotel in Yogyakarta develop their workforce schedule for a month for all the 3 departments observed, even they use cyclic shift allocation with cyclic period less than a month. Schedule period of 4 weeks is different with schedule period of a month, because a month is not exactly equal with 4 weeks. End of period for 4 weeks schedule period may not coincide with end of period for a month.

Table 3: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for Security Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter					
	A	B	H	F	C	E
SC1 (1)	A1	B31	H0	F4	D0	E0
SC2 (1)	A3	B2	H21	F2	D0	E0
SC3 (1)	A4	B1	H62	F7	D0	E0
SC4 (1)	A4	B2	H0	F6	D0	E0
SC5 (1)	A4	B31	H0	F0	D1	E0
SC6 (1)	A4	B31	H0	F3	D1	E0
SC7 (3)	A4	B31	H0	F4	D0	E0
SC8 (1)	A4	B31	H0	F4	D1	E0
SC9 (1)	A4	B31	H31	F3	D1	E1
SC10 (3)	A4	B31	H31	F3	D0	E0
SC11 (2)	A4	B31	H32	F3	D0	E0
SC12 (1)	A4	B31	H42	F4	D0	E0
SC13 (1)	A4	B32	H0	F0	D0	E0
SC14 (1)	A4	B4	H0	F0	D0	E0
SC15 (1)	A4	B4	H31	F3	D0	E0
SC16 (1)	A4	B4	H32	F3	D1	E1

For hotels labeled with B1 means that the hotels apply 1 shift for 24 hours. The worker will assigned for 24 hours a day during the work-stretch and will have off-day at the end of cyclic period for cyclic pattern application or any day with approval from the supervisor in advance for non-cyclic pattern. This condition results in the workers have long working hours. Data in Table 1 to 3 also show that there are hotels that have long cyclic period, 2 weeks to a month. Consequently, the worker will have long workday and one day-off every 2 weeks for 2 weeks cyclic period, instead one day-off every a month for monthly cyclic period.

The data in Table 1 to 3 shows that most of the hotels have no distinctive shift allocation and distinctive work-stretch. It is because most of non-star hotel in Yogyakarta have no hierarchy of positions between workers in Front Office, House Keeping, and Security Department. The

workers of three department observed are directly supervised by owner or workers who have responsibilities as general manager.

For each department observed, hotels having the same parameter of shift scheduling characteristic will be grouped into one group. Each of the group constitutes as a model of shift scheduling of non-star hotel in Yogyakarta. The grouping process is performed using cluster analysis in SPSS 15.0. We use hierarchical clustering to determine number of groups. The output of hierarchical clustering for Front Office Department data shows that there are bigger jump in step 8, then we deducted this value to number of data to get number of groups, i.e. 27 groups. This number of group is used in K-means clustering to determine members of group. The same procedure is applied for data of Housekeeping and Security Department. The result is there are 27 groups of shift scheduling model for Front Office Department, 19 groups of shift scheduling model for Housekeeping Department, and 16 groups of shift scheduling model for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta.

### 3.3 The Problem Arise from The application of The Schedule

Most of the workers of observed hotels reveal that there is no specific problem arises due to their schedule. However, the actual shift scheduling applied in observed hotels results in some of problems. The application of one shift in 24 hours causes the workers have long working hours. The working long hours may give negative impact on workers' health (de Castro *et al.*, 2010). The researchers have observed that there is relation between increased risk of injury with consecutive workdays and longer cumulative working hours (Hopcia *et al.*, 2012).

The shift pattern assignment applied in the observed hotels also results in weakness of short hours in between-shifts. Most of observed hotels have less than 15 hours in between-shift. For Front Office Department, there are 83% hotels have less than 15 hours in between-shift, 76% for Housekeeping Department, and 87% for Security Department. Short hour in between-shift results in quick return for working. This condition can lead insomnia, excessive sleepiness, excessive fatigue, and shift work disorder for the workers (Eldevik *et al.*, 2013; Di Milia *et al.* 2013).

The observed hotels also have weakness in assignment night shift in more than 2 consecutive days. The data shows that 49% of Front Office Department, 38% of Housekeeping Department, and 52% of Security Department have night shift more than 2 consecutive days.

Researchers have reported that working in consecutive night sleep may cause negative effect on psychomotor performance (Haire *et al.*, 2012). Working in night shift also may cause high cardiovascular risk (Esquirol *et al.*, 2011; Pimenta *et al.*, 2013; Haus & Smolensky, 2013), obesity (Antunes *et al.*, 2010; Chen *et al.*, 2010; Haus & Smolensky, 2013), and cancer (Haus & Smolensky, 2013).

The weaknesses founded in the applied shift scheduling of observed hotels become important element that have to be considered in developing the shift scheduling for non-star hotels in Yogyakarta for the next research. The development of shift scheduling in next research should be eliminate the weaknesses of the actual shift scheduling applied by considering the human factor to optimize human performance and well-being (Lodree, Jr. 2009)

#### 4. CONCLUSION

This research has been founded that shift scheduling used by non-star hotels in Yogyakarta has weaknesses of long working hours, short hours in between-shift, and night shift in more than 2 consecutive days. This research also results in mapping of shift scheduling characteristic of non-star hotels in Yogyakarta. Based on identified parameters of shift scheduling characteristic, there are 27 models of shift scheduling for Front Office Department, 19 models of shift scheduling for Housekeeping Department, and 16 models of shift scheduling for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta by considering the human factor to eliminate the weakness of the actual shift scheduling applied.

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# Message from the APIEMS President



Greeting and a warm welcome to the participants of the 15th Asia Pacific Industrial Engineering and Management Systems Conference. Started in 1998, APIEMS has grown to become the premier conference for industrial engineering and management systems in the region with participants from all around the world. The main theme of this year conference: “Sustainable Industrial Systems and Big Data Management”, is an attempt to address the balance among economic and technical development, social development, and environmental protection in this fast changing world.

I congratulate and thank Prof. Dr. Chi-Hyuck Jun, the conference chair, whose leadership made this APIEMS 2014 conference possible. We are also grateful for the enthusiastic support of APIEMS from the KIIE and the Korea research community.

On behalf of the Asia Pacific Industrial Engineering and Management Society, I wish you a successful conference with many thoughtful discussions and debates with old and new friends.

A handwritten signature in blue ink, which appears to read 'V. Kachitvichyanukul'. The signature is fluid and cursive.

Professor Voratas Kachitvichyanukul  
APIEMS President, (2013-2014)  
Professor of Industrial & Manufacturing Engineering  
Dean, School of Engineering and Technology  
Asian Institute of Technology, THAILAND

# Message from the General Chair



Welcome to APIEMS 2014 in Jeju City, a beautiful island located at the most south of Korea. It is our great pleasure to organize this conference, which is supported by Korean Institute of Industrial Engineers (KIIE). APIEMS conferences have rapidly emerged as an important forum for exchange of ideas and information about latest developments in the field of industrial engineering and management systems among professionals mostly from Asia-Pacific countries. APIEMS 2014 conference encourages contributors to address the topical theme: Sustainable Industrial Systems and Big Data Management. Papers will represent the latest academic thinking and successful case examples. The wider audience will benefit from the knowledge and experience of leading practitioners and academics in this area.

The conference seeks research contributions from researchers, educators, modelers, software developers, users and practitioners. We hope that you enjoy participating in APIEMS 2014 and staying in Jeju.

A handwritten signature in black ink that reads "Chi H. Jun". The signature is written in a cursive, flowing style.

Professor Chi-Hyuck Jun  
General Chair, APIEMS 2014  
Industrial & Management Engineering  
POSTECH, Korea

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# Keynote Speech

## **Keynote Speech I** **Research Issues in Future Logistics**

***Oct 13 (Monday) 11:00-12:00***

***Room: Ramada-1***

### **Chung– Yee Lee**

Hong Kong University of Science and Technology, China



Dr. Chung-Yee Lee is Chair Professor/Cheong Ying Chan Professor of Engineering in the Department of Industrial Engineering & Logistics Management at Hong Kong University of Science and Technology. He served as Department Head for seven years (2001- 2008). He is also the Founding and Current Director of Logistics and Supply Chain Management Institute. He is a Fellow of the Institute of Industrial Engineers in U.S. and also a Fellow of Hong Kong Academy of Engineering Science. Before joining HKUST in 2001, he was Rockwell Chair Professor in the Department of Industrial Engineering at Texas A&M University. He worked as a plant manager and also had few years consulting experience in Taiwan. In the past thirty years he has engaged in more than forty research projects sponsored by NSF, RGC, ITF, IBM, Motorola, AT&T Paradyne, Harris Semiconductor, Northern Telecom, Martin Marietta, Hong Kong Air Cargo Terminal, Hongkong International Terminal, Philips Medical, ...,etc.

His search areas are in logistics and supply chain management, scheduling and inventory management. He has published more than 130 papers in refereed journals. According to an article in *Int. J. Prod. Eco.* (2009), which looked at all papers published in the 20 core journals during last 50 years in the field of production and operations management, he was ranked No. 6 among all researchers worldwide in h-index.

He received a BS degree in Electronic Engineering (1972) and a MS degree in Management Sciences (1976) both from National Chiao-Tung University in Taiwan. He also received a MS degree in Industrial Engineering from Northwestern University (1980) and PhD degree in Operations Research from Yale University (1984).

# Keynote Speech

## **Keynote Speech II Data-Driven Decision Making in Manufacturing: Lessons Learned and Future Opportunities**

*Oct 14 (Tuesday) 11:00-12:00*

*Room: Ramada-1*

### **Ronald G. Askin**

Arizona State University, USA



Ronald G. Askin, Ph.D., is a Professor of Industrial Engineering and Director of the School of Computing, Informatics, and Decision Systems Engineering at Arizona State University. Professor Askin received his B. S. in Industrial Engineering from Lehigh University followed by an M.S. in Operations Research and PhD in Industrial and Systems Engineering from the Georgia Institute of Technology. He has over 30 years of experience in the development, teaching and application of methods for systems design and analysis with particular emphasis on production and material flow systems. Other interests include quality engineering and decision analysis. He has published over 120 journal and conference proceedings papers in these areas.

Dr. Askin is a Fellow of the Institute of Industrial Engineers (IIE) and serves as Editor-in-Chief of IIE Transactions. He has served on the IIE Board of Trustees, as President of the IIE Council of Fellows, Chair of the Association of Chairs of Operations Research Departments (ACORD) Chair of the Industrial Engineering Academic Department Heads (CIEADH) and President of the INFORMS Manufacturing and Service Operations Management Society (MSOM). He was also General Chair of the 2012 INFORMS Annual Conference. His list of awards includes a National Science Foundation Presidential Young Investigator Award, the Shingo Prize for Excellence in Manufacturing Research, IIE Joint Publishers Book of the Year Award (twice), IIE Transactions on Design and Manufacturing Best Paper Award (twice), the Eugene L. Grant best paper award from The Engineering Economist, and the IIE Transactions Development and Applications Award.

# Keynote Speech

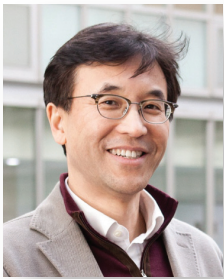
## **Keynote Speech III Big Data Management**

***Oct 14 (Tuesday) 13:00-14:00***

***Room: Ramada-1***

### **Sungzoon Cho**

Seoul National University, Korea.



Sungzoon Cho is currently professor of Industrial Engineering Department, the director of Data Mining Center at Seoul National University (SNU) and a member of Government 3.0 Committee of Korean government. He is on the editorial board of International Journal of Operations Research and Information Systems and International Journal of Cognitive Biometrics. He served as the president of Hyundai Motors, Hyundai Heavy Industries, POSCO, Daewoo Shipbuilding and Marine Engineering, LG Electronics, Doosan Infracore, SK Hynix, SK Telecommunication and CJ. He advised nine PhDs and 56 Master students. He teaches Data Mining and Computational Intelligence at SNU as well as at firms. He received BS and MS in Industrial Engineering at SNU. He won a Fulbright Scholarship to obtain Masters and PhD at University of Washington in Seattle, US, and University of Maryland in College Park, US, respectively.

# Detailed Program

## MA1 Data Mining 1

Mara, 08:30-10:10

Chair: Kuo-Hao Chang (National Tsing Hua University, Taiwan)

MA1-1 (528)	<a href="#">The Development Of An Educational Social Network To Support Blended-Learning In A University</a> <i>Vo DuyKhoi(International University, Viet Nam), *Do Truc(Vietnam National University HoChiMinh City, Viet Nam), Pham Quoc Son Lam, Le Thanh Son(International University, Viet Nam)</i>	1
MA1-2 (207)	<a href="#">A model for improving the customers' purchase willingness considering their latent intentions and media contacts.</a> <i>*Keisuke Korenaga, Satoshi Kumagai(Aoyama Gakuin University, Japan), Hiroki Nakano(NIFTY Corporation, Japan)</i>	7
MA1-3 (276)	<a href="#">The research of the onset factor of sports injuries in basketball</a> <i>*Takashi Matsumoto, Yukio Maruyama(Tokyo Metropolitan University, Japan), Hisashi Yamamoto(Nippon Institute of Technology, Japan)</i>	14
MA1-4 (324)	<a href="#">Multi-Objective Genetic Algorithm Using Fuzzy Membership Chromosome for Categorical Data</a> <i>*Chao-Lung Yang, Thi-Phuong-Quyen Nguyen, Ren-Jieh Kuo(National Taiwan University of Science and Technology, Taiwan)</i>	19
MA1-5 (296)	<a href="#">Using data mining methods to forecast book purchase quantities</a> <i>*Farnaz Pirasteh(Pukyong National Univesity, Korea), Mohammad Rouzbeh(Dayche Data Mining Group, Iran), Jay Liu(Pukyong National Univesity, Korea)</i>	25

## MA2 Management of Technology and Innovations 1

Biyang, 08:30-10:10

Chair: Muh-Cherng Wu (National Chiao Tung University, Taiwan)

MA2-1 (100)	<a href="#">Analyzing the effect of platform update period on platform diffusion in mobile ecosystem</a> <i>Gyesik Oh, *Yoo Hong(Seoul National University, Korea)</i>	29
MA2-2 (111)	<a href="#">Integrated Coal Gasification Technology Selection Model Considering Company's Research &amp; Development and Operational Decison Making</a> <i>*Iwan Wiratmadja(Bandung Institute of Technology, Indonesia), Muhammad Akbar, Anas Ma'ruf, Nanda Rusyda Saufa, Rajesri Govindaraju, Indryati Sunaryo(Faculty of Industrial Technology, Indonesia)</i>	35
MA2-3 (143)	<a href="#">ASSESSING TECHNOLOGY LEVEL OF INDUSTRIAL ESTATE TO MEET STANDARD OF ENVIRONMENT</a> <i>Dwi F.D. Nurcahya(Ministry of Industry, Indonesia), Muhammad Akbar(Bandung Institute of Technology, Indonesia), *dradjad irianto(bandung institute of technology, Indonesia)</i>	43
MA2-4 (44)	<a href="#">Economic Evaluation Method and Procedure for Improvement Activities</a> <i>*Hirokazu Kono(Keio University, Japan)</i>	50
MA2-5 (97)	<a href="#">A Market-Share-Driven Membership Pricing Strategy for Gyms</a> <i>*Muh-Cherng Wu, Wan-Ling Shen, Chung-Yu Chung(National Chiao Tung University, Taiwan)</i>	57

## MA3 ERP/E-Business

Udo, 08:30-10:10

Chair: Kazuhiko Yasuda (Tohoku University, Japan)

MA3-1 (37)	<a href="#">Review of the Concepts, Meanings, and Uses of Life Cycle</a> <i>*Kazuhiko Yasuda(Tohoku University, Japan), Tingting Huang(TOHOKU University, Japan)</i>	62
MA3-2 (38)	<a href="#">ERP Life Cycle Models: An Annotated Bibliographic Review</a> <i>*Kazuhiko Yasuda(Tohoku University, Japan), Tingting Huang(TOHOKU University, Japan)</i>	70
MA3-3 (352)	<a href="#">Analysis of Pricing and Promotional Strategies In The SAP ERP Simulation Game By Using A Model of A Dynamic System</a>	78

*\*yuli rochman(Universitas Islam Indonesia, Indonesia), erlangga fausa(Islamic University of Indonesia, Indonesia)*

MA3-4 (360)	<a href="#">Causal Analysis of Time Gap between Events in Multi-dimensional Process View</a> <i>Riska Sutrisnowati(Pusan National University, Korea), Sung-ook Sul(Total Soft Bank Ltd., Korea), *Hyerim Bae(Pusan National University, Korea)</i>	82
MA3-5 (255)	<a href="#">The Alignment Relationships between Electronic Business Strategy and Information Technology Capabilities</a> <i>*Yue-Yang Chen(I-Shou University, Taiwan), Szu-Yuan Sun, Chang-Yuan Chen(National Kaohsiung First University of Science and Technology, Taiwan)</i>	88

#### MA4 Service Sciences 1

Chuja, 08:30-10:10

Chair: Kwang-Jae Kim (POSTECH, Korea)

MA4-1 (54)	<a href="#">Service Quality Measurement Using Fuzzy Analytic Hierarchy Process: A Case Study</a> <i>*Chirakiat Saithong, Dusadee Yaimana(Kasetsart University, Thailand)</i>	93
MA4-2 (55)	<a href="#">Quantifying the Relationships Among Service Quality, Customer Satisfaction, and Behavioural Intentions in Fast Food Restaurants Using Structural Equation Modelling</a> <i>*WILLY ZALATAR(DE LA SALLE UNIVERSITY, Philippines)</i>	100
MA4-3 (108)	<a href="#">Product-Service System Development Methods and Knowhow: A Review and Classification</a> <i>Chie-Hyeon Lim, *Kwang-Jae Kim(POSTECH, Korea)</i>	105
MA4-4 (215)	<a href="#">Designing a Service Process for Hypertension Patient Support</a> <i>Ryeok-Hwan Kwon, Chie-Hyeon Lim, Ki-Hun Kim, *Kwang-Jae Kim(POSTECH, Korea), Yea Eun Kim, Sung-Hong Kang(Inje University, Korea)</i>	111
MA4-5 (244)	<a href="#">A Data-Driven Approach to Developing Service Concepts for Driving Safety Enhancement (a Case Study)</a> <i>Min-Jun Kim(POSTECH, Korea), Changho Lee(Quality System Laboratory, Korea), Chie-Hyeon Lim, *Kwang-Jae Kim, JINWOO JEON(POSTECH, Korea), Kyungim Choi, Yongsung Park(Korea Transportation Safety Authority, Korea)</i>	116

#### MA5 Quality Engineering & Management 1

Ramada-1, 08:30-10:10

Chair: Ruey Huei (Robert) Yeh (National Taiwan University of Science and Technology, Taiwan)

MA5-1 (23)	<a href="#">Application of a Design for Six Sigma (DFSS) Framework on a Proposed Launch of Operation of an Airline Exclusively for Pets</a> <i>*Marc Immanuel Isip(University of the Philippines Los Banos, Philippines)</i>	122
MA5-2 (28)	<a href="#">Traceability System for Quality Assurance on Make to Order Products</a> <i>*Iwan Vanany(Institut Teknologi Sepuluh Nopember Surabaya, Indonesia), Nur Aini Rahmawati(Institut Teknologi Sepuluh Nopember (ITS), Indonesia)</i>	130
MA5-3 (109)	<a href="#">Sequential Sampling Plan on Operating Characteristics Indexed by Quality Loss</a> <i>*Ryosuke Tomohiro, Ikuo Arizono(Okayama University, Japan), Yasuhiko Takemoto(Prefectural University of Hiroshima, Japan)</i>	137
MA5-4 (113)	<a href="#">Variable Repetitive Group Sampling Plan with Screening for Acceptance Quality Loss Limit Scheme</a> <i>*Yusuke Okada, Ryosuke Tomohiro, Ikuo Arizono(Okayama University, Japan)</i>	145
MA5-5 (226)	<a href="#">A Proposed Measures for Evaluation of Quality Excellence Practices in United Arab Emirates Industries</a> <i>*Mehran Doulat Abadi(Universiti Teknologi Malaysia (UTM), Malaysia), Sha'ri Mohd. Yusof(Universiti Teknologi Malaysia, Malaysia)</i>	153

#### MA6 Production and Operations Management 1

Ramada-2, 08:30-10:10

Chair: Daisuke Hirotani (Prefectural University of Hiroshima, Japan)

MA6-1 (75)	<a href="#">Hybrid Algorithm Based on an Integration of Genetic Algorithm and Recommended Heuristic Rules for Job Shop Scheduling Problem</a> <i>*Amer Boushaala, <u>Amer Boushaala</u>(Benghazi University, Benghazi, Libya, Libya)</i>	159
MA6-2 (158)	<a href="#">Efficient Machine Layout Design Method with a Fuzzy Set Theory within a Bay in a TFT-LCD plant</a> <i>*<u>Teng-Sheng Su</u>(National Taiwan University, Taiwan), Shih-Han Lin(National Chiao Tung University, Taiwan)</i>	168
MA6-3 (211)	<a href="#">Evaluating the Efficiency of International Hotels in Taiwan</a> <i>*<u>Ming-Chi Tsai</u>(College of Management, Taiwan), Khac Hung Dinh(College of Language Arts, Taiwan), Meei-Ing Tsai(I-Shou University, Taiwan)</i>	176
MA6-4 (269)	<a href="#">Worker Rearrangement Policy Using Worker's Position to Decrease Production Loss for Self-balancing Production Line with Worker's Learning</a> <i>*<u>Daisuke Hirotsani</u>(Prefectural University of Hiroshima, Japan), Katsumi Morikawa, Katsuhiko Takahashi(Hiroshima University, Japan)</i>	183
MA6-5 (213)	<a href="#">To Evaluate the Operational Efficiency of Commercial Banks in Vietnam</a> <i>*<u>Ming-Chi Tsai</u>(College of Management, Taiwan), Duc Hieu Nguyen(I-Shou University, Taiwan), Meei-Ing Tsai(College of Management, Taiwan)</i>	190

### MA7 Metaheuristics

Ramada-3, 08:30-10:10

**Chair:** Ching-Jung Ting (Yuan Ze University, Taiwan)

MA7-1 (42)	<a href="#">A Particle Swarm Optimization Algorithm for Solving Economic Lot Scheduling Problems</a> <i>*<u>The Jin Ai</u>, Ririn Diar Astanti, Agustinus Gatot Bintoro(Universitas Atma Jaya Yogyakarta, Indonesia), Dah Chuan Gong(Chung Yuan Christian University, Taiwan)</i>	198
MA7-2 (43)	<a href="#">Application of Particle Swarm Optimization for the Capacitated Team Orienteering Problem</a> <i>Gustav Albertzeth, *<u>The Jin Ai</u>(Universitas Atma Jaya Yogyakarta, Indonesia)</i>	204
MA7-3 (175)	<a href="#">Variable Neighborhood Search for the Pollution Routing Problem</a> <i>*<u>Artva Lathifah</u>, A.A.N Perwira Redi, Vincent Yu(National Taiwan University of Science and Technology, Taiwan), Nur Aini Masrurroh(Gadjah Mada University, Indonesia)</i>	210
MA7-4 (353)	<a href="#">Generation and Transmission Expansion Planning by Particle Swarm Optimization</a> <i>Mu-Hsuan Wu, *<u>Ching-Jung Ting</u>(Yuan Ze University, Taiwan)</i>	218
MA7-5 (465)	<a href="#">Differential Evolution Algorithm Method to Solve Appropriate Transport Chain Arrangement in Milk Run System</a> <i>*<u>Jakkapong Lohapaiboonkul</u>, Rapeepan Pitakaso(Metaheuristics for Logistics Optimization Laboratory Ubonratchathani University, Thailand)</i>	226

### MA8 Financial Models & Engineering

Ramada-4, 08:30-10:10

**Chair:** Bong-Gyu Jang (POSTECH, Korea)

MA8-1 (41)	<a href="#">Effect of Firm Age in Credit Scoring Model for Small Sized Firms</a> <i>*<u>Kenzo Ogi</u>, Masahiro Toshiro(Japan Finance Corporation, Japan), Norio Hibiki(Keio University, Japan)</i>	233
MA8-2 (146)	<a href="#">Computing default probability using ensemble method</a> <i>*Youngdoo Son, <u>Saerom Park</u>, Hyeongmin Byun, Jaewook Lee(Seoul National University, Korea)</i>	241
MA8-3 (180)	<a href="#">Credit Scoring Model for Creditworthiness Estimation of SMEs in Indonesia</a> <i>*<u>Dea Putri</u>(Institut Teknologi Bandung (Bandung Institute of Technology), Indonesia), Joko Siswanto(Bandung Institute of Technology, Indonesia)</i>	249
MA8-4 (267)	<a href="#">Analysis of major crashes in Korean stock market</a> <i><u>Bong Gyun Ko</u>(seoul national university, Korea), *Jae Wook Song, Woojin Chang(Seoul National University, Korea)</i>	257
MA8-5 (273)	<a href="#">Portfolio Selection Applying BPT</a> <i>*<u>Michael Young</u>, Kuo-Hwa Chang(Chung Yuan Christian University, Taiwan)</i>	262

**MA9 Uncertainty Theory (Session I)**

Halla(8F), 08:30-10:10

**Chair:** Jinwu Gao (Renmin University of China, China)

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MA9-2 (555)	<a href="#">Uncertain Differential Game</a> <i>*Jinwu Gao(Renmin University, China)</i>	278
MA9-3 (556)	<a href="#">A Class of Two-Stage Reliable Path Choice Problems in Dynamic and Stochastic Transportation Networks</a> <i>*Lixing Yang(Beijing Jiaotong University, China)</i>	279
MA9-4 (584)	<a href="#">Uncertain Process</a> <i>*Kai Yao(University of Chinese Academy of Sciences, China)</i>	280

**MB1 Decision Support Systems & Expert Systems**

Mara, 13:30-15:30

**Chair:** Hyerim Bae (Pusan National University, Korea)

MB1-1 (173)	<a href="#">Performance Indicators Identification and Performance Dashboard Model Development for State-Owned Mining Companies in Indonesia</a> <i>*Aisyah Shalih Mardhotillah, Joko Siswanto(Bandung Institute of Technology, Indonesia)</i>	281
MB1-2 (254)	<a href="#">Development of crime risk indices and crime prediction model at real-time condition</a> <i>Taehun Kim(POSTECH, Korea), Seunghwan Bang(Pohang University of Science and Technology, Korea), *Hyunbo Cho(POSTECH, Korea)</i>	289
MB1-3 (290)	<a href="#">Process Model Classification based on Multiple Association Rules</a> <i>Iq Pulshashi, *Hyerim Bae, Riska Sutrisnowati(Pusan National University, Korea), Dongha Lee(Daewoo Shipbuilding &amp; Marine Engineering Co., Korea)</i>	294
MB1-4 (460)	<a href="#">Development of Decision Support System for the Most Efficient Berth Operation in DSME shipyard</a> <i>Iksoon Kwak, *Dongha Lee, Yongwoo Kang, Seongchan Bae, Hoyun Lee, Youngho Kim, Heungwon Suh(Daewoo Shipbuilding &amp; Marine Engineering Co. Ltd., Korea)</i>	299
MB1-5 (116)	<a href="#">Performance Measurement for MIS Department in the Local Governmentnt</a> <i>*Yi Hui Liang(I-Shou university, Taiwan), Chi-Chih Chang(I-Shou University, Taiwan)</i>	305
MB1-6 (538)	<a href="#">Applying intuitionistic type-II fuzzy inference system for medical diagnosis system</a> <i>*Kuo-Ping Lin, Yu-Ming Lu, Chia-Hao Chang, I-Hao Liao(Lunghwa University of Science and Technology, Taiwan)</i>	310

**MB2 Probability & Statistical Modeling**

Biyang, 13:30-15:30

**Chair:** Junghye Lee (POSTECH, Korea)

MB2-1 (190)	<a href="#">Statistical Analysis for Characterizing the Tensile Stress of Concrete</a> <i>James C. Chen(National Tsing Hua University and department of Industrial Engineering and Engineering Management, Taiwan), Xi-Mei Huang(National Taipei University of Technology, Taiwan), *Yu-Hui Peng(National Tsing Hua University and department of Industrial Engineering and Engineering Management, Taiwan)</i>	315
MB2-2 (299)	<a href="#">Bayesian Network Analysis ?Hypertension and Its Complications Incidence Analysis</a> <i>Junghye Lee, Wonji Lee, Hyeseon Lee, *Chi-Hyuck Jun(POSTECH, Korea), Sung-Hong Kang(The Inje University, Korea)</i>	321
MB2-3 (333)	<a href="#">The Proposal of Statistical Model Selection of Linear Regression for Privacy Preserving Data Mining</a> <i>*Kiichiro YUKAWA(Graduate School of Waseda University, Japan), Kenta MIKAWA, Masayuki GOTO(Waseda University, Japan)</i>	328
MB2-4 (334)	<a href="#">Distance Metric Learning with Low Computational Complexity based on Ensemble of Low-dimensional Matrices</a> <i>Hiroshi SAITO(Graduate School of Waseda University, Japan), *Fumihiko Yamazaki, Kenta Mikawa, Masayuki Goto(Waseda University, Japan)</i>	336

MB2-5 (335)	<a href="#">A Statistical Model for Recommender System to Maximize Sales Amount Focusing on Characteristics of EC Site Data</a> <i>*Kan YAMAGAMI(Graduate Student of Waseda University, Japan), Naohiro Fujiwara, Kenta Mikawa, Masayuki Goto(Waseda University, Japan)</i>	342
MB2-6 (450)	<a href="#">A New Estimation Method of Latent Class Model with High Accuracy by Using Both Browsing and Purchase Histories</a> <i>*Naohiro Fujiwara(Graduate School of Waseda University, Japan), Kenta Mikawa, Masayuki Goto(Waseda University, Japan)</i>	349

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Udo, 13:30-15:30

Chair: Mao-Jiun Wang (National Tsing Hua University, Taiwan)

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MB3-2 (131)	<a href="#">Identifying the Potential for Control Button Back Pressures to Create Within-Cycle Micro-breaks in Repetitive Assembly Tasks</a> <i>*Paul Dickinson(Adelaide Ergonomics Pty Ltd, Australia)</i>	361
MB3-3 (305)	<a href="#">Psychosocial and Physical Workload of Hotel's Shift Worker in Yogyakarta Indonesia</a> <i>*Luciana Dewi, Deny Yuniartha(Universitas Atma Jaya Yogyakarta, Indonesia), Ignatius Luddy Indra Purnama(ATMA Jaya Yogyakarta University, Indonesia)</i>	367
MB3-4 (315)	<a href="#">Anthropometric data of Taiwanese children for pillow design</a> <i>Chienfu Chen, *Dengchuan Cai(National Yunlin University of Science and Technology, Taiwan)</i>	373
MB3-5 (326)	<a href="#">Design Furniture for Early Childhood Education in Javanese-Indonesia using Hedonomics Approach</a> <i>Anizha Wulandari, *Amarria Sari, Muhammad Suryoputro, Hari Purnomo(Islamic University of Indonesia, Indonesia)</i>	379
MB3-6 (332)	<a href="#">Good Practices on Workplace Improvement Using Ergonomics Approach for Bed Cover's Tailor in West Java</a> <i>Lesly Nulul Azmi(Islamic University of Indonesia, Indonesia), *Muhammad Suryoputro, Ratih Dianingtyas(Universitas Islam Indonesia, Indonesia), Amarria Sari, Hari Purnomo(Islamic University of Indonesia, Indonesia)</i>	383

### MB4 Service Sciences 2

Chuja, 13:30-15:30

Chair: Chen-Yang Cheng (Tunghai University, Taiwan)

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MB4-2 (401)	<a href="#">Enhancing the Service Quality of Non-Profit Organizations through Lean Thinking</a> <i>Chia-Leng Lee, Jose Chiu-C Chen, *Chen-Yang Cheng(Tunghai University, Taiwan)</i>	395
MB4-3 (411)	<a href="#">An Analysis of Strategic Factors Attracting Customer from Customers' Perspective</a> <i>*Fuyume Sai, Michio Amagasa(Faculty of business Administration, Japan)</i>	400
MB4-4 (479)	<a href="#">Distribution Optimization in Fashion Retail Industry : a Case Study at Kolon Sports</a> <i>Shin Woong Sung(Korea Advanced Institute of Science and Technology (KAIST), Korea), *Young Jang(KAIST, Korea), Ji Eun Roh, Eun Jeong Ko, Seung Yoon Lee, So Yeon Kim, Yoonki Hong, Sun Kyung Oh(Korea Advanced Institute of Science and Technology (KAIST), Korea)</i>	407
MB4-5 (504)	<a href="#">Development of Measurement Tool for Project Management Maturity (Case Study: A Coal Mining Company in Indonesia)</a> <i>*Sukoyo-, Patricia Racel R, Iwan I. Wiratmadja(Bandung Institute of Technology, Indonesia)</i>	412
MB4-6 (323)	<a href="#">Collaborative Product-Service System Design and Optimal Module Mix Selection for Multi-segment</a> <i>*Rosita Surjani, Udisubakti Ciptomulyono, Maria Anityasari(Institute of Technology Sepuluh Nopember, Indonesia)</i>	421

**MB5 Quality Engineering & Management 2**

Ramada-1, 13:30-15:30

**Chair:** Shu-Kai Fan (National Taipei University of Science and Technology, Taiwan)

MB5-1 (227)	<a href="#">Quality Control Analysis of Slab Steel Manufacturing Process</a> <i>*Nashrullah Setiawan, Rayanda Utomo Abdianto(Faculty of Industrial Technology Islamic University of Indonesia, Indonesia), Iwan Kurniawan(Islamic University of Indonesia Yogyakarta, Indonesia)</i>	429
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MB5-3 (229)	<a href="#">An EWMA-based Sampling Plan for Lot Sentencing</a> <i>Chou-Chun Wu, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	440
MB5-4 (246)	<a href="#">Developing a Two-Plan Sampling System Based on Process Loss Index</a> <i>Ping-Jung Chiang, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	445
MB5-5 (294)	<a href="#">A similarity ranking approach to reduce false alarm of defect classification in CMOS Image Sensor Manufacturing</a> <i>Chu-Yuan Fan, *Kuo-Hao Chang, Chen-Fu Chien, Ying-Jen Chen(National Tsing Hua University, Taiwan)</i>	449
MB5-6 (307)	<a href="#">Identification Quality Management System Requirement for Creative Industries SME's in Bandung</a> <i>*Sribagjawi Suparman, Iman Sudirman, Joko Siswanto, Sukoyo -(Bandung Institute of Technology, Indonesia)</i>	453

**MB6 Production and Operations Management 2**

Ramada-2, 13:30-15:30

**Chair:** Gyu M. Lee (Pusan National University, Korea)

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MB6-2 (362)	<a href="#">A Study of Process Design for Manufacturing Line aimed at Levelization and Productivity on Mix Production</a> <i>*Takumi Wada, Masahiro Arakawa(Nagoya Institute of Technology, Japan)</i>	467
MB6-3 (394)	<a href="#">An Integrated Algorithm for Hybrid Flow Shop Scheduling Problem</a> <i>*Shu-Fen Li, Chen-Yang Cheng, Zi-Hao Hong(Tunghai University, Taiwan)</i>	474
MB6-4 (396)	<a href="#">Multi-Objective Genetic Algorithm for Energy-Efficient and Lot-Streaming Hybrid Flow Shop Scheduling</a> <i>*TZU CHEN, Yi Chou(Fu Jen Catholic University, Taiwan), Yen Chen(Industrial Technology Research Institute, Taiwan)</i>	481
MB6-5 (442)	<a href="#">Bounds for Spatial Scheduling Problem in Shipbuilding</a> <i>*Gyu M. Lee, Sunghee Park(Pusan National University, Korea)</i>	488

**MB7 Green Manufacturing/Management**

Ramada-3, 13:30-15:30

**Chair:** Hsiao-Fan Wang (National Tsing Hua University, Taiwan)

MB7-1 (417)	<a href="#">Equilibrium Contract Rents and Reward Money with Modularity Consideration in Reverse Supply Chains of Incomplete Information</a> <i>*I-Hsuan Hong, Pei-Yun Ho(National Taiwan University, Taiwan)</i>	496
MB7-2 (550)	<a href="#">Demand response modeling for retailer considering operating ratio in electricity market</a> <i>JINSIK KIM, *Chulung Lee(Korea University, Korea)</i>	504
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MB7-4 (156)	<a href="#">Sustainability Product Design Assessment: Case Study of A Screw Design</a> <i>Zahari Taha(Faculty of Manufacturing Engineering, Malaysia), *Hadi Abdul Salaam(Universiti</i>	517

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- MB7-5 (342) [A Method of Heat Allocation by the Virtual Heat Storage Source in Air Conditioning System](#) 525  
*Ryota Aizawa*, \*Satoshi Kumagai(Aoyama Gakuin University, Japan), kishima shuuzou(Environmental Urban Systems Section, Japan)
- MB7-6 (361) [Environmental Dynamics Analysis and Dynamic Capabilities Of Enterprises Competitiveness](#) 531  
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## MB8 Transportation

Ramada-4, 13:30-15:30

Chair: Jinho Lee (Korea Naval Academy, Korea)

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- MB8-2 (91) [Break or Not?: Pioneering the Northern Sea Route with Presence of Icefloes](#) 548  
 Jaehyung An(Samsung Electronics, Korea), \*Jinho Lee(Korea Naval Academy, Korea)
- MB8-3 (103) [Taxi Carpooling Problem Solved by Genetic Algorithm and Ant Colony Optimization Method](#) 553  
 \*Bryan Ngai, Howard Sheng, Feng-Cheng Yang(National Taiwan University, Taiwan)
- MB8-4 (312) [Dairy transportation problem with no mixing of raw milk and time windows constraints](#) 561  
 Kongkidakhon Worasan(Faculty of Engineering, Thailand), \*Kanchana Sethanan(Khon Kaen University, Thailand), Nantika Chaikanha(Faculty of Engineering, Thailand)
- MB8-5 (340) [Online conflict-free dispatching and routing of personal rapid transits based on the nearest neighbor dispatching rule](#) 567  
 Chung-Kyun Han(Pusan National University, Korea), Baek-Hyun Kim(Korea Railroad Research Institute, Korea), \*Byung-Hyun Ha(Pusan National University, Korea)
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## MB9 Ergonomics & Welfare Management

Halla(8F), 13:30-15:30

Chair: Hiromi Ban ((Nagaoka University of Technology, Japan)

- MB9-1 (488) [Development of the view measuring device for a visual field impaired person](#) 578  
 \*Yuko Shimomura, Hiroyuki KAWABE(Kinjo University, Japan), Hidetaka Nambo(Kanazawa University, Japan), Syoji Yamada(Japan Advanced Institute of Science and Technology, Japan), Yasuaki Matumoto(Ecosysnetwork Co., Japan), Kazuaki Kojima(Ltd., Japan)
- MB9-2 (484) [Development of eye tracking HMD system for visual field impaired students](#) 582  
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- MB9-3 (530) [Direction of sound source estimation method for informing the speech direction to the unsound person](#) 586  
 Katsuya Kondo(Graduate of Science and Engineering, Japan), \*Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)
- MB9-4 (485) [Detection of speaker by a lip motion for hearing impaired student](#) 590  
 \*Shuichi Seto(Kinjo College, Japan), Hiroyuki KAWABE, Yuko Shimomura(Kinjo University, Japan), Hidetaka Nambo(Kanazawa University, Japan)
- MB9-5 (471) [Approach of Health-care Administration Utilizing Purchase Data of School Cafeteria](#) 594  
 \*Shoji Takechi(Kanazawa Institute of Technology, Japan)
- MB9-6 (505) [Recognition of the Distance between Plant and Human by Plant Bioelectric Potential](#) 602  
 \*XINGYI JIN, Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)

**MC1 Supply Chain Management 1**

Mara, 15:50-17:50

**Chair:** Rainisa Heryanto (Maranatha Christian University, Indonesia)

MC1-1 (252)	<a href="#">A Multi-Criteria Selection for Inventory Aggregation Problem under Risk Pooling: A Case Study</a> <i>*Kanokporn Rienkhemaniyom, Nipa Suttachat(King Mongkut's University of Technology Thonburi, Thailand)</i>	607
MC1-2 (261)	<a href="#">A Multi-Objective Closed-Loop Supply Chain Model For Multiple Generations of a Product with Mandatory Product Take-back</a> <i>Justin Contreras(De La Salle University - Manila, Philippines), *Dennis Cruz(De La Salle University, Philippines)</i>	615
MC1-3 (279)	<a href="#">The Proposal of Applying Multi Echelon Inventory to Minimize Supply Chain Total Cost for Soft Drinks</a> <i>*Santoso-, Rainisa Heryanto(Maranatha Christian University, Indonesia)</i>	623
MC1-4 (280)	<a href="#">The Improvement of the Model of Wheat Flour Requirement at Eastern Indonesia by Determining the Number Location of the New Plant</a> <i>*Rainisa Heryanto(Maranatha Christian University, Indonesia), Senator Bahagia(Bandung Institute of Technology, Indonesia)</i>	630
MC1-5 (355)	<a href="#">Coordination of supply chains with risk-averse members under budget constraints</a> <i>*Ilkyeong Moon, Xuehao Feng(Seoul National University, Korea)</i>	638
MC1-6 (336)	<a href="#">A MECE Feature Selection Framework for Yield Improvement in Semiconductor Manufacturing</a> <i>*CHIA-YEN LEE, BO-SYUN CHEN(National Cheng Kung University, Taiwan)</i>	645

**MC2 Reliability & Maintenance**

Biyang, 15:50-17:50

**Chair:** Shinya Mizuno (Shizuoka University, Japan)

MC2-1 (118)	<a href="#">DELPHI-AHP BASED METHODOLOGY FOR SELECTING THE OPTIMUM MAINTENANCE STRATEGY FOR SHIP MACHINERY SYSTEMS</a> <i>*Ikuobase Emovon, Rosemary Norman, Alan Murphy(Newcastle University, United Kingdom), Biliaminu Kareem(Federal University of Technology, Nigeria)</i>	653
MC2-2 (121)	<a href="#">Cost Minimization for Achieving a Target Operational Availability of a Warship through Sensitivity Analysis</a> <i>Jinho Lee, *Ki-Hoon Song(Korea Naval Academy, Korea)</i>	661
MC2-3 (153)	<a href="#">Method of Minimizing Costs in Consideration of System Backup Intervals and Expected Costs</a> <i>*Shinya Mizuno(Center for Information Infrastructure, Japan), Naoki Kondo(Shizuoka Professional Training College of Industrial Technology, Japan), Haruki Inoue, Takahiro Hasegawa, Naokazu Yamaki(Center for Information Infrastructure, Japan)</i>	667
MC2-4 (320)	<a href="#">Applied Algorithm for the Optimal Arrangement Problem of a Connected-(r, s)-out-of-(m, n):F System</a> <i>*Toru Omura, Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)</i>	673
MC2-5 (580)	<a href="#">Interaction in Virtual Reality: A Review</a> <i>*Bereket Woldegiorgis, Chiuhsiang Lin(National Taiwan University of Science and Technology, Taiwan)</i>	680
MC2-6 (582)	<a href="#">The implementation of the mobile-Computerized Procedure System Editor</a> <i>Dae Seung Park, *Yeonsub Jung(Central Research Institute of Korea Hydro and Nuclear Power Co., Korea)</i>	688

**MC3 Ergonomics/Human Factors 2**

Udo, 15:50-17:50

**Chair:** Zahari Taha (Universiti Malaysia Pahang, Malaysia)

MC3-1 (456)	<a href="#">Ergonomic Assessment on Fatigue among Malaysian Express Bus Drivers Using the Partial Least Squares (PLS) Approach</a> <i>YUSOF HASHIM, *ZAHARI TAHA(Universiti Malaysia Pahang, Malaysia)</i>	692
MC3-2 (359)	<a href="#">Usability Point of View for Klasiber E-Learning in Islamic University of Indonesia</a> <i>*Muhammad Suryoputro(Universitas Islam Indonesia, Indonesia), Amarria Sari(Islamic University of Indonesia, Indonesia), amalia rahmayani(islamic university of indonesia, Indonesia), Miftahulkhair Adianto(Islamic University of Indonesia, Indonesia)</i>	702
MC3-3 (393)	<a href="#">The Relationships among Hand Size, Grip Span and Maximum Volitional Contraction and Hand-Grip Control Exerting</a> <i>*Kun Liao, Kun Liao(Taiwan Shoufu University, Taiwan)</i>	709
MC3-4 (419)	<a href="#">Evaluating the Appropriateness of Qualitative Research data using the measures in Semantic Network Analysis</a> <i>Ye Lim Rhie(Seoul National University, Korea), *Ji Hyoun Lim, Min Ho Lee(Hongik University, Korea), Myung Hwan Yun(Seoul National University, Korea)</i>	718
MC3-5 (449)	<a href="#">Analysis and Proposal about the Effect of Time, Types of Subject and Types of Room Factor to the Students' Concentration</a> <i>*Elty Sarvia, Evan Sentosa(Maranatha Christian University, Indonesia)</i>	724
MC3-6 (341)	<a href="#">Walking on the spot effects on sleep quality</a> <i>Ting Shao, *Dengchuan Cai(National Yunlin University of Science and Technology, Taiwan)</i>	731

#### MC4 Network Optimization

Chuja, 15:50-17:50

**Chair:** Hsiao-Fan Wang (Universiti Malaysia Pahang, Taiwan)

MC4-1 (407)	<a href="#">Paired Property Analysis for Optimal Worker Assignment -Worker Efficiency vs. Task -</a> <i>*Xianda Kong, Hisashi Yamamoto, Peiya Song(Tokyo Metropolitan University, Japan), Jing Sun(Nagoya Institute of Technology, Japan), Masayuki Matsui(Kanagawa University, Japan)</i>	739
MC4-2 (363)	<a href="#">Optimal Energy Supply-mix Model with Uncertain Monthly Capacity Factor of Renewable Energies</a> <i>Meng-Ping Sung, *Hsiao-Fan Wang(National Tsing Hua University, Taiwan), Hsin-Wei Hsu(Industrial Technology Research Institute (ITRI), Taiwan)</i>	745
MC4-3 (268)	<a href="#">Search Process for Pareto Solutions of a Two-objective Network by Combination of Network Properties</a> <i>*Natsumi Takahashi, Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)</i>	753
MC4-4 (515)	<a href="#">Acceleration Techniques of the Dynamic Programming Algorithms for Resource-Constrained Elementary Shortest Path Problem</a> <i>Hyunchul Tae, *Byung-In Kim(POSTECH, Korea)</i>	760
MC4-5 (319)	<a href="#">Solving the Multi-Modal Orienteering Problem with Time Windows using Paritcle Swarm Optimization</a> <i>Vincent F. Yu, *Parida Jewpanya, A.A.N. Perwira Redi(National Taiwan University of Science and Technology, Taiwan)</i>	768
MC4-6 (142)	<a href="#">Alternative-Fuel station location problem: efficiency and fairness</a> <i>Sungjae Park(Sungkyunkwan University, Korea), Chang hyun Kwon(University at Buffalo, United States), *Byung Do Chung(Sungkyunkwan University, Korea)</i>	776

#### MC5 Quality Engineering & Management 3

Ramada-1, 15:50-17:50

**Chair:** Chia-Yu Hsu (Yuan Ze University, Taiwan)

MC5-1 (325)	<a href="#">Developing a Variables Multiple Dependent State Sampling Plan with Loss-based Capability Index</a> <i>Zih-Huei Wang, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	783
MC5-2 (328)	<a href="#">Overall Automatic-optical-inspection efficiency (OAE) for Yield Enhancement in CMOS Image Sensor Manufacturing</a> <i>Ying-Jen Chen, Ci-An Rong, Kuo-Hao Chang, *Chen-Fu Chien(National Tsing Hua University, Taiwan)</i>	788

MC5-3 (339)	<a href="#">Variables Quick Switching Sampling System based on Process Performance Index</a> <i>Mei-Hsu Shih, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	793
MC5-4 (346)	<a href="#">Applying Evolutionary Algorithm Approach for Optimizing Design of Chip Size</a> <i>*Chia-Yu Hsu, Shih-Chang Chiu(Yuan Ze University, Taiwan)</i>	799
MC5-5 (370)	<a href="#">Quality Design of Yarn Dyed Production Residu based on Taguchi and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method</a> <i>*Ali Parkhan, Faisal M, Djeni Hartika, Imam Widodo(Islamic University of Indonesia, Indonesia)</i>	804
MC5-6 (402)	<a href="#">Tool to Identify and Assess Human Values for TQM Implementation: A Proposal</a> <i>*muhammad malik(Universiti teknologi Malaysia, Malaysia), Sha'ri Mohd Yusof(Universiti Teknologi Malaysia, Malaysia)</i>	810

## MC6 Simulation 1

Ramada-2, 15:50-17:50

Chair: Pudji Astuti (Trisakti University, Indonesia)

MC6-1 (500)	<a href="#">Development of an Artificial Housing Market Using Agent-Based Modeling</a> <i>Byeungchun Kwon, RI YU, KyeongTae Lee(Bank of Korea, Korea), *Nam-Wook Cho(Seoul National University of Science &amp; Technology, Korea)</i>	817
MC6-2 (196)	<a href="#">Design and development of a semiconductor wafer manufacturing simulation system</a> <i>*Li-Chih Wang(Tunghai University, Taiwan), Allen Wang(Department of Industrial Engineering and Enterprise Information Tunghai University, Taiwan), Chun-Ya Chueh(Tunghai University, Taiwan), Tai-Yen Tseng(Department of Industrial Engineering and Enterprise Information, Taiwan)</i>	823
MC6-3 (424)	<a href="#">CONCEPTUAL MODEL FOR SIMULATION OF COMMUTER LINE TRAFFIC AND OPTIMIZING HEADWAY</a> <i>*Pudji Astuti, Winnie Septiani, Sucipto Adisuwiryo, Liana Antoni(Trisakti University, Indonesia)</i>	829
MC6-4 (66)	<a href="#">Automatic defect inspection of TFT-LCD panels using Fourier image reconstruction</a> <i>*Du-Ming Tsai, Yan-Hsin Tseng(Yuan-Ze University, Taiwan), Wei-Yao Chiu(Industrial Technology Research Institute, Taiwan)</i>	834
MC6-5 (179)	<a href="#">Application of value stream mapping for lean management: a case study of air conditioner production line</a> <i>*Yi-Hsin Hu, James C. Chen(National Tsing Hua University, Taiwan), Tzu-Li Chen(Fu Jen Catholic University, Taiwan), Kirin Chen, Amy Hung(AXIS-group, Taiwan), Chun-Ju Lin(National Tsing Hua University, Taiwan)</i>	842

## MC7 Healthcare Systems 1

Ramada-3, 15:50-17:50

Chair: Chie-Hyeon Lim (POSTECH, Korea)

MC7-1 (482)	<a href="#">Measuring Performance of Health Care Organizations using Integrated Balance Scorecard-AHP Technique</a> <i>*ira setyaningsih(Islamic State University UIN Sunan Kalijaga Yogyakarta, Indonesia)</i>	849
MC7-2 (99)	<a href="#">The Risk Assessment of Drug Safely for Emergency Patients Using Modified HFMEA</a> <i>*Chien-Chih Wang(Ming Chi University of Technology, Taiwan), Li-Jung Huang(Division Director, Taiwan), Hsin-Ning Pan, Yun-Ru Yang(Ming Chi University of Technology, Taiwan)</i>	856
MC7-3 (112)	<a href="#">A Multi-Perspective Approach to Service Quality Assessment in Private Hospitals</a> <i>*Joy Mari Bautista, Jazmin Tangsoc(De La Salle University, Philippines)</i>	859
MC7-4 (194)	<a href="#">A Personalized Tele-home Care System for Solitary Elders</a> <i>Jiun-Han Lin, *Hsiao-Fan Wang(National Tsing Hua University, Taiwan)</i>	866
MC7-5 (248)	<a href="#">A Robust Parameter Design Approach for Emergency Department Simulation</a> <i>*Chumpol Yuangyai, suriyaphong nilsang(King Mongkut's Institute of Technology Ladkrabang, Thailand), Kanokporn Rienkhemaniyom(King Mongkut's University of Technology Thonburi, Thailand), Udom Janjarassuk(King Mongkut's Institute of Technology Ladkrabang, Thailand)</i>	872

## MC8 Optimization Techniques 1

Ramada-4, 15:50-17:50

**Chair:** Shi-Woei Lin (National Taiwan University of Science and Technology, Taiwan)

MC8-1 (374)	<a href="#">Evaluating the Economic Performance of ASEAN Countries by Data Envelopment Analysis</a> <i>Mohammad Jerusalem, *Shi-Woei Lin(National Taiwan University of Science and Technology, Taiwan)</i>	879
MC8-2 (217)	<a href="#">Detecting the Masked Efficient DMU in DEA</a> <i>Chiao-Pin Bao(I-Shou University, Taiwan), *Meei-Ing Tsai, Ming-Chi Tsai(College of Management, Taiwan)</i>	887
MC8-3 (201)	<a href="#">Process and Cost Optimization for Plastic Injection Molding by Data Envelope Analysis and Mathematical Programming</a> <i>Wu-Lin Chen(Providence University, Taiwan), Wan-Qiao Lai, Chen-Yu Huang, *Chin-Yin Huang(Tunghai University, Taiwan)</i>	894
MC8-4 (169)	<a href="#">Stochastic Global Optimization Using Sequential Kriging Metamodeling</a> <i>Yan-Han Lu, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>	901
MC8-5 (206)	<a href="#">Optimization of Air-Conditioning Energy Conservation by Mathematical Programming</a> <i>Wu-Lin Chen(Providence University, Taiwan), Chung-Wei Chou, Szu-han Chiu, *Chin-Yin Huang(Tunghai University, Taiwan)</i>	907
MC8-6 (271)	<a href="#">Expertise-based Experts Ranking at Multiplicative Preference Relations on Alternatives</a> <i>evy herowati, *evy herowati, evy herowati(University of Surabaya and Institute of Technology Sepuluh Nopember, Indonesia), Udisubakti Ciptomulyono(Institute of Technology Sepuluh Nopember, Indonesia), Joniarto Parung(University of Surabaya, Indonesia), Suparno Suparno(Institute of Technology Sepuluh Nopember, Indonesia)</i>	914

### MC9 Educational Support System

Halla(8F), 15:50-17:50

**Chair:** Masahide Yamamoto (Kanazawa Seiryu University, Japan)

MC9-1 (501)	<a href="#">A system of real time advice for speech improvement</a> <i>*Hiroshi Arai(Kinjo college, Japan), Hidetaka Nambo(Kanazawa University, Japan), Yuko Shimomura, Hiroyuki KAWABE(Kinjo University, Japan), Shuichi Seto(Kinjo College, Japan)</i>	920
MC9-2 (562)	<a href="#">Consideration on English Learning for Undergraduates Using the Nintendo DS</a> <i>*Hiromi Ban(Nagaoka University of Technology, Japan), Haruhiko Kimura(Kanazawa University, Japan), Takashi Oyabu(Kokusai Business Gakuin College, Japan)</i>	924
MC9-3 (448)	<a href="#">The Analysis of Concept and Effect Factors on Financial Literacy</a> <i>*Yuji Kitano(Kanazawa Seiryu University, Japan), Koji Osanai(Shiga Junior college, Japan), Keiichiro Nishio(Matsuyama University, Japan)</i>	929
MC9-4 (455)	<a href="#">The Present Conditions of the Computerization of Education and its Problems Concerning the Educator</a> <i>*Yumi Tatsushima(Kanazawa Seiryu University, Japan)</i>	936
MC9-5 (154)	<a href="#">AN ANALYSIS OF JOB SATISFACTION OF FACULTY MEMBERS OF BULACAN STATE UNIVERSITY MAIN CAMPUS (COLLEGE OF ENGINEERING)</a> <i>*Dyan Gonzales(Philippine Institute of Industrial Engineers, Philippines)</i>	941
MC9-6 (507)	<a href="#">Analysis the Influence of Study Program's Education Quality towards Graduates' Potential Marketing</a> <i>*Yulianti Talar, Jimmy Gozaly(Maranatha Christian University, Indonesia)</i>	948

### TA1 Supply Chain Management 2

Mara, 08:40-10:40

**Chair:** Etsuko Kusakawa (Osaka Prefecture University, Japan)

TA1-1 (50)	<a href="#">Impact of information sharing regarding customer returns ratio on optimal sales strategy under e-commerce</a> <i>*Yuta Saito, Etsuko Kusakawa(Osaka Prefecture University, Japan)</i>	957
TA1-2 (59)	<a href="#">Analyzing the evolutionary stability for behavior strategies in green supply chain</a> <i>*Daijiro Tomita, Etsuko Kusakawa(Osaka Prefecture University, Japan)</i>	965
TA1-3 (60)	<a href="#">Pareto-Based PSO Algorithm for Multi-Objective LRP</a> <i>*jie liu(student, Thailand), Voratas Kachitvichyanukul(professor, Thailand), jie liu(student, Thailand)</i>	973

TA1-4 (61)	<a href="#">Optimal Ordering Policy in Dual-Sourcing Supply Chain considering Supply Disruptions and Demand Information</a> <i>*Naoki Watanabe, Etsuko Kusakawa(Osaka Prefecture University, Japan)</i>	980
TA1-5 (130)	<a href="#">Research in Supply Chain Management: Issue and Area Development</a> <i>elisa kusrini(Department of Industrial Engineering, Indonesia), *siti Budijati(Faculty of Engineering, Indonesia), subagyo subagyo(Indonesian Islamic University, Indonesia), nuraini masrurroh(Yogyakarta, Indonesia)</i>	988
TA1-6 (161)	<a href="#">Cold Chain Logistics Development: Analyzing Taiwan Influences in Indonesia Market</a> <i>James C. Chen(National Tsing Hua University, Taiwan), Janet Chen, Yun-Wei Hung(Industrial Technology Research Institute, Taiwan), *Muhammad Rinaldi Darmawan, Nadia Aulia Arifin, Hsin-Yu Shih(National Tsing Hua University, Taiwan)</i>	996

## TA2 Communication Support

Biyang, 08:40-10:40

**Chair:** Sakiko Ogoshi (Kanazawa University, Japan)

TA2-1 (443)	<a href="#">Discrimination of Positive / Negative Attitude Using Optical Flow</a> <i>*Yuta Kobayashi(Kanazawa University, Japan), Munehiro Nakamura(Kanazawa Institute of Technology, Japan), Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)</i>	1003
TA2-2 (535)	<a href="#">Development of the support system for facial expression training</a> <i>*Yusuke Amagata, Yasuhiro Ogoshi(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(Chiba, Japan)</i>	1010
TA2-3 (489)	<a href="#">Discrimination of Micro-Expression with Subjective Assessments</a> <i>*Kiyotaka nakashima(Graduate School of Natural Science, Japan), Munehiro Nakamura(Kanazawa Institute of Technology, Japan), Haruhiko Kimura(Graduate School of Natural Science, Japan)</i>	1015
TA2-4 (536)	<a href="#">Facial electromyogram (FEMG) analysis of perception and rendering of facial expression</a> <i>*Akira Takahara, Yasuhiro Ogoshi(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(University of Fukui, Japan)</i>	1020
TA2-5 (480)	<a href="#">Text extraction in natural image</a> <i>*Masayoshi Ueno, Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)</i>	1025
TA2-6 (537)	<a href="#">Electroencephalogram activity during imagined imitative learning</a> <i>*Shu Momose(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Yasuhiro Ogoshi(University of Fukui, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(University of Fukui, Japan)</i>	1030

## TA3 Data Mining 2

Udo, 08:40-10:40

**Chair:** Jong-Seok Lee (Sungkyunkwan University, Korea)

TA3-1 (128)	<a href="#">AUC-based C4.5 tree induction for imbalanced data classification</a> <i>Jungmin Lee, Sungho Lee, *Jong-Seok Lee(Sungkyunkwan University, Korea)</i>	1035
TA3-2 (147)	<a href="#">Comparison of machine learning classifiers for glaucoma diagnosis using variable selection</a> <i>Su-Dong Lee, Jihyung Lee, Heecheon You, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1042
TA3-3 (203)	<a href="#">An iterative random sampling procedure for outlier detection</a> <i>Jihyun Ha, Seulgi Seok, *Jong-Seok Lee(Sungkyunkwan University, Korea)</i>	1049
TA3-4 (392)	<a href="#">Development of Knowledge Management for Forecasting in Restaurant Using Association Rule Mining and Regression Analysis</a> <i>*Annisa Khasanah, Agus Mansur, Yasser Ulil Albab(Universitas Islam Indonesia, Indonesia)</i>	1057
TA3-5 (412)	<a href="#">Data stream clustering by controlling decision errors</a> <i>Jeonghwa Lee, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1064
TA3-6 (216)	<a href="#">The moderating impact of employee's perceived self-efficacy on knowledge sharing intention</a> <i>*Mei-Fang Chen, Ssu-Wei Huang(Tatung University, Taiwan), Pei-Ju Tung(National Chengchi University, Taiwan)</i>	1071

**TA4 Tourism Management/ Topics in IE/MS**

Chuja, 08:40-10:40

**Chair:** Hidetaka Nambo (Kanazawa University, Japan)

TA4-1 (472)	<a href="#">Evaluation for painting show of kindergartner on rout bus in Kaga City</a> <i>Eri Ishikawa, Ayano Kawasaki, Izumi Yamasaki(Kanazawa Seiryō University, Japan), *Takashi Oyabu(Kokusai Business Gakuin College, Japan)</i>	1077
TA4-2 (444)	<a href="#">Utilization of historical materials and CGM for foreign visitors</a> <i>*Ayako Sawada(Hokuriku Gakuin Junior College, Japan), Taketoshi Yoshida(Japan Advanced Institute of Science and Technology, Japan)</i>	1084
TA4-3 (564)	<a href="#">The Verification of Mass Customization Systems in the Chinese Market</a> <i>*Bin Fang(Kanazawa Seiryō University, Japan), Akinori Ono(Keio University, Japan)</i>	1090
TA4-4 (15)	<a href="#">Using SWOT Analysis to Evaluate the Public Procurement in Compliance with SNI (Case Study: Government Agency at Central of Java)</a> <i>*Aries Susanty, Hery Suliantoro, Diana Puspitasari, Diena Novitasari, Nia Budi Puspitasari(Diponegoro University, Indonesia)</i>	1094
TA4-5 (264)	<a href="#">Designing Variables Quick Switching System with Process Loss Consideration</a> <i>Yi-Jhen Jian, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	1100
TA4-6 (225)	<a href="#">A Variables Multiple Dependent State Sampling Plan for Products with Unilateral Specification Limit</a> <i>Chih-Chieh Chang Chien, *Chien-Wei Wu, Yi-Feng Hung(National Tsing Hua University, Taiwan)</i>	1105

**TA5 Sustainable Management**

Ramada-1, 08:40-10:40

**Chair:** Mei-Fang Chen (Tatung University, Taiwan)

TA5-1 (35)	<a href="#">Sustainable supply chain management in competitiveness environment</a> <i>Ming-Lang Tseng(Lunghwa University of Science and Technology, Taiwan), *Anthony Shun Fung Chiu(De La Salle University, Philippines), Ming Lim(Derby University, United Kingdom)</i>	1110
TA5-2 (114)	<a href="#">Sustainable management of Taiwan's semiconductor supply chain</a> <i>*Chi-Tai Wang, Chui-Sheng Chiu(National Central University, Taiwan)</i>	1119
TA5-3 (136)	<a href="#">The Use of Smart Meter Data to Analyze the Consumption Patterns</a> <i>Chia-Yu Shen(National Tsing Hua University, Taiwan), *Hsiao-Fan Wang(Hsinchu, Taiwan)</i>	1124
TA5-4 (137)	<a href="#">Time of Use Electricity Pricing Optimization in a Monopolized Electricity Market</a> <i>Hsin-Yu Chiang, *Hsiao-Fan Wang(National Tsing Hua University, Taiwan)</i>	1131
TA5-5 (291)	<a href="#">Modeling and Optimization of Power Storage Strategy of Hybrid Renewable Energy System in Uncertainty Environments</a> <i>Chi-Kang Su, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>	1136
TA5-6 (347)	<a href="#">What psychological factors influence the protection motivation of climate change?</a> <i>*Mei-Fang Chen(Tatung University, Taiwan)</i>	1141

**TA6 Simulation 2**

Ramada-2, 08:40-10:40

**Chair:** Udom Janjarassuk (King Mongkut's Institute of Technology Ladkrabang, Thailand)

TA6-1 (98)	<a href="#">Application of Agent-Based Modeling and Simulation for an Outpatient Department in a Hospital</a> <i>*Chumpol Yuangyai(King Mongkut's Institute of Technology Ladkrabang, Thailand), Udom Janjarassuk(Faculty of Engineering, Thailand), Chonnupong Siritan(King Mongkut's Institute of Technology Ladkrabang, Thailand), Kanokporn Rienkhemaniyom(King Mongkut's University of Technology Thonburi, Thailand)</i>	1147
TA6-2 (105)	<a href="#">Integrated Maintenance and Inventory Optimisation Model for Offshore Assets</a> <i>*Winda Cahyo(Islamic University of Indonesia, Indonesia)</i>	1154

TA6-3 (221)	<a href="#">A PSO-based Hybrid Approach for Buffer Allocation Problem with Uncertainty</a> <i>*James T. Lin, <u>Chun-Chih Chiu</u>(National Tsing-Hua University, Taiwan)</i>	1161
TA6-4 (272)	<a href="#">State-based Modeling and Simulation of Urban Traffic Systems Including Signalized Intersections</a> <i>*Mira Myong, Donghun Kang, Byoung Kyu Choi(KAIST, Korea)</i>	1167
TA6-5 (295)	<a href="#">MCMC algorithm using self-adaptive differential evolution and local optimization technique for Bayesian framework of complex systems</a> <i>Jun-Seong Kim, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1174
TA6-6 (356)	<a href="#">Evaluation of the Behavior of Persons on a Floor in a Disaster Situation by Multi-Agent Simulation</a> <i>*Keita Sugiura, Masahiro Arakawa(Nagoya Institute of Technology, Japan)</i>	1179

## TA7 Production & Operations Management 1

Ramada-3, 08:40-10:40

**Chair:** Takayoshi Tamura (Aichi Institute of Technology, Japan)

TA7-1 (282)	<a href="#">Study and findings based on actual case data of the degree of the integration in regard to the production quality of information systems</a> <i>*Hideaki Hayashi, Etsuji Ohmura(Osaka University, Japan)</i>	1187
TA7-2 (327)	<a href="#">A Study on Standard Productivity for Comparing Productivity of an Assembly Line in Diversified Production Conditions</a> <i>*Kagehisa Nakayama(Waseda University, Japan), Shohei Machida, Hisashi Onari(WASEDA University, Japan)</i>	1195
TA7-3 (349)	<a href="#">Inventory Valuation Model Considering Profitability and Risk</a> <i>Kiho Kamiya, *Satoshi Kumagai(Aoyama Gakuin University, Japan), Ohba Masaaki(College of Economics, Japan)</i>	1201
TA7-4 (431)	<a href="#">A method of operational planning for project-based production in consideration of learning effects and demand uncertainty</a> <i>*YOSHIHIKO SUZUKI(Seiryō Technica Co. Ltd, Japan), Nobuaki Ishii(Bunkyo University, Japan), masaaki muraki(Emeritus Professor, Japan)</i>	1208
TA7-5 (104)	<a href="#">Integrated Transport Terminal: Its Effect on Commuters' Travel Time, Cost, and Comfort (Or How Bitter-Sweet is the Metro Manila SWITT?)</a> <i>*RUMEL ATIENZA, <u>RUMEL ATIENZA</u>, Carlo Tansuk(DE LA SALLE UNIVERSITY, Philippines)</i>	1213
TA7-6 (218)	<a href="#">Effectiveness of an Exponential Smoothing System for a Multi-Stage Multi-Item Production System with Advance Demand Information</a> <i>*Takayoshi Tamura(Aichi Institute of Technology, Japan), Tej Dhakar(Southern New Hampshire University, United States)</i>	1219

## TA8 Logistics Management

Ramada-4, 08:40-10:40

**Chair:** Anchalee Supithak (Thai-Nichi Institute of Technology, Thailand)

TA8-1 (440)	<a href="#">Logistics Management of Oil Palm in Southern Region of Thailand</a> <i>*Phajongjit Pijitbanjong(Faculty of Industrial Technology, Thailand), Paroon Mayachearw(Songkhla Rajabhat University, Thailand), Rapeepan Pitakaso(Songkhla, Thailand)</i>	1227
TA8-2 (477)	<a href="#">On the resources required to provide persistent robotic service agents: Multiple immobile customers and a single service station</a> <i>Hyorin Park, *James Morrison(KAIST, Korea)</i>	1234
TA8-3 (483)	<a href="#">Solving Integrated Inventory and Open Vehicle Routing Problem in Two Depots and Multiple Retailers' Distribution System</a> <i>*Anchalee Supithak(Thai-Nichi Institute of Technology, Thailand)</i>	1242
TA8-4 (543)	<a href="#">Competitive Facility Location and Design Problem by Considering Conditions of Government Regulation and Regional Saturation</a> <i>Suprayogi Suprayogi, <u>Yosi Hidayat</u>(Institut Teknologi Bandung, Indonesia), *Utaminingsih Linarti(Ahmad Dahlan University, Indonesia)</i>	1250
TA8-5	<a href="#">Cooperative Tactical Planning in Road Transportation with Backhauling Management</a>	1256

- (344) \*Apichit Manee-ngam(Faculty of Engineering, Thailand), Apinanthana Udomsakdigool(King Mongkut's University of Technology Thonburi, Thailand)
- TA8-6 **Monitoring Framework for Dynamic Inbound Flows** 1264  
(313) *Kiyoul Lee*(POSTECH (Pohang University of Science & Technology), Korea), *Hyunbo Cho*(POSTECH (Pohang University of Science & Technology), Korea), \**Mooyoung Jung*(UNIST (Ulsan National Institute of Science & Technology), Korea)

### TA9 Uncertainty Theory (Session II)

Halla(8F), 08:40-10:40

Chair: Xiaowei Chen (Nankai University, China)

- TA9-1 **Towards Uncertain Network Optimization** 1270  
(558) \**Jin Peng*(Huanggang Normal University, China)
- TA9-2 **Viral Marketing of Multiple-Attribute Products in a Social Network** 1271  
(559) *Wei Li*, \**Yaodong Ni*(University of International Business and Economics, China)
- TA9-3 **Uncertain Logic Controller and Its Applications** 1279  
(560) \**Wei Dai*(Central University of Finance and Economics, China)
- TA9-4 **Uncertain Random Multilevel Programming** 1280  
(561) \**Hua Ke*(Tongji University, China)
- TA9-5 **Assets Pricing and Risk Management in Uncertain Market** 1281  
(565) \**Xiaowei Chen*(School of Economics Nankai University, China)
- TA9-6 **Liquidity Crashes and Robust Portfolio Management** 1282  
(428) *Seungkyu Lee*(Pohang University of Science and Technology, Korea), \**Bong-Gyu Jang*, *Seyoung Park*(POSTECH, Korea)

### TB1 Supply Chain Management 3

Mara, 14:20-16:00

Chair: Muhammad Rusman (Hasanuddin University, Indonesia)

- TB1-1 **Nash Equilibrium Retail Prices in a Planer Duopoly Market** 1295  
(165) \**Koichi Nakade*, *Akira Kanazawa*(Nagoya Institute of Technology, Japan)
- TB1-2 **A Proposal of Bargaining Solution for Cooperative Contract in a Supply Chain** 1303  
(176) \**Wakana Kato*, *Ikuo Arizono*(Okayama University, Japan)
- TB1-3 **Capacity Planning and Partnership Management** 1310  
(208) \**Cheng-Hung Wu*, *Wen-Lan Hsu*(National Taiwan University, Taiwan)
- TB1-4 **A multi-objective facility location problem in congested systems with service level for each facility and competitive environment** 1314  
(160) \**Mahsa Boroushaki*(M.Sc. student of industrial engineering, Iran), *hasan hosseini nasab*(Associate professor, Iran)
- TB1-5 **Blood Bank Location Model for Blood Distribution Planning in Makassar City** 1323  
(234) \**Muhammad Rusman*(Hasanuddin University, Indonesia), *Amrin Rapi*(Ministry of Industry of Republic of Indonesia, Indonesia)

### TB2 Management of Technology and Innovations 2

Biyang, 14:20-16:00

Chair: Chih Wang (National Chiao Tung University, Taiwan)

- TB2-1 **Establishment and development of the innovation-promoting organization for Industry** 1328  
(188) \**Kana Hayase*, *Nobutaka Odake*(Nagoya Institute of Technology, Japan), *Takeshi Matsumoto*(Osaka Gas Co., Japan)
- TB2-2 **Using Innovative Intellectual Property Indicators to Identify National Knowledge Flow Effects** 1336  
(425) \**Chin-Yuan Fan*, *Chia-Hao Hsu*(Science & Technology Policy Research and Information Center, Taiwan), *shu-hao Chang*(National Applied Research Labs, Taiwan), *pin-hua Lin*(Zhongli, Taiwan)

TB2-3 (317)	<a href="#">Development of Virtual Organisation Framework Model in Tourism Industry Using Axiomatic Design</a> <i>*Agus Fauzi, Ery Maftuchah, Nasrullah Setiawan, Bambang Suratno(Universitas Islam Indonesia, Indonesia)</i>	1345
TB2-4 (150)	<a href="#">Supporting Technology Foresight for Disruptive Innovation: Keyword-based Visual Analysis for Futuristic Data</a> <i>Jieun Kim, *Yongtae Park(Seoul National University, Korea)</i>	1352
TB2-5 (22)	<a href="#">Combining correspondence analysis with association rule mining to carry out market segmentation and product configuration</a> <i>*Chih Wang(National Chiao Tung University, Taiwan)</i>	1358

### TB3 Data Mining 3

Udo, 14:20-16:00

Chair: Jen-Ying Shih (National Taiwan Normal University, Taiwan)

TB3-1 (437)	<a href="#">Comparative Benchmarking Analysis among Fine Jewelry and Costume Jewelry Companies in the Philippines Using Data Envelopment Analysis (DEA)</a> <i>*Dennis Beng Hui, Emil Fernandez(De La Salle University Manila, Philippines)</i>	1366
TB3-2 (469)	<a href="#">A Prediction Method based on Weighted Ensemble of Decision Tree on Alternating Decision Forests.</a> <i>*Shotaro Misawa, Naohiro Fujiwara(Graduate Student of Waseda University, Japan), Kenta Mikawa(Waseda University, Japan), Masayuki Goto Goto(Waseda University., Japan)</i>	1375
TB3-3 (486)	<a href="#">Creating Attractive Digital Signage Content at Universities</a> <i>*RYO AKAIWA(Aoyama Gakuin University, Japan), RYUJI MAEKAWA, KAKURO AMASAKA(AOYAMA GAKUIN UNIVERSITY, Japan)</i>	1383
TB3-4 (502)	<a href="#">A Data Mining Approach for Loan Marketing Response Model</a> <i>*Jen-Ying Shih(National Taiwan Normal University, Taiwan), Wun-Hwa Chen(National Taiwan University, Taiwan)</i>	1388
TB3-5 (581)	<a href="#">The 7-Eleven Rule in the Simulation Output Analysis</a> <i>*Wheyming Song(professor, Taiwan)</i>	1394

### TB4 Scheduling & Sequencing 1

Chuja, 14:20-16:00

Chair: Byung Do Chung (Sungkyunkwan University, Korea, )

TB4-1 (122)	<a href="#">A two-stage assembly scheduling problem with makespan minimization</a> <i>Lulu Hu, *Tsui-Ping Chung, Hongying Shan(Jilin University, China), Chien-Ming Chen(Harbin Institute of Technology Shenzhen Graduate School, China)</i>	1413
TB4-2 (233)	<a href="#">Particle swarm Optimization for minimizing electrical consumption for flexible flowshop problem</a> <i>Krisanarach Nitisiri(Research Unit on Advanced Productivity Improvement and Logistics Management, Thailand), *Kanchana Sethanan(Faculty of engineering, Khon Kaen university, Thailand)</i>	1420
TB4-3 (284)	<a href="#">Campaign Planning for Multi-Purpose Batch Plants: A Case Study from the Pharmaceutical Industry</a> <i>Mao-Kai Hsu, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>	1427
TB4-4 (287)	<a href="#">Multi-Jobs Lot Streaming to Minimize the Mean Maximum Completion Time in Multi-Stages Hybrid Flow Shop Scheduling</a> <i>*Said Syahputra(Institut Teknologi Bandung, Indonesia, Indonesia), Anas Ma'ruf(Indonesia, Indonesia)</i>	1434
TB4-5 (309)	<a href="#">Shift-Scheduling Characteristic Identification of Non-Star Hotel Industry in Yogyakarta Indonesia</a> <i>*Deny Yuniartha(Universitas Atma Jaya Yogyakarta, Indonesia), Ignatius Luddy Indra Purnama(Atma Jaya Yogyakarta University, Indonesia)</i>	1442

### TB5 Knowledge & Information Management

Ramada-1, 14:20-16:00

**Chair:** Minseok Song (Ulsan National Institute of Science and Technology, Korea)

TB5-1 (250)	<a href="#">Mergers and Acquisitions of ICT Firms for Technological Knowledge Sourcing</a> <i>Yoonjung An, *Yongtae Park(Seoul National University, Korea)</i>	1449
TB5-2 (278)	<a href="#">Analyzing Service Processes Using Process Mining: A Case Study</a> <i>Hanna Yang, *Minseok Song(Ulsan National Institute of Science and Technology, Korea)</i>	1454
TB5-3 (445)	<a href="#">Document Control for Research Reactor Construction by Advanced Nuclear Safety Information Management System</a> <i>*Kook-Nam Park(Korea Atomic Energy Research Institute, Korea), Sung-Kyu Lee(Divi-vision Co., Korea), Seung-Mi Baek(Korea Atomic Energy Research Instituti, Korea), Min-Ho Choi(Korea Atomic Energy Research Institute, Korea), Yong-Se Kwon(Korea Atomic Energy Research institute, Korea)</i>	1458
TB5-4 (297)	<a href="#">Factors influencing user acceptance of intelligent personal assistants on smart devices</a> <i>Jihye Park(LG Household &amp; Health Care, Korea), Euiho Suh(Pohang University of Science and Technology, Korea), *Kiwon Lee(Pohang University of Science and Technology (POSTECH), Korea)</i>	1463
TB5-5 (389)	<a href="#">Prognosis and Survival Prediction of Lung Cancer by Bayesian Network</a> <i>*Shi-Woei Lin, Yu-Wei Chen, Mohammad Jerusalem(National Taiwan University of Science and Technology, Taiwan)</i>	1471

## TB6 Production & Operations Management 2

Ramada-2, 14:20-16:00

**Chair:** Ivy Mar Lamos (Bulacan State University, Philippines)

TB6-1 (49)	<a href="#">Application of ECRS and Simulation Techniques in Bottleneck Identification and Improvement:A Paper Package Factory</a> <i>*Chompoonoot Kasemset, Prin Pinmanee, Primapun Umarin(Chiang Mai University, Thailand)</i>	1477
TB6-2 (124)	<a href="#">Assembly line type II problem of sewing lines in garment industry</a> <i>James C. Chen(National Tsing Hua University, Taiwan), Tzu-Li Chen(Fu Jen Catholic University, Taiwan), Yi-Jhen Lin, *Chun-Ju Lin, Yi-Hsin Hu(National Tsing Hua University, Taiwan)</i>	1485
TB6-3 (151)	<a href="#">EFFICIENCY AND BETTER PRODUCTION FLOW FOR A MANUFACTURER OF STATUES: AN APPLICATION OF MOTION AND TIME STUDY</a> <i>*Ivy Mar Ramos, Ivy Mar Ramos(Bulacan State University, Philippines)</i>	1492
TB6-4 (187)	<a href="#">A Genetic Algorithm for Solving Assembly Line Balancing Problem in Footwear Stitching Line</a> <i>James C. Chen, Tzu-Li Chen, *Chieh-Ying Lin, Chun-Ju Lin(National Tsing Hua University, Taiwan)</i>	1500
TB6-5 (12)	<a href="#">Pricing, Production, and Channel Coordination with Stochastic Learning</a> <i>Tao Li(Santa Clara University, United States), *Suresh Sethi(University of Texas At Dallas, United States), Xiuli He(University of North Carolina at Charlotte, United States)</i>	1507

## TB7 Healthcare Systems 2

Ramada-3, 14:20-16:00

**Chair:** Gino Lim (University of Houston, UnitedStates)

TB7-1 (95)	<a href="#">Construct the Analysis Platform for Evaluating the Static Postural Stability</a> <i>*Chih-Hung Jen(Lunghwa University of Science and Technology, Taiwan), Bernard C. Jiang(National Taiwan University of Science and Technology, Taiwan), Yin-Sung Chen(Yuan Ze University, Taiwan)</i>	1512
TB7-2 (106)	<a href="#">Recent Advances in Intensity Modulated Proton Therapy Treatment Planning Optimization</a> <i>*Gino Lim, Wenhua Cao(University of Houston, United States), Radhe Mohan(The University of Texas MD Anderson Cancer Center, United States)</i>	1520
TB7-3 (306)	<a href="#">Developing A Productivity Improving Framework by Overall Equipment Efficiency and An Empirical Study in A Hospital</a> <i>*Chen-Fu Chien, Pei-Chun Chu, Mei-Li Kuo(National Tsing Hua University, Taiwan)</i>	1526
TB7-4 (379)	<a href="#">An analysis of patients flow in a hospital case study using Simulation model and plant layout</a>	1534

*Patcharaphorn Poobanchao*(KhonKaen University, Thailand), \**Panitarn Peerapattana*(Department of Industrial Engineering Faculty of Engineering of Khon Kean University, Thailand)

- TB7-5 (76) [Willingness to pay for BPJS Health Insurance: Findings from an Exploratory Study](#) 1540  
 \**Aries Susanty*(Lecturer, Indonesia), *nia puspitasari*(diponegoro university, Indonesia), *Purnawan Wicaksono*(Lecturer, India), *Petty Primatury*(Student, Indonesia)

### TB8 Flexible Manufacturing Systems

Ramada-4, 14:20-16:00

**Chair:** Ibrahim Buseif (, Libya)

- TB8-1 (579) [The Comparison between Perpetual and Periodic-Review Models for Fast-Moving Products in Convenience Store Distribution Center](#) 1547  
 \**Yosi Hidayat*, *Veronica Adelein*, *Lucia Diawati*(Institut Teknologi Bandung, Indonesia)
- TB8-2 (48) [Using Petri Net \( PN \) Model for Design Flexible Manufacturing Systems \( Prototype FMS's \)](#) 1554  
 \**Ibrahim Buseif*(Staff member, Libya)
- TB8-3 (62) [New Model of FMS using FTPN with Demand Variability and Machine Breakdown](#) 1561  
 \**Muhammad Haris Aziz*(University of Engineering and Technology, Pakistan), *Erik L.J. Bohez*(Asian Institute of Technology, Thailand), *Abid Ali*, *Neelum Iqbal*(UET Taxila, Pakistan)
- TB8-4 (286) [Cellular Manufacturing System Model under Demand Uncertainty](#) 1567  
 \**Muhammad Shodiq Abdul Khannan*(Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia), *Anas Ma'ruf*(Indonesia, Indonesia), *Rachmawati Wangsaputra*(Institut Teknologi Bandung, Indonesia), *sutrisno sutrisno*(UPN Veteran Yogyakarta Indonesia, Indonesia)
- TB8-5 (457) [An iterative production planning approach for flexible semiconductor fabrication](#) 1575  
 \**Sun Hoon Kim*, *Young Hoon Lee*, *Cheng Yu Hwang*, *Kee Yong Shin*, *Ki Yol Nam*(Yonsei University, Korea)

### TB9 Topics in IE/MS

Halla(8F), 14:20-16:00

**Chair:** Taufiq Immawan (Islamic University of Indonesia, Indonesia)

- TB9-1 (575) [A study on relieving electric power shortage by on-site solar power supply](#) 1579  
*SangYun Choe*, \**Jinwoo Park*(Seoul National Univ., Korea)
- TB9-2 (354) [Preliminary Study for Mapping of Business Process Re-engineering of Batik in Jogja and Solo](#) 1584  
 \**Taufiq Immawan*(Islamic University of Indonesia, Indonesia)
- TB9-3 (378) [Evaluation Method of Information Value Applying for Website](#) 1590  
 \**GaoYang Liang*(Graduate School of Business Administration Daito Bunka University, Japan), *Kiyoshi Nagata*(Informatics Faculty of Business Administration and Department of Business Studies Daito Bunka University, Japan)
- TB9-4 (212) [Lean Production in Automotive Parts Industry-A Case Study](#) 1598  
*James C. Chen*(National Tsing Hua University, Taiwan), *Tzu-Li Chen*(Fu Jen Catholic University, Taiwan), *Kirin Chen*, *Amy Hung*(AXIS-group, Taiwan), \**Yu Liang*, *Chun-Ju Lin*(National Tsing Hua University, Taiwan)
- TB9-5 (202) [Optimum Humanitarian Relief Logistics for Facility and Stock Location under Time Restriction: Thai Flooding Case Study](#) 1604  
 \**WAPEE MANOPINIWES*, *KEISUKE NAGASAWA*, *TAKASHI IROHARA*(Sophia University, Japan)

### TC1 Heuristics/Metaheuristics

Mara, 16:20-18:00

**Chair:** Ma. Cecilia Buseif (Mapua Institute of Technology, Philippines)

- TC1-1 (70) [GA-BASED OPTIMAL FACILITY LAYOUT DESIGN: CROSSOVER AND MUTATION PROBABILITY EVALUATIONS](#) 1612  
 \**Maricar Misola*(Technological Institute of the Philippines- Quezon City, Philippines), \**Ma. Cecilia Carlos*(Mapua Institute of Technology, Philippines), *Bryan Navarro*(Philippine Institute of Industrial Engineers (PIIE), Philippines)

TC1-2 (464)	<a href="#">An Improved Differential Evolution Algorithm for Vehicle Routing Problem: An Application in Mobile Medical Equipment Maintenance Unit</a> <i>*Kanokwan Supakdee</i> (Department of Industrial Management Technology, Thailand), Natthapong Nanthasamroeng(Faculty of Industrial Technology, Thailand), Rapeepan Pitakaso(Metaheuristics for Logistics Optimization Laboratory (MLO), Thailand)	1620
TC1-3 (481)	<a href="#">Heuristic for multi-stage capacitated p-median problem with supplier evaluation</a> <i>*Anurak Chaiwichian</i> , Rapeepan Pitakaso(Ubonratchathani University, Thailand)	1626
TC1-4 (520)	<a href="#">Heuristic Shift Scheduling for Airport Ground Staff</a> <i>*Kong Weng Lee</i> (UNIMAS, Malaysia), San Nah Sze(Faculty of Computer Science and Information Technology Universiti Malaysia Sarawak, Malaysia), Keat Keong Phang(Faculty of Computer Science and Information Technology Universiti Malaya, Malaysia)	1633
TC1-5 (192)	<a href="#">Optimization of Milk Productivity in Dairy Cattles by Genetic Algorithm</a> <i>*Senol Altan</i> (Gazi University, Turkey), <i>Fatih Akturk</i> (Ulsan National Institute Of Science and Technology, Korea), <i>Emre Can Ozeler</i> (Republic of Turkey Ministry of Food, Turkey)	1639

## TC2 Inventory Modeling / Artificial Intelligence

Biyang, 16:20-18:00

Chair: Wisut Supithak (Kasetsart University, Thailand)

TC2-1 (381)	<a href="#">Multi-Item Economic Production Quantity Model with the Consideration of Raw Material Inventory Management Costs</a> <i>*Wisut Supithak</i> (Kasetsart University, Thailand), Sasiprapa Limpakan(Kasetsart University, Thailand)	1647
TC2-2 (123)	<a href="#">A Stochastic Programming Model for Vendor Managed Inventory System of an Animal Feed Factory and Farm Network</a> <i>*Thawee Nakrachata-Amon</i> (Faculty of Engineering, Thailand), Supachai Pathumakul(Khon Kaen University, Thailand)	1654
TC2-3 (101)	<a href="#">Vender Managed Inventory for Fresh Agricultural Products</a> <i>*Mitsuyoshi Horikawa</i> , Takeo Takeno, Mitsumasa Sugawara(Iwate Prefectural University, Japan)	1659
TC2-4 (318)	<a href="#">Vehicle risk assessment in accidents using neural network</a> <i>Yuri Castro</i> , <i>*Young Jin Kim</i> , Baek An Sun(Kyung Hee University, Korea)	1665

## TC3 Artificial Intelligence

Udo, 16:20-18:00

Chair: Ronaldo Polanco (De La Salle University, Philippines)

TC3-1 (182)	<a href="#">The Study of Tokai Cluster as a Leader of CFRP Industries in Japan</a> <i>*Akihito Zenke</i> , Nobutaka Odake(Nagoya Institute of Technology, Japan)	1672
TC3-2 (260)	<a href="#">Agent-based Real-time Scheduling for Smart Household Appliances</a> <i>Bobby Kurniawan</i> , <i>*Anggoro Pramudyo</i> , Didik Aribowo(Untirta, Indonesia), Anas Ma'ruf(Institut Teknologi Bandung, Indonesia)	1678
TC3-3 (391)	<a href="#">APPLICATION OF CLOUD-BASED KANBAN SYSTEM IN PROJECT MANEGEMENT</a> <i>Chi-Wei Shih</i> , <i>*Chen-Yang Cheng</i> (Tunghai University, Taiwan)	1683
TC3-4 (490)	<a href="#">User's Free Time Estimation When Using Smartphone</a> <i>*kohei Yamamoto</i> (Kanazawa Graduate School of Natural Science and Technology, Japan), Tatsuhito Hasegawa(Tokyo Health Care University, Japan), Haruhiko Kimura(Kanazawa University, Japan)	1688
TC3-5 (499)	<a href="#">Earned Value Management considering Milestone Weighting and Dependency Structure Matrix</a> <i>*Ronaldo Polanco</i> (De La Salle University, Philippines)	1692

## TC4 Scheduling & Sequencing 2

Chuja, 16:20-18:00

Chair: Hans-Otto Guenther (Seoul National University, Korea)

TC4-1 (399)	<a href="#">Improvement of Scheduling n Jobs m Machines Parallel Algorithm to Minimize Makespan</a> <i>*Rifa Arifati</i> (University of Pembangunan Nasional Veteran Jakarta, Indonesia), Aji P.	1696
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TC4-2 (405)	<p><a href="#">A Batch-scheduling problem to minimize actual flowtime of parts through the shop which has m heterogenous batch processors</a></p> <p><i><u>Nita Hidayat</u>(Industrial Engineering ITB, Indonesia), Andi Cakravastia, TMA Ari Samadhi(Bandung Institute of Technology, Indonesia), *Abdul Halim(Industrial Engineering ITB, Indonesia)</i></p>	1701
TC4-3 (418)	<p><a href="#">Genetics Algorithm for Hybrid and Flexible Flowshop with Non-Identical Machines and Subcontract Case</a></p> <p><i>*Nora Azmi(Trisakti University, Indonesia), Gibtha Fitri Laksmi(Ibnu Khaldun University, Indonesia)</i></p>	1707
TC4-4 (398)	<p><a href="#">Mixed Integer Linear Programming for Un-related Parallel Machine Problems to Minimize Total Earliness and Tardiness - A Case Study of Precision Metal Tools Industry</a></p> <p><i><u>Chun Hsiung Laj</u>, *Chen-Yang Cheng(Tunghai University, Taiwan)</i></p>	1714
TC4-5 (79)	<p><a href="#">A block planning model for integrated lot sizing and scheduling of continuous casters and hot strip mills in the steel industry</a></p> <p><i>*Hans-Otto Guenther(Seoul National University, Korea), Imke Mattik(TU Berlin, Germany)</i></p>	1719

### TC9 Lean Production Management

Halla(8F), 16:20-18:00

**Chair:** Kenichi Nakashima (Kanagawa university, Japan)

TC9-1 (542)	<p><a href="#">Single-period inventory model considering a competitive store and two qualities of the product</a></p> <p><i>*Takashi Hasuike(Osaka University, Japan)</i></p>	1720
TC9-2 (546)	<p><a href="#">A Single-Producer Multi-Retailer Integrated Inventory System with Scrap in Production and Shortage in sale</a></p> <p><i>*Hitoshi Hohjo, Tomoki Koreeda(Osaka Prefecture University, Japan)</i></p>	1728
TC9-3 (94)	<p><a href="#">Joint replenishment problem with can-order policies under carrier capacity and correlated demands</a></p> <p><i>*KEISUKE NAGASAWA, Takashi Irohara(Sophia University, Japan), Yosuke Matoba, Shuling Liu(Fairway Solutions Inc., Japan)</i></p>	1733
TC9-4 (545)	<p><a href="#">Inventory-Production System with Non-Zero Target Inventory</a></p> <p><i>*Mohammadreza Parsanejad(Keio University, Japan), Bongsung Chu(Soonchunhyang University, Japan), Hiroaki Matsukawa(Keio University, Japan)</i></p>	1741
TC9-5 (547)	<p><a href="#">A Lean Supply Chain Control Problem with Stochastic Demand</a></p> <p><i>*Kenichi Nakashima, Thitima Sornmanapong(Kanagawa University, Japan), Hans Ehm(Infineon Technologies AG, Japan), Geraldine Yachi(Infineon Technologies AG, Japan)</i></p>	1746

### WA1 Inventory Modeling & Management

Mara, 08:30-10:10

**Chair:** Nobuaki Ishii (Bunkyo University, Japan)

WA1-1 (65)	<p><a href="#">A Lot Size-Based Collaborative Demand-to-Supply Management System for Make-to-Order Environment</a></p> <p><i>*Nobuaki Ishii(Bunkyo University, Japan), Ko Sakashita, Tetsuo Yamada(University of Electro-Communications, Japan), Masaaki Ohba(Nihon University, Japan), Masayuki Matsui(Kanagawa University, Japan)</i></p>	1754
WA1-2 (80)	<p><a href="#">Reorder Point Determination Considering Customer Service Constraint under Limited Demand Information</a></p> <p><i>*Yasuhiko Takemoto(Prefectural University of Hiroshima, Japan), Ikuo Arizono(Okayama University, Japan)</i></p>	1762
WA1-3 (71)	<p><a href="#">Inventory Classification Involving Substitution Rules</a></p> <p><i>*ikou kaku, Xinyi Zhang(Tokyo City University, Japan)</i></p>	1769
WA1-4 (446)	<p><a href="#">Reducing Inventory using Inventory Management Models</a></p> <p><i>*Sakgasem Ramingwong, Danuchin Anantana(Center of Excellence in Logistics and Supply Chain Management, Thailand)</i></p>	1775
WA1-5 (518)	<p><a href="#">An Approach for Avoiding Information Loss in Managing Product Safety Issue Associated with Suppliers</a></p> <p><i>Muhammad Saad Memon, *Young Hae Lee, Sonia Irshad Mari(Hanyang University, Korea)</i></p>	1779

**WA2 SCM and Forecasting 1**

Biyang, 08:30-10:10

**Chair:** Kazuhiro Takeyasu (Tokoha University, Japan)

WA2-1 (92)	<a href="#">Forecasting utilizing a Day of the Week Index in the Case of Cafe</a> <i>*Koumei Suzuki, Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1787
WA2-2 (31)	<a href="#">Building BTO System in the Sanitary Materials Manufacturer Under the Improvement of Forecasting Accuracy</a> <i>*Kazuhiro Takeyasu(Tokoha University, Japan), hirotake yamashita(Chubu University, Japan)</i>	1795
WA2-3 (34)	<a href="#">UTILIZATION OF GENETIC ALGORITHM TO IMPROVE FORECASTING ACCURACY ? AN APPLICATION TO THE DATA OF A TUBE AND A CATHETER?</a> <i>*Daisuke Takeyasu(The Open University of Japan, Japan), Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1803
WA2-4 (32)	<a href="#">Optimal operation for green supply chain with quality of recyclable parts and contract for recycling activity</a> <i>*Etsuko Kusukawa(Osaka Prefecture University, Japan), Sho Akizawa(Nara Institute of Science and Technology, Japan)</i>	1811
WA2-5 (102)	<a href="#">A Hybrid Method to Improve Forecasting Accuracy In the Case of Japanese Food Restaurant</a> <i>*Jun Tatebayashi, Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1819

**WA3 Production Design & Management 1**

Udo, 08:30-10:10

**Chair:** Philip Ermita (PIIE, Philippines)

WA3-1 (117)	<a href="#">Development a Latex Pillow to Meet Customer Requirements</a> <i>*Nattapong KONGPRASERT(Facluty of Engineering, Thailand)</i>	1827
WA3-2 (162)	<a href="#">BananaNut Paper: REENGINEERING PAPER COMPONENT</a> <i>*Marianne Calayag(Bulacan State University, Philippines)</i>	1834
WA3-3 (198)	<a href="#">An Optimal Modularity for Platform-based Product Family Design of Wind Power Generators</a> <i>*Qingnan Li(University of Southern Denmark, Denmark)</i>	1838
WA3-4 (222)	<a href="#">Composite Board Development: Use of Cardava Banana Peel and Watermelon Rind as Alternative Raw Materials</a> <i>*Philip Ermita(PIIE, Philippines)</i>	1845
WA3-5 (249)	<a href="#">Fairing of High Speed Milling tool-path by Using The Cubic NURBS</a> <i>*Anh Duong, Anh Duong(International University in Vietnam, Viet Nam)</i>	1852

**WA4 Scheduling & Sequencing 3**

Chuja, 08:30-10:10

**Chair:** San-Nah Sze (Universiti Malaysia Sarawak, Malaysia)

WA4-1 (85)	<a href="#">Scheduling with multi-attribute setup times on unrelated parallel machines</a> <i>Ching-Jong Liao(National Taiwan University of Science and Technology, Taiwan), *Cheng-Hsiung Lee(Chihlee Institute of Technology, Taiwan), Hsing-Tzu Tsai, Kuo-Jui Wu(National Taiwan University of Science and Technology, Taiwan)</i>	1859
WA4-2 (120)	<a href="#">Scheduling on parallel machines with mold constraints</a> <i>Haidan Zhao, *Tsui-Ping Chung, Hongying Shan(Jilin University, China), Chien-Ming Chen(Harbin Institute of Technology Shenzhen Graduate School, China)</i>	1867
WA4-3 (177)	<a href="#">Transient Period Scheduling of Dual Armed Cluster Tools</a> <i>*Nurhak Aktas, Taesun Yu, Tae-Eog Lee(KAIST, Korea)</i>	1874
WA4-4 (316)	<a href="#">Adaptive Hybrid Genetic algorithm for solving two-stage reentrant flexible flow shop with blocking constraint</a> <i>Chatnugrob Sangsawang, *Kanchana Sethanan(Research Unit on Advanced Productivity</i>	1880

- WA4-5 Decision Support System for Order Online Delivery 1888  
(509) \*San-Nah Sze, Bui-Fat Thian, Kang-Leng Chiew(Universiti Malaysia Sarawak, Malaysia)

### WA5 Fuzzy Logic

Ramada-3, 08:30-10:10

**Chair:** Rionel Caldo (Lyceum of the Philippines University - Laguna, Philippines)

- WA5-1 Predictive Approach of Assessing the Passing of Engineering Board Courses in Lyceum of 1894  
(30) the Philippines University-Laguna (LPU-L) Using Fuzzy Logic Technology  
\*Rionel Caldo(Lyceum of the Philippines University - Laguna, Philippines)
- WA5-2 Fuzzy Logic Simulation of DC-DC Boost Converter Using Matlab Fuzzy Logic Toolbox 1902  
(58) Rionel Caldo, \*Rionel Caldo(Lyceum of the Philippines University - Laguna, Philippines)
- WA5-3 Cost Effectiveness Analysis Comparing Mastectomy versus Lumpectomy with Fuzzy Logic 1908  
(224) Aysun Aktas, \*gozde tutuncu(Izmir University of Economics, Turkey)
- WA5-4 Fuzzy AHP based Supplier Selection considering the Triple Bottom Line Concept 1914  
(576) Wannimit Khampanya, Tritos Laosirihongthong(Thammasat University, Thailand), \*Premaratne Samaranyake(University of Western Sydney, Australia)

### WA6 Optimization Techniques 2

Ramada-4, 08:30-10:10

**Chair:** Daniel Siek (Chung Yuan Christian University, Taiwan)

- WA6-1 Impact of Globalization on Total Factor Productivity of the Manufacturing Sector in Pakistan 1920  
(125) \*Usama Bin Perwez, Muhammad Faseeh Tahir, Aamir Ahmed Baqai(National University of Sciences & Technology, Pakistan)
- WA6-2 Optimal Solar Photovoltaic (PV) Penetration in Secondary Distribution Network Using 1929  
(69) Genetic Algorithm  
Bryan Navarro(Technological Institute of the Philippines, Philippines), \*Maricar Misola(Technological Institute of the Philippines- Quezon City, Philippines)
- WA6-3 Numerical Analysis of Three Rookies Assignment Optimization in Limited-Cycled Model 1937  
(288) with Multiple Periods -the case of Erlang Distribution  
\*Peiya Song, Xianda Kong, Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Jing Sun(Nagoya Institute of Technology, Japan), Masayuki Matsui(Kanagawa University, Japan)
- WA6-4 Optimal Ordering Policies under a Progressive Interest Scheme with Supplier's Quantity 1945  
(577) Discount  
Gary Chen, \*Daniel Siek, Hui Wee(Chung Yuan Christian University, Taiwan)
- WA6-5 An analysis on the influences of flat pricing for unlimited voice callings: the aspects of 1951  
(415) MNOs and consumers in Korea  
\*SEONGJUN LEE, SAESOL CHOI(Electronics and Telecommunications Research Institute, Korea)

### WB1 Industrial Engineering Education

Mara, 10:30-12:10

**Chair:** Young Jae Jang (KAIST, Korea)

- WB1-1 Solution Based Learning: A New Approach in Product Design and Development Andragogy 1957  
(526) \*Risdiyono Risdiyono(Islamic University of Indonesia, Indonesia)
- WB1-2 A study for making standardized-work tables suited for enterprises of the engineering / 1962  
(139) metalworking industry  
\*Masahiro Shibuya(Tokyo Metropolitan University, Japan), Kenichi Iida(Hokkaido Research Organization, Japan), Koki Mikami(Hokkaido University of Science, Japan)
- WB1-3 "Implementation of methods and solutions for improving statistical thinking of non-English 1967  
(256) speaking students studying in Industrial Engineering field"  
\*Huy Nguyen, Huy Nguyen, Huy Nguyen(International University - Vietnam National University

WB1-4 (495)	<a href="#">Industrial Engineering Education using KAIST LEGO Manufacturing Systems (KLMS)</a> <i>*Young Jang, Vina Yosephine(KAIST, Korea), Sun Kyung Oh(Korea Advanced Institute of Science and Technology, Korea), Sukhyun Cho, Kiryong Kyeong(KAIST, Korea)</i>	1975
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### WB2 SCM and Forecasting 2

Biyang, 10:30-12:10

**Chair:** Kazuhiro Takeyasu (Tokoha University, Japan)

WB2-1 (52)	<a href="#">Improving Forecasting Accuracy in the Case of Intermittent Demand Forecasting</a> <i>Daisuke Takeyasu(The Open University of Japan, Japan), *Asami Shitara(Tax Corporation Arknet, Japan), Kazuhiro Takeyasu(Shizuoka City, Japan), Asami Shitara(Tax Corporation Arknet, Japan)</i>	1983
WB2-2 (36)	<a href="#">Reformation of Production System Based Upon Demand Forecasting</a> <i>hirotake yamashita(Chubu University, Japan), *Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1991
WB2-3 (87)	<a href="#">A Hybrid Method to Improve Forecasting Accuracy with An Application to the Data of Bread</a> <i>*Yuki Higuchi(Setsunan University, Japan), Hiromasa Takeyasu(Kagawa??? Junior??? College, Japan), Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1999
WB2-4 (413)	<a href="#">EXTENDED OPTIMAL REPLACEMENT POLICY FOR A TWO-UNIT SYSTEM UNDER CUMULATIVE DAMAGE MODEL</a> <i>*Shey-Huei Sheu, TZU-HSIN LIU(Providence University, Taiwan), ZHE-GEORGE ZHANG(Western Washington University, United States)</i>	2006

### WB3 Production Design & Management 2

Udo, 10:30-12:10

**Chair:** Masahiro Arakawa (Nagoya Institute of Technology, Japan)

WB3-1 (283)	<a href="#">The Implementation of Affective Based Product Design in Small Enterprise Manufacturers</a> <i>*Imam Widodo, Tio Sampurno(Islamic University of Indonesia, Indonesia)</i>	2007
WB3-2 (348)	<a href="#">A Study of Product Design Using Parts and Parts Structures Characterized by Reviews on Internet</a> <i>*Masahiro Arakawa, Eriko Katou(Nagoya Institute of Technology, Japan)</i>	2012
WB3-3 (350)	<a href="#">Derivation of design freeze sequence using Bayesian network framework</a> <i>Jihwan Lee, *Yoo Hong(Seoul National University, Korea)</i>	2018
WB3-4 (93)	<a href="#">Investigation of PLA/PCL biocomposite scaffolds fabricated via SVM rapid prototyping</a> <i>Kanokporn Kamonchit, *Thittikorn Phattanaphibul(Kasetsart University (Sriracha Campus), Thailand)</i>	2025
WB3-5 (84)	<a href="#">Assessment of an ERP Graphical User Interface Design Related to Human Cognition</a> <i>*Grace Lorrain Intal, Catherine Briones(Mapua Institute of Technology, Philippines)</i>	2031

### WB4 Scheduling & Sequencing 4

Chuja, 10:30-12:10

**Chair:** Katsumi Morikawa (Hiroshima University, Japan)

WB4-1 (329)	<a href="#">Simulation-based outpatient appointment scheduling with the aid of clearing function</a> <i>*Katsumi Morikawa, Katsuhiko Takahashi(Hiroshima University, Japan), Daisuke Hirotani(Prefectural University of Hiroshima, Japan)</i>	2040
WB4-2 (46)	<a href="#">Flexible Jobshop Scheduling Model Considering Production Cost and Tardiness Cost Simultaneously</a> <i>*Devvy Sari, Anas Ma'ruf(Institut Teknologi Bandung (Bandung Institute of Technology), Indonesia)</i>	2048
WB4-3 (403)	<a href="#">Batch Scheduling for a Single Machine with Forgetting Effect to Minimize Total Actual Flow Time</a> <i>Rinto Yusriski, *Sukoyo -(Bandung Institute of Technology, Indonesia), T.M.Agung Samadhi(Institut Teknologi Bandung, Indonesia), Abdul Halim(Industrial Engineering ITB, Indonesia)</i>	2055
WB4-4 (426)	<a href="#">Integrating Batch Production and Maintenance Scheduling on a Deteriorating Machine to Minimize Production and Maintenance Costs in Just in Time Environment</a>	2061

ZAHEDI \*(INSTITUT TEKNOLOGI BANDUNG, Indonesia), TMA Ari Samadhi, Suprayogi  
 .(Bandung Institute of Technology, Indonesia), \*Abdul Halim(Industrial Engineering ITB, Indonesia)

- WB4-5  
 (454) [Creation of Total Shift Scheduling Model in Restaurant Service -An Example of the Highly Classical Luxury Hotel Restaurant -](#) 2070  
 \*Kazuki Fujita, Kakuro Amasaka(Aoyama Gakuin University, Japan)

### WB5 Quality Engineering & Reliability

Ramada-3, 10:30-12:10

**Chair:** Rionel Caldo (Lyceum of the Philippines University - Laguna, , Philippines)

- WB5-1  
 (453) [Establishment of a New Vietnam Production Model](#) 2077  
 \*Shogo Miyashita, Kakuro Amasaka(Aoyama gakuin University, Japan)
- WB5-2  
 (508) [A taxonomy of failure rate indexes based on literature review](#) 2083  
sanghyeon koh(Pohang University of Science and Technology, Korea), kiwook jung, Bongjun Ji(Pohang university of science and technology, Korea), \*Hyunbo Cho(POSTECH, Korea)
- WB5-3  
 (270) [Comparative Study of SA algorithms of optimal arrangement problem in a Multi-state k-out-of-n:F system](#) 2090  
 \*Naoki Yoshida(Tokyo Metropolitan University, Japan), Koji Shingyochi(Jumonji University, Japan), Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)
- WB5-4  
 (517) [A New Universal Generating Function Method to Search for all Minimal Paths Generate in Networks](#) 2098  
 Wei-Chang Yeh(National Tsing Hua University, Taiwan), \*Hui-Wen Lee(National Tsing Hua University Hsinchu, Taiwan)
- WB5-5  
 (421) [Prioritizing the Factors for Quality Excellence Practices Using Analytic Hierarchy Process \(AHP\) Method](#) 2106  
 \*Mehran Doulat Abadi(Universiti Teknologi Malaysia (UTM), Malaysia), Sha'ri Mohd. Yusof(Universiti Teknologi Malaysia, Malaysia)

### WB6 Lean Manufacturing

Ramada-4, 10:30-12:10

**Chair:** Daniel Siek (Chung Yuan Christian University , Taiwan)

- WB6-1  
 (129) [LINEASSEMBLY ANALYSIS FOR PC-250 PRODUCT TYPE WITH HEURISTIC METHOD AT PT. TIRTA INTIMIZU NUSANTARA](#) 2107  
 \*Lina Gozali(Tarumanagara University, Indonesia), Silvi Ariyanti(University of Mercu Buana, Indonesia), Rendy .(University of Tarumanagara, Indonesia)
- WB6-2  
 (371) [Waste Reduction in Work Processes Using Lean Tools and Simulation: A Case Study Logistics Service Providers](#) 2113  
Worakit Changjutturas(Department of Industrial Engineering Faculty of Engineering of Khon Kaen University, Thailand), \*Panitarn Peerapattana(Department of Industrial Engineering Faculty of Engineering of Khon Kean University, Thailand)
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 (553) [A Framework to Apply Cellular Manufacturing](#) 2119  
 \*Wei Weng, Atsushi Fukui, Shigeru Fujimura(Waseda University, Japan)
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 \*Nestor Ong(University of Santo Tomas, Philippines), Patricia Kamil Kinol, Angela Camille San Miguel, Charlene Mae Ramirez(Faculty of Engineering, University of Santo Tomas, Philippines)
- WB6-5  
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 (47) [Measuring organizational performance by integrating competitive intelligence into decision support system](#) 2142

*\*Chi-Yen Yin(National Taiwan University, Taiwan)*

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POSTER-3 (166)	<a href="#">A Framework for Intelligent Condition Monitoring System using Knowledge Discovery in Databases</a> <i>Sedo Oh, *Young-jin Kim(Kyung Hee University, Korea)</i>	2156
POSTER-4 (204)	<a href="#">Ergonomically Designed Armchair for Both Left- and Right-Handed Students</a> <i>*Juan Tecson(Bulacan State University, Philippines)</i>	2159
POSTER-5 (220)	<a href="#">Scheduling outpatient appointments in a neurosurgery department of a university hospital</a> <i>Youngmin Ki, *Byung-In Kim(POSTECH, Korea), Byung Kwan Choi(School of Medicine Pusan National University, Korea), Sung-Hong Kang(Inje University, Korea)</i>	2165
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POSTER-9 (365)	<a href="#">A New approach in Fault Recognition using Mel Cepstrum Coefficients and Hidden Markov Models</a> <i>*Young Kim, Monica Chamay Castro(Kyung Hee University, Korea)</i>	2183
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POSTER-16 (435)	<a href="#">An improved quantum-behaved particle swarm optimization based multilayer perceptron classifier for medical data classification</a> <i>*Jui-Yu Wu(Lunghwa University of Science and Technology, Taiwan)</i>	2219
POSTER-17 (451)	<a href="#">Evaluating Credit Ratings Prediction by Using the Distance to Default and Data-mining techniques</a> <i>*Hsu-Che Wu, Wu Yu-Ting(National Chung Cheng University, Taiwan)</i>	2225
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POSTER-21 (527)	<a href="#">Can the ease of information retrieval change aesthetics judgments principle?</a> <i>*Wei-hao Yang, <u>Yu-Shan Chen</u>, Lien-ti Bei(National Chengchi University, Taiwan)</i>	2242
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# Shift-Scheduling Characteristic Identification of Non-Star Hotels Industry in Yogyakarta Indonesia

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**Abstract.** Shift arrangement in developing work schedule become classical problem faced by non-star hotel in Yogyakarta. They have to maintain their service well by keep the workforce in good performance and give competitive facilities in order to survive in increasing number of hotel in Yogyakarta. However, as well as other non-star hotel, they override the balance between the work load and the workforce well-being factor. Most of non-star hotel in Yogyakarta develop their work schedule base on subjective consideration of the officer who responsible to arrange the schedule. The objective of this research is to identify the shift scheduling characteristics of non-star hotel in Yogyakarta and the weaknesses effect of the schedule. Based on identified parameters of shift scheduling characteristic, there are 27 models of shift scheduling for Front Office Department, 19 models of shift scheduling for Housekeeping Department, and 16 models of shift scheduling for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta by considering the human factor to eliminate the weakness of the actual shift scheduling applied.

**Keywords:** shift scheduling, non-star hotel, characteristic identification

## 1. INTRODUCTION

Human resources are an important factor in hotel industry management since the workforce becomes a part of services that have direct interaction with the consumers. Requirement of operational time for 24 hours a day and 7 days a week is not in line with workforce availability in non-star hotel which limited by operational cost budget. Departments which operate for 24 hours, such as Front Office or Security, apply shift work which divided operational time into certain number of shifts. Available workforce is alternately assigned in each shift. Ideally, shift pattern assign to each workforce have to consider the balance between work load and working time duration, as well as family and social time needs. Therefore, the hotel management should be able to manage shift work schedule well in order to meet the workforce requirement according to the appointed standard, however still consider workforce

personal needs, such as between-days break time, on leave, and weekend off-day. Meeting the workforce requirement and workforce personal needs in workforce scheduling for hotel industry become important factor because it have direct impact on the service quality provided by the workforce. Workforce in hotel industry is charged always have a good performance, in both physical appearance and servicing. A bad arrangement in shift scheduling for the workforce in hotel industry may influence the workforce performance. Chiang *et al.* (2010) in their research have founded that job demands in hotel and catering industry are not necessarily stressful, particularly when employees have control over their job responsibilities and receive sufficient support from their organizations (e.g., work-life balance policies). It requires active support from the organization in utilizing human resource management strategies to increase the level of well-being at work. And one of work-life balance application in human resource management

strategies is flexible scheduling and work arrangements.

On the other hand, workforce scheduling has a significant proportion of operational cost in hotel industry. Payroll and related expenses are sometimes over 30% of the operating cost of a hotel. A reduction in this by even 1% represents considerable cost savings (Ernst *et al.*, 2004). So that staff scheduling in hotel industry become a complex problem to determine optimal solution that fulfill the staff requirement and minimize cost, meet the staff preferences, and distribute shifts equitably among staffs.

Limited financial resources and number of staffs owed by non-star hotel becomes additional constraint in developing the workforce schedule. Commonly they override the balance between working times and break time, even less family and social time needs. The resulting workforce schedule become inflexible due to limited workforce available while the workforce requirement is fixed even increasing in certain period, such as holiday or long week-end. Therefore, workforce schedule developing in non-star hotel should be compromise between workforce requirements, limited workforce available, and workforce personal needs, to obtain schedule that fulfill the workforce requirement.

However in developing the workforce schedule, non-star hotel sometimes override the balance between the work load and the workforce well-being factor, i.e. physiological, psychological, and psychosocial factor. Kroemer *et al.* (2001) stated that several researches have shown that statistically, workforce who work in shift more have health problems than workers who work in normal hours, morning to evening. They also experience negative psychosocial effects, which interfere their family activities and other social activities. Wright Jr. *et al.* (2013) have shown there are increasing evidences that indicates negative influence of shift-work schedules to worker physiology, health, and safety. Moreover, shift workers are at risk for shift work disorder (SWD), which is a circadian rhythm sleep disorder. This circumstance needs a management strategies include approaches to promote sleep, wakefulness, and adaptation of the circadian clock to the imposed work schedule. Shift work is also reported have negative effect in associated with increased work to family conflict (Halbesleben, 2009; Tuttle and Garr, 2012), as negative effect to social life (Loudoun, 2008).

Besides the negative effect for the workforce, shift work also reported has negative effect to the hotel organization itself. Lee *et al.* (2011) have found that hotel workers' overall job satisfactions are influence by their schedule flexibility satisfaction and the decreased turnover intent is a consequence of schedule flexibility satisfaction. The managerial approach offered for this circumstance is to arrange the work schedule as flexible as possible. Therefore, the work schedule developing in the form of a combination

of shift arrangements imposed on workforce who work with operating hours of 24 hours have to consider the balance of workforce physiological, psychological, and psychosocial factors.

Shift arrangement in developing work schedule also become classical problem that faced by non-star hotel in Yogyakarta. They have to maintain their service well by keep the workforce in good performance and give competitive facilities in order to survive in increasing number of hotel in Yogyakarta. As one of tourist destination in Indonesia, the tourism industry in Yogyakarta continues to develop. The tourism development in Yogyakarta also followed by the tourism supporting-facilities development, such as hotels, restaurants, souvenir shops, travel agencies, etc. One of the tourism supporting-facilities industries which are currently growing rapidly is the hotel industry. The development of hotel industry is shown by the increasing number of hotels in Yogyakarta. Data of Central Statistics Agency showed that the number of hotels in Yogyakarta increasing every year (Central Statistics Agency of Special District of Yogyakarta, 2013). Increasing number of hotels in Yogyakarta prosecute the hotels management to improve services provided as the competitiveness of their business.

Yogyakarta is famous as low cost with remain qualified tourist destinations so that there are many small scale hotel with low rates in Yogyakarta. Data of Ministry of Tourism and Creative Economy of Republic of Indonesia showed that in 2011 there are 42 star hotels and 1058 non-star hotels in Yogyakarta. The non-star hotels include the budget hotels, lodging, cottage, and other accommodation services (Ministry of Tourism and Creative Economy of Republic of Indonesia, 2013). In general, non-star hotels in Yogyakarta are professionally managed although they have limited resources, so that management must be capable in managing its limited resources to obtain quality and profit. However, as well as other non-star hotel, they override the balance between the work load and the workforce well-being factor. Most of non-star hotel in Yogyakarta develop their work schedule base on subjective consideration of the officer who responsible to arrange the schedule.

Therefore, we need a method that facilitates the management of non-star hotels in Yogyakarta for arranging work schedules of its workforce which use shift system. This scheduling method must consider the limited resources constraints, which is a major problem of the non-star hotel in Yogyakarta. The proposed scheduling methods should be easy to use and accessible by the hotel management, given its have various limitation. Hence, it is necessary to have software for helping the management in developing workforce scheduling that considering the balance between workload and the workforce well-being factor. The proposed workforce scheduling software will be

developed in on-line form (web-based), so it will be easy to be accessed and used by the non-star hotel management. The proposed web-based workforce scheduling software is expected to be a tool for the non-star hotel in Yogyakarta to manage its workforce in order to improve the quality of services provided to consumers.

This research is the first part of research in developing the web-based workforce scheduling software for the non-star hotel in Yogyakarta. The objective of this research is to identify the shift scheduling characteristics of non-star hotel in Yogyakarta and the weaknesses effect of the schedule. Hereinafter, the result of this research will be used for next research in developing the shift scheduling model which considering the balance between workload and workforce well-being and eliminate the weaknesses effect of the schedule.

## 2. RESEARCH METHODOLOGY

Data used in this research are obtained from observation using questionnaires to 35 Front Office Department, 25 House Keeping Department, and 21 Security Department of non-star hotel in Yogyakarta. The questions in the questionnaire are in form of open question, i.e.:

1. Managerial
  - a. Authority to develop the schedule
  - b. Schedule period
  - c. Starting time to develop the schedule
  - d. Dynamic or static schedule
2. Shift type
  - a. Number of shifts in 24 hours
  - b. Start and end times of each shift (overlapping or continuous)
3. Workday and off-day
  - a. Work-stretch and off-day
  - b. Consecutive day-off
  - c. Off-day allocation
  - d. Weekend-off consideration
  - e. National holiday replacement
4. Shift pattern allocation
  - a. Fixed shift pattern allocation
  - b. Cyclic shift pattern
  - c. Between-days break-time consideration
  - d. Shift allocation policy for female workforce
  - e. Workforce preference consideration
5. Managerial and technical reason in developing the schedule
6. Problem arising from the application of the schedule
  - a. Physical
  - b. Productivity
  - c. Relationship between workers
  - d. Social and family relationship

Data resulted from questionnaire then analyzed to identify the operational profile using question number 1 and 5, the parameters of the shift scheduling characteristics using question number 2 to 4, and the problem arise from the application of the schedule using question number 6. The analysis use hierarchical clustering in SPSS 15.0 to determine number of groups. In hierarchical clustering, we use between-groups linkage cluster method and squared-euclidean distance measure interval. Then we use K-means clustering in SPSS 15.0 to determine the group members. The method used is iterate and classify. As the input for number of clusters is result of hierarchical clustering in previous step.

## 3. RESULT AND DISCUSSION

### 3.1 Operational Profile

The data shows that the official worker that responsible in developing the schedule is the supervisor of the department. For a few number of workers, the supervisor of all the observed departments is given to one person, sometimes directed by the manager. The schedule period is for a week until a month and mostly the schedule is prepared 2 until 15 days in advance. The schedule is performed as static schedule, but in reality if there is incidental condition, the worker can deal with other worker to switch the shift allocated to him/her. This condition will not change the applicable schedule and should be approved by the supervisor.

### 3.2 Identification of Shift Scheduling Characteristics

The results of shift scheduling characteristic identification for non-star hotel in Yogyakarta are shown in the Table 1 to Table 3. The identified parameters of shift scheduling characteristic are:

1. Schedule period (A)
2. Number and type of shift in 24 hours (B)
3. Shift allocation (H)
4. Work-stretch and off-day pattern (F)
5. Shift allocation policy for female workforce (C)
6. Distinctive shift allocation (D)
7. Distinctive work-stretch (E)

Parameter of schedule period consists of a week (A1), 2 weeks (A2), 4 weeks (A3), or a month (A4). Number and type of shift is denoted by letter B followed 1 or 2 digit number. The first digit shows the number of shift in 24 hours, 1 for 1 shift, 2 for 2 shifts and so forth. Two digit numbers is just owned by 3 shifts, consists of continuous shift type denoted by 1 and 2 for overlapping. Continuous means that the starting time of a shift is equal to the end

time of previous shift. Overlapping shift type is for condition that starting time of a shift is a few hours before the end of the previous shift. It means there are a few hours that coincide between 2 consecutive shifts. For 3 shifts application, it may in form of continuous or overlapping, but for more than 3 shifts application, it absolutely in form of overlapping.

Table 1: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for Front Office Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter						
	A	B	H	F	C	D	E
FO1 (1)	A1	B31	H0	F3	C0	D0	E1
FO2 (1)	A1	B31	H32	F3	C2	D0	E0
FO3 (1)	A2	B32	H0	F0	C0	D0	E0
FO4 (3)	A4	B1	H11	F1	C0	D0	E0
FO5 (1)	A4	B1	H21	F5	C0	D0	E0
FO6 (1)	A4	B1	H51	F6	C0	D0	E1
FO7 (3)	A4	B2	H0	F0	C0	D0	E0
FO8 (1)	A4	B2	H0	F3	C0	D1	E0
FO9 (1)	A4	B31	H0	F0	C2	D0	E0
FO10 (1)	A4	B31	H0	F3	C2	D0	E0
FO11 (1)	A4	B31	H0	F0	C1	D0	E0
FO12 (1)	A4	B31	H0	F0	C1	D1	E0
FO13 (3)	A4	B31	H0	F0	C2	D0	E0
FO14 (2)	A4	B31	H0	F0	C2	D1	E0
FO15 (1)	A4	B31	H0	F0	C0	D0	E0
FO16 (1)	A4	B31	H0	F2	C2	D1	E0
FO17 (1)	A4	B31	H21	F2	C0	D0	E0
FO18 (1)	A4	B31	H22	F2	C2	D0	E0
FO19 (2)	A4	B31	H22	F2	C2	D1	E0
FO20 (1)	A4	B31	H22	F2	C2	D1	E1
FO21 (1)	A4	B31	H32	F3	C2	D0	E0
FO22 (1)	A4	B31	H32	F3	C0	D1	E1
FO23 (1)	A4	B32	H32	F3	C2	D1	E0
FO24 (1)	A4	B4	H0	F0	C2	D0	E0
FO25 (1)	A4	B4	H0	F3	C2	D0	E0
FO26 (1)	A4	B4	H0	F3	C2	D0	E1
FO27 (1)	A4	B4	H72	F7	C0	D0	E0

Shift allocation consists of 2 conditions, i.e. cyclic and non-cyclic. Cyclic condition means that shift allocation on the schedule forms a certain pattern that repeated for a fixed period. Inversely, there is no certain pattern of shift allocation in non-cyclic condition; the shift can differ for each worker or each period. Shift allocation parameter is denoted by letter H followed by 1 or 2 digits number. One digit number is only for non-cyclic condition using number 0. Cyclic condition uses 2 digit numbers. The first digit shows the code for the cyclic period, i.e. number 1 to 7 for

2 days, 3 days, 6 days, 7 days, 18 days, 2 weeks, 1 month, respectively. The second digit is denoted by 1 for the same shift pattern allocation for each worker, and 2 for different pattern allocation for each worker. The type of cyclic period in shift allocation should be relevant with pattern of work-stretch and off-day. In cyclic shift pattern, off-day is commonly placed at the end of period. Work-stretch and off-day pattern shows pattern of consecutive workday and off-day. This parameter is denoted by letter F followed by 1 digit number. Number 1 to 8 is for work-stretch and off-day pattern 1-1, 2-1, 5-1, 6-1, 7-1, 4-2, 13-1, 30-1, respectively. Number 0 following letter F means that no certain pattern for work-stretch and off-day.

Table 2: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for House Keeping Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter					
	A	B	H	F	C	D
HK1 (1)	A1	B4	H0	F4	C0	D1
HK2 (1)	A2	B2	H0	F0	C1	D0
HK3 (1)	A3	B31	H0	F0	C0	D1
HK4 (2)	A4	B1	H0	F0	C0	D0
HK5 (1)	A4	B1	H42	F4	C0	D0
HK6 (1)	A4	B1	H62	F7	C0	D0
HK7 (1)	A4	B2	H0	F0	C0	D0
HK8 (1)	A4	B2	H0	F5	C0	D1
HK9 (1)	A4	B2	H42	F3	C0	D0
HK10 (1)	A4	B3	H0	F3	C0	D1
HK11 (1)	A4	B3	H52	F3	C0	D0
HK12 (3)	A4	B31	H0	F0	C0	D0
HK13 (2)	A4	B31	H31	F3	C0	D0
HK14 (3)	A4	B31	H32	F3	C0	D0
HK15 (1)	A4	B32	H0	F3	C0	D1
HK16 (1)	A4	B32	H32	F3	C0	D0
HK17 (1)	A4	B32	H42	F4	C0	D0
HK18 (1)	A4	B4	H31	F6	C0	D0
HK19 (1)	A4	B5	H0	F3	C2	D0

For safety reason, hotels will apply particular shift allocation for female workforce. Shift allocation policy for female workforce parameter is denoted by letter C followed with 1 digit number. Number 1 shows that female worker is assigned for morning shift only, number 2 for female worker assigned in morning and evening shift, number 0 means there are no female worker. Distinctive shift allocation shows that for specific worker, as supervisor, senior worker, or casual worker, usually assigned in specific shift, different with other workers. It is also applies for distinctive work-stretch. Distinctive shift allocation and distinctive work-stretch parameter is denoted by letter D

and E, respectively, followed with number 0 or 1. Number 0 means there is no specific shift allocation or work-stretch for a specific worker and 1 for otherwise.

Data in the Table 1 to Table 3 shows that most of non-star hotel in Yogyakarta develop their workforce schedule for a month for all the 3 departments observed, even they use cyclic shift allocation with cyclic period less than a month. Schedule period of 4 weeks is different with schedule period of a month, because a month is not exactly equal with 4 weeks. End of period for 4 weeks schedule period may not coincide with end of period for a month.

Table 3: Shift Scheduling Characteristic of Non-Star Hotel in Yogyakarta for Security Department

Group (Number of Hotel)	Shift Scheduling Characteristic Parameter					
	A	B	H	F	C	E
SC1 (1)	A1	B31	H0	F4	D0	E0
SC2 (1)	A3	B2	H21	F2	D0	E0
SC3 (1)	A4	B1	H62	F7	D0	E0
SC4 (1)	A4	B2	H0	F6	D0	E0
SC5 (1)	A4	B31	H0	F0	D1	E0
SC6 (1)	A4	B31	H0	F3	D1	E0
SC7 (3)	A4	B31	H0	F4	D0	E0
SC8 (1)	A4	B31	H0	F4	D1	E0
SC9 (1)	A4	B31	H31	F3	D1	E1
SC10 (3)	A4	B31	H31	F3	D0	E0
SC11 (2)	A4	B31	H32	F3	D0	E0
SC12 (1)	A4	B31	H42	F4	D0	E0
SC13 (1)	A4	B32	H0	F0	D0	E0
SC14 (1)	A4	B4	H0	F0	D0	E0
SC15 (1)	A4	B4	H31	F3	D0	E0
SC16 (1)	A4	B4	H32	F3	D1	E1

For hotels labeled with B1 means that the hotels apply 1 shift for 24 hours. The worker will assigned for 24 hours a day during the work-stretch and will have off-day at the end of cyclic period for cyclic pattern application or any day with approval from the supervisor in advance for non-cyclic pattern. This condition results in the workers have long working hours. Data in Table 1 to 3 also show that there are hotels that have long cyclic period, 2 weeks to a month. Consequently, the worker will have long workday and one day-off every 2 weeks for 2 weeks cyclic period, instead one day-off every a month for monthly cyclic period.

The data in Table 1 to 3 shows that most of the hotels have no distinctive shift allocation and distinctive work-stretch. It is because most of non-star hotel in Yogyakarta have no hierarchy of positions between workers in Front Office, House Keeping, and Security Department. The

workers of three department observed are directly supervised by owner or workers who have responsibilities as general manager.

For each department observed, hotels having the same parameter of shift scheduling characteristic will be grouped into one group. Each of the group constitutes as a model of shift scheduling of non-star hotel in Yogyakarta. The grouping process is performed using cluster analysis in SPSS 15.0. We use hierarchical clustering to determine number of groups. The output of hierarchical clustering for Front Office Department data shows that there are bigger jump in step 8, then we deducted this value to number of data to get number of groups, i.e. 27 groups. This number of group is used in K-means clustering to determine members of group. The same procedure is applied for data of Housekeeping and Security Department. The result is there are 27 groups of shift scheduling model for Front Office Department, 19 groups of shift scheduling model for Housekeeping Department, and 16 groups of shift scheduling model for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta.

### 3.3 The Problem Arise from The application of The Schedule

Most of the workers of observed hotels reveal that there is no specific problem arises due to their schedule. However, the actual shift scheduling applied in observed hotels results in some of problems. The application of one shift in 24 hours causes the workers have long working hours. The working long hours may give negative impact on workers' health (de Castro *et al.*, 2010). The researchers have observed that there is relation between increased risk of injury with consecutive workdays and longer cumulative working hours (Hopcia *et al.*, 2012).

The shift pattern assignment applied in the observed hotels also results in weakness of short hours in between-shifts. Most of observed hotels have less than 15 hours in between-shift. For Front Office Department, there are 83% hotels have less than 15 hours in between-shift, 76% for Housekeeping Department, and 87% for Security Department. Short hour in between-shift results in quick return for working. This condition can lead insomnia, excessive sleepiness, excessive fatigue, and shift work disorder for the workers (Eldevik *et al.*, 2013; Di Milia *et al.* 2013).

The observed hotels also have weakness in assignment night shift in more than 2 consecutive days. The data shows that 49% of Front Office Department, 38% of Housekeeping Department, and 52% of Security Department have night shift more than 2 consecutive days.

Researchers have reported that working in consecutive night sleep may cause negative effect on psychomotor performance (Haire *et al.*, 2012). Working in night shift also may cause high cardiovascular risk (Esquirol *et al.*, 2011; Pimenta *et al.*, 2013; Haus & Smolensky, 2013), obesity (Antunes *et al.*, 2010; Chen *et al.*, 2010; Haus & Smolensky, 2013), and cancer (Haus & Smolensky, 2013).

The weaknesses founded in the applied shift scheduling of observed hotels become important element that have to be considered in developing the shift scheduling for non-star hotels in Yogyakarta for the next research. The development of shift scheduling in next research should be eliminate the weaknesses of the actual shift scheduling applied by considering the human factor to optimize human performance and well-being (Lodree, Jr. 2009)

#### 4. CONCLUSION

This research has been founded that shift scheduling used by non-star hotels in Yogyakarta has weaknesses of long working hours, short hours in between-shift, and night shift in more than 2 consecutive days. This research also results in mapping of shift scheduling characteristic of non-star hotels in Yogyakarta. Based on identified parameters of shift scheduling characteristic, there are 27 models of shift scheduling for Front Office Department, 19 models of shift scheduling for Housekeeping Department, and 16 models of shift scheduling for Security Department. These models will be the basis for next stage of the research in developing shift scheduling for non-star hotels in Yogyakarta by considering the human factor to eliminate the weakness of the actual shift scheduling applied.

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# Psychosocial and Physical Workload of Hotel's Shift Worker In Yogyakarta Indonesia

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**Abstract.** Shift works are common in hospitality industries, such as hotel industries. Shift work can cause many human problems for worker, e.g. circadian rhythms, fatigue, health effects, individual factors, social and family factors, etc. The objective of the present study was to identify and examine the psychosocial and physical workload on employees working as hotel's shift worker in Yogyakarta, Indonesia. Copenhagen Psychosocial Questionnaire (COPSOQ) which covers 18 aspects of psychosocial workload has been used as the instrument to measure psychosocial workload of hotel's shift workers. Physical workload was assessed based on rating of perceived exertion (RPE) Borg's Scale. The psychosocial and physical workload analysis was done to the employees of 3 departments of 20 hotels in Yogyakarta, i.e. front office, security and housekeeping. The results of the statistical analysis show no differences for both physical and psychosocial workload in morning shift and afternoon or night shift. There were also no differences for both physical and psychosocial workload of security staff, front officer and housekeeper. This study concludes with suggestions for hotels management in shift work arrangement, particularly for front office, security and housekeeping departments.

**Keywords:** shift work, psychosocial workload, physical workload, COPSOQ, RPE Borg's Scale

## 1. INTRODUCTION

Yogyakarta is one of tourist destination city in Indonesia. As a tourism city, the development of hospitality industries, particularly hotel industries continually increased. There were 54 star hotels and 1100 non star hotels in Yogyakarta by 2012 (Central Bureau of Statistics Special Province of Yogyakarta, 2012). The present study object was hotels' employees in Yogyakarta. The hotels' employees represent the most important critical success factor of services in hotel industries (Ivankovic & Jerman, 2010).

Shift work is popularly regarded as work in which employees shift schedules on some regular basis from day time to evening or night time (Finn, 1981). Normally, the term shift work is used to denote work schedules that divide the 24 hours into roughly similar sizes and that use three or more teams to provide full 24-hour coverage. The teams can alternate between early morning, afternoon (swing), and night shifts or may work a permanent shift (Akersted & Wright, 2009). Shift work are common in

service sector demands, such as hotel industries. In the service sector there are many types of job where people are needed around the clock (Helander, 2006). From the results of established research it has become well known that shift work can lead to many human problems for worker, e.g. productivity, safety, health, family life, and social life (Nielsen, Garde, Albertsen, & Diderichsen, 2011; White & Bruce, 1990; Hemamalini, Priyadarshini, & Saravanan, 2013; Guo, et al., 2013; Grosswald, 2004; Harrington, 2001; Hanna, 2008).

Employee performance is one of emphasized topic in the hospitality context. Physical and psychosocial are factors contributing to employee performance (Green & Taylor, 2008). The factor associated with musculoskeletal problems is physical factor. The psychosocial factor is associated with the way individuals interact with the demand of their job and their environment. Several studies examine the evidence for physical and psychosocial workload at work (Unge, et al., 2007; Kausto, et al., 2011; Shan, 2012)

The objective of the present study was to identify and

examine the psychosocial and physical workload on employees working as hotel's shift worker in Yogyakarta, Indonesia.

## 2. METHODOLOGY

Physical and psychosocial workload was assessed in shift workers of 20 hotels in Yogyakarta. The sample consists of 3 groups, i.e. (1) shift worker working as front officer (FO), (2) shift worker working as security staff (S), and (3) shift worker working as housekeeper (HS). The data was collected for two shifts in each hotel, morning shift (MS) and afternoon or night shift (A/NS).

### 2.1 Physical Workload Assessment

Physical workload was assessed based on rating of perceived exertion (RPE) Borg's Scale. Subjects were measured the heart rate before and after performing the task. The maximum heart rate data was recorded. Heart rate measurement of 60 to 200 beats per minute corresponding to the RPE scale from 6 to 20. Table 1 shows the RPE scale and interpretation of rating.

Table 1: The Borg RPE Scale (Bridger, 2003)

Rating	Interpretation of Rating
6	No exertion et all
7	
8	Extremely light
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very Hard
18	
19	Extremely hard
20	Maximal exertion

### 2.2 Psychosocial Workload Assessment

Copenhagen Psychosocial Questionnaire (COPSOQ) has been used as the instrument to measure psychosocial workload of hotel's shift workers. The COPSOQ has been developed and validated by Kristensen and Borg of the Danish National Institute for Occupational Health in Copenhagen (Pejtersen, Kristensen, Borg, & Bjorner, 2010).

The Indonesian version COPSOQ short size was developed by translation of the English version questionnaire (Kristensen & Borg, 2003) into Indonesian.

The short version COPSOQ covers 18 aspects to measure psychosocial demands at job environment and consists of 44 numbers of questions. Table 2 presents the list of COPSOQ scale and number of question for each scale. The questions have five response options which are weighted: 0, 25, 50, 75, and 100. The scale value is calculated as the simple average.

Table 2: COPSOQ Scale and Number of Questions (Kristensen & Borg, 2003)

Scale	Number of questions
Quantitative demands	3
Emotional demands	2
Demands for hiding emotions	1
Influence at work	3
Possibilities for development	2
Degree of freedom at work	1
Meaning of work	2
Commitment to the workplace	2
Predictability	2
Quality of leadership	2
Social support	2
Feedback at work	2
Sense of community	2
Insecurity at work	4
Job satisfaction	4
General health	1
Mental health	5
Vitality	4

### 2.3 Statistical Analysis

Statistical analysis was involved descriptive analysis, *t*-test and analysis of variance (ANOVA). Descriptive analyses were carried out in order to obtain range, means and standard deviations of RPE and COPSOQ scales. Student's *t*-tests were used for the comparisons of two means workload in morning shift (MS) and afternoon or night shift (A/NS). ANOVA were carried out in order to compare means of physical and psychosocial workload of security staff, front officer and housekeeper. The variety of tests led to the establishment of significance at  $p < 0.05$ .

Table 3: COPSOQ Score of Hotel’s Shift Worker

HOTEL	H1		H2		H3		H4		H5		H6		H7		H8		H9		H10	
SHIFT	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS
S	71.02	55.11	74.43	72.1	64.20	75.00	47.16	65.34	69.32	64.77	60.80	67.61	69.89	63.64	70.45	69.89	67.61	64.20	69.3	68.18
FO	65.91	69.89	77.84	65.91	77.84	67.05	64.77	63.64	76.70	70.45	71.59	79.55	67.61	76.14	67.05	71.02	64.20	65.34	64.20	72.73
HS	67.05	73.86	67.05	60.23	65.91	63.64	63.07	48.86	71.59	68.18	77.84	58.52	65.91	67.05	72.16	68.75	58.52	72.16	71.02	68.75
HOTEL	H11		H12		H13		H14		H15		H16		H17		H18		H19		H20	
SHIFT	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS
S	63.07	75.57	74.43	78.98	74.43	68.18	68.75	65.34	57.39	60.23	63.07	60.23	77.84	75.57	60.80	58.52	78.41	73.30	84.09	77.27
FO	60.23	68.18	69.89	77.27	69.32	67.61	71.02	75.57	68.75	67.61	60.23	64.77	64.20	69.32	69.89	73.86	64.20	73.30	81.82	62.50
HS	73.86	68.18	68.18	67.05	58.52	72.16	71.02	71.02	61.93	68.75	71.59	65.34	75.00	65.91	66.48	70.45	53.41	56.82	75.57	78.98

MS: Morning Shift ; ANS: Afternoon/Night Shift ; S: Security Staff ; FO: Front officer ; HS: Housekeeper

### 3. RESULTS

Table 3 shows the COPSOQ score of observed hotels’ shift worker which represent the psychosocial workload and Table 4 shows the RPE which represent the physical workload. The statistical data of student *t*-test of RPE and COPSOQ score is presented in Table 5, while the one of ANOVA is presented in Table 6.

Descriptive data of RPE shows the lowest RPE is 6.1 (security staff, morning shift), means no exertion et all. The highest RPE is 10.8 (housekeeper, morning shift), means light physical workload (see Table 1). The range of COPSOQ scale is from 0 to 100, which higher scale is positive (lower level of psychosocial workload). The scale is classified into 5 classes: very heavy (0-20), heavy (>20 – 40), moderate (>40 – 60), light (>60 -80) and very light (>80 – 100). Descriptive data of COPSOQ scale shows the lowest scale is 47.16 (security staff, morning shift), means moderate psychosocial workload. The highest COPSOQ scale is 84.09 (security staff, morning shift), means very light psychosocial workload.

A two-sample student’s *t*-test assuming equal variances using a pooled estimate of the variance was performed to test the hypothesis that the resulting mean RPE and COPSOQ scale for morning shift and afternoon or night shift were equal. The mean RPE of security staff who working in MS and A/NS were not significantly different,  $t(37) = 0.30579, p = 0.129$ . The mean RPE of front officer who working in MS and A/NS were not significantly different,  $t(38) = -0.0300, p = 0.453$ . The mean RPE of housekeeper who working in MS and A/NS were not significantly different,  $t(38) = 0.0700, p = 0.403$ . The mean

COPSOQ score of security staff who working in MS and A/NS were not significantly different,  $t(38) = -3.1305, p = 0.208$ . The mean COPSOQ score of front officer who working in MS and A/NS were not significantly different,  $t(38) = -1.2225, p = 0.236$ . The mean COPSOQ score of housekeeper who working in MS and A/NS were not significantly different,  $t(38) = 1.0510, p = 0.307$ .

One way ANOVA was performed to test the hypothesis that the resulting mean RPE and COPSOQ scale for security staff, front officer and housekeeper were equal. The mean RPE of S, FO and HS who working in morning shift were not significantly different  $F(2,56) = 2.164, p = 0.887$ . The mean RPE of S, FO and HS who working in afternoon or night shift were not significantly different  $F(2,57) = 0.909, p = 0.224$ . The mean COPSOQ scale of S, FO and HS who working in morning shift were not significantly different  $F(2,57) = 0.120, p = 0.124$ . The mean COPSOQ scale of S, FO and HS who working in afternoon or night shift were not significantly different  $F(2,57) = 1.537, p = 0.409$ .

Table 4: RPE of Hotel’s Shift Worker

HOTEL	H1		H2		H3		H4		H5		H6		H7		H8		H9		H10	
SHIFT	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS
S	6.1	10.3	10.7	8.9	8.9	7.5	8.6	8.8	8.8	8.6	9.5	8.5	8.9	7	8.8	8.1	8.6	7.7	8.2	8.4
FO	7.6	6.9	7.3	8.7	8.2	8.5	8.5	9.6	10	6.6	7.1	7	8.8	7.8	8.3	8.2	7.9	7.5	7.9	7.6
HS	6.3	8.7	9.5	7.7	8.5	9.2	7.7	9.6	8.8	8.9	8.7	7.8	8	8.8	8.1	9.2	8.2	9.1	10.8	6.9
HOTEL	H11		H12		H13		H14		H15		H16		H17		H18		H19		H20	
SHIFT	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS	MS	ANS
S	8.6	8	7.3	6.4	8.4	8.6	-	7.3	8.7	9	6.6	6.6	8.9	8.4	9.1	9.6	10	9.7	9	9.1
FO	8.6	8.4	7.1	7.4	7.9	8.7	8	7.8	8.9	8.2	6.8	7.7	7.8	9.9	7.7	8.8	7.9	8.5	8.2	7.3
HS	8.8	8.9	8.1	7.4	9.9	8.2	8.2	7.8	9	8.6	7.6	7.8	6.9	7.3	9.5	9.2	8.4	8.4	8.8	8.9

MS: Morning Shift ; ANS: Afternoon/Night Shift ; S: Security Staff ; FO: Front officer ; HS: Housekeeper

Table 5: Statistical Data of Student *t*-Test

Worker	RPE			COPSOQ score		
	df	Mean diff.	<i>p</i> value	df	Mean diff.	<i>p</i> value
S	37	0.30579	0.129	38	-3.1305	0.208
FO	38	-0.0300	0.453	38	-1.2225	0.236
HS	38	0.0700	0.403	38	1.0510	0.307

#### 4. DISCUSSION

The physical workload of all workers in observed hotels showed in low level. It means no significant physical exposures for security staff, front officer and housekeeper in observed hotels. This condition induces low risk in musculoskeletal disorders for hotels’ employees. It was dissimilar condition for psychosocial workload of observed hotels’ shift workers. There were many hotel’s shift workers who had moderate level of psychosocial workload (COPSOQ scale >40 – 60). It showed that there were a little problems in the way individuals interact with the demands of their job and their work environment. Psychosocial risk factors need to be more considered and addressed than physical factors in order for organisations to prevent and manage worker performance.

This study showed that no differences for both physical and psychosocial workload in morning shift and afternoon or night shift for observed hotels’ shift workers. Furthermore, there were also no differences for both physical and psychosocial workload of security staff, front officer and housekeeper. The ability to learn was, therefore, equal in physical and psychosocial workload for observed

hotels’ shift workers and all shift schedules.

All observed hotels in this research, applied rotation strategy in their shift allocation policy. By this strategy, workers did not work in permanent shift time, but in varies shift time. This strategy is also familiar for most hotels in Yogyakarta. The rotation strategies that applied were varied among observed hotels. No observed hotels applied permanent shift allocation policy in scheduling. Previous research revealed that permanent shifts impaired cognitive and psychomotor performance of worker (Petru, Wittmann, Nowak, Birkholz, & Angerer, 2005) and rotating shift give positive effect on performance (Muecke, 2005). This is in accordance with the findings of this research that both physical and psychosocial workload were in relatively good level (the maximum mean of RPE = 8.616 and the minimum mean of COPSOQ scale = 66.7330) owing no permanent shifts applied among observed hotels. Furthermore, the rotation strategies in shift allocation rendered no differences of physical workload among jobs and between morning and night shift. The equal condition also occurred in psychosocial workload.

This research found that different shift time (MS and A/NS) showed equal physical and psychosocial workload for all observed job (S, FO and HS). Most hotels in Yogyakarta take on costumer check in and check out every time. There is no specific pattern of costumer departure and arrival. There is also no specific pattern of work intensity in all departments. All workers in varies job should give services every time for hotel’s costumer. So, even if the job description and shift time are different, the workloads are equal.

Table 6: Statistical Data of ANOVA

SHIFT	WORKER	RPE						COPSOQ Scale					
		MEAN	S.D	RANGE	df	F value	p value	MEAN	S.D	RANGE	df	F value	p value
MS	S	8.616	1.0563	6.1 – 10.7	2 56	2.164	0.887	68.3240	8.34304	47.16 – 84.09	2 57	0.12	0.124
	FO	8.025	0.7290	6.8 – 10.0				68.8630	5.94385	60.23 – 81.82			
	HS	8.494	1.0111	6.3 – 10.8				67.7840	6.34326	53.41 – 77.84			
A/NS	S	8.325	1.0244	6.4 – 10.3	2 57	0.909	0.224	67.9545	6.70447	55.11 – 78.98	2 57	1.537	0.409
	FO	8.055	0.8605	6.6 – 9.9				70.0855	4.77675	62.50 – 79.55			
	HS	8.420	0.7592	6.9 – 9.6				66.7330	6.68114	48.86 – 78.98			

The findings of this research become an important thing in shift scheduling of hotel management in Yogyakarta. In general, rotation strategy in shift scheduling give positive effect to physical and psychosocial workload of hotel’s shift worker in Yogyakarta.

**5. CONCLUSION**

In conclusion, this study identified that physical and psychosocial workload of hotels’ shift worker in Yogyakarta relative in good level. The rotation strategy in shift allocation give positive effect to physical and psychosocial workload of hotels’ shift worker in Yogyakarta.

There was no specific work intensity pattern in security, front office and housekeeping departments of Yogyakarta’s hotels. Both physical and psychosocial factors were equal in these three departments.

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