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Welcome Message

Dear participants,

A very warm welcome to you to the 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2017) to be held from 10-13 December 2017 in Singapore.

Some eleven years ago, the first IEEM was held in Singapore in 2007. We were encouraged by the support and enthusiasm of our colleagues in Asia and had organized the conference every year without fail since then. It has grown into a high-quality conference in the fields of industry engineering and engineering management, with participants from all corners of the world. For this we are very gratefully to authors, reviewers, participants, and also our co-hosts in Hong Kong, Macau, Bali, Bangkok, Kuala Lumpur during this period. We can now confidently say that IEEM brings together the community's most innovative thinkers and dynamic researchers from around the world to share the latest research findings in industrial engineering and engineering management.

This year, IEEM2017 received nearly 1000 submissions from more than 50 countries. As in the past, each paper was sent to at least three reviewers. The acceptance decisions were based on at least two consistent recommendations, ensuring the quality and standard of the conference. These papers, organized around 20 topics, will be presented in oral and poster sessions. We are also privileged to have with us two distinguished speakers to deliver the keynote presentations:

Professor Andy Neely, Pro-Vice Chancellor, University of Cambridge, United Kingdom, will present on "Rethinking Operations Strategy in an Age of Digital Manufacturing".

Professor Benjamin W. Wah, Provost and Wei Lun Professor, Chinese University of Hong Kong, Hong Kong SAR, will discuss on "Using Kernels to Harness the Complexity of Big Data."

We are also honored to have Professor Jianjun Shi, editor-in-chief of IISE Transactions, who is also the Carolyn J. Stewart Chair and Professor at the H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, to run a workshop on "How to Publish in Top Journals".

We would like to thank all authors and participants for their interests, contributions and continued support to IEEM. Lastly, we are also grateful to the technical program committee members and reviewers for their help in the review process.

Have a fruitful conference, and we hope that you will enjoy the cultural experiences of Singapore.

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Conference Program

*Subject to change without notice

Sunday, 10 December 2017 SUNTEC Singapore, Level 3										
Venue	**Gather at SUNTEC Big Screen, Level 1**									
09:00 - 13:00	**"Pre-Conference Tour "Singapore Ethnic Treasures"** (Requires Advance Booking)									
Venue	**Foyer 5**									
13:00 - 17:00	**Registration**									
Venue	**MR334**									
13:30 - 15:30	**Workshop** (Requires Advance Booking) **"How to Publish in Top Journals"** **Jianjun SHI** - *Carolyn J. Stewart Chair and Professor, H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology*									
15:30 - 15.40	**General Chair's Welcome** **Arnoud DE MEYER** - *IEEM2017 General Chair* *President, Singapore Management University, Singapore*									
15:40 - 17:00	**Welcome Reception**									
Monday - 11 December 2017 SUNTEC Singapore, Level 3										
Venue	**Foyer 5**									
08:00 - 17:30	**Registration**									
08:30 - 09:00	**Morning Refreshments**									
Venue	**Summit 2**									
09:00 - 09:15	**IEEM2017 Opening**									
09:15 - 10:00	**Keynote 1** **"Rethinking Operations Strategy in an Age of Digital Manufacturing"** **Andy NEELY** - *Pro-Vice Chancellor, University of Cambridge, United Kingdom*									
10:00 - 10:45	**Keynote 2** **"Using Kernels to Harness the Complexity of Big Data"** **Benjamin W. WAH** - *Provost and Wei Lun Professor, The Chinese University of Hong Kong, Hong Kong SAR*									
Venue	**Nicoll 1-2**									
10:45 - 11:15	**AM Coffee/Tea Break**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
11:15 - 12:45	Healthcare Systems and Management 1	Big Data and Analytics 1	Operations Research 1	Engineering Education and Training 1	Intelligent Systems	"Meet-the Editors" Panel Session	Supply Chain Management 1	Information Processing and Engineering 1	Production Planning and Control 1	Project Management 1
Venue	**Nicoll 1-2**									
12:45 - 13:45	**Lunch**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
13:45 - 15:15	Healthcare	Big Data and	Operations	Engineering	Human	Systems	Supply Chain	Information	Production	Project

	Systems and Management 2	Analytics 2	Research 2	Education and Training 2	Factors 1	Modeling and Simulation 1	Management 2	Processing and Engineering 2	Planning and Control 2	Management 2

Venue	Nicoll 1-2									
15:15 - 15:45	**PM Coffee/Tea Break**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
15:45 - 17:30	Reliability and Maintenance Engineering 1	Service Innovation and Management 1	Operations Research 3	Technology and Knowledge Management 1	Human Factors 2	Systems Modeling and Simulation 2	Supply Chain Management 3	Decision Analysis and Methods 1	Manufacturing Systems 1	Quality Control and Management 1

Tuesday - 12 December 2017
SUNTEC Singapore, Level 3

Venue	Foyer 5									
08:00 - 18:30	**Registration**									
08:30 - 09:00	**Morning Refreshments**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
09:00 - 10:45	Reliability and Maintenance Engineering 2	Service Innovation and Management 2	Operations Research 4	Technology and Knowledge Management 2	Human Factors 3	Systems Modeling and Simulation 3	Supply Chain Management 4	Decision Analysis and Methods 2	Manufacturing Systems 2	Quality Control and Management 2
Venue	**Nicoll 1-2**									
10:45 - 11:15	**AM Coffee/Tea Break**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
11:15 - 12:45	Reliability and Maintenance Engineering 3	Service Innovation and Management 3	Operations Research 5	Technology and Knowledge Management 3	Safety, Security and Risk Management 1	Systems Modeling and Simulation 4	Supply Chain Management 5	Decision Analysis and Methods 3	Manufacturing Systems 3	Quality Control and Management 3
Venue	**Nicoll 1-2**									
12:45 - 13:45	**Lunch**									
13:45 - 15:30	**Poster Setup**									
Venue	**MR308**	**MR309**	**MR327**	**MR328**	**MR329**	**MR330**	**MR332**	**MR333**	**MR334**	**MR335**
13:45 - 15:30	Reliability and Maintenance Engineering 4	E-Business and E-Commerce	Operations Research 6	Technology and Knowledge Management 4	Safety, Security and Risk Management 2	Systems Modeling and Simulation 5	Supply Chain Management 6	Decision Analysis and Methods 4	Engineering Economy and Cost Analysis	Project Management 3
Venue	**Nicoll 1-2**									
15:30 - 16:00	**Closing & Award Presentation**									
16:00 - 18:00	**Poster Session & Chill-Chat-Connect!**									
18:00 - 18:30	**Poster Teardown**									

Venue	**The Edge, Pan Pacific Hotel**
18:30 - 22:00	**Conference Dinner - 18:30 to 20:30** **Open Top Bus Experience - 20:30 to 22:00** Ticketed Event - 1 Ticket Admits ONE Person Only"
Wednesday - 13 December 2017	
Venue	**Gather at SUNTEC Big Screen, Level 1**
08:30 - 13:00	**Advanced Remanufacturing and Technology Centre (ARTC) and Air Traffic Management Research Institute (ATMRI) Technical Visit** (Requires Advance Booking)

Library Facility Layout Design for Digital Native Generation

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Abstract – **Digital native generation grows up with information technology attached to their daily life. This advantage changes their way to find information, only with one click they have all the answers in their gadget. This situation effect library that used to be the source of information, numbers of library visit has been reduced significantly in the last century. Therefore library needs basic changes to accommodate digital native generation. Library needs to facilitate their need by repositioning itself as a community hub, a place to meet, interact, learn and collaborate.**

Anish I and Arish Ibrahim (2014), propose to use Systematic Layout Planning (SLP) to design library facility layout. The purpose is to maximize the satisfaction of employee, management, and library users. This paper gives the framework for systematic layout planning but has not applied it using computer simulation tool such as CRAFT.

Research is conducted to four universities owned libraries in Surabaya, Indonesia. Two from state universities and another two from private universities. A heuristic improvement algorithm CRAFT (Computerised Relative Allocation of Facilities Technique) will be applied to re-layout library facilities. Adjustment to each facility will also be done and as the result, new library facility layout will be more suitable to meet digital native generation needs. The implication of this adjustment is additional investment in new facilities and repositioning current layout.

Keywords – **Digital native, facility layout, library**

I. INTRODUCTION

One of the traits of digital native generation is they are always connected to the internet. They are born after 1994 [1] and grew up with information technology attached in their daily life [2,3]. This advantage changes their way to find information, only with one click they have all the answers.

Library for centuries has always been the source of information for society. Information kept in form of books, manuscripts, newspapers, maps, films, CD, DVD, e-books, and other formats. Public and institutional library is organized to serve the needs of information sourcing and maintaining collections, but nowadays numbers of library visits have been reduced. Research has been done to know factors which affect students visit libraries in Surabaya [4].

There are 5 latent factors in Library Quality: *Personal Control* (PC), *Information Access* (IA), *Library as a Place* (LP), *Affect of Service Personal* (ASP), *Affect of Service Organizational* (ASO). The most important factor in a library for digital native generation is information access, but the number of library visit will not increase even when all library quality is fulfilled. Therefore library need basic changes to accommodate digital native generation [5,6].

There are three pillars of a modern academic library: technology as the basic element, space and service. The main function of a modern library in the user-driven model is to educate their user, not just providing service. Research also has been done to explore Digital Native Generation needs and wants, and also more detail understanding of stakeholders goals.

Actions need to be taken to increase library visitor, especially from digital native generation. Library needs to facilitate their need by repositioning itself as a community hub, a place to meet, interact, learn and collaborate. Research also has been done to know which facility need to be prioritized to achieve this goal. Digital native generation want the library to have extensive book collections (physical and digital), good wifi connection, ease of access to online collections, comfortable place with discussion rooms, and friendly helpful staff [7].

Anish I and Arish Ibrahim [8], propose to use Systematic Layout Planning (SLP) to design library facility layout. The purpose is to maximize the satisfaction of employee, management, and library users. This paper gives the framework for systematic layout planning but has not applied it using computer simulation tool such as CRAFT.

II. METHODOLOGY

There are many procedures has been developed to solve facility layout problem, and they can be classified as optimal algorithms and heuristic algorithm. Optimal algorithm requires high memory and computer time, but heuristic algorithms produce good enough result but with less resource. Heuristic algorithms for facility layout problems can be divided into: construction, improvement, and hybrid algorithms. Construction algorithms are used to generate new facility by adding facility one by one to an empty location. Improvement algorithm systematically modifies the starting solution and evaluate the result every iteration until no better solution can be found. The quality of improvement algorithm final result depends on starting solution. Therefore hybrid algorithms try to find better solution by combining construction and improvement algorithms [9].

CRAFT (Computerised Relative Allocation of Facilities Technique) originally developed by Armour and Buffa in 1963. CRAFT start the algorithm with initial layout and switch departments pairwise to minimize transportation cost. The result will be close to optimum but the algorithm will not check all possible department switching to find the improved layout, therefore CRAFT can be considered as heuristic improvement algorithm.

CRAFT algorithm requires dimensions of the building and departments to arrange, initial layout, transportation or flow between departments, and departments restrictions. This research will use ARC (Activity Relationship Chart) to show importance level between departments, and the result will be used as replacement for flow between department. Departments with high importance level will be weighted higher so they can be placed closer in the improved layout.

$$\sum_{k=1,k\neq l,k\neq j}^{n} f_{ik}d_{ik} + \sum_{k=1,k\neq l,k\neq j}^{n} f_{jk}d_{jk} - \sum_{k=1,k\neq l,k\neq j}^{n} f_{jk}d_{ik} - \sum_{k=1,k\neq l,k\neq j}^{n} f_{ik}d_{jk}$$

CRAFT switch facilities to minimize total momentum. Let i and j be the two facilities that will be switched. Where d_{ij} is the distance between the facilities, and f_{ij} is the flow or importance between facilities. The switching process will be repeated for all n facilities. Calculation for CRAFT algorithm in this research use Microsoft excel facility layout add-in [10].

Final improved layout from CRAFT algorithm will be validated and adjusted to meet digital native generations needs who used these library facilities. The previous study indicates that these generations need a comfortable place to meet, interact, learn and collaborate while continuously connected to the internet. Library needs to repositioning themselves as a community hub for digital native generations, although this may seems to contradict to library main purpose as the center of knowledge and information.

III. RESULTS

This research is conducted to four university owned library in Surabaya, Indonesia. Two from state universities, Institute Technology of Sepuluh Nopember (ITS) and Universitas Pembangunan Nasional (UPN).Another two from private universities, Petra Christian University (PCU) and University of Surabaya (UBAYA). The previous study in these libraries indicates that most of them already have the facilities which needed by digital native generations, but the placement is not arranged properly. They need facilities like wifi zone, reading and discussion rooms, computers with internet connections, digital and physical collections, online catalog and library website, electrical plugs and air conditioning area.

All four libraries for the case study have similarities, they are situated in more than two floors with each floor has a specific function. Basic function area in libraries is: administration area, books collection area, audio visual area, and reading/discussion area. Library total area is often limited but the number of non-digital collections continues to grow each year which causes library area to be dominated by book shelves. New facilities are placed in an available spare area inside the library. Current library layout consists more of book shelves and traditional tables and chairs for reading.

Table 1.
Library Facilities for Digital Native Generation

Digital Native Generation	PCU	UBAYA	UPN	ITS
Wi-fizone	v	v	v	v
Relaxing reading rooms	v	v	v	v
Discussion rooms	x	x	v	v
Computers with internet access	v	v	v	v
Non-digital collections	v	v	v	v
Digital collections	v	v	v	v
Tables and chairs	v	v	v	v
Onlinecatalogue/ library website	v	v	v	v
Electrical plug	v	v	v	v
Air Conditioner	v	v	v	v
Librarian	v	v	v	v

Fig. 1. PCU's Library 7th floor current condition

All four libraries for the case study have similarities, they are situated in more than two floors with each floor has specific function. Basic function area in libraries are: administration area, books collection area, audio visual area, and reading/discussion area. Library total area are often limited but the number of non-digital collections continue to grow each year which cause library area to be dominated by book shelves. New facilities are placed in available spare area inside the library. Current library layout consist more of book shelves and traditional tables and chairs for reading.

Initial library layout is gathered by measuring each facility dimension and surveying their functions. A deeper discussion is also conducted with the librarian in each library to determine importance level of each facility through the Activity Relationship Chart. These information needed to find new layout using CRAFT algorithm.

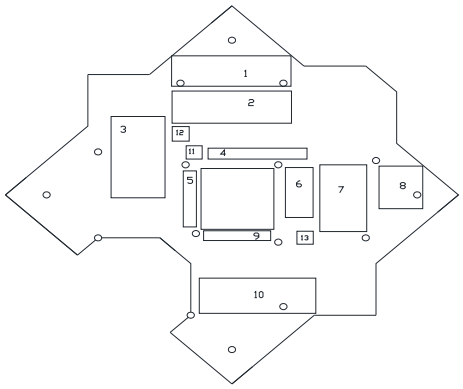

Fig. 2. PCU's Library 7th floor initial layout

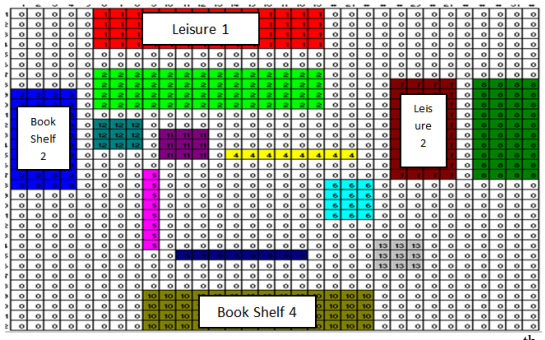

Fig. 3. CRAFT initial layout for PCU's Library 7th floor

CRAFT algorithm exchange facilities in initial layout to minimize the momentum which measured from distance and importance level of each facility. Exchange will be done for facilities with similar size, in an example in fig. 3 for bookshelf 2 and 4, also for Leisure 1 and 2. The initial layout of the library put leisure 1 area behind the book shelf and leisure 2 far from the stairs. Leisure area is needed by digital native generation to spend time in a library, but currently, it is not strategically placed. As the result, not all visitor know there are leisure area in the 7th floor or reluctant to use it. Leisure area in 7th floor consists of carpeted space with comfortable bean bags and sofas.

The final result of the CRAFT algorithm move leisure1 and leisure2 area closer to the stair access to the 7th floor. Book shelves are moved farther because they are still reachable for visitors who want to look or borrow the collections. In the future library non-digital collections also going to be replaced with digital ones.

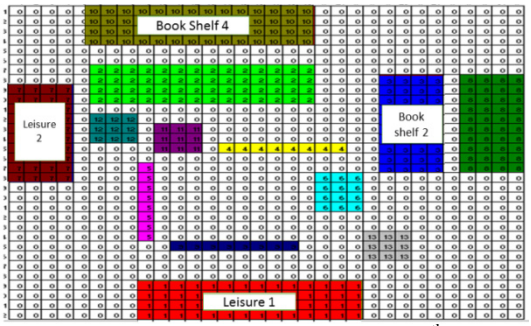

Fig.4. CRAFT result for PCU's library 7th foor

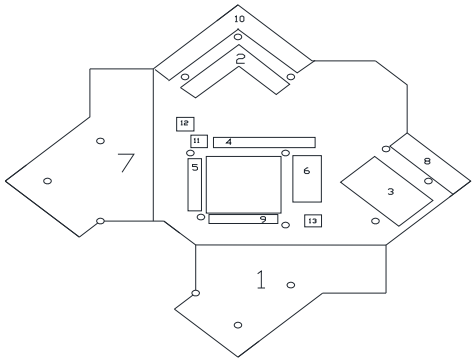

Fig. 5. PCU's Library 7th floor final layout

The process to facility re-layout using CRAFT algorithm also done for other floors in PCU's library and also for other three libraries which is used in the case study. Not all result significantly different final layout from its initial ones. This is due to the initial layout or current facilities in all four libraries already considering digital native generation needs.

Adjustments are still needed after CRAFT algorithm re-layout process. There are many constraints especially in building shapes that cannot be accomodated by CRAFT. Facility adjustment also can be done to improve the function. The traditional reading area with table and chair can be adjusted to becoming leisure area with sofas and bean bags.

IV. DISCUSSION

Library re-layout and adjustment for four libraries in Surabaya focus to make these facilities easier to access by digital native generation. A facility like leisure area, discussion room, reading area with chairs and tables, computer with internet connection, audio visual room, and theater are needed by digital native generation. Book shelves and administration area are moved back farther.

Table.2. also shows that there are no significant differences for re-layout and adjustment between a public university and a private university. Libraries in this research already improve their facilities from time to time to meet digital native generation needs. Although the number of visits to library still decreasing every year.

The implication of this library facility layout adjustment is additional investment in new facilities and repositioning current layout. Many traditional libraries are full of shelves and book collections. It will require a lot of effort to reduce or change these collections into a digital one. The library also required providing more open space for leisure with internet connections.

Findings from EunYoung Yoo-Lee, Tae Heon Lee, and LaTesha Velez in 2013 [11] shows that millenials undergraduate students in the USA frequent to use the physical library on weekday nights to study or doing collaborative work, and socializing. These findings cannot

be applied for library in Surabaya since most of them only open on office hours or until afternoon. But the idea that undergraduate students like to use the space to do collaborative work and socializing can be implemented here.

Table.2.
Library Re-layout and Adjustment

University	Floor	Re-layout	Adjustment
PCU	5th	Theater room, audio visual room, warehouse	• Leisure area and audio visual room are easier to access • Transform reading area into leisure area • Create more semi cubicle for group discussion
	6th	Secretariat room, reference area, computer area, book shelves, exhibition area, reading area.	
	7th	Leisure area, book shelves.	
	8th	Children book area, reserved book area.	
UBAYA	2nd	Reading room, collection room, registration and circulation area.	• Reading area are easier to access • Transform reading area into leisure area
	3rd	Thesis room, journal room.	
	4th	Circulation room and internet room.	
	5th	Reading area, book shelves1.	
UPN	2nd	Administrative room, head of library room, locker, books return area.	• Area important to library visitor are placed near the access stair • Transform reading area into leisure area
	3rd	Praying room, reference room, book shelves, reading area	
	4th	Discussion room, thesis room, magazine shelves, journal shelves.	
ITS	1st	Computer room, reading room.	• Area important to library visitor are placed near the entrance access
	2nd	-	
	3rd	Book shelves, SNI area, leisure2, sampoerna room, borrowing area.	
	4th	Theater room, audio visual room.	

V. CONCLUSION

The new library facility layout which has been adjusted will fulfill the needs of the digital native generation. Library as a community hub needs to provide open spaces for their visitor, which now dominated by digital native generation. A library must become a place to meet, interact, learn and collaborate. These new library function did not diminish their original purpose as a source of information, but enriched it by adapting to the new needs.

Digital native generation tends to look for instant information which available on the internet, and they did not re-check the source. There are many cases of wrong information distributed through the internet and become viral. The library can help to counter this problem by becoming a convenience and easy to access place by digital native generation for information.

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