UNTAR
FACULTY OF ENGINEERING

ICET 2015

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PROCEEDINGS

2nd International Conference on Engineering of Tarumanagara

"Urban Engineering for Future Generation"

Jakarta, 22-23 October 2015

Auditorium M Building, Campus I,
Tarumanagara University
Jl. Letjen. S. Parman No. 1,
Jakarta 11440 - Indonesia

UNTAR
Universitas Tarumanagara

PROCEEDINGS

2nd International Conference on Engineering of Tarumanagara
(ICET)

"Urban Engineering For Future Generation"
Jakarta, 22-23 Oktober 2015

ISBN 978-602-71459-1-7

FACULTY OF ENGINEERING
TARUMANAGARA UNIVERSITY
JAKARTA-INDONESIA
2015

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FOREWORDS
CHAIRMAN OF THE ORGANIZING COMMITTEE

First of all let's pray and say thanks to God for giving us His mercy and blessings.

The development of technology nowadays is growing up so fast. It aims to meet the necessary of the community to get a better life. Technological innovation which needed to develop technology products that can help people in improving their lives. Therefore the academics are not only required to implement the learning process, but also have to do research and community service to produce innovative scientific research.

Indonesian academics today are eager to involve in research activities. Therefore we required a scientific forum for mutual discussion, exchange information about the research that has been carried out especially related to Urban Engineering.

Faculty of Engineering, University of Tarumanagara conducts the second international conference to bring the academics, researchers to develop their knowledge and exchange ideas so that the researchers can improve the results of research that has been done. The conference called the 2nd International Conference on Engineering Tarumanagara, 2015, which is held on the Auditorium at the 8th floor of M Building, Campus I, University of Tarumanagara from 22 to 23 October 2015. The ICET 2015 conference theme is Urban Engineering for Future Generations. Future generations as the frontier of national development should be prepared from now on, along with the necessary infrastructure. The role of technology is to support the enhancement of the ability of future generations. This event includes to the presentation of scientific papers by keynote speakers, parallel sessions presenting papers of academics and research poster exhibition.

The more extensive the information obtained, the more knowledge that we gained. Some papers submitted by researchers and academics from different countries such as, Germany, Malaysia will enrich the science and technological development.

This conference proceedings contain the full text of all papers presented International Conference on Engineering of Tarumanagara 2015. Papers are categorized based on Engineering disciplines set by the organizing committee. Then, the presentation is divided into parallel sessions.

On this occasion I would like to thank to: Foundation of Tarumanagara, Rector of Tarumanagara University, Dean of Faculty of Engineering Tarumanagara University and Sponsors of ICET 2015, for the support and help that has been given. I also would like to thank the authors for their contributions.

Finally I would like to apologies if there are deficiencies in the activity. Thank you for all the attention.

I Wayan Sukania, S.T., M.T.
Chairman of the Organizing Committee

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FOREWORDS
DEAN OF FACULTY OF ENGINEERING

I would like to warmly welcome all participants of the 2nd International Conference on Engineering of Tarumanagara (ICET 2015). This conference is organized by Faculty of Engineering, Tarumanagara University. The main aim of this conference was to respond the problem related to urban engineering for future generation. As this conference was designed to gather scientists, engineers, practitioners, and industries in engineering related disciplines, I expect intense discussion will happen among them so that some brilliant ideas to be used to improve the quality of human life can be produced.

I hope this conference will create an international networking and collaborating, especially in engineering research and publication.

I would like to congratulate the organizing committee of ICET 2015, for their outstanding efforts. I would also like to express my gratitude to the sponsors for their contributions in making this conference a resounding success.

I wish the International Conference on Engineering of Tarumanagara (ICET 2015) a very useful and fruitful occasion.

Thank you for your attention and contribution.

Prof. Dr. Agustinus Purna Irawan
Dean of Faculty of Engineering

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	Mekar Sari, S.T., M.Sc.
	Didi Widya Utama, S.T. M.T.

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PROGRAM OVERVIEW

Thursday, 22 October 2015

No	Time	Program
1	08.30-09.00	Registration
2	09.00-09.30	Opening Ceremony
		a) Balinese Welcome Dance
		b) National Anthem + Mars Tarumanagara
		c) Chairman Speech
		d) Opening by Vice Rector of Academics and Student Affairs, Untar
		e) Photo Session (WRA, Dean, Chairman, Keynote Speakers, Presenters, Sponsors)
3	09.30-09.40	Sponsorship Presentation
4	09.40-11.40	Keynote Speaker 1: Prof. Zaidi Mohd. Ripin University Sain Malaysia, Malaysia
		Keynote Speaker 2: Ir. Irwansyah. Industrial Estate Association of Indonesia (Himpunan Kawasan Industri) Head of Environmental and Spatial Planning
5	11.40-11.50	Appreciation to Keynote Speakers, Moderator, Sponsors)
6	11.50-12.00	Sponsorship Presentation
7	12.00-12.10	Technical Information
8	12.10-13.00	Lunch
9	13.00-15.00	Parallel Session I
10	15.00-15.30	Coffee Break
11	15.30-17.00	Parallel Session II

Friday, 23 October 2015

No	Time	Program
1	08.30-09.00	Registration
2	09.00-11.00	Parallel Session III
3	11.00-11.15	Closing Ceremony
4	11.15-12.00	Lunch

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List of Papers - Urban Engineering

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PARALLEL SESSION SCHEDULE
22 October 2015

ROOM : 1
MODERATOR : Klara Puspa Indrawati, S.T., M.Ars.
SESSION : 1

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	AE-02	Performance Analysis in Home Industry Scale Production of Modified Traditional Brick as Green Building Material With Reed as Filler *Kurniati Ornam, Masykur Kimsan, La Ode Ngkoimani*
2	13.15-13.30	AE-10	Study of Staircases Design and Visitors' Perception at Commercial Building *Siti Belinda Amri, Santi, La Ode Abdul Syukur, Aspin*
3	13.30-13.45	AE-11	Greenship Rating of Wood Materials in Building *James Rilatupa*
4	13.45-14.00	AE-12	Study of Bioclimatic Application to the Spatial Habitation Along the River Bank Ciliwung *Handajani Asriningpuri, Ratih Budiarti, Harlisa*
5	14.00-14.15	AE-14	Bornean Long House: Cosmological Value in Socio-Cultural Transformation Stream *Klara Puspa Indrawati*
6	14.15-14.30	AE-15	Potential Tour Toward Village of Cultural Conservation of Baluwerti, Surakarta, Jawa Tengah, Indonesia *Naniek Widayati Priyomarsono*
7	14.30-14.45	UE-03	Urban Sprawl Effect to Sustainable City *Andas Budy*
8	14.45-15.00	UE-04	Arrangement Model on the Sustainable Coastal Settlement in Makassar *Naidah Naing, Asdar Djamereng, Bulgis*

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PARALLEL SESSION SCHEDULE
22 October 2015

ROOM : 1
MODERATOR : Ir. Hadian Satria Utama, MSEE
SESSION : 2

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	UE-05	Implementation for Optimizing the Turnkey Project Scheme in Highrise Buiding/Flat Development Base on Duration and Interest Rate *Sylvie Wirawati, Ricky Pittra Halim*
2	13.15-13.30	UE-06	Spatial Articulation and Coexistence of Mode of Production in the Dynamics of Development at the Urban Fringe of Makassar City *Batara Surya*
3	13.30-13.45	EE-01	Sentiment Classification for Academic Questionnaire Using NBC and SVM *Amir Hamzah, Naniek Widyastuti*
4	13.45-14.00	EE-04	Analysis, Simulation and Implementation of Linear Block Codes Using a Microcontroller *Joni Fat*
5	14.00-14.15	EE-05	Visual Performance of Tunnel Lighting Along the Jakarta Outer Ring Road *Endah Setyaningsih, Jeanny Pragantha*
6	14.15-14.30	EE-06	Microcontroller Based Speed Controller of One Phase Induction AC Motor in Escalators *Hadian Satria Utama, Edward Naulibasa Lie, Pono Budi Marjoko*
7	14.30-14.45	EE-07	Implementation Hadoop on Private IaaS Cloud Computing *Edy Kristianto*

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PARALLEL SESSION SCHEDULE
22 October 2015

ROOM : 2
MODERATOR : Dr. Widodo Kushartomo, S.Si., M.Si.
SESSION : 1

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	CE-01	The Understanding and the Use of Motorcycle Special Stopping Space in Signalized Intersection *Leksmono Suryo Putranto, Minggaza Suhindra*
2	13.15-13.30	CE-02	Identification of Volcanic Rocks in Imogiri Yogyakarta Based on Subsurface Geologic Data *Winarti, Hill Gendoet Hartono*
3	13.30-13.45	CE-03	Model Test of Influence Groundwater Pumping to Decrease Surface of the Land *Nurnawaty, M. Selintung, M.Arsyad Thaha, F. Marikar*
4	13.45-14.00	CE-05	Flexural Behavior of Bamboo Reinforced Concrete Beams *Ika Bali, Erianto Wijaya*
5	14.00-14.15	CE-06	Identification of Hazardous Road Sections Using Over Dispersion-Excess Zero Data of Vehicle Accident at Johor Federal Roads *Joewono Prasetijo, W Zahidah Musa, Zaffan Farhana Zainal*
6	14.15-14.30	CE-07	Speed Profile Based on Design Consistency *Joewono Prasetijo, Zaffan Farhana Zainal, W. Zahidah Musa*
7	14.30-14.45	CE-09	Analysis Energy Consumption and Price of Fuel Truck in Makassar *Mukhtar Lutfie, Lawalenna Samang, Sakti Adji Adisasmita, Isran Ramli*
8	14.45-15.00	CE-11	Analysis of the Influence of Longitudinal Beam Toward the Concrete's Nominal Shear Strength *Daniel Christianto, Fannywati Itang, Widodo Kushartomo, and Irene Natasha Kosasih*

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PARALLEL SESSION SCHEDULE
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ROOM : 2
MODERATOR : Dr. Ir. M. Sobron Yamin Lubis, M.Sc
SESSION : 2

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	ME-02	Model Reduction Methods for Cracked Rotor Dynamics Analysis *Rugerri Toni Liong*
2	13.15-13.30	ME-12	Simulation of Non-Newtonian Fluid Flow Through Encapsulation of 3-Dimensional Stacked Flip-Chip Package Using Lattice Boltzmann Method *M.H.H. Ishak, M.Z. Abdullah, Aizat Abas, M.I. Ismail, M.S. Mohamad*
3	13.30-13.45	ME-13	Cyclone Turbine Ventilator as a Power Source Lamps for Home Lighthing *Jenny Delly, Welly Liku Padang, Baso Mursidi, Budiman Sudia*
4	13.45-14.00	ME-15	Pathological Tremor Measurement and Reproduction *Ping Yi Chan, Zaidi Mohd Ripin*
5	14.00-14.15	ME-07	Effect of Tool Nose Radius on Surface Roughness for Machining ST 60 Steel Using Carbide Inserts *Sobron Lubis, Erwin Siahaan, Teguh Imam Suyatno*
6	14.15-14.30	ME-16	FSI Analysis on the Effect of Membrane Rigidity on Laminar Flow Separation Over NACA 64_3-218 Airfoil *M.S. Abdul Aziz, M.Z. Abdullah, S.M. Firdaus, H. Yusoff, K.A. Ahmad, M. Zubair*
7	14.30-14.45	ME-19	Experimental Investigation on Electronic Cooling Performance Using Porous Medium Heat Sink *Muhammad Zaakir Angsoommuddin, Mohd Zulkifly Abdullah, Third Author*
8	14.45-15.00	ME-20	Tensile Strength Polymer Matrix Composite With Reinforcement Gigantochloa Apus *Sofyan Djamil, Mohamed Azlan Suhot, Mohd Zaki Hasan*

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PARALLEL SESSION SCHEDULE
22 October 2015

ROOM : 3
MODERATOR : Dr. Lamto Widodo, S.T., M.T.
SESSION : 1

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	IE-01	Rapid Tooling Manufacturability Advanced Materials Using Automation Fuzzy-AHP Method for Injection Gyro-Magnetic Hot Mold *Moh. Hardiyanto*
2	13.15-13.30	IE-03	Designing a "Voice of Customer" Program to Support Knowledge-Based-QFD *Ronald Sukwadi, Mokh. Suef, Enny Widawati, Cynthia Giovany*
3	13.30-13.45	IE-06	Developing Algoritm to Design Jig & Fixture in SME Supporting Industry Based on Quality Function Deployment Methods (Case Study: Design Assy Machine and Leakage Testing Machine for Air Brake Coupling Hose) *Cucu Wahyudin, Aan Mintarsih*
4	13.45-14.00	IE-07	Comparison of Modular Layout and Distributed Layout Using Simulation Approach *Trifenaus Prabu Hidayat, Andre Sugioko*
5	14.00-14.15	IE-08	Optimization Replacement Schedule of Chisels Based on Quality Cost With Exponentially Increasing Failure Rate *Dadang Arifin*
6	14.15-14.30	IE-09	Re-Design The High of Handlebar on Semarang's Bus Rapid Transit Using Anthropometry and Ergonomy Approach *Annissa Lutfiah Hatuwe, Annisa Nindya Putri, Hanung Kurniawan, Reza Prisman*
7	14.30-14.45	IE-13	Improvement of Service Performance in PO. Sandy Putra by Implementation of Safety Management System for Public Transport *Hanung Kurniawan*
8	14.45-15.00	IE-14	Designing a Closed Loop Tutelage System to Support Student in Preparing and Executing the Study Plan *Andrijanto*

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PARALLEL SESSION SCHEDULE
22 October 2015

ROOM : 3
MODERATOR : Harto Tanujaya, S.T., M.T., Ph.D.
SESSION : 2

No.	Time	Paper ID	Title/Author/Authors
1	13.00-13.15	IE-16	Heuristic Model With Discritized Time Horizon for Solving Alternative Machine Scheduling Problem on Single Operation *Irwan Sukendar*
2	13.15-13.30	IE-19	Embodiment Design of High Capacity Mixer (Case Study: Steamed Sponge Cake Production at "M" Home Industry) *Adrian Christiady, Vivi Triyanti*
3	13.30-13.45	IE-20	The Comparison of MTM-1 and MOST in Predicting Work Element Time *Ivana Theresia Libardus, Vivi Triyanti*
4	13.45-14.00	ME-04	Assessment of Outside Air Supply for Split AC System. Part B: Experiment *K. D. Putra, A. Bimaridi, E. Djunaedy*
5	14.00-14.15	ME-05	Assessment of Outside Air Supply for Split AC System. Part A: Affordable Instrumentation *A. Bimaridi, K. D. Putra, E. Djunaedy*
6	14.15-14.30	ME-03	Design and Construction of a Prototype of Screw Press for the Collection of Coconut Milk *I Wayan Surata, Tjokorda Gde Tirta Nindhia, Davied Budyanto, Ahmad Eko Yulianto*
7	14.30-14.45	ME-14	Finite Element Analysis of Modified In-Wheel Electric Motor for Hybrid Electric Motorcycle *Didi Widya Utama*
8	14.45-15.00	ME-17	Analysis Ethyl Ester in Biodiesel of Raw Material Waste Coconut Oil and Arak *I Wayan Bandem Adnyana, Ni Made Suaniti*
9	15.00-15.15	ME-18	Design and Development of Quadcopter Prototype *Riyan Fenaldo Alphonso, Agustinus Purna Irawan, Frans Jusuf Daywin*
10	15.15-15.30	ME-21	Effectivity of Heat Exchanger Using Coolant Fluid *Harto Tanujaya*

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PARALLEL SESSION SCHEDULE
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ROOM : 1
MODERATOR : Mekar Sari, S.T., M.Sc.
SESSION : 3

No.	Time	Paper ID	Title/Author/Authors
1	09.00-09.15	AE-01	Catholic Church: Influence of Liturgical Ritual in the Building Design (Studied on Four Catholic Churches in DKI Jakarta Area) *Rudy Trisno, Sugiri Kustedja*
2	09.15-09.30	AE-03	The Study of Defense Space on Chinatown Petak Sembilan, West Jakarta *Nafi'ah Solikhah*
3	09.30-09.45	AE-04	Survey on the Fulfillment of the Construction Requirements for Non-Engineered Houses in North Sumatra *Darwin*
4	09.45-10.00	AE-05	Reveal Knowledge Pacitan Rural Java Architecture *Triyuniastuti, HB Satrio Wibowo, Sukirman*
5	10.00-10.15	AE-06	Uniqueness Omah Dudur Dawa Architecture *Satrio HB Wibowo, Sudaryono, E. Pradipto*
6	10.15-10.30	AE-07	Global and Local, at the Same Time *Franky Liauw*
7	10.30-10.45	AE-08	Conducting Smart Programs in the Old Kampoeng Beyond the Modern Era City of Surabaya *Danny Santoso Mintorogo Wanda K. Widigdo, Liliany S. Arifin, Anik Yuniwati*
8	10.45-11.00	AE-09	Adaptation to Climate Change as the Controller of Disaster Vulnerability in Coastal Settlements in Mempawah Hilir, West Kalimantan *Ely Nurhidayati*
9	11.00-11.15	AE-13	Public Engagement in Public Space as the Elements of City Branding *Olga Nauli Komala*

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PARALLEL SESSION SCHEDULE
23 October 2015

ROOM : 2
MODERATOR : Ir. Sofyan Djamil, M.Sc
SESSION : 3

No.	Time	Paper ID	Title/Author/Authors
1	09.00-09.15	CE-10	Influence of Economic External Factors on Construction Project Duration Identification *Basuki Anondho, Yusi Yusianto, Jemmy Wijaya*
2	09.15-09.30	ME-06	Analysis Energy Usage and OTTV in the University Building *Suci, Ery Djunaedy, M. Ramdlan Kirom*
3	09.30-09.45	ME-08	Design Can Cover for Feeding Conveyor for Closing Cans in Cans Machine Maker *Gusti Ryandi Arief, Agung, Wina Libyawati, Yohannes Dewanto*
4	09.45-10.00	ME-09	Design of Cessna Aircraft Model JD - 010 Use Scale 8:1 Based Radio Control *Muhammad Ahda, Ahmad Ilham Firdaus, Erick H.K., Yohannes Dewanto*
5	10.00-10.15	ME-10	Magnet for Generate Electric Power Applications *Dzulfi S Prihartanto, Alva Abdul Ganis, I.G.Eka Lesmana*
6	10.15-10.30	ME-11	Dynamic Analysis on Conditions For Stay off Airfoil, Flying and Landing *Bismil Rebetta, Aprilia Sakti, Erick H.K.*
7	10.30-10.45	ME-01	Study of the Phenomenon of Collapse and Buckling the Car Body Frame *Didik Sugiyanto, Audri Deacy Cappeberg*
8	10.45-11.00	ME-22	Alitizing Process of Low Alloy Steel Emergency Doors in High Rise Building *Erwin Siahaan*

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PARALLEL SESSION SCHEDULE
23 October 2015

ROOM : 3
MODERATOR : M. Agung Saryatmo, S.T., M.M.
SESSION : 3

No.	Time	Paper ID	Title/Author/Authors
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2	09.15-09.30	IE-04	The Strategy for Improving the Quality of Printing Film Production at PT X *Lithrone Laricha S, Delvis Agusman, Lucky*
3	09.30-09.45	IE-05	Research Comparison Among Business Incubator Research Sample and Analysis in the World *Lina Gozali, Maslin Masrom, Habibah @ Norehan Haron, Teuku Yuri M. Zagloel*
4	09.45-10.00	IE-10	Optimization of Production Planning Using Goal Programming Method (Study in a Cement Plant) *Syamsul Anwar, Lonny Afrizalmi*
5	10.00-10.15	IE-11	Risk Assessment of Distal Upper Extremity by Strain Index Method in a Small Shoes-Making Industry *Syamsul Anwar, Yuri Fandi Tanjung*
6	10.15-10.30	IE-12	The Effect of Working Environment Conditions on Employees' Job Satisfaction in a Palm Oil Industry *Elsa Febriani, Musdirwan, Syamsul Anwar*
7	10.30-10.45	IE-15	Design of Eco-Friendly Dairy Farm Business Plan Using Business Canvas Model *Meity Martaleo, William Bobby Susanto, Marcellia Susan*
8	10.45-11.00	IE-17	Simulator of Pitot Tube, Using The Sensor MPX5100 in an Aircraft Model *Joko Sugiarto, Dwijati, Hendardi, Yohannes Dewanto*
9	11.00-11.15	IE-18	Ergonomic Aspect of Physical Environment in Junior High School (Between Individual Comfort and Saving Energy Behavior) *Lamto Widodo, Fransisca Iriani, Endah Setyaningsih*

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PARALLEL SESSION SCHEDULE
23 October 2015

ROOM : 4
MODERATOR : I Wayan Sukania, S.T., M.T.
SESSION : 3

No.	Time	Paper ID	Title/Author/Authors
1	09.00-09.15	UE-01	Decision Design Support System of Urban Landscape Planning Using 3D Interactive Visualization *Herry Santosa, Shinji Ikaruga, Takeshi Kobayashi*
2	09.15-09.30	UE-02	Sustainability Level of Settlement in Gajah Wong Riverside Area, Kotagede, Yogyakarta *Abraham Bhaskara Singgih*
3	09.30-09.45	CE-04	Analysis on the Needs of Bike Share in Institut Teknologi Sepuluh Nopember Surabaya *Siera Rozanah, Ervina Ahyudanari*
4	09.45-10.00	CE-08	DAB as an Effective Dispute Resolution in Construction Industry *Purnomo*
5	10.00-10.15	CE-12	Stabilization of Marine Dredged Sediment With Hydraulic Binders and Silica Fume *Ernesto Silitonga*
6	10.15-10.30	EE-02	GUI Applications on Ground Segment Research Rockets *Imam Sampurno Nugroho, Yahan Nuryad, Nanniek Andiani, Yohannes Dewanto*
7	10.30-10.45	EE-03	Document Subjectivity and Target Detection in Opinion Mining Using HMM Pos-Tagger *Amir Hamzah, Naniek Widyastuti*

International Conference on Engineering of Tarumanagara (ICET 2015)
Faculty of Engineering, TarumanagaraUniversity, Jakarta-Indonesia, October,22-23,2015
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HEURISTIC MODEL WITH DISCRITIZED TIME HORIZON FOR SOLVING ALTERNATIVE MACHINE SCHEDULING PROBLEM ON SINGLE OPERATION

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Abstract

This research addresses on developing heuristic model with discretized time horizon for solving the alternative machine scheduling problem on single operation. The objective function is to minimize total weighted tardiness. To develop the model, there are some asumptions : (1)All the jobs are considered available at the time k=1, (2)Processing time job already includes the set up time, (3) The execution of a job nonpreemptive, (4)K time horizon considered long enough to complete all the jobs, $Ci \leq K$ for all I, (5)Every job is done simultaneously between one machine and one operator. The Model is applied on numerical instance 10 jobs 6 machines and having a good solution.

Keywords: scheduling, alternative machine, heuristic, discrete time horizon

INTRODUCTION

Scheduling is allocation resources to do some jobs on defined time [Baker, 1997]. The solving of scheduling can be done by mathematic formulating. Morton and Pentico [1993] said that there are two versions of matematic formulations : disjunctive constraint and discretized time horizon.

Some authors have a lot to develop models of alternative scheduling engine. Most of them use mathematical formulas disjunctive constraint. Authors include: Ma'Ruf [1995], Toha [1996], Halim and Chandrawijaya [1996], Dewi [2000], and Baykasoglu [2004].

Ma'ruf [1995] developed a heuristic model disjunctive constraint with a genetic algorithm for scheduling problem where job routing alternatives linear structure and function mimimisasi purpose makespan.

Toha [1996] writes integer linear programming model disjunctive constraint for alternate routing scheduling problem where job linear structure with the objective function minimization actual flow time.

Halim and Chandrawinata [1996] writes about the disjunctive constraint heuristic model with beam search for alternate machine scheduling problem with the objective function mimimisasi makespan.

Dewi [2000] investigated a heuristic model of disjunctive constraint in the development of algorithms consider rescheduling affected operation of alternative machines to complete the job structure with a linear objective function minimization mean flow time.

Baykasoglu et al [2004] writes about the disjunctive constraint heuristic model with Tabu search for alternative scheduling problems linear machine where the job structure and function of makespan minimization purposes.

Meanwhile, some other authors developed a model of alternative scheduling engine with a mathematical formulation of the discrete time horizon. They include: Morton and Pentico [1993], Suprayogi and Toha [2002], and Sukendar [2007].

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Morton and Pentico [1993] developed a model of the classic engine scheduling a single operation with a mathematical formula discrete time horizon.

Based on on the time horizon discrete mathematical formula created by Morton and Pentico [1993], Suprayogi and Toha [2002] developed the formulation for modeling scheduling alternative engine for the simultaneous minimization total weighted tardiness.

Based on scheduling model written by Suprayogi and Thoha [2002], Sukendar [2007], developed a model of alternative scheduling parallel machines a single operation.

[Morton and Pentico, 1993] said that Disjunctive constraint version of mathematic formulation can be easily done if we ignore resource conflict. But solving it is much more difficult if there are adding constraint. But discretized time horizon version of mathematic formulation is much more general.

Based on scheduling model written by Sukendar [2007], this study wanted to develop an alternative model of heuristic scheduling parallel machines based on the mathematical formulation of the discrete time horizon.

MATERIALS AND METHOD

Problem-solving approach

Sukendar [2007] describes the alternative scheduling engine as follows: Suppose given a set job I.. Each job has a due date $i \in I$ Di and wi importance weight. Each job has a number of operations $i \in I$ Ji. Suppose H denote the set of alternative machines. Each type of machine has a k h on slot availability HHK. $Hij \subseteq H$, $Hij \neq \varnothing$ denote the set of alternative machines that can do the job i j operations. Each operation on the job j i can be done on one machine $h \in Hij$. Pij denote the set of operations that become presedence direct operations in job i j. Operating time job i on machine j h is expressed by the matrix tijh. Dideskritisasi time horizon in K unit time. The execution of each operation j requires operators. Availability operator at slot k is expressed by Pk.

Suppose there are 6 jobs and 4 engines and each job specified due date and weight. Job 1 and 4 have two operations, while the other job has one operation. Availability engines 1 and 4 each time slot is 1, while the availability of machine 2 and 3 each time slot is 2. Horison didiskretisasi time in 8 units of time. Those problems tabulated in Table 1 and Table 2 and illustrated in Figure 1.

Table 1. Problems of alternative scheduling engine [Sukendar, 2007]

Job	Operation	Job processing time for each machine (days)				Due date (days)	Weight	Time horizon (days)
		1	2	3	4			
1	1	t_{111}	t_{112}	-	-	D_1	w_1	K
	2	-	-	t_{123}	t_{124}			
2	1	t_{211}	t_{212}	-	-	D_2	w_2	
3	1	-	-	t_{313}	t_{314}	D_3	w_3	
4	1	t_{411}	t_{412}	-	-	D_4	w_4	
	2	-	-	t_{423}	t_{424}			
5	1	t_{511}	t_{512}	-	-	D_5	w_5	
6	1	-	-	t_{613}	t_{614}	D_6	w_6	

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Table 2. Availability sources in the slot *k* [Sukendar, 2007]

Sumber	The availability of resources (HHK and Pk)							
	Time Horizon *(K)*							
	1	2	3	4	5	6	7	8
Machine 1	1	1	1	1	1	1	1	1
Machine 2	2	2	2	2	2	2	2	2
Machine 3	2	2	2	2	2	2	2	2
Machine 4	1	1	1	1	1	1	1	1
Oparator	8	8	8	8	8	8	8	8

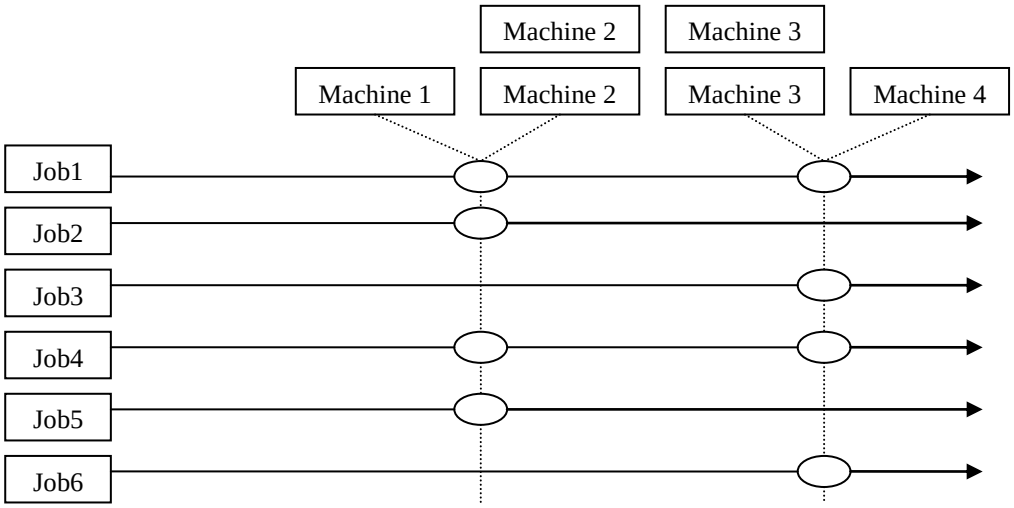

Figure 1. alternate scheduling problem machines [Sukendar, 2007]

Notation

1. Assemblage
   Hi = the set of alternative machines to do the job i.
2. index
   i = job
   h = machine
   k = time slot
3. Parameter
   N = the number of jobs
   Wi = weight of job i
   In = DueDate job i
   K = the time horizon
   tih = processing time job i on machine h, where h$\in$ Hi
   HHK = constant which indicates the availability of slot machines in k h.
   Pk = operator availability at time slot k
4. Decision Variabel
   Ci = when completed construction job i.
   Tch = when completed construction job i on machine h
   Xih = binary variable 0-1 stating that the job is done by machine i h
   Cihk 0-1 = binary variable, equal to 1 if the job is done on a machine i h completed in the time slot k, is 0 if not.
   Ti = tardiness job i

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Ei = earliness job i
ti = time processing job i
Xihk 0-1 = binary variable, equal to 1 if job i at time slot k h using a machine, worth 0 if for others
Bi = We began construction job i.

5. Performance Measure
   Z = *total weighted tardiness*

Assumption

Assuming the model is as follows:

1. All the job is considered available when k = 1
2. Processing time job already includes the set up time.
3. The execution of a job nonpreemptive.
4. K time horizon considered long enough to complete all the jobs, Ci ≤ K for all i.
5. Each job is done simultaneously between one machine and one operator

Scheduling Heuristic models Alternative Engines

Compound job scheduling algorithm for single operation are as follows:

1. Sort job from a job that has in the shortest until the job that has in the longest (ascending). If in the same sort of job start job that has the largest wi until the job that has the smallest wi (descending). If wi is same, sort randomly job. Suppose a stated order of job.
2. Set a = 1 [1]
3. Set h = 1, h∈Ha, Ha = 1 [2]
4. Set k = 1 [3]
5. For l = k to l = k + tah-1 [4]
   if hhl ≥1 and Pl ≥1, proceed to step 6. [5]
   If not, set k = k + 1 and repeat step 5 [6]
6. Create a temporary schedule,
   set Bah = k; ∀l [7]
   Xahl = 1, [8]
   l = k to l = k + tah-1; [9]
   Cah = Bah + tah-1; [10]
   Hhl = hhl -1, -1 [11]
   Pl = Pl for ∀l, [12]
   l = k to l = k + tah-1; [13]
   Calculate Zah, Zah = max (Cah-Da, 0).wa, then proceed to step 7 [14]
7. If h <Ma, set h = h + 1, (h∈Ha, Ha = 1) and return to step 4. [15]
   Otherwise go to step 8 [16]
8. Compare Zah, tah. Select a schedule that gives the smallest Zah, Zah *. [17]
   If the same Zah, select a schedule that gives the smallest tah, tah *. [18]
   If, tah equal, choose a random schedule. [19]
   Selected h is h * and L chosen is L *. Proceed to Step 9 [20]
9. Set a fixed schedule: Bah *, XAH * l *, Cah *, Hh * l *, and Pl *. [21]
   Proceed to Step 10
10. Reset schedule another temporary: Bah, Xahl, Cah, hhl, and Pl. [22]
    Proceed to Step 11
11. If a <N, set a = a + 1 and return to step 3. If it does not stop the algorithm [23]

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RESULTS AND DISCUSSION

The Model that has been developed, is applied on scheduling numeric example 10 job 6 mesin [Sukendar, 2007] :

Table 3. Scheduling Numeric example [Sukendar, 2007]

Job	Job processing time for each source (days)						*Due date* (days)	Weight	Time horizon (days)
	1	2	3	4	5	6			
1	3	4	3	7	5	6	3	1	12
2	5	6	4	4	3	2	3	5	
3	5	3	4	6	7	5	3	2	
4	6	7	3	4	6	5	3	3	
5	7	7	6	5	4	3	3	3	
6	3	7	5	6	3	4	3	4	
7	7	4	4	5	6	3	6	4	
8	5	7	3	4	5	6	6	2	
9	7	6	5	3	4	6	6	5	
10	7	7	6	3	5	4	6	1	
Paralel source	2	1	1	1	1	1			
operator	7								

With 10 job 6 engine case scenario, as well as the due date and the weight is known, then the scheduling solution is as follows:

Table 4. Sceduling solution [Sukendar, 2007]

machine	Paralel source	Time horizon											
		1	2	3	4	5	6	7	8	9	10	11	12
1	1	6	6	6									
	2	3	3	3									
2	1	1	1	1	1								
3	1	4	4	4	8	8	8						
4	1	9	9	9	10	10	10						
5	1	5	5	5	5								
6	1	2	2	7	7	7							
operator		7	7	7	5	3	2	0	0	0	0	0	0
operator availability		7	7	7	7	7	7	7	7	7	7	7	7

This scheduling solutions generate total weighted tardiness for 4 days. This solution was only slightly with the solutions produced by the model optimization mathematical formula on a discrete time horizon Sukendar study [2007], which amounted to 3 days.

CONCLUSIONS

1. Model alternative scheduling heuristic engine developed discrete time horizon consists of 11 step algorithm
2. The model of numerical example was aplicated to 10 jobs 6 resources. The solution

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of minimization total weighted tardiness is 4 days. This solution was only sedikt optimal scheduling model with time horizon dikret alternative engine developed by Sukendar [2007], which is 3 days.

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