

An aerial photograph of the Las Vegas skyline at dusk. The city lights are beginning to glow, and the sky is a deep twilight blue. In the foreground, the Wynn hotel is prominent with its signature script logo on its facade. Other high-rise buildings are scattered across the cityscape, with mountains visible in the distance under a darkening sky.

The 13<sup>th</sup> Annual International Conference  
on Industrial Engineering  
- Theory, Applications and Practice

Las Vegas, Nevada  
September 7-10, 2008

Editors:

JE Fernandez

JB Schamburg

AR Kumar

A Subramanian

P Evangelista

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The Editors would like to thank all authors and participants for their efforts in making this conference a success.

Dr. JE Fernandez  
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- [Sorted by Author](#)

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**Papers listed (alphabetically) by First Author's Last Name**

[A](#)   [B](#)   [C](#)   [D](#)   [E](#)   [F](#)   [G](#)   [H](#)   [I](#)   [J](#)   [K](#)   [L](#)   [M](#)  
[N](#)   [O](#)   [P](#)   [Q](#)   [R](#)   [S](#)   [T](#)   [U](#)   [V](#)   [W](#)   [X](#)   [Y](#)   [Z](#)

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Aeyoon, A	<a href="#">The Collaborative Knowledge Management on the Value Chain in the Information Intensive-based Industries</a> - A Aeyoon
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Alba-Baena, N	<a href="#">Wood Molding Operation Analysis and Tool Redesign</a> - N Alba-Baena, AG Jaime, and SL Jiménez
Alexander, RS	<a href="#">Decision Support Tools for Military Planning</a> - RS Alexander
Ayala, G	<a href="#">Optimal Capacity Increase for Multiproduct Batch Plants</a> - G García-Ayala, and O Chacón-Mondragón

[Back to Top](#)

**B**

Bardhan, TK	<a href="#">A Simulation Approach to the PERT/CPM Time-Cost Trade-Off Problem</a> - TK Bardhan <a href="#">Duration and Budget Issues of Time Constrained Projects: A Simulation Approach</a> - TK Bardhan
Bernardo, CL	<a href="#">Case Based Reasoning Applied in the Implantations of Quality Management Systems in the Oil &amp; Gas Industry</a> - CL Bernardo
Bustillos, DLV	<a href="#">Determination of the Maximum Acceptable Weights in Non-standard Positions</a> - DLV Bustillos, EJB Hernández, G Erandy, C Estrada, C Selene, and RV Graciela

[Back to Top](#)

**C**

Cao, L	<a href="#">Do Benefit Program and Services Make a Difference to the Knowledge Workers in the Emerging Market? A Comparative Study of American and Japanese MNCs in China</a> - L Cao
Carlson, MI	<a href="#">Human Factors in the Soldier as a System</a> - ML Carlson
Carrillo, H	<a href="#">Simulation of Knight Algorithm in the Formation of Manufacturing Cells under Production Flow Analysis</a> - H Carrillo, JS Echeverría, JJ Díaz, and ME Gurruchaga
Chang, W-W	<a href="#">Applying Estimation of Distribution Algorithms for Network Reliability Problem</a> - W-W Chang and K-J Wang
Chatsirirungruang, P	<a href="#">Application of Genetic Algorithm to Numerical Experiment in Robust Parameter Design for Signal Multi-response Problem</a> - P Chatsirirungruang and M Miyakawa



- Chávez, AV [Success Factors of Continuous Improvement-Kaizen Projects: A Meta-Analysis Study](#)  
- AV Chávez, SN Morales, and EM Gomez
- Chen, KY [Applying RFID Hand-Held Device in Factory Equipment Diagnosis](#)  
- K-Y , C-T Yu, C-W Tung, Y-H Liao, and C-T Cheng  
[Applying RFID to Picking Process in Warehouse](#)  
- K-Y Chen, C-J Fan, C-W Tung, Y-F Hwang, and S-J Hsieh
- Chiu, C-Y [An Integrated Inventory Model with Present Value and Dependent Crashing Cost is Polynomial under the Imperfect Production Process in the Supply Chain](#)  
- C-Y Chiu, I-T Kuo, and M-H Lin
- Chopra, A [Enhancing Profits Through Quality Costs: A Case Study](#)  
- A Chopra, D Garg, and N Walia
- Chuang, C-L [An Integrated Data-mining Approach to Improve Credit Scoring](#)  
- C-L Chuang and R-H Lin
- Costa, RN [Multiple Response Optimization – Simpler and Effective](#)  
- RN Costa
- Cruz, JHDL [Optimal Allocation of Police Patrols to Patrolling Zones at a Large City in Mexico](#)  
- JHDL Cruz

[Back to Top](#)

## D

- Davidson, J [The Role of Battle Command in Information System Assessments](#)  
- J Davidson, A Pogel, and JA Smith
- Dávila-Ríos, I [A Certified Automated Welding Process Using 3D Simulation Environment](#)  
- I Dávila-Ríos, LM Torres-Treviño, I López-Juárez
- Desai, A [Evolution of Concepts Related to Quality](#)  
- A Desai and A Mital  
[A Review of Design for Maintenance Concepts](#)  
- A Desai and A Mital

[Back to Top](#)

## E

- Elkins, TT [Alternate Care Facilities for a Mass Casualty](#)  
- TT Elkins
- Escamilla, I [Surface Roughness Prediction Modeling in Machining of Ti 6Al 4V Alloy Using Neural Network and Linear Regression](#)  
- I Escamilla, L Torres, P Perez, and P Zambrano

[Back to Top](#)

## F

- Feliciano, MM [Levels of Interoperability between Manned and Unmanned Systems: An Experimental Study of Cooperative Engagements](#)  
- MM Feliciano and B Sperling  
[Feasibility Study of Replacing the MK19 Grenade Launching System](#)  
- MM Feliciano, K Hurst, N Klein, S Warner, S Crino, and R Kewley
- Fernandez, JE [Statistical Methods in Time Studies: Industrial Engineering and Health Care](#)  
- JE Fernandez, M Halpern, Anand Subramanian, AR Kumar, and BF Ware
- Forget, P [Collaborative Agent-Based Negotiation in Supply Chain Planning](#)  
- P Forget, T Monteiro, S D'Amours, and J-M Frayret

[Back to Top](#)

## G

- Galbreath, D [Measuring the Effects of Counter-Improvised Explosive Device \(C-IED\) Activities](#)  
- D Galbreath, J Griffin, C Landers, J Roach, and P Evangelista
- Garcia-C, AB [Line Balancing Through Heuristic Methods as a Step to Work Standardization](#)  
- AB García C, H Carillo R, and JL Garcia A  
[Methodology for Work Standardization in a Production Line](#)  
- AB García C and JL Garcia A
- Garcia, A [A Multi-Criterion Approach for the Location of a Produce Warehouse](#)  
- JL Garcia A, SA Noriega M, and EA Martínez G
- Garzon, J [An Integrated Real-Time Visual Shop Floor Monitoring System in a Server Manufacturing Environment](#)  
- J Garzon and S Ramakrishnan
- Gaudreault, J [A Multi-Agent and OR-Based Approach to Operations Planning in the Lumber Industry](#)  
- J Gaudreault, P Forget, J-M Frayret, A Rousseau, and S D'Amours

- [Operations Coordination in the Lumber Industry: From Heuristics To Machine Learning](#)  
- J Gaudreault, J-M Frayret, , G Pesant, P Forget, and S D'Amours
- Goerger, NC [Decision Analysis Framework for Architecting and Environment to Assess Unmanned Ground Systems](#)  
- NC Goerger, S DeLong, JA Nagle, and R Jones
- González, B. [Predictive Models of the Corrosion Rate and Deterioration of Steel used in Industry to Control the Refinery Maintenance through Intelligent System](#)  
B. González, L. Torres, F. A. Reyes, C. Vera, and R. Colas
- Gonzalez-Gonzalez, DS [Optimization of the Partial Likelihood Breslow Function in Cox Model by Hybrid Approach](#)  
- DS Gonzalez-Gonzalez, MR Piña-Monarez, and LM Torres-Treviño

[Back to Top](#)

## H

- Halpern, MT [Patient Costs Among Individuals with Cancer](#)  
- MT Halpern, and Y-C T Shih
- Hargrove, SK [A Neural Network Approach for Determining Wire-EDM Cutting Parameters and the Thermal Effect on Workpiece Surface Layers](#)  
- SK Hargrove and JM Ngeru  
[Promoting an Emerging Discipline of SSME for Instruction & Research at HBCs](#)  
- SK Hargrove, JO Thomas, and M Washington
- Harper, W [The Effects of Weapon Mass and Center of Mass on Shooting Performance with an Assault Rifle](#)  
- W Harper, M LaFiandra, and P Wiley
- Hasgul, S [An Agent-based Framework for a Multi-robot Project Scheduling](#)  
- S Hasgul, I Saricicek, M Ozkan, and O Parlaktuna
- Hayakawa,S [The Business Strategy of Industrial Goods in Small and Medium-sized Enterprise--the Case of Universal Joint Manufacturer](#)  
- S Hayakawa, N Otake, and T Horikoshi
- Herrera-Zamora, JA [Exploration of Optimization Techniques for the Machine Sequence Planning \(Open Shop and Job Shop\) with Multiple Precedences: A Real Scenario](#)  
- JA Herrera-Zamora, LM Torres-Treviño, and P Pérez-Villanueva
- Hiiragi, S [Accounting Suitable for the Just-In-Time Production System \(JIT\) - Fair Performance Measurements Based on Evolving A Customer-Value-Oriented "JIT Pull System"](#)  
- S Hiiragi
- Hill, A [Personnel Processing Center Ft Campbell Kentucky](#)  
- A Hill, JY Oh, and MJ Kwinn, Jr
- Horner, DA [Institute for Maneuverability and Terrain Physics Simulation \(IMTPS\)](#)  
- DA Horner and PM Sullivan
- Hu, T-L [Relations of Channel Strategy, Channel Power, Retailer Competitive Strategy and Channel Performance](#)  
- T-L Hu, S-Y Chuang, W-C Hsieh, and RJ Kuo
- Hudak, D [Determining the Impact of Information on Decision-Making in Contexts Lacking Well-Defined Utility Functions](#)  
- D Hudak, J Mullen, and A Pogel

[Back to Top](#)

## I

- Ibarra-Mejia, G [Ergonomics in Mexico: Standards and their Application](#)  
- G Ibarra-Mejia, SN Morales, BF Ware, AR Kumar, A Subramanian, and JE Fernandez
- Ishikawa, K [Restructure of TMP Activity by Visualization Tool Utility](#)  
- K Ishikawa, H Yamada, N Otake, and T Horikoshi  
[Application and Execution of Systematic Knowledge Creation Method toward TPM Activity for the Purpose of Maintenance Prevention](#)  
- K Ishikawa, H Yamada, N Otake, and T Horikoshi

[Back to Top](#)

## J

- Jones, E [Supply Chain Management: Ergonomics, Quality and Information System Issues](#)  
- E Jones and RR Bishu
- Joshi, A [A Comparative Study of Multivariate Techniques and Support Vector Machines](#)  
- A Joshi, N Kulkarni, P Samant, and S Lu  
[A Framework for Vendor Evaluation System in a Machine Assembly Environment](#)  
- A Joshi, P-F Tsai, and K Srihari

[Back to Top](#)

## K

- Kapanoglu, M** [A Hyper-Genetic Algorithm for Scheduling Computer-Integrated Job-Shops with Due Date based Objectives](#)  
- M Kapanoglu and M Alikalifa
- Karkle, DE** [Evaluation of Football Shaped Rumble Strips for Prevention of Highway Run-off-the-road and Crossover Accidents](#)  
- DE Karkle and MJ Rys
- Kartal, Z** [Using AHP to Optimize Product Mix in a Multi-Bottleneck Environment](#)  
- Z Kartal and S Hasgul
- Kattel, BP** [Effect of Type Background Noise on the Acceptable Noise Level \(ANL\) for an Individual with Normal Hearing](#)  
- BP Kattel, BK Fasanya, TR Letowski, and SK Hargrove
- Kempf, M** [A Bayesian Approach for Estimating Survival Probabilities](#)  
- M Kempf
- Kewley, R** [Federated Modeling Architectures for Simulation of Command and Control Capabilities](#)  
- R Kewley
- Khadem, M** [Shop Floor Modeling and Simulation for Performance Improvement for Car Battery Manufacturing](#)  
- M Khadem and A Ali
- Kim, C-S** [Development of Evaluation Indicators for the Proposals of National Defense Core-Technology R&D Projects](#)  
- C-S Kim, W-J Kang, and K-K Cho
- Krauss, D** [Additional Considerations When Applying the “Safety Engineering Hierarchy” in Industrial Work Settings](#)  
- D Krauss, SR Arndt, SD Lakhiani, and F Khan
- Kulkarni, N** [Enhancing the Efficiency of the Server Assembly Process through Simulation Modeling](#)  
- N Kulkarni, P-F Tsa, K Srihari, and M Testani
- Kulkarni, R** [Offset Splicing of Polarization Maintained Optical Fibers in an Electronics Manufacturing Environment](#)  
- R Kulkarni, P-F Tsai, K Srihari, and J Arbulich  
[Splice Loss Measurement for Dissimilar Optic Fibers in an Electronics Manufacturing Environment](#)  
- R Kulkarni, P-F Tsai, K Srihari, and J Arbulich
- Kumar, A R** [Thermal Comfort and Seating: A Review](#)  
- AR Kumar  
[Applications and Ergonomic Guidelines for Dual Monitors](#)  
- AR Kumar, BF Ware, A Subramanian, S McClellan, E Noriega, and JE Fernandez
- Kuo, RJ** [Integration of Particle Swarm Optimization-Based Fuzzy Neural Network and Artificial Neural Network for Supplier Selection](#)  
- RJ Kuo, SY Hong, and T-L Hu
- Kwon, Y** [Network-based Vision Control of Robotic Automation for E-Quality](#)  
- Y Kwon, R Chiou, and B Tseng

[Back to Top](#)

## L

- LaFiandra, M** [Facilities and Techniques for Studying the Effects of Solder Equipment on the Dismounted Warrior](#)  
- M LaFiandra  
[The Effects of Weapon Mass and Center of Mass on Aiming Movement](#)  
- M LaFiandra, W Harper, and P Wiley
- Lee, Y- C** [Process Based Resource Management System for Computer Aided Engineering Project](#)  
- Y-C Lee and H-R Bae
- Lee, BY** [A Study on Developing MES \(Manufacturing Execution System\) in a Fabrication Shop for Power Shovel](#)  
- BY Lee, SH Lee, SK Min, TH Baek, SJ Ha, JO Kim, DS Kim
- Lin, C P** [Capability Measures for Processes with One-sided Specification Limit and Target Value](#)  
- PC Lin and YT Chung

[Back to Top](#)

## M

- Maikala, RV** [Near-infrared Spectroscopy-derived Circulatory Responses in Healthy Women Workers During Psychophysically-Determined Cart Pushing on Low and High Frictional Floors](#)  
- RV Maikala, VM Ciriello, PG Dempsey, and NV O'Brien
- Marley, RJ** [Recent Evolutions in the Curricula of Leading Industrial Engineering Programs within the US](#)  
- RJ Marley, LM Stanley, and A Muthumani

- Martin, A** [Forward and Reverse Supply Chain Management for the Electronics Industry: Use of an Outsourced Manufacturer and the Benefits](#)  
- A Martin and MD Sarder
- Masumitsu, T** [Oyster Traceability Information System for Safety Management in Japan](#)  
- T Masumitsu and K Yasuda
- McGinnis, ML** [Challenges and Opportunities in Modeling and Simulation: Public Policy and Public-Private Partnership for Growth in the Decade Ahead](#)  
-ML McGinnis, and CM Banks
- Mendoza-León, JG** [Adjusted Operations and Continuous Improvement Management Technology as Tools for Innovation in Manufacturing SMEs in Northwestern Mexico](#)  
- JG Mendoza-León and CL Villarreal- L
- Min, SG** [A Case Study of Spatial Scheduling for the Accommodation Production Shop in the Shipbuilding](#)  
- SG Min, SJ Ha, TH Baek, TH Choi, JO Kim, and DS Kim
- Molina, RD** [Analysis of Variance and Comparison of Means in Designs with Mixed Factors through Bayesian Inference](#)  
- RD Molina, MA Rodriguez, JL Garcia, and SA Noriega
- Mostafaipoor, A** [Impact of Lean Manufacturing on Supply Chain Management](#)  
- A Mostafaipoor, N Roy, and J Kumar

[Back to Top](#)

## N

- Nagai, M** [The Survey of Companies' Present Condition And Consciousness on Information Literacy of the University Graduates In Japan](#)  
- M Nagai, T Goto, and S Tomita
- Nagarur, N** [Inventory Management of Packaging Materials in a Pharmaceutical Warehouse: A Case Study](#)  
- N Nagarur, P Kaluskar, and M Doelling

[Back to Top](#)

## O

- Odake, N** [Woolen Textile Cluster and Recycle Wool in the Bishu Region](#)  
- N Odake, Y Fnahashi, and T Horikoshi
- Olguin, MCIP** [Treatment of the Robust Model of Aggregate Production Planning Subject to Uncertainty with Costs of Replacement of Tools](#)  
- MCIP Olguin, MR Medina, and MCAP Limon
- Orzúa-González, ME** [Application of the Multivariate Non Parametrical Control Process to Stamping Torque Converter 6L80/6L90](#)  
- ME Orzúa-González, MR Piña-Monarez, and LM Torres-Treviño

[Back to Top](#)

## P

- Pennathur, A** [Two Lectures to Go With Video Please: Pedagogical Aspects of Podcasting in Industrial Engineering Courses](#)  
- A Pennathur
- Petzelt, D** [Using Predetermined Standard Times in the Digital Factory for Deriving Operation Times](#)  
- D Petzelt and J Deuse
- Piña-Monarez, MR** [ANOVA Construction based in the Inverse of the Covariance Matrix in Multiple Linear Regression](#)  
- MR Piña-Monarez and SA Noriega-Morales  
[A Note on Confidence Interval Estimation for the Eigen Values](#)  
- MR Piña-Monarez and F Zertuche-Luis
- Prado-León, LR** [Ergonomic Assessment of Postures, Lifting Tasks and Physical Exertion in Mexican Workplaces](#)  
- LR Prado-León, R Avila-Chaurand, and C Aceves-González
- Praja-Alejo, RJ** [Comparison Between Several Neural Networks Models Using Statistical Methods](#)  
- RJ Praga-Alejo, LM Torres-Treviño, and MR Piña-Monarez  
[An Optimization Using Multiple Linear Regression and Genetic Algorithm in Welding Process](#)  
- RJ Praga-Alejo, LM Torres-Treviño, and MR Piña-Monarez

[Back to Top](#)



## R

- Ramakrishnan, S [Constraint-Based Modeling for Capacity Planning in an Electronics Manufacturing Service Provider's Facility](#)  
- S Ramakrishnan and K Srihari
- Ramirez, CS [Sensitivity Analysis of the Impact of Inventory and Cycle Time on Performance of the Automotive Supply Chain](#)  
- CS Ramirez, MGC Campos, and PP Villanueva  
[Security in the Supply Chain Automotive, Process Analysis and Key Cost](#)  
- CS Ramirez and MGC Campo
- Ray, PS [The Challenge of Low Productivity In Construction Industry](#)  
- PS Ray
- Resendiz-Zamudio, LG [Understanding and Reducing Process Variation on Manufacturing Applications](#)  
- LG Resendiz-Zamudio, MR Piña-Monarez, and P Perez-Villanueva

[Back to Top](#)

## S

- Sabar, M [A Multi-Agent Approach Based on Kernel-Stable Coalitions for Personnel Scheduling in Assembly Centers](#)  
- M Sabar, B Montreui, and J-M Frayret
- Salaskar, S [Enhancing Personal Satisfaction of the United States Workforce](#)  
- S Salaskar, A Samson, S Ramakrishnan, S Wang, and K Srihari
- Samant, S [Application of Artificial Neural Networks to Predict Defect Levels in Wave Soldering Processes](#)  
- P Samant, DL Santos, and J Tripp
- Sanchez, J [Optimization of the Capability Index for a Flash Welding Process with Sequential Experimentation](#)  
- J Sanchez, JJ Aguirre, and JV Garcia
- Santos, DL [Beyond Six Sigma – A Control Chart for Tracking Defects Per Billion Opportunites \(DPBO\)](#)  
- DL Santos
- Schmeidler, NF [Human Capital: Outyear Planning](#)  
- NF Schmeidler and JA Mainardi
- Schott, E [A Heuristic Algorithm to Solve Distribution Problems with Set-up Costs](#)  
- E Schott, E Quinonez-Rico, and DJ Valles-Rosales
- Shanmugam, R [Visual Inspection of Tablets in Pharmaceutical Industry](#)  
- R Shanmugam and RR Bishu
- Scopardi, A [Application of Fuzzy FMEA to the Intensive Care Coronary Unit Electric Bed Design](#)  
- A Scopardi
- Sood, S [Using Design of Experiments \(DOE\) to Improve the Reliability of an Automated Prescription Dispensing System: A Case Study](#)  
- S Sood, P-F Tsai, J Bobik, T Bower, and K Srihari
- Stanley, L M [Psychophysical Methods for Studying Interface Design in Automotive Advanced Crash Avoidance Technologies](#)  
- LM Stanley and RJ Marley
- Steffey, D [Troubleshooting Analyses of Production Data](#)  
- D Steffey, A Ostarello, J Clevenger, and M Villarraga
- Subramanian, A [Role of Supply Chain Metrics and Quality Control in the Supply Chain Cycle](#)  
- A Subramanian and AR Kumar

[Back to Top](#)

## T

- Terrones, MA [A Study of Robot Arm Precise Positioning Using SVM Classification Algorithm](#)  
- MA Terrones, H Lu, and S Lu
- Tomita, S [The Effective and Practical Use of Information and Communication Technology \(ICT\) for the Vocational Initiation and Education in the School at the Same Time](#)  
- S Tomita, T Goto, M Nagai, T Kondoh, and T Suzuki
- Torres-Treviño, L [An Intelligent System for the Innovation Value Chain Evaluation](#)  
- LM Torres-Treviño, RP Morales-Valdes, and C Gonzalez-Rodríguez
- Treviño, NJG [A Model for Predicting Stresses in Deep Water Pipes](#)  
- NJGamez-Treviño, MR Piña-Monarez, and MP Guerrero-Mata
- Tseng, T-L [Autonomous Decision Making in Bio-Manufacturing: A Data Mining Approach](#)  
- T-L Tseng and Y Kwon
- Tshibangu, W-M A [Process and Productivity Improvement through Facility Layout Using a Lean Approach - A Case Study](#)  
- W-M A Tshibangu and S Berlinski

[Back to Top](#)

## V

- Valles, A [Design of Experiment to Reduce the Flash Generation on CNC Machining](#)  
- A Valles, J Sanchez, F Zorrilla, R Villegas, and G Sandoval
- VijayaKumar, A [Evaluation of Motorcycle Riders Safety Impacts on Centerline Rumble Strips](#)  
- A VijayaKumar and MJ Rys

[Back to Top](#)

## W

- Wax, SJ [Reopening Artillery Gate: A Study on Traffic Control at the Presidio of Monterey, California](#)  
- SJ Wax, JY Oh, and MJ Kwinn, Jr
- Weakley, E [Sports Complex Facilities Design Review](#)  
- E Weakley and MD Sarder
- Wiley, PW [Manipulation of a Commercial Game to Provide a Cost Effective Simulation to Evaluate Wearable Information Systems](#)  
- PW Wiley, DR Scribner, and WH Harper
- Woder, MCSR [A Bayesian Inference Replacement Policy for Material Feeders in Automatic Surface Mount Devices Machines](#)  
- MCSR Woder, M Rodríguez, and MCH Gonzalez
- Wu, C [Using Data Mining Techniques to Discover Constant Biclusters](#)  
- C Wu

[Back to Top](#)

## Y

- Yearout R [A Methodology to Attain Noise Compliance for a Small Company \(A Health & Safety Case Study\)](#)  
- R Yearout, K Barrow, C McKenzie, AG Garcia, and VV Flores
- Yepez, D [A Comparison of Processing Techniques to Create Registration Holes on Continuous Roll-To-Roll Flexible Electronics Substrates Using SPC Techniques](#)  
- D Yepez, P Moschak, C Chase, D Santos, B Sammakia, and M Poliks
- Yokota, A [Identifying Maintenance Tasks in Enterprise Information System Lifecycle](#)  
- A Yokota and K Yasuda

[Back to Top](#)

## Z

- Zhao, W [Mapping of Postures from Jack to IGRIP](#)  
- W Zhao and V Madhavan
- [Study of the Accuracy of Postures Obtained by Immersive Virtual Reality for Use in Ergonomic Analysis](#)  
- W Zhao, V Madhavan, and JE Fernandez

[Back to Top](#)



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June 9, 2008

Apriani Soepardi  
UPN "Veteran" Yogyakarta  
Jl Babarsari 2 Tambakbayan Yogyakarta 55283

Subject: Abstract acceptance of your paper at the IJIE 2008 Conference in Las Vegas, Nevada

Dear Dr. Soepardi:

The organizing committee has accepted your abstract and invites you to present your paper titled "**Application of Fuzzy FMEA to the Intensive Care Coronary Unit Electric Bed Design – A Case Study**" (paper number: **Soepardi\_1**) at the 13<sup>th</sup> Annual International Conference on Industrial Engineering Theory, Applications & Practice to be held from September 7- 10, 2008 in Las Vegas, Nevada

Please note that this acceptance, as well as the publication of your paper in the Conference Proceedings and the presentation at the conference is subject to your sending the Registration Fee and the Copyright form. The registration form can be downloaded from the conference website (<http://ijienr.org/registration.htm>). Also, please note that early registration deadline is **July 17, 2008**.

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## APPLICATION OF FUZZY FMEA TO THE INTENSIVE CARE CORONARY UNIT ELECTRIC BED DESIGN

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**Abstract:** According to *Medical Device Good Manufacturing Practices Regulation*, FMEA technique is devoted to determining design reliability by considering potential causes of failure and their effects on the medical equipment. Intensive care unit (ICU) and intensive care coronary unit (ICCU) electric bed is a development of manual bed type in which the motion system had used electric power and gas-spring. There is a difference significant of RPN rating results between a traditional and fuzzy FMEA. Consider 88 failure modes that resulted from failure analysis, only 15.9% (14 failure modes) have the same RPN rating position.

### 1. INTRODUCTION

Failure Mode and Effect Analysis (FMEA) deals with the identification of its failure modes, failure causes and frequencies and the effect that might result if any specific failure occurs during the process operation. Traditionally, FMEA has been a design tool, used extensively in the recognition and understanding of inherent design weaknesses. Based on the information provided by FMEA, design and management personnel are better informed about the way to determine what can be done in order to avoid or mitigate failure modes. This information also provides basic input to reliability models that can be used to predict and measure product reliability performance against specified targets and requirement.

In a traditional FMEA, the criticality assessment is performed by developing a risk priority number (RPN). RPN is the product of the severity, occurrence, and detection ratings. These parameter are assumed to be equal importance, but this may not be the case in practice. Failure modes having a higher RPN are assumed to be more important and given a higher priority for corrective action than those having a lower RPN. It has been pointed out that the same RPN can be obtained from a number of different score combinations of severity, occurrence and detection. The same value of RPN may imply difference risk representations. According Xu et al. (2002) FMEA team usually suffers from several difficulties when conducting FMEA in real industrial situation. In conducting FMEA, the diversity and ability of the FMEA team members are the most important considerations. It is difficult to share the team members' experience.

Fuzzy system is a knowledge-based system which is constructed from expertise and experience in the form of fuzzy IF-THEN rules. Through building knowledge-based model, expert knowledge and judgment could be utilized to make the FMEA assessment method more reasonable and convenient.

In this paper, we focus on the use and applicant of fuzzy inference technique as an alternative to overcome the weakness associated with the traditional FMEA system. Comparing with traditional FMEA, the fuzzy approach allows failure risk evaluation and prioritization to be conducted based on experts' knowledge.

#### 1.1 The Traditional FMEA

Considered as the last point in failure investigation, FMEA is devoted to determining design reliability by considering potential causes of failure and their effects on the system under study. Briefly, FMEA is concerned with listing each potential failure mode of a (global) system and its effects on the listed subsystems (Braglia, 2000). This bottom-up approach can be utilized at any level, from complete systems to components.

The main advantages of FMEA are: it is a visibility tool that can easily be understood and used, a systematic procedure which is arranged in a computer program based on a data base, it identifies weakness in the system design, focusing attention on a few components rather than on many and useful in design comparison.

The traditional FMEA procedure is explained as follows. First, listing the subsystem and parts of the system (functional analysis). Second, listing and description of all failure modes for the part under consideration. Third, assign the severity rating of each failure mode according to the respective effects on the system, assign the occurrence rating of each failure mode according to its likelihood of occurrence, assign the detection rating of each failure mode. Fourth, calculate RPN and establish the priorities for attention. Fifth, take recommended action to enhance and correct the performance of system.

### 1.2 Fuzzy FMEA

In fuzzy FMEA, the three input factors of the RPN function, i.e. severity, occurrence and detect, are assumed to be the input factors of the fuzzy RPN function as well. According to Yeh and Hsieh (2007), this approach is similar to the fuzzy expert system and control system, the inference process of fuzzy FMEA includes:

1. Fuzzification:

Through defining the membership functions of input fuzzy sets which are determined by expertise, the three parameters, (S), (O), and (D) ratings, can be transformed into fuzzy input.

2. Rule evaluation:

By using the IF-THEN rules gathered from experts and engineers and integrating them into fuzzy rule, the fuzzy IF-THEN rules in fuzzy rule base can be combined into a mapping from fuzzy inputs to fuzzy conclusion.

3. Defuzzification:

Through defining the membership functions of output fuzzy sets and defuzzifier, fuzzy conclusion can be converted into a real-valued risk representation.

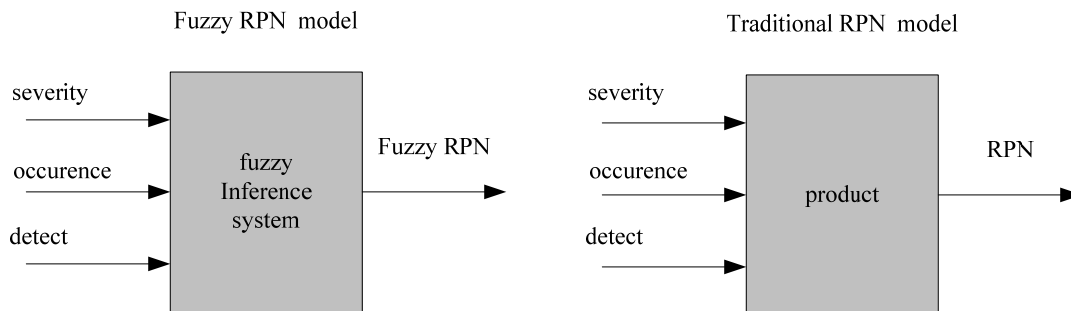


Figure 1. Comparison between the traditional and fuzzy RPN function  
 (Tay and Lim, 2006)

## 2. METHODOLOGY

### 2.1 Fuzzy Membership Function

The variables used in the case studies consists of input variable and output variable. Input variable consists of severity (S), occurrence (O), and detection (D) value, is varied from 1 to 10. Similar to the traditional RPN system, the fuzzy RPN output is assumed to be varying from 1 to 1000.

In this paper, input variable is divided into five linguistic terms equal partitions namely: remote (R), low (L), moderate (M), high (H), and very high (VH). Risk, the output variable, is used to represent the priority for corrective action with five



linguistic terms: low (L), low medium (LM), medium (M), high (H), and medium high (MH). In the proposed fuzzy FMEA approach, several experts are required to develop the membership functions of the input and output variables.

The triangular membership function ( $a, b, c$ ) is used to represent each linguistic terms. Abscissa ( $x$ ), represents the specified rating and ordinate ( $\mu(x)$ ) represents the value of its membership function, i.e. the degree of membership. The input membership functions of five linguistic terms for occurrence in this example can be presented in Equation 1 and illustrated in Figure 2.

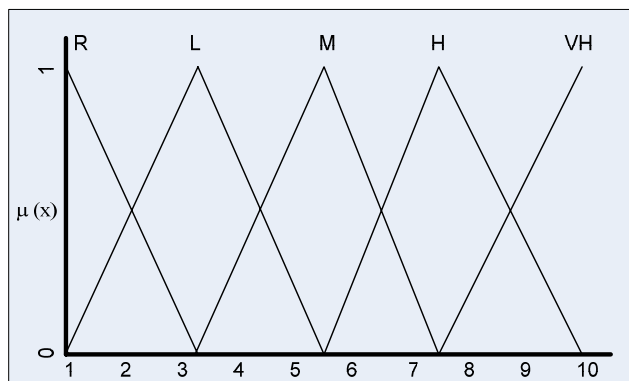


Figure 2. Membership Function for Occurrence

## 2.2 Fuzzy Rule Base

In a fuzzy inference system, experts' knowledge is represented with a rule base comprising fuzzy production rules (Jang et al., 1997). Each fuzzy production rule consists of two parts: an antecedent (input) and consequent (output). Generally, a fuzzy production rule has the form (Tay and Lim, 2006):

**If**  $X_1$  is  $F_1$  and ...  $X_n$  is  $F_n$ , **then**  $Y$  is  $G$

where  $X_i$  and  $Y$  are the inputs and output of the fuzzy inference system,  $F_i$  and  $G$  are input and output linguistic variables, respectively.

Considering the input and the linguistic terms describing each inputs as exemplified in this case studies, the fuzzy rule base has 125 ( $5 \times 5 \times 5$ ) rules in total using the grid partition approach. All the combinations should be grouped to generate the fuzzy rule base. The example of some rules presented in Table 1.

Table 1. An Example of Fuzzy Rules

Rule #	<b>IF</b>			<b>THEN</b>
	Severity	Occurance	Detection	Risk
R1	R	R	VH	L
R27	L	R	H	LM
R40	L	M	R	H
R56	M	L	VH	L

R65	M	M	R	H
R96	H	V	VH	L
R97	H	V	H	LM
R108	VH	L	M	M
R125	VH	V	R	H

In this studies, minimum inference engine is used to combine the fuzzy IF-THEN rules in fuzzy rule base and implicate the fuzzy conclusion. The minimum inference engine uses: 1) *min* operator for and in the IF-part of rules and *max* operator for or in the IF-part of rules, 2) the *union* combination (*max* operator) to aggregate the consequence of individual rules.

### 2.3 Defuzzification

In this paper, the product-sum composition inference was used in the fuzzy inference system while the weighted average method was used as the defuzzification approach.

## 3. RESULTS

The actual case study here proposed deals with a medical equipment, i.e. intensive care unit (ICU) and intensive care coronary unit (ICCU) electric bed. According to its functions, ICU-ICCU electric bed can be classified into five subsystem function level 1: place the uses, defense load, arrange mattress position, move the bed, place the bed, and arrange the slope. In order to mathematical express each failure mode, let  $F_{ijkl}$  represent the  $k$ -th potential effect failure mode in the  $i$ -th subsystem function level 1 and  $j$ -th subsystem function level 2. Subscript  $l$  used to represent potential cause failure mode.

Consider 88 failure modes that resulted from failure analysis. The failure mode  $F_{611e}$ ,  $F_{611c}$ ,  $F_{311d}$  have the same RPN of 140 and the same priority of 7. However, the different ratings combinations can infer different fuzzy risk. Thus, they have the fuzzy rankings of 2, 4, and 11, respectively. By using the fuzzy FMEA, it is convenient for user to differentiate the risk representations in the failure having the same RPN.

Consider that the failure modes  $F_{211a}$  and  $F_{341g}$  where the RPN is 16. The value of (S), (O), (D) ratings are 8, 2, 1 and 4, 4, 1, respectively. Although the RPN for both failure modes are the same, the risk level may be different. The fuzzy ranks of 27 and 28. The failure mode  $F_{211a}$  has a higher priority than  $F_{341g}$ . Thus, the traditional FMEA may result in a different action.

In addition, the ranking produced by the proposed method doesn't differentiate the failure modes which have the adjacent ratings. Failure modes  $F_{331i}$  and  $F_{421d}$ , where (S), (O), (D) ratings are 5, 2, 1 and 5, 6, 4. The fuzzy ranking is 24 for both failure modes. This entails these two failure modes should be given the same priority. However, the traditional FMEA method procedures the resulting RPN of 10 and 120, respectively.

Table 2. The Part of Priority RPN and Fuzzy RPN Results

Failure mode	Input Variable			RPN	RPN RANKING	FUZZY RPN	FRPN RANKING
	(S)	(O)	(D)				
6.1.1.g	10	3	7	210	4	665	1
6.1.1.e	10	2	7	140	7	610	2
2.5.1.b	10	2	7	140	7	610	2
6.1.1.a	10	4	7	280	3	583	3
6.1.1.c	10	2	7	140	7	565	4
3.1.1.d	5	4	7	140	7	472	11
4.1.1.c	5	4	7	140	7	472	11
4.2.2.b	6	3	6	108	10	463	12
3.3.1.i	5	2	1	10	30	305	24
4.2.1.d	5	6	4	120	9	305	24
2.1.1.a	8	2	1	16	27	113	27
2.1.1.b	8	2	1	16	27	113	27
3.4.1.d	4	2	1	8	32	113	27
3.4.1.g	4	4	1	16	27	85	28

#### 4. CONCLUSION

The analysis of the results produced by the traditional FMEA and the fuzzy FMEA methods shows that a more accurate, reasonable ranking can be achieved by applying fuzzy FMEA. The most critical disadvantage of the traditional FMEA is that various combinations of the three parameter ratings may procedure an identical value of RPN. However, the risk representations may be thoroughly different.

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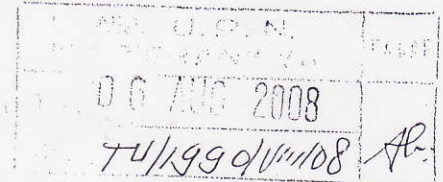
**DEPARTEMEN PENDIDIKAN NASIONAL**  
**DIREKTORAT JENDERAL**  
**PENDIDIKAN TINGGI**

Jalan Raya Jenderal Soedirman Pintu I, Senayan Jakarta 10002  
Telepon: (021) 57946100 ( HUNTING )

Nomor : 195/D3/DP2M/VIII/2008  
Lampiran : 1 berkas  
Perihal : Persetujuan Bantuan Biaya Seminar Luar Negeri  
Bagi Peneliti/Dosen di Perguruan Tinggi

Kepada Yth. : Rektor UPN "Veteran" Yogyakarta  
Jl. SWK 104 Ringrut Utara Condong Catur, Sleman

1 Agustus 2008



Dengan Hormat

Sehubungan dengan surat Direktur Penelitian dan Pengabdian Kepada Masyarakat No. 187/D3/LL/2008 tanggal 26 Maret 2008 perihal " Program Bantuan Seminar Luar Negeri Bagi Peneliti Dosen Di Perguruan Tinggi " dan menindak lanjuti surat Direktur Penelitian dan Pengabdian Kepada Masyarakat No. 760/D3/TU/2008 tanggal 11 Juli 2008 dan sehubungan dengan usulan dari universitas saudara bersama ini kami sampaikan " Daftar Nominasi Penerima Bantuan Seminar Luar Negeri Tahun 2008 " yang telah disetujui pembiayaannya ( daftar terlampir)

Setelah ditanda tangani Kwitansi dan Surat Perjanjian terlampir segera disampaikan kepada Kami untuk diusulkan ke Departemen Keuangan untuk pencairan bantuan dananya

Mohon kepacia yang bersangkutan membuat laporan kegiatan dan rincian biaya yang dilakukan pada saat seminar diluar negeri setelah kepulangan dari mengikuti seminar tersebut.

Demikian Kami sampaikan, atas perhatian dan kerjasamanya diucapkan terima kasih.

Direktorat Penelitian dan Pengabdian  
Kepada Masyarakat  
Penanggung Jawab Kegiatan

  
R.M. Wibowo  
NIP. 130 803 390

Tembutsan Yth :

1. Direktur Jenderal Pendidikan Tinggi Depdiknas ( Sebagai Laporan )
2. Direktur Penelitian dan Pengabdian Pada Masyarakat
3. Yang bersangkutan



LAMPIRAN SEMINAR INTERNASIONAL

NOMOR :  
 PERGURUAN TINGGI : UPN "Veteran" Yogyakarta  
 TANGGAL DIPA : 31 Desember 2007  
 NOMOR DIPA : 0145.0/023-04.0/-/2008  
 UNIT ORGANISASI : Direktorat Jenderal Pendidikan Tinggi  
 LEMBAGA/DEPARTEMEN : Departemen Pendidikan Nasional

NO	NAMA	SEMINAR	NEGARA TUJUAN	TANGGAL PELAKSANAAN	JUMLAH DANA
1.	Prof.Dr.Ir. Sari Bahagiarti K, M.Sc	The 14th International Conference of Women and Scientists)	Lille, Perancis	15 Juli 2008 s/d 18 Juli 2008	Rp. 19,150,000
2.	Apriani Soepardi, STP, MT	The 13th Annual International Conference on Industrial Engineering Theory, Application & Practice	Las Vegas, Amerika Serikat	7 September 2008 s/d 10 September 2008	Rp. 19,800,000
TOTAL DANA Terbilang : Tiga puluh delapan juta sembilan ratus lima puluh ribu rupiah					Rp. 38,950,000

Direktur Penelitian dan Pengabdian kepada Masyarakat



Prof. Dr. Ir. Moch. Munir, MS.  
 NIP. 130 935 075





**SURAT PERJANJIAN  
BANTUAN SEMINAR INTERNASIONAL  
TAHUN ANGGARAN 2008  
Nomor : 0064/TU/DP2M/2008**

Pada hari ini **Senin** tanggal **empat belas** bulan **Juli** tahun **Dua Ribu Delapan**, kami yang bertandatangan dibawah ini :

1. **Prof.Dr.Ir. Mochammad Munir, MS.** : **Direktur Penelitian dan Pengabdian kepada Masyarakat, Direktorat Jenderal Pendidikan Tinggi** yang berkedudukan di Jakarta, dalam hal ini bertindak selaku Pejabat Pembuat Komitmen, berdasarkan Surat Keputusan Direktur Jenderal Pendidikan Tinggi Nomor: 01/DIKTI/Kep/2008 tanggal 2 Januari 2008; untuk selanjutnya disebut **PIHAK PERTAMA.**
  
2. **Dr.H.Didit Wely Udjiyanto MS** Sebagai **Rektor UPN "Veteran" Yogyakarta** yang berkedudukan di Yogyakarta, dalam hal ini bertindak untuk dan atas nama perguruan tinggi tersebut; untuk selanjutnya disebut **PIHAK KEDUA.**

Kedua belah pihak berdasarkan kepada:

1. Undang-Undang Republik Indonesia No. 20 Tahun 2003;
2. Undang-Undang Republik Indonesia No. 17 Tahun 2003;
3. Undang-Undang Republik Indonesia No. 01 Tahun 2004;
4. Undang-Undang Republik Indonesia No. 15 Tahun 2004;
5. Peraturan Pemerintah Republik Indonesia No. 20 Tahun 2004;
6. Peraturan Pemerintah Republik Indonesia No. 21 Tahun 2004;
7. Keputusan Presiden Republik Indonesia No. 42 Tahun 2002;
8. Keputusan Presiden Republik Indonesia No. 72 Tahun 2004;
9. Keputusan Presiden Republik Indonesia No. 85.M Tahun 1999;
10. Keputusan Presiden Republik Indonesia No. 102 Tahun 2001;
11. Keputusan Menteri Pendidikan Nasional Nomor : 029/O/2001;
12. Keputusan Menteri Pendidikan Nasional Nomor : 18274/A.A3/KU/2005;
13. Peraturan Menteri Pendidikan Nasional Nomor : 15 Tahun 2005;
14. Keputusan Menteri Pendidikan Nasional Nomor : 451/A3.3.KU/2005;
15. DIPA (Daftar Isian Pelaksanaan Anggaran) Nomor : 0145.0/023-04.0/-/2008 Tanggal 31 Desember 2007;
16. POK (Pedoman Operasional Kegiatan) Tahun Anggaran 2008 Nomor : 15/D/B/2008 Tanggal 4 Januari 2008.

PIHAK PERTAMA dan PIHAK KEDUA secara bersama-sama bersepakat mengikatkan diri dalam suatu Perjanjian Pelaksanaan Pekerjaan Bantuan Seminar Internasional dengan ketentuan dan syarat-syarat diatur dalam pasal-pasal berikut:

#### PASAL 1

- (1) **PIHAK PERTAMA** memberi tugas kepada **PIHAK KEDUA**, dan **PIHAK KEDUA** menerima tugas tersebut sebagai penanggungjawab pelaksanaan Pekerjaan Bantuan Seminar Internasional
- (2) Pelaksanaan Pekerjaan Bantuan Seminar Internasional sebagaimana dimaksud pada ayat (1) dibebankan pada DIPA (Daftar Isian Pelaksanaan Anggaran) Nomor: 0145.0/023-04.0/-/2008 tanggal 31 Desember 2007.

#### PASAL 2

- (1) **PIHAK PERTAMA** memberikan dana untuk kegiatan sebagaimana dimaksud pada Pasal 1 sebesar **Rp. 38,950,000,- (Tiga puluh delapan juta sembilan ratus lima puluh ribu rupiah)** yang dibebankan kepada DIPA Direktorat Jenderal Pendidikan Tinggi, Departemen Pendidikan Nasional Nomor : 0145.0/023-04.0/-/2008 tanggal 31 Desember 2007, Nama dosen dan jumlah batuan seminar internasional sebagaimana dimaksud tercantum pada lampiran surat perjanjian ini.
- (2) Dana pelaksanaan sebagaimana dimaksud pada ayat (1) dibayarkan oleh **PIHAK PERTAMA** kepada **PIHAK KEDUA** sekaligus (100%) setelah Surat Perjanjian Pelaksanaan Pekerjaan Bantuan Seminar Internasional ditandatangani oleh Kedua belah Pihak.

#### PASAL 3

- (1) Dana Pelaksanaan Pekerjaan Bantuan Seminar Internasional sebagaimana dimaksud Pasal 2 ayat (1) dibayarkan kepada Institusi/Lembaga Perguruan Tinggi sebagai berikut:

Nama Perguruan Tinggi	: UPN "Veteran" Yogyakarta
Nama Penerima pd Rek.	: UPN "Veteran" Yogyakarta
Nomor Rekening	: 0039226650
Nama Bank	: BNI Cabang UGM Yogyakarta
Alamat Bank	: Jln. Persatuan No.1 Bulaksumur Yogyakarta
Kota	: Yogyakarta
NPWP Perguruan Tinggi	: 02.034.606.0.542.000

- (2) **PIHAK PERTAMA** tidak bertanggungjawab atas keterlambatan dan/atau tidak terbayarnya sejumlah dana sebagaimana dimaksud pada Pasal 2 ayat (1) yang disebabkan karena kesalahan **PIHAK KEDUA** dalam mengisi data lembaga, nama bank, nomor rekening, alamat, dan persyaratan lainnya yang tidak sesuai dengan ketentuan.



#### PASAL 4

- (1) **PIHAK KEDUA** harus menyampaikan laporan hasil seminar internasional sebagaimana dimaksud pada Pasal 1 selambat-lambatnya 2 ( dua ) Bulan setelah selesai seminar di luar Negeri.
- (2) Laporan hasil Pelaksanaan Pekerjaan Bantuan Seminar Internasional harus dikirimkan ke Direktorat Penelitian dan Pengabdian kepada Masyarakat, Direktorat Jenderal Pendidikan Tinggi.
- (3) Bukti pengiriman dan/atau tanda terima sebagaimana dimaksud pada ayat (2) disimpan oleh **PIHAK KEDUA**.

#### PASAL 5

- (1) Apabila **PIHAK KEDUA** berhenti dari jabatannya, sebelum pelaksanaan perjanjian ini selesai, maka **PIHAK KEDUA** wajib menyerahkan terimakan tanggung jawabnya kepada pejabat baru yang menggantikannya.
- (2) Apabila **PIHAK KEDUA** tidak dapat melaksanakan tugas sebagaimana dimaksud pada Pasal 1 maka harus mengembalikan dana yang telah diterimanya ke Kas Negara;
- (3) Apabila dikemudian hari terbukti pelaksanaan sebagaimana dimaksud pada Pasal 1 dijumpai adanya indikasi duplikasi dengan pelaksanaan lain dan/atau diperoleh indikasi ketidak jujuran/iktikad kurang baik, maka kegiatan Pelaksanaan Pekerjaan Bantuan Seminar Internasional tersebut dinyatakan batal dan **PIHAK KEDUA** wajib mengembalikan dana Pelaksanaan Pekerjaan Bantuan Seminar Internasional yang telah diterima ke Kas Negara.

#### PASAL 6

Hal-hal dan segala sesuatu yang berkenaan dengan kewajiban pajak berupa PPN dan/atau PPh menjadi tanggung jawab **PIHAK KEDUA** dan harus dibayarkan ke Kas Negara sesuai dengan ketentuan peraturan perundang-undangan yang berlaku.

#### PASAL 7

- (1) Apabila terjadi perselisihan antara **PIHAK PERTAMA** dan **PIHAK KEDUA** dalam pelaksanaan perjanjian ini akan dilakukan penyelesaian secara musyawarah dan memilih pengadilan negeri Jakarta Selatan apabila tidak tercapai penyelesaian secara musyawarah.
- (2) Hal-hal yang belum diatur dalam perjanjian ini diatur kemudian oleh kedua belah pihak secara musyawara

PASAL 8

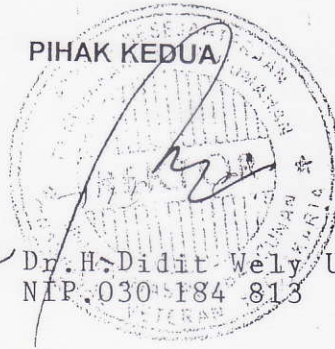
Surat Perjanjian Pelaksanaan Pekerjaan Bantuan Seminar Internasional ini dibuat rangkap 4 (empat), dan dua diantaranya bermaterai cukup sesuai dengan ketentuan yang berlaku, dan biaya materainya dibebankan kepada PIHAK KEDUA.

PIHAK PERTAMA



Prof. Dr. Ir. Moch. Munir, MS  
NIP. 130 935 075

PIHAK KEDUA



Dr. H. Didit Wely Udjianto MS  
NIP. 030 184 813

DAFTAR NOMINASI PENERIMA BANTUAN SEMINAR LUAR NEGERI  
TAHUN 2008

No.	Nama Pengusul	Perguruan Tinggi	Nama Seminar	Negara Tempat Seminar	Tanggal Pelaksanaan		Jumlah Dana Rp.
					Mulai	Selesai	
1	Prof.Dr.Ir. Sari Bahagiarti K, M.Sc	UPN "Veteran" Yogyakarta	The 14th International Conference of Women and Scientists	Lille, Perancis	15 Juli 08	18 Juli 08	19,150,00
2	Apriani Soepardi, STP, MT	UPN "Veteran" Yogyakarta	The 13th Annual International Conference on Industrial Engineering Theory, Application & Practice	Las Vegas, Amerika Serikat	07-Sep-08	10-Sep-08	19,800,00
<b>Jumlah</b>							<b>38,950,00</b>

Direktorat Penelitian dan Pengabdian Kepada Masyarakat,