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Proceeding

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5th International Seminar on Industrial Engineering & Management (5th ISIEM)

"Innovation in technology, information, and management concerning worldwide economic challenge"

February 14-16, 2012
Aston Hotel, Manado, Indonesia

Organized by:

TRISAKTI UNIVERSITY
UNTAR
Universitas Esa Unggul
ATMAJAYA UNIVERSITY
PASUNDAN UNIVERSITY
UAI Universitas Al Azhar Indonesia
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FOREWORD

This issue is published in line with the Fifth International Seminar on Industrial Engineering and Management (5th ISIEM). The theme to this seminar is "Innovation in Technology, Information, and Management Concerning Worldwide Economic Challenge". The articles cover a broad spectrum of topics including **Quality Engineering and Management, Supply Chain Management, Operation Research, Decision Support System and Artificial Intelligence, Production System, Industrial management, and Ergonomics**. The articles provide an overview of critical research issues reflecting past achievements and future challenges.

Full papers were reviewed by peer reviewers and finally we published 80 titles. This issue and seminar become special as more delegates come and join from various country as well as universities. We host 77 delegates both from abroad and local.

First and second ISIEM are hosted only by three universities, namely Trisakti, Esa Unggul and Gunadarma Universities. This year event, it's hosted by **seven** universities, i.e. Atma Jaya Catholic University of Indonesia, Trisakti University, Esa Unggul University, Pasundan University, Al-Azhar Indonesia University, Tarumanagara University, and last but not least, De La Salle Manado University

In this occasion, let us give special thank to Mr Marcus Pitt, President Director PT SOHO Industri Pharmasi and Assoc. Prof. Dr. Chuvej Chansa-ngavej, Director, SIU Research Center Program Director - PhD in Management Science, School of Management Shinawatra University (SIU International), Thailand. Your contribution to this seminar as reviewers and as keynote speakers makes this event more valuable. We are also grateful to all reviewers, for their commitment, effort and dedication in undertaking the task of reviewing all of the abstracts and full paper. Without their help and dedication, It would not be possible to produce this proceeding in such a short time frame.

We want to thank all those who submitted papers for review and those whose papers were chosen for presentation at the seminar and those who submitted manuscripts to be published in this proceeding. We highly appreciate all members of committee director, steering committee and organizing committee for mutual efforts and invaluable contributions for the success of the seminar.

Finally, have intensive discussion in this seminar and enjoyable stay in Manado

Vivi Triyanti ST. M.Sc
(Atma Jaya Catholic University of Indonesia)

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EVALUATION TO PRODUCTION PERFORMANCE CONSIDERING DEPARTMENTS DISTANCE AND ROUTE TIME USING SIMULATION WITH ARENA

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ABSTRACT

This study is about the application of a simulation model to assist performance evaluation of production considering departments distance and route time by using empirical data on a shoe-making industry. The existing condition is composed of 3 main parts which are processed into 9 departments of production. Departments 1st – 5th are a fabrication process, Departments 6th – 7th are the assembling process 1st and 2nd, Department 8th is the process of packing, and the department 9th is the inspection/Quality Control process. The three components through different fabrication processes, and the time between arrival meet to exponential distribution with an average of 13 minutes. Percentage of arrival for each component was 26% for parts A, 48% for part B, and 26% for part C.
Key words: simulation, departments distance, route time.

1. INTRODUCTION

Simulation technique is a tool for analyzing and testing solutions before implementing in the real system. As computer, because more powerful, so the use of simulation techniques as a tool for research and solving problems became more popular [1].
Concept of simulation technique is to imitate the real system as a model and after that use the model to work in many conditions and study the effects to evaluate the solution strategies for the real system. Since the simulated model will show the results and the side effect of different conditions as assumption in testing stage of the simulation model. These outcomes help the analyzer better understand the transient stage of the system and predict the effects that showed occurr during changing the system (see [2], [3] and [4]).
This study is about the application of a simulation model to assist performance evaluation of production considering departments distance and route time by using empirical data on a shoe-making industry. The existing condition is composed of 3 main parts which are processed into 9 departments of production. Departments 1st – 5th are a fabrication process, Departments 6th – 7th are the assembling process 1st and 2nd, Department 8th is the process of packing, and the department 9th is the inspection/Quality Control process.
The problem that occurs is how to improve production performance as measured by the total output of goods or product, the total time of the production process, The total of WIP, and the average waiting time in queue of each process on the Shop floor by considering the distance of the department and route time component. Simulation is used to evaluate the best alternatives generated by analyzing the behavior of the system from any scenario that has been made.

2. SYSTEM EXPLANATION

The existing condition on a shoe-making industry is composed of 3 main parts which are processed into 9 departments of production. Departments 1st – 5th are a fabrication process, Departments 6th – 7th are the assembling process 1st and 2nd,

Department 8th is the process of packing, and the department 9th is the inspection/Quality Control process.
Production Process of Shoe is shown at Figure 1 Operation Process Chart. Distance between Departments/stations is shown at Table 1. Probability distribution generated for the processing time at each station can be shown in Table 2.

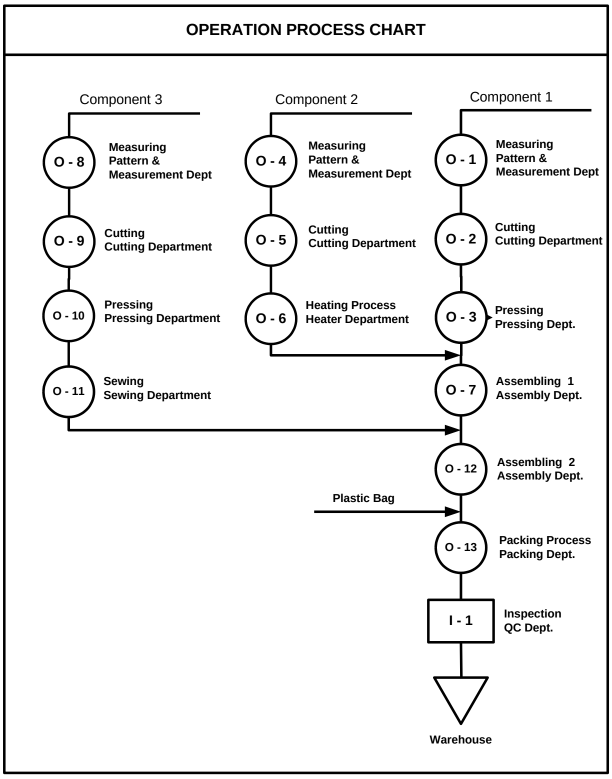

Figure 1. Operation Process Chart

Table 1. Distance Between Dept./Stations

DISTANCE BETWEEN STATIONS	A	B	C	D	E	F	G	H	I	J	K	L	M
A. Acceptance of components		17	13	19	14	16	10	10	7	7	12	11	6
B. measuring table.Station	17		12	8	10	22	7	7	5	5	12	17	19
C. Cutting machine.Station	13	12		12	11	11	8	8	9	9	20	4	21
D. Press Machine.Station	19	8	12		11	20	12	12	9	9	12	13	14
E. Heater.Station	14	10	11	11		18	15	15	19	19	11	13	6
F. Sewing Machine.Station	16	22	11	20	18		6	6	7	7	6	8	6
G. component 1 Assembling 1.Station	10	7	8	12	15	6		1	13	13	19	11	6
H. component 2 Assembling 1.Station	10	7	8	12	15	6	1		17	17	5	5	16
I. component 3 Assembling 2.Station	7	5	9	9	19	7	13	17		1	7	17	15
J. component Assembling 1.Station	7	5	9	9	19	7	13	17	1		17	10	10
K. Packing.Station	12	12	20	12	11	6	19	5	7	17		4	7
L. Inspection.Station	11	17	4	13	13	8	11	5	17	10	4		7
M. Warehouse.Station	6	19	21	14	6	6	6	16	15	10	7	7	

Table 2. Distribution probability for each processing time

Parts	Departements				
	Pattern & Measurement	Cutting	Pressing	Heater	Sewing
1	EXPO (10)	EXPO (9)	EXPO (20)		
2	EXPO (15)	EXPO (7)		EXPO (10)	
3	EXPO (10)	EXPO (10)	EXPO (18)		EXPO (25)

3. MODEL AND SIMULATION

3.1. Model Assumptions

The assumptions used in the model as follows :

- Simulation Setting (Run Setup) : 1 time number of replication and replication length : 6 days with 8 work-hour per day.
- Processing time for each station/department are exponentially distributed (see Table 2).
- Fixed capacity operator 1 person for each machine.
- Rute time needed at the time of leaving each station is constant 0.25 minute delay for each unit and the transporter that is used as a transfer material has a velocity of 10 seconds for each unit of movement.
- Rejected/failed product are assumed at 10% of the products manufactured.

3.2. Performance Measures

The problem that occurs is how to improve production performance as measured by the total output of goods or product, the total time of the production process, The total of WIP, and the average waiting time in queue of each process on the Shop floor by considering the distance of the department and route time component.

- Total output : the number of product output in a range of simulation time
- Total time for completed processing of product.
- Number of WIP : number of product work in process or waiting in queue for processed.
- Average waiting time in queue for each production process.

3.3. Simulation Model

The model places the logic model flow in ARENA block modelling according to the process flows of each components as follows the operation process chart in Figure 1. The logic model with ARENA block modelling shown in Figure 2, 3, 4, 5, 6 and Figure 7 respectively:

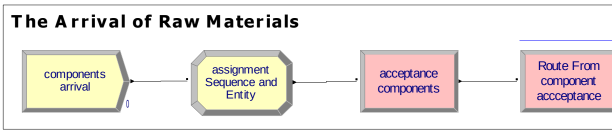

Figure 2. The Arrival of Raw Material Model

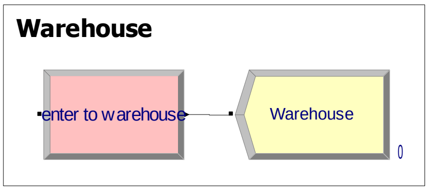

Figure 3. Warehouse Block Model

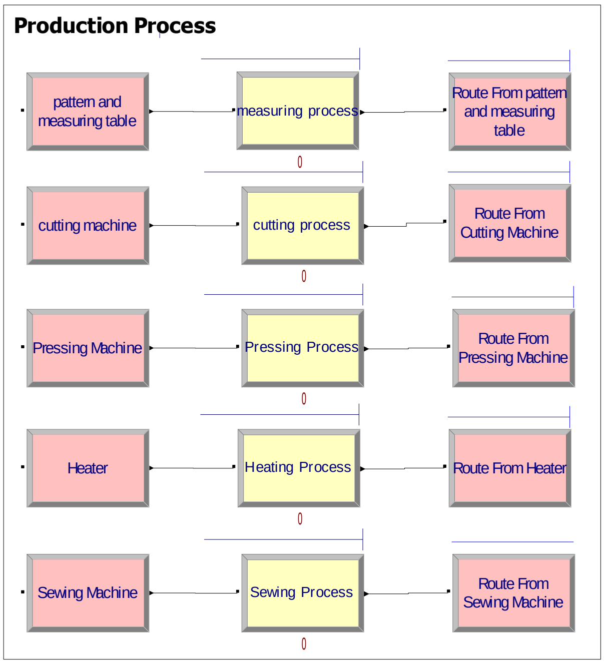

Figure 4. The Production Process Model

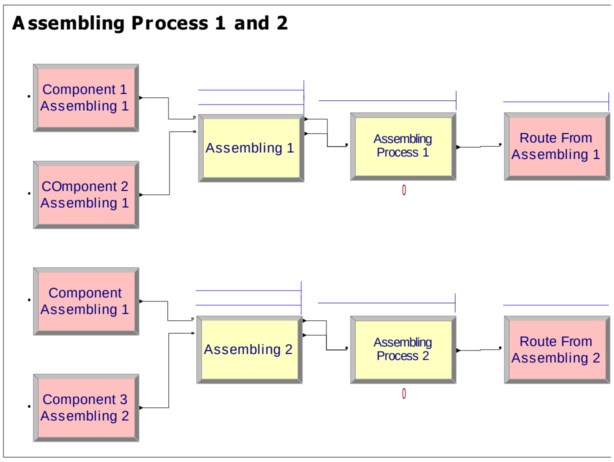

Figure 5. Assembling Process 1 & 2 Block Model

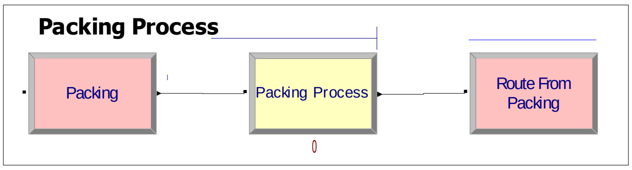

Figure 6. The Packing Process Model

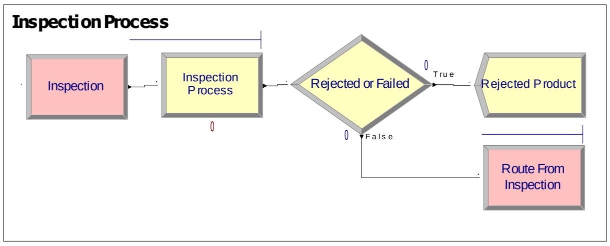

Figure 7. The Inspection Process Model

Model is built using the ARENA model of basic process modules, advanced process and transfer advanced to represent the real system. Use of the transfer module is intended to generate a route time behavior. As for the distance between the department used distance and transporter module.

The parameters that has been given to the simulation model in accordance with the system previously mentioned assumptions.

4. SIMULATION EXPERIMENTS

Simulation experiment is carried out by using 3 simulated scenarios. The scenario is constructed aiming to observe the behavior of the system from changes in total WIP, total output, the average waiting time in queue, and processing time at each station / department to consider the route time and distance between departments.

The first scenario is original empirical data and existing condition. The second scenario make changes to the original route time constant of 0.25 minute per unit of motion, transformed into exponentially distribution with mean 0.25 minute. While the third scenario is to make changes in the distances between departments.

The distance between stations for 3rd scenario shown in Table 3.

Table 3. Distance Between Stations for 3rd Scenario

DISTANCE BETWEEN STATIONS	A	B	C	D	E	F	G	H	I	J	K	L	M
A. Acceptance of components		3	6	9	10	12	4	5	7	6	15	10	5
B. Measuring table.Station	3		3	6	9	12	4	5	7	6	8	8	5
C. Cutting machine.Station	6	3		3	6	9	12	13	10	9	8	6	7
D. Press machine.Station	9	6	3		4	10	6	5	4	5	6	7	2
E. Heater.Station	10	9	6	4		11	8	8	10	10	3	4	2
F. Sewing machine.Station	12	12	9	10	11		7	6	8	9	6	7	5
G. Component 1 assembling 1.Station	4	4	12	6	8	7		3	6	4	10	5	3
H. Component 2 Assembling 1.Station	5	5	13	5	8	6	3		10	10	4	3	5
I. Component 3 Assembling 2.Station	7	7	10	4	10	8	6	10		6	7	6	9
J. Component Assembling 1.Station	6	6	9	5	10	9	4	10	6		13	5	7
K. Packing.Station	15	8	8	6	3	6	10	4	7	13		4	5
L. Inspection.Station	10	8	6	7	4	7	5	3	6	5	4		2
M. Warehouse.Station	5	5	7	2	2	5	3	5	9	7	5	2	

4.1. Output Analysis

The Results of the three scenarios after a simulation run gives as shown in Table 4, 5, and 6.

Table 4. The Result of 1st Scenario

Process	Processing Time (minute)	Waiting Time (minute)	Total Output (units)	Total Average WIP	
				Comp/Parts	(units)
Assembling Process 1	10.68	13.22	17	Component 1	17.17
Assembling Process 2	15.61	35.44			
Packing Process	10.27	4.67			
Heating Process	12.88	8.08	17	Component 2	45.81
Inspection Process	2.59	0.00			
Cutting Process	22.58	28.98			
Pattern & Measuring Process	37.32	206.56	34	Component 3	8.99
Sewing Process	19.63	22.51			
Pressing Process	29.46	55.95			

Table 5. The Result of 2nd Scenario

Process	Processing Time (minute)	Waiting Time (minute)	Total Output (units)	Total Average WIP	
				Comp/Parts	(units)
Assembling Process 1	31.31	16.42	29	Component 1	11.92
Assembling Process 2	24.83	43.69			
Packing Process	18.35	17.15			
Heating Process	17.98	11.46	28	Component 2	48.34
Inspection Process	3.45	0.16			
Cutting Process	27.37	34.65			
Pattern & Measuring Process	45.63	596.47	56	Component 3	8.43
Sewing Process	25.33	12.92			
Pressing Process	35.12	83.33			

Table 6. The Result of 3rd Scenario

Process	Processing Time (minute)	Waiting Time (minute)	Total Output (units)	Total Average WIP	
				Comp/Parts	(units)
Assembling Process 1	15.24	17.56	23	Component 1	13.88
Assembling Process 2	17.44	25.33			
Packing Process	15.3	12.6			
Heating Process	20.02	24.68	22	Component 2	51.01
Inspection Process	2.35	0.19			
Cutting Process	28.99	22.71			
Pattern & Measuring Process	39.82	167.63	44	Component 3	3.49
Sewing Process	18.11	5.09			
Pressing Process	27.25	20.47			

4.2. Validation and Verification

Validation and verification evidence was gathered from the simulation results for the run simulating 6 days of activities. Since this was a closed queuing network there were no new entities entered or leaf the system except the entities indicated to ship-out from the plant as finished goods. The simulation output was verified by using a constant number to check with the summation of processing time of one flow line equal to simulation running result in order to make sure that model represented the real production system.

5. CONCLUSION

From the simulation results, shows that the outcomes of the 3rd scenario that showed better results, which obtained the reduction of processing time, average time waiting in queue, total output is larger and less total WIP. In the 3rd scenario is a reduction of the distance between departments to close departments that have the longest time in the process of movement between departments.

The best result to scenario comparison can be shown in Table 7, and 8.

Table 7. The Comparison of Procesing Time

Process	Processing Time		
	1st Scenario (minute)	2nd Scenario (minute)	3rd Scenario (minute)
Assembling Process 1	10.68	13.31	15.24
Assembling Process 2	15.61	24.83	17.44
Packing Process	10.27	18.35	15.3
Heating Process	12.88	17.98	20.02
Inspection Process	2.59	3.45	2.35
Cutting Process	22.58	27.37	28.99
Pattern & Measuring Process	37.32	45.63	39.82
Sewing Process	19.63	25.33	18.11
Pressing Process	29.46	35.12	27.25

Table 8. The Comparison of WIP

Component / Parts	Total Output			Total Work In Process		
	1st Scenario units	2nd Scenario units	3rd Scenario units	1st Scenario units	2nd Scenario units	3rd Scenario units
Component 1	17	29	23	17.17	11.92	13.88
Component 2	17	28	22	45.81	48.34	51.01
Component 3	34	56	44	8.99	8.43	3.49

Graphic Processing Time, Total Output and Total Work in Process for three scenarios can be shown in Figure 8, 9 and 10

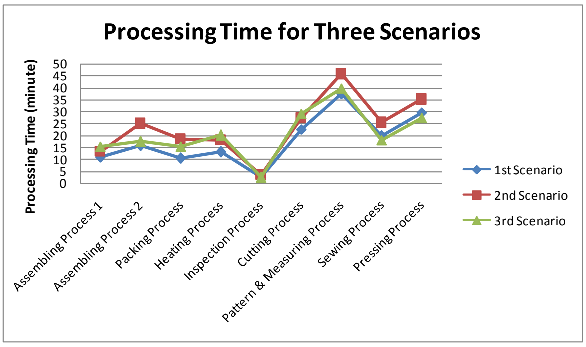

Figure 8. Processing Time for Three Scenarios

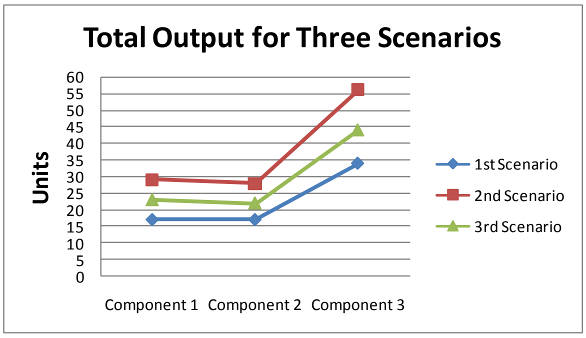

Figure 9. Total Output for Three Scenarios

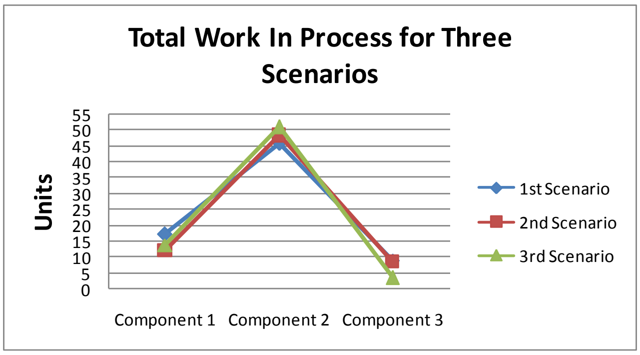

Figure 10. Total Work In Process for Three Scenarios

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