DESIGNING PRODUCTION SCHEDULING WITH FUZZY PERT TO SOLVE RESOURCE CONSTRAINTS THROUGH LANG'S ALGORITHM

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ABSTRACT

XYZ is a manufactured company which produces shoes. This company has scheduling problem. Machine utilization and labor management is not manage and schedule properly. It will become a threat in the future for this growing company. Recently, scheduling is running by owner's intuition. Thus, this research applied Fuzzy PERT and Lang's Algorithm in the company for scheduling production. This research used information from the company to make scheduling by production time, production process and expert judgement. Production time used to measure standard time in shoes production. Expert judgment used to Fuzzy PERT, so the production total time with expert judgement can be define. Then, that two production total time become a Lang's Algorithm input. Thus, this research can define optimization level between labor with nowadays production time. The comparison is between standard total time and Fuzzy Pert total time. The results from data processing define with the Fuzzy PERT method, production total time can be reduce. Standard time for shoes production is 1946,48 seconds or 32,44 minutes. Fuzzy PERT production time is 1835,12 seconds or 30,59 minutes. Through Lang algorithm analysis, it is not necessary to increase number of labor, because the difference of total time between standard time and Fuzzy PERT is not too significant. The production scheduling use the results from Fuzzy PERT method because the production time can be reduce 111,36 seconds or 1,86 minutes. The scheduling use 35 labors and 22 work stations.

Key words: standard time, optimization, production scheduling

1. INTRODUCTION

Production scheduling is one factor which has an important role in the production of an industrial activity. Scheduling interpreted as a hint or indication of what should be done, by whom and by what equipment to complete a task at any given time. Judging from the usability and usefulness in an industry, scheduling can determine the quality of the system and methods of working in the industry. Good industry certainly has a good scheduling planned and structured so that scheduling can be used as an indicator to see whether the industry has run a good working system.

XYZ is a manufacturing company which produces shoes. It has a plant that is used as a place of production. Shoes production capacity has not been large enough, however, to meet the demand of customer orders or even still be a delay in its fulfillment. In the production run, it uses resources such as production machinery and employ more labor. However, when viewed from a working system that has been running for this, this company still has many problem, especially in terms of scheduling. The use of production machinery and manpower schedule management still have not scheduled properly. In terms of opportunities in markets where the need shoes that have become a staple to the community is wide, that there is a shortage for this company. This problem can become a constraint, because it may loss sales if it cannot produce according to the needs that exist in the market or cannot meet customer requested orders.

From the background above, this company must have a scheduling with optimal production time and number of labor use a calculation method appropriate with the company circumstances so the use of resources can be achieved to the best level.

The problem studied in this research is how many total standard time required to produce a pair of shoes, how much total time required to produce a pair of shoes using fuzzy PERT, how the ratio between

the number of workers currently in the workforce after using the method of fuzzy PERT using Lang's Algorithm, and how to design scheduling production of shoes in this company.

The purpose of the study is to determine the total standard time required to produce a pair of shoes, determine the total time required to produce a pair of shoes using fuzzy PERT, comparing the number of workers currently in employment after using the method of fuzzy PERT based on Lang's algorithm, and design a production scheduling shoes in this company.

2. THEORETICAL BACKGROUND

PERT development with Fuzzy Delphi method is use with calculate the value of t_1, t_M dan t_2 on each activity. Experts give the activity finishing time with triangular number (t_1, t_M, t_2). For each activity, the mean of triangular number can be calculate. The defuzzification is use for find the crisp value from the activity. Maximizing value or mean formula can be use for defuzzification.

The first thing to do is expert give the judgement for each activity completion time be in he form of optimistic time, most likely time and pessimist time. After the expert judgment gather, the calculation continued by find the mean of each activity completion time with the formula (Bojadziev, 1999):

$$A_{ave} = \frac{A_1+\cdots+A_n}{n} \quad (1)$$

Then, the calculation is continued with do defuzzification to A_{ave} value from each activity to get crisp value. This is the defuzzification formula (Bojadziev, 1999):

$$t_{max}^{(1)} \frac{m_1+m_M+m_2}{3} \quad (2)$$

$$t_{max}^{(2)} \frac{m_1+2m_M+m_2}{4} \quad (3)$$

$$t_{max}^{(3)} \frac{m_1+4m_M+m_2}{6} \quad (4)$$

Then, the calculation is continued with calculate the geometric mean for combine the judgement from expert. The geometric mean formula is (Marimin, 2004):

$$\bar{X}_G = \sqrt[n]{\pi^n X_i} \quad (5)$$

The result from the geometric mean is the final results from fuzzy PERT calculation. There two earlier research were used as literature in this last assignment report. First article wrote a science journal and the title is “Implementation Method of AHP TOPSIS in Ranking Priority Work Order and Determination of Critical Path with Fuzzy PERT”.

This research discuss the implementation of AHP TOPSIS method in ranking priority work order at a company. The criteria weighting is use with AHP and to rank the work order is use TOPSIS. This study also determines the critical path of the priority order that is ranked first with fuzzy PERT approach (Himmah and Ciptomulyono, 2008). Second article wrote a science journal and the journal title is “Analysis and Simulation of PERT Activity Acceleration”. The journal use PERT method for solving the problem. The critical path is solved by network analysis. PERT acceleration use two methods, and the methods are with constructed optimization model and CPM acceleration (Setianingrum, 2011).

The previous research which used Lang’s Algorithm method was to calculate the number of optimal workforce at garment small scale industry. Output from its algorithm is used to build simulation modeling by Promodel (Nurhasanah, 2014).

3. RESEARCH METHOD

Figure 1 illustrates a flowchart of research method.

4. RESULT AND DISCUSSION

At Lang's algorithm calculation, the input data is the production standard time, the production time based on fuzzy PERT method and the amount of labor employed in the shoe production process. This calculation aims to seek employment optimality. This calculation is divided into two parts based on the input data used. Table 1 shown classify work elements, and Figure 2 shown the network based on Fuzzy PERT.

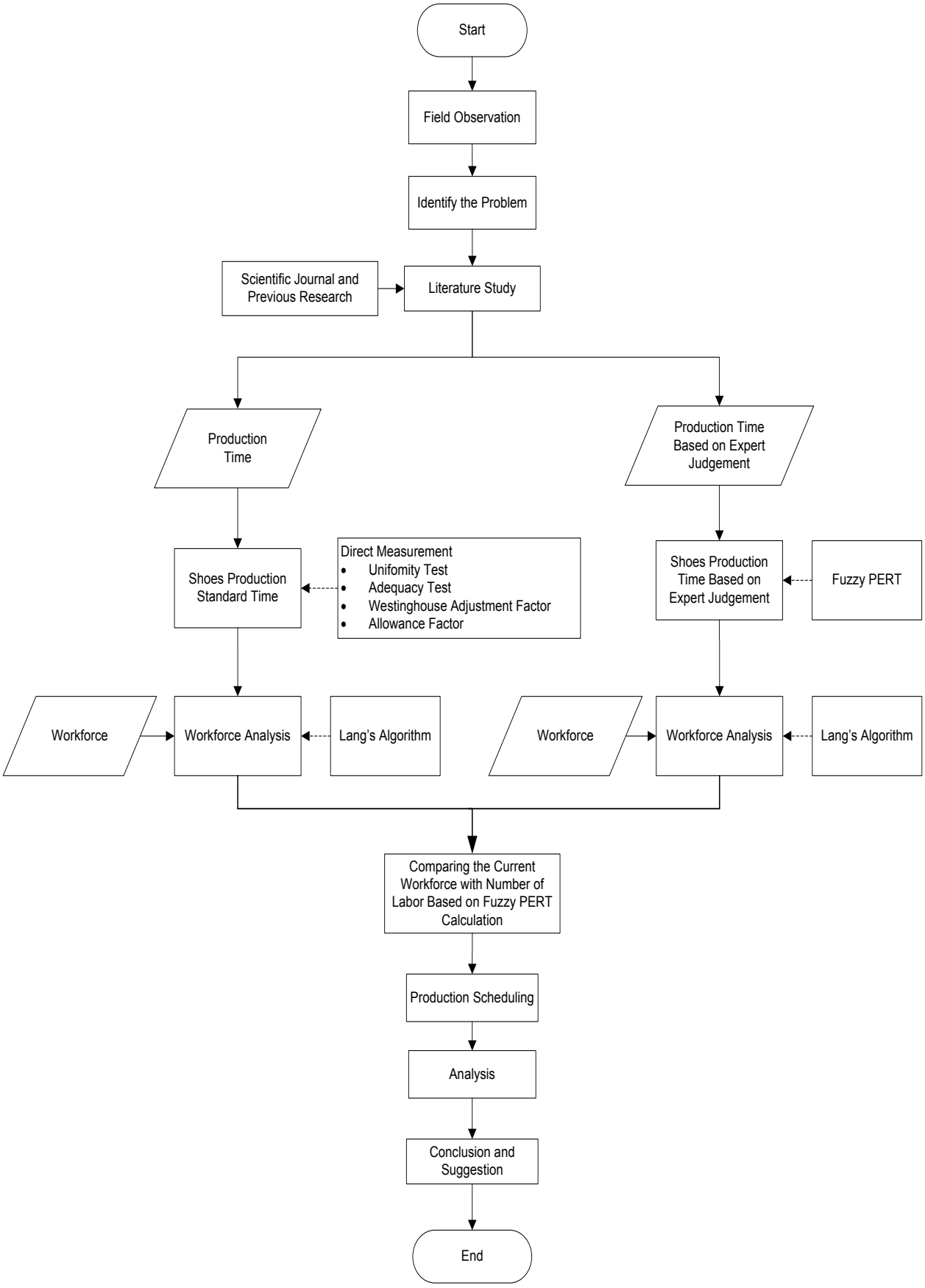

Figure 1. Research Method

Table 1. The Classifiy of Work Elements Based on the Fuzzy PERT

Work Element	Process Name	Processing Time	Work Station	Process Name	Processing Time
1	Vamp Cutting	7	1	Vamp Cutting	21
2	Vamp Skinned	8		Right Quarter Cutting	
3	Vamp Inspection	8		Left Quarter Cutting	
4	Right Quarter Cutting	7	2	Vamp Skinned	24
5	Right Quarter Skinned	8		Right Quarter Skinned	
6	Right Quarter Inspection	8		Left Quarter Skinned	
7	Left Quarter Cutting	7	3	Vamp Inspection	24
8	Left Quarter Skinned	8		Right Quarter Inspection	
9	Left Quarter Inspection	8		Left Quarter Inspection	
10	Lining Cutting	7	4	Lining Cutting	7
11	Front Lining Cutting	12	5	Front Lining Cutting	12
12	Front Lining Machine Hemming	13	6	Front Lining Machine Hemming	13
13	Mat Cutting	12	7	Mat Cutting	18
14	Insole Cutting	6		Insole Cutting	
15	Mat-Insol Gluing	6	8	Mat-Insol Gluing	6
16	Front Hardener Cutting	5	9	Front Hardener Cutting	10
17	Back Hardener Cutting	5		Back Hardener Cutting	
18	Sole Cutting (Compound)	7	10	Sole Cutting (Compound)	7
19	Sewing	328	11	Sewing	334
20	Sewing Inspection	6		Sewing Inspection	
21	Lasting	548	12	Lasting	553
22	Lasting Inspection	5		Lasting Inspection	
23	Cavity Removal	37	13	Cavity Removal	37
24	Buffing	95	14	Buffing	100
25	Buffing Inspection	5		Buffing Inspection	
26	Cementing	46	15	Cementing	46
27	Molding	467	16	Molding	472
28	Molding Inspection	5		Molding Inspection	
29	Surface Cleaning	15	17	Surface Cleaning	15
30	Painting	25	18	Painting	30
31	Painting Inspection	5		Painting Inspection	
32	Polishing	20	19	Polishing	20
33	Hole Assembly	20	20	Hole Assembly	48
34	Shoelace Assembly	28		Shoelace Assembly	
35	Final Inspection	5	21	Final Inspection	5
36	Packing	30	22	Packing	30

After the sorting is complete, researchers create a Gantt chart to analyze the ideal workforce. Figure 3 presents the Gantt chart in the calculation of fuzzy PERT. Based on Lang's algorithm calculations, it is not necessary to add the workforce. Companies only need to optimize the existing workforce at this time.

Production Scheduling Design

Production scheduling used the best production scheduling based on the criteria of production time and labor. Lang's algorithm calculation using 2 different input which uses standard time and fuzzy PERT. Both of these methods have different results. The calculation using fuzzy PERT produces shoes faster with the different production time 111.36 seconds or 1.86 minutes than calculations using the standard time.

Calculation using fuzzy PERT is a best result that will be used to design a shoes production scheduling in ABC. Production scheduling are based on fuzzy PERT calculation with total production time is 1835.12 seconds or 30.59 minutes which consists of 22 work stations and use 35 people as workers. Figure 4 presents the ABC shoe production scheduling scheme.

5. CONCLUSION

1. Total of standard time to produces a shoes is 1946 seconds or 32,44 minutes
2. Fuzzy PERT shoes production total time is 1835,12 seconds or 30,59 minutes
3. Based on Gantt chart analysis in Lang's algorithm computation, sum up the labour is not necessary because the total time difference between standard time and Fuzzy PERT is not to far
4. The result from shoes production scheduling design at XYZ is use the best production time. The production scheduling use the results from Fuzzy PERT method because the production time can be reduce 111,36 seconds or 1,86 minutes. The scheduling use 35 labours and 22 work stations.

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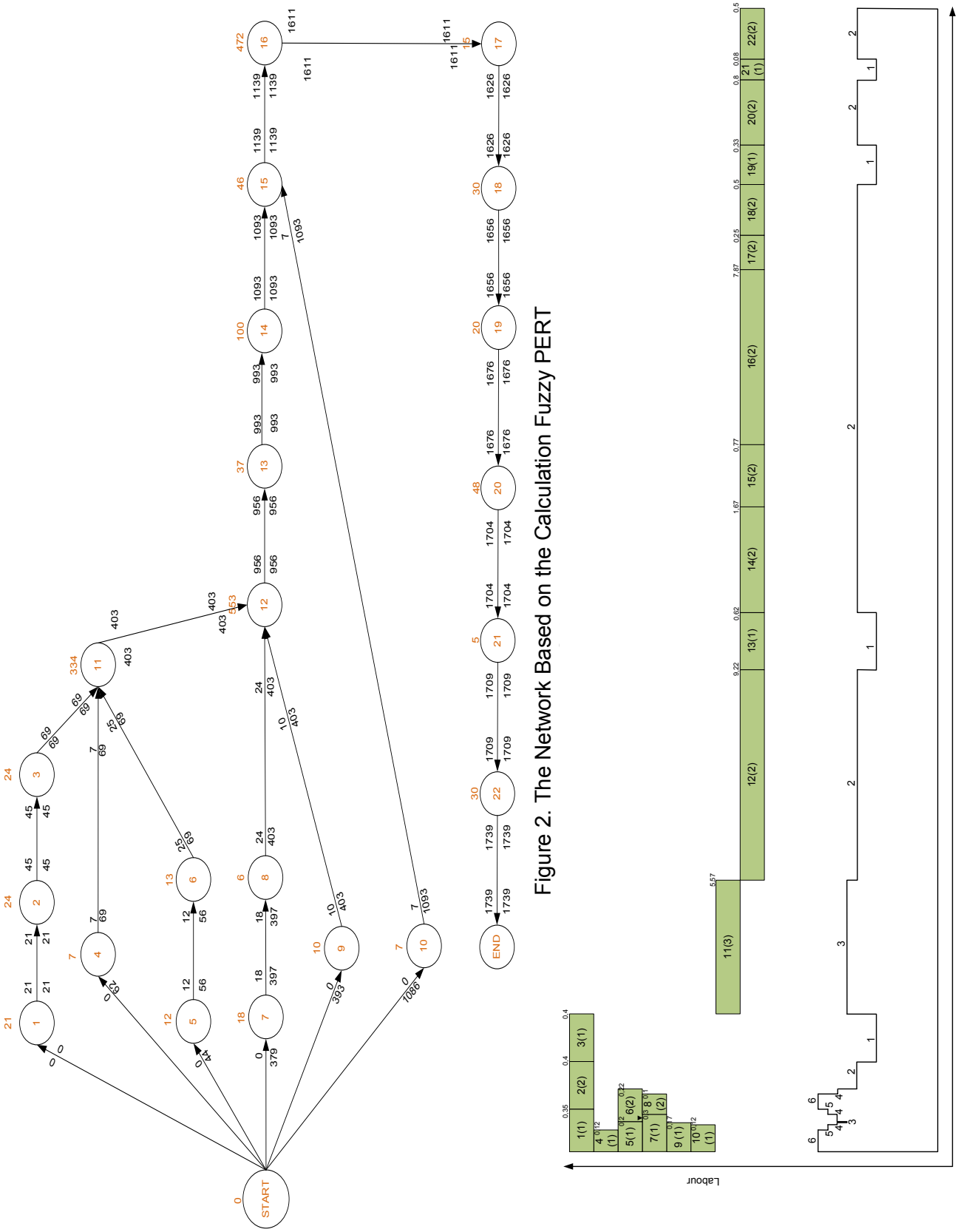

Figure 2. The Network Based on the Calculation Fuzzy PERT

Figure 3. Gantt Chart in the Fuzzy PERT Calculation