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Production Scheduling Analysis to Minimize Makespan with Nawaz Enscore Ham Method at Maros Futry Bakery and Cake Shop

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Abstract

This study aims to regulate the production schedule to reduce product makespan caused by increasing demand. This study using the Nawaz Enscore Ham method to minimize makespan on the production schedule at the Maros Futry Bakery and Cake Shop is very relevant and important. The results of this study are obtained from job sequences from the NEH method are J3-J2-J1 with a makespan time of 2.72 hours Based on the analysis and discussion, the conclusion of this study is the sequence of work in the futry bakery and cake shop obtained by the nawaz enscore ham method, namely J3-J2-J1 or on the product bolu mabel – bolu rempah – maros bread obtained during makespan which is 9827.84 seconds or 163.79 minutes or equal to 2.72 hours. So that it can reduce the buildup of demand with an increasingly fast time compared to the company's makespan time, which is 7.18 hours.

Keywords: ***Production Delivery, Makespan, Nawaz Enscore Ham (NEH) Method***

1. Introduction

Scheduling is defined as decision-making to complete a set of jobs on time and maintain their quality according to company standards through adjustments to the activities and resources owned by the company (Fachryansyah, Jhon, & Vladimir, 2021). Scheduling is done with several objectives, namely increasing utility or reducing waiting time so as to reduce process time and increase productivity (Afandi & Yulianis, 2018). There are several terms in scheduling, namely processing time, due-date, slack time, flow time, completion time, lateness, tardiness, and makespan (Harto, Garside, & Utama, 2016). Toko Futry Bakery and Cake Maros is a business engaged in the production of bread and cakes in Maros City, South Sulawesi. This store already has quite a lot of customers. There are three types of products produced, namely maros bread, spice sponge, and mabel sponge, where the three types of products are mixed in the same tool. Along with the rapid growth of the business, the demand for products also increases. The data on the average number of requests per day are: 185 pcs of original flavored maros bread, 85 pcs of durian flavored maros bread, 85 pcs of maros srikaya bread, 150 pcs of bolu rempah, and 125 pcs of balo mabel. Meanwhile, the daily production capacity for maros bread products is 250 pcs, bolu rempah 100 pcs, and bolu mabel 100 pcs.

This causes problems in managing production schedules, where the production schedule applied by the store starts at 08:30 AM to 2:00 PM. As a result, stocks always run out, so production employees work overtime. From this statement, the production schedule is still not right when compared to the store schedule, since the store itself is open from 06:00 AM to 11:59 PM. From these problems, the method carried out is the Nawaz Enscore Ham (NEH) method. The NEH method is an incremental construction algorithm that has received recognition as one of the best heuristic methods in the flow shop problem, so

it is expected to be able to provide assistance in solving company problems related to delays that can affect production costs (Arifandi, Lasalewo, & Hasanuddin, 2022). This heuristic algorithm proposes that jobs with longer overall processing times should be prioritized over jobs with shorter overall processing times (Indah, Asmal, Mangngenre, & Istiqa, 2020; Abidin, Kulsum, & Gunawan, 2017).

2. Literature Review

Scheduling is an important aspect of controlling operations in both the manufacturing and service industries. By increasing the emphasis on the market and production volume, companies can improve customer satisfaction. Effective scheduling can also increase profits in future operating functions (Abidin, Kulsum, & Gunawan, 2017). Scheduling is done with several goals, namely increasing utility or reducing waiting time to reduce process time and increase productivity, reducing makespan for a job and average flow time for each process, reducing the level of intermediate goods (work in progress) or work waiting in the queue, minimizing production costs, reducing set-up time, as well as meeting consumer demands in terms of product quality and timeliness of delivery (Afandi & Yulianis, 2018). Scheduling can be classified according to several factors. These factors include the number of machines, process flow patterns, job arrival patterns, and information systems. Scheduling based on the number of machines is divided into two, namely scheduling on one machine (single machine) and scheduling on several machines (parallel machine). Scheduling based on process flow patterns is also divided into two, namely scheduling with the flow shop model and the job shop model (Afandi & Yulianis, 2018).

3. Research Methodology

3.1 Place and Time of Research

This research will be conducted at Futry Bakery and Cake Shop located on Jl. Poros Makassar – Maros, Lagoosi Ruko No. 3 – 6, Mandai District, Maros Regency, South Sulawesi, with a research period of ± one month.

3.2 Data Sources

Secondary data is data obtained directly or indirectly from the object of the location of the place of research which is additional data but supports the course of research.

3.3 Data Collection Methods

The data collection methods used in this study are as follows:

a. Observation
   The observations made in this study are, by observing the system or how existing employees work, observing the production process from beginning to end, and production activities.
b. Documentation
   In this study the documents obtained are in the form of reports on production activities, reports on the number of production work stations.

3.4 Data Processing Methods

The method used in this study is the *Nawaz Enscore Ham* Method. The following are the stages of data processing after data collection:

a. Data Uniformity Test
b. Data Sufficiency Test
c. Nawaz enscore Ham (NEH)
d. Determine the value of iteration 1
e. Determine iteration value 2
f. Determine the iteration value on the NEH method
g. Determine makespan values
h. Compare scheduling results from the NEH method and the company method.

4. Result And Discussion

4.1 Data Uniformity Test

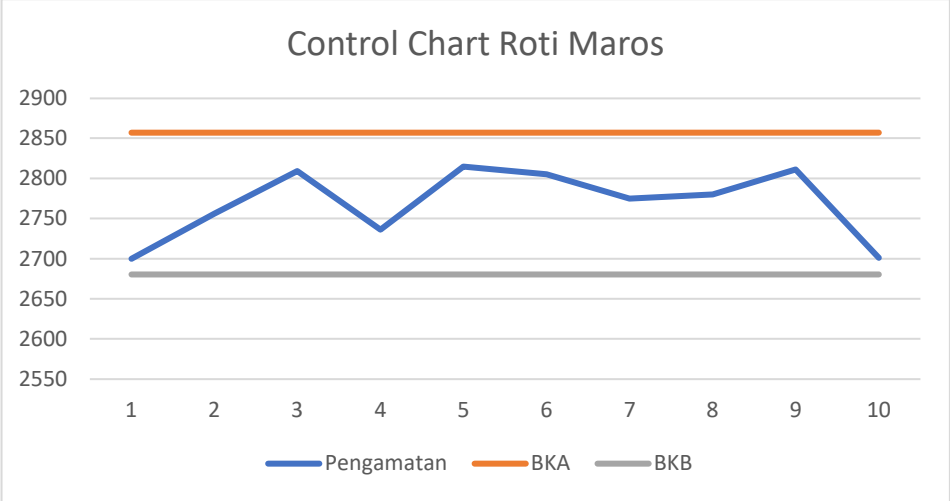

Figure.1 Control Chart Roti Maros

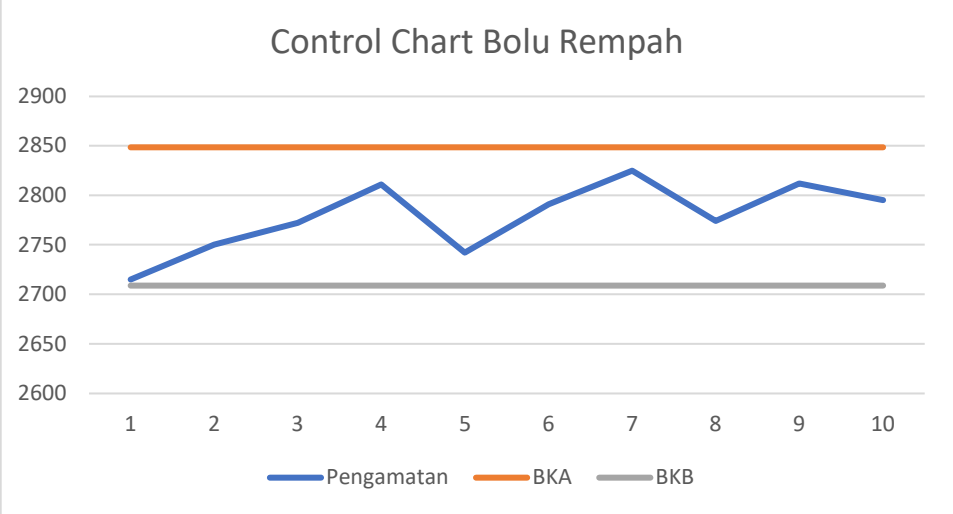

Figure.2 Control Chart Bolu Rempah

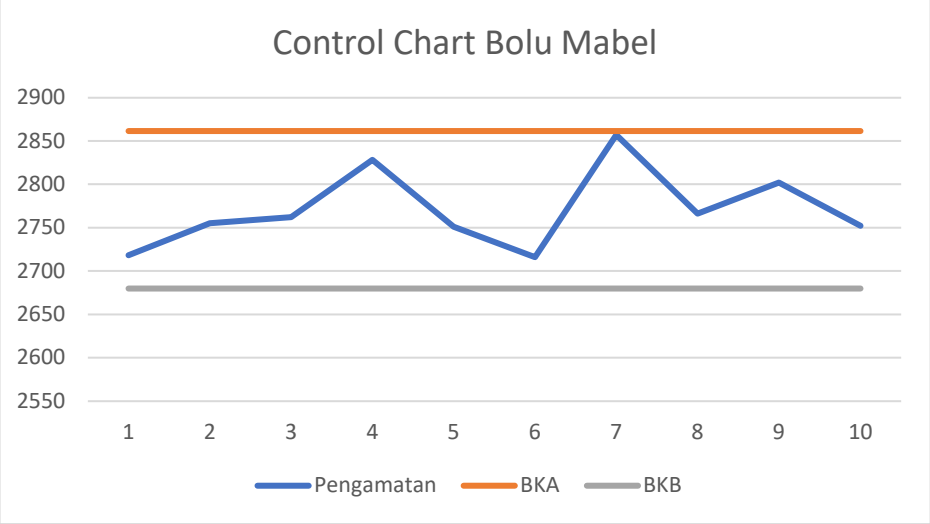

Figure.3 Control Chart Bolu Mabel

4.2 Data Adequacy Test

This step is done so that the data obtained is sufficient for further data processing. The number of observations in this study was 10. The observed data requires a 95% confidence level and 5% accuracy with a value of k = 2. The calculation of data adequacy tests for maros bread, spice sponge and mabel sponge is as follows:

Table 1. Roti Maros Product Data Adequacy Test

Job	x	∑	Data Adequacy Test			
			k	s	N	N'
Mixing	x	27688	2	0.05	10	0.366
	x^2	76680110				
Panning	x	12055	2	0.05	10	1.328
	x^2	14533509				
Filling	x	6395	2	0.05	10	2.283
	x^2	4095439				
Baking	x	36358	2	0.05	10	0.060
	x^2	132195446				
Packing	x	7369	2	0.05	10	7.856
	x^2	5456881				

Table 2. Bolu Rempah Product Data Adequacy Test

Job	x	∑	Data Adequacy Test			
			k	s	N	N'
Mixing	x	27787	2	0.05	10	0.228
	x^2	77222745				
Panning	x	12191	2	0.05	10	0.397
	x^2	14865737				
Baking	x	36350	2	0.05	10	0.018
	x^2	132133818				
Packing	x	7057	2	0.05	10	8.904
	x^2	5007841				

Table 3. Bolu Mabel Product Data Adequacy Test

Job	x	∑	Data Adequacy Test			
			k	s	N	N'
Mixing	x	27707	2	0.05	10	0.386
	x^2	76786347				
Panning	x	12118	2	0.05	10	0.801
	x^2	14691952				
Baking	x	36366	2	0.05	10	0.032
	x^2	132251274				
Packing	x	6311	2	0.05	10	8.381
	x^2	4003735				

4.3 Raw Time Calculation

At this stage is to calculate the standard time of each product. The results are as follows.

Table 4. Roti Maros Product Raw Time Results

Job	x	∑	Raw Time Calculation				
			P	All	Ws	Wn	Wb
Mixing	x	27688	0.82	17	2768.8	2270.41	2733.58
	x^2	76680110					
Panning	x	12055	0.87	15	1205.5	1048.78	1233.86
	x^2	14533509					
Filling	x	6395	0.87	17	639.5	556.36	669.86
	x^2	4095439					
Baking	x	36358	0.80	19	3635.8	2908.64	3590.91
	x^2	132195446					
Packing	x	7369	0.85	13	736.9	626.36	719.95
	x^2	5456881					

Table 5. Bolu Rempah Product Raw Time Results

Job	x	∑	Raw Time Calculation				
			P	All	Ws	Wn	Wb
Mixing	x	27787	0.82	17	2778.7	2278.53	2743.35
	x^2	77222745					
Panning	x	12191	0.87	15	1219.1	1060.61	1247.78
	x^2	14865737					
Baking	x	36350	0.87	17	3635	3162.45	3810.18
	x^2	132133818					
Packing	x	7057	0.80	19	705.7	564.56	696.98
	x^2	5007841					

Table 6. Bolu Mabel Product Raw Time Results

Job	x	∑	Raw Time Calculation				
			P	All	Ws	Wn	Wb
Mixing	x	27707	0.82	17	2770.7	2271.97	2735.45
	x^2	76786347					
Panning	x	12118	0.87	15	1211.8	1054.26	1240.31
	x^2	14691952					
Baking	x	36366	0.87	17	3636.6	3163.84	3811.85
	x^2	132251274					
Packing	x	6311	0.80	19	631.1	504.88	623.30
	x^2	4003735					

4.4 NEH Method

Table 7. Value MAX t

Job Order	Job	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J1	Roti Maros	2733.58	1233.86	669.86	3590.91	719.95
J3	Bolu Mabel	2735.45	1240.31		3811.85	623.30
J2	Bolu Rempah	2743.35	1247.78		3810.18	696.98

Table 8. Iteration 1 at w=2 (alternative 1)

Job Order	Job	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J1	Roti Maros	2733.58	3967.44	4637.3	8228.21	8948.16
J3	Bolu Mabel	5469.03	5207.75		12040.06	9571.46

Table 9. Iteration 1 at w=2 (alternative 2)

Job Order	Job	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J3	Bolu Mabel	2735.45	3975.76		7787.61	8410.91
J1	Roti Maros	5469.03	5209.62	669.86	11378.52	9130.86

Table 10. Iteration 2 at w=2+1 (alternative 1)

Job Order	*Job*	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J1	Roti Maros	2733.58	3967.44	4637.3	8228.21	8948.16
J3	Bolu Mabel	5469.03	5207.75		12040.06	9571.46
J2	Bolu Rempah	8212.38	6455.53		15850.24	10268.44

Table 11. Iteration 2 at w=2+1 (alternative 2)

Job Order	*Job*	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J1	Roti Maros	2733.58	3967.44	4637.3	8228.21	8948.16
J2	Bolu Rempah	5476.93	5215.22		12038.39	9645.14
J3	Bolu Mabel	8212.38	6455.53		15850.24	10268.44

Table 12. Iteration 2 at w=2+1 (alternative 3)

Job Order	*Job*	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J2	Bolu Rempah	2743.35	3991.13		7801.31	8498.29
J1	Roti Maros	5476.93	5224.99	669.86	11392.22	9218.24
J3	Bolu Mabel	8212.38	6465.3		15204.07	9841.54

Table 13. Iteration 2 at w=2+1 (alternative 4)

Job Order	*Job*	Machine/Auxiliary Equipment (Seconds)				
		1	2	3	4	5
J3	Bolu Mabel	2735.45	3975.76		7787.61	8410.91
J2	Bolu Rempah	5478.8	5223.54		11597.79	9107.89
J1	Roti Maros	8212.38	6457.4	669.86	15188.7	9827.84

Table 14. Iteration at NEH Method

Iteration NEH	Job Order	*Job Sequence*	*Makespan* (seconds)
Iteration 1	J1-J3	Roti Maros – Bolu Mabel	9571.46
	J3-J1	Bolu Mabel – Roti Maros	9130.86
Iteration 2	J1-J3-J2	Roti Maros – Bolu Mabel – Bolu Rempah	10268.44
	J1-J2-J3	Roti Maros – Bolu Rempah – Bolu Mabel	10268.44
	J2-J1-J3	Bolu Rempah – Roti Maros – Bolu Mabel	9841.54
	J3-J2-J1	Bolu Mabel – Bolu Rempah – Roti Maros	9827.84

Table 15. Value Makespan Futry Bakery and Cake Shop

Job Order	Machine/Auxiliary Equipment (Seconds)				
	1	2	3	4	5
J1	2733.58	3967.44	4637.3	8228.21	8948.16
J2	11691.51	12939.29		16749.47	17446.45
J3	20181.9	21422.21		25234.06	25857.36

Table 16. Comparison of Scheduling Results from the NEH Method and the Enterprise Method

Method	Job Order	*Makespan* (Hour)
NEH	J3-J2-J1	2.72 Hours
Company	J1-J2-J3	7.18 Hours

Based on the results obtained using the *nawaz enscore ham method*, the work with the smallest total process processing time (*makespan*) is 9827.84 seconds or 163.79 minutes or equal to 2.72 hours. In order of *job* priority, namely J3-J2-J1. While the calculation results using the method from the futry *bakery and cake* shop, obtained the flow of completing work J1-J2-J3 with a *makespan* value of 25857.36 seconds or 430.95 minutes or equal to 7.18 hours.

5. Conclusion

Based on the analysis and discussion, the conclusion of this study was the sequence of work at the futry *bakery and cake* shop obtained by the *nawaz enscore ham* method, namely J3-J2-J1 or on the product bolu mabel - sponge spice - maros bread obtained *makespan* time which is 9827.84 seconds or 163.79 minutes or equal to 2.72 hours. So that it can reduce the buildup of demand with an increasingly fast time compared to the company's *makespan* time, which is 7.18 hours.

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