International Journal of Advances in Applied Sciences (IJAAS)
Vol. 8, No. 1, March 2019, pp. 8~13
ISSN: 2252-8814, DOI: 10.11591/ijaas.v8.i1.pp8-13

Machining time and number of machine for the production planning of wheel nut releaser with the demand of 100 units/day

Nanang Qosim[1], Mohammad Hartono[2]
[1]Department of Mechanical Engineering, Faculty of Engineering, Universitas Indonesia, Indonesia
[2]Department of Mechanical Engineering, Politeknik Negeri Malang, Indonesia

Article Info

Article history:

Received Dec 17, 2018
Revised Feb 6, 2019
Accepted Feb 17, 2019

Keywords:

Demand
Machining time
Number of machines
Production planning

ABSTRACT

The impact of competition in the industry has driven people to improve the effectiveness of production process. One of the main factors supporting that effectiveness is the good planning of both the need and the number of machines. The aim of this study is to estimate the machining times to determine the number of machines to manufacture 100/day of the nut releaser tool for car wheel. The result shows that the need of the number of machines to manufacture each component of the nut releaser tool for car wheel are 7 units of power hacksaw, 27 units of lathe machine, 8 units of drilling machine, 12 units of milling machine, 2 units of EDM machine and 25 units of bench work.

Corresponding Author:

Nanang Qosim,
Department of Mechanical Engineering, Faculty of Engineering,
Universitas Indonesia,
Kampus Baru UI, Depok 16424, Jawa Barat, Indonesia.
Email: nanang2307@yahoo.com

1. INTRODUCTION

To effect the effectiveness of the production process of the nut releaser tool for car wheel, there is required a planning of needs of machines based on the estimation or calculation of precise machining time. In the era of industrialization, the factory is no longer merely a simple manufacturing consolidation but is a set of integrated technology systems with the optimal arrangement and planning. The advanced technology and good product design will be meaningless due to the imprecise planning. Mistakes made in the planning of the need of machines will lead to fatal losses, as the production activities of an industry will run for a long time [1].

Machining Time, symbolized by (Tm), is the range of time taken by a machine to work on one unit of product [2]. The accurate estimation of machining time is essential for estimating the production costs, as well as assisting production process planning [3]. To produce the nut releaser tool for car wheel, the machines and facilities used are power hacksaw, lathes machine, milling machine, drilling machine, EDM machine and bench work, with the differences of machining time for each machine. The differences of machining time for each component of the nut releaser tool for car wheel, as shown in Figure 1, are influenced by the design and dimensions of each component.

2. MATERIALS AND METHODS

2.1. Technical drawing of each component

The main data required in this study is the technical drawing for each component. Figure 1 is the technical drawing for each component of the nut releaser tool for car wheel.

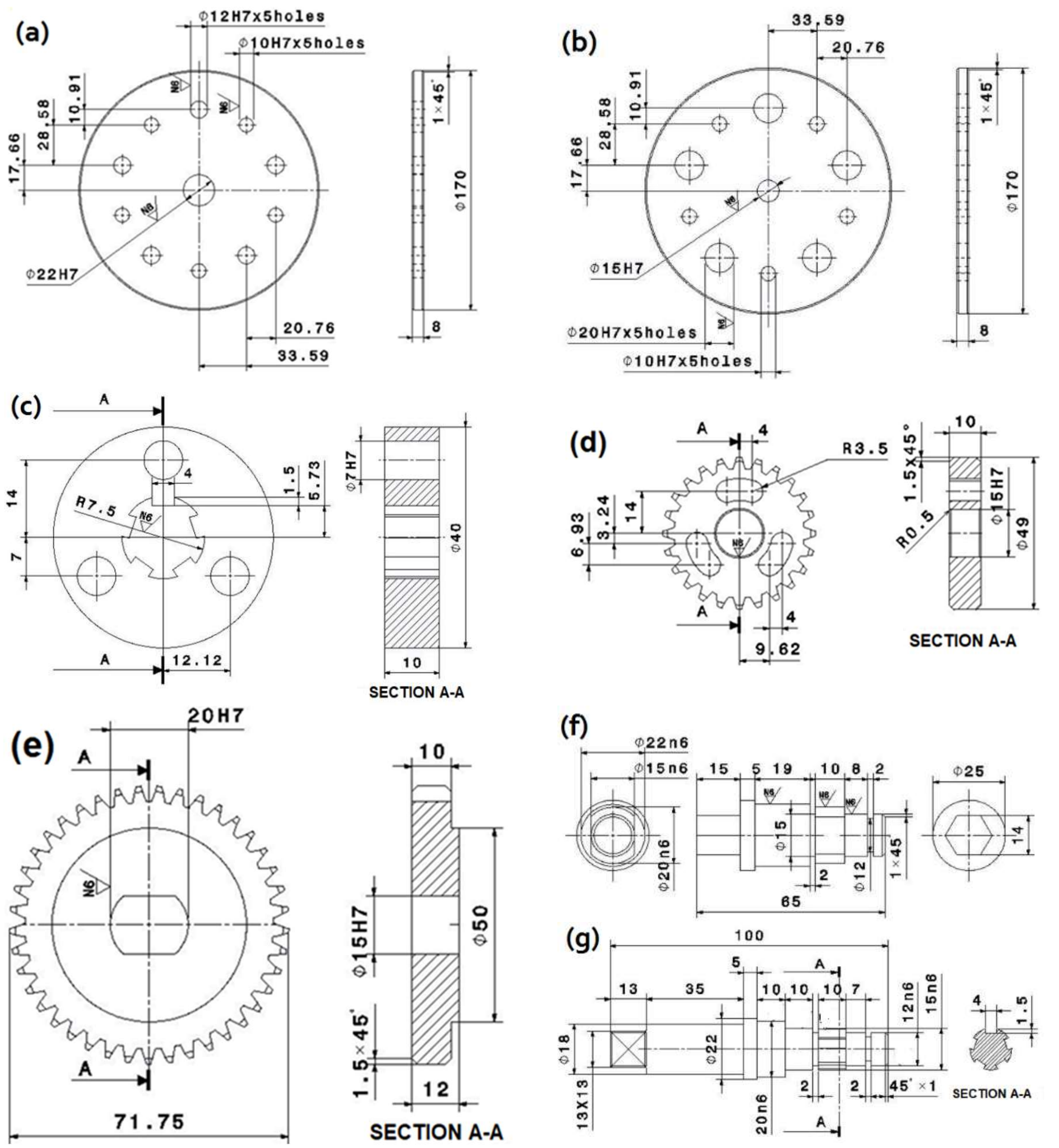

Figure 1. Main components of the nut releaser tool for car wheel: (a) Top side; (b) Bottom side; (c) Connector; (d) Main gear; (e) Sub gear; (f) Main shaft; (g) Shock shaft

2.2. The calculation of machining time

The calculation of machining time on power hacksaw is determined by the thickness of material to be sawed, t (mm); number of strokes, V (strokes/min) and depth of feeding, f (mm/strokes) with the expression as (1) [4]:

$$Tm = \frac{h}{V \times f} \quad (1)$$

Other parameters for determining the machining time on power hacksaw may refer to Westermann Tables for The Metal Trade [5].

There are two main types of work on the lathe machine, ie facing and longitudinal cutting, with the expression of each as (2) and (3) [6]:

$$Tm = \frac{df \ x \ i}{Sf \ x \ N} \quad (2)$$

$$Tm = \frac{l \ x \ i}{S \ x \ N} \quad (3)$$

where df (mm) is the length of surface to be removed; i (mm/rev) is the intensity of feeding; S is feed rate; Sf (mm/rev) is feed rate for facing process; N (rev/min) is the rotation of engine spindle; and l (mm) is the length of the surface to be removed plus the tolerance of 1.

Other parameters for determining the machining time on the lathe machine can refer to Westermann Tables for The Metal Trade [5].

On the milling machine, the calculation of machining time is influenced by both the total path length, L (mm); and feed rate, s (mm/rev), with the expression as (4) [3]:

$$Tm = \frac{L}{s} \quad (4)$$

Other parameters for determining machining time on the milling machine may refer to Westermann Tables for The Metal Trade [5].

The calculation of machining time on the drilling machine is determined by the length of the drilling tool, L (mm); the depth of the material to be drilled, l (mm); diameter of the drilling tool, d (mm); feed rate, S (mm/rev); and cutting speed, v (m/min) with the following expression [5]:

$$Tm = \quad (5)$$

$$\text{where, } L = l + 0{,}3d \quad (6)$$

Other parameters for determining machining time on the drilling machines may refer to Westermann Tables for The Metal Trade [5].

2.3. Standard time and Output Standard

Based on the data of the machining time calculation, it can be determined the Standard time (ST) and Output Standard (OS). ST is a standard of time estimation taken by a machine to produce one component after added by the setting time, auxiliary time and allowance time. Formulated in an expression as (7) [7]:

$$ST = Tm + \text{Setting time} + \text{Allowance time} + \text{Auxiliary time} \quad (7)$$

OS is the quantity of the product that can be produced by a machine within a day. On the nut releaser tool for car wheel factory, there are assumed three shifts of work within a day, 8 hours for a shift. The OS value itself can be determined if the value of ST has been determined by converting the unit as (8) [7]:

$$OS = \ x \ \ x \quad (8)$$

3. RESULTS AND DISCUSSION

Based on the calculation of machining time of each component, there is obtained the data of calculation as presented in Table 1.

Tabel 1. The data of machining time calculation

Part	Machine	ST (min/unit)	OS (unit/day)
A	Power hacksaw	8,98	161,98
	Lathe machine	28,52	50,49
	Drilling machine	12,92	111,46
	Bench work	37,5	38,4
B	Power hacksaw	8,98	160,36
	Lathe machine	28,52	50,49
	Drilling machine	14,62	98,5
	Bench work	37,5	38,4
C	Power hacksaw	3,2	450
	Lathe machine	12,06	119,4
	Drilling machine	8,31	173,28
	Bench work	11,5	125,22
	EDM	1,88	766,50
D	Power hacksaw	3,87	372,09
	Lathe machine	17,89	80,49
	Drilling machine	8,02	179,55
	Milling machine	18,41	78,22
	Bench work	8	180
E	Power Hacksaw	4,53	317,88
	Lathe machine	20,57	70
	Milling machine	46,02	31,29
	EDM	6,99	206
F	Power Hacksaw	2,4	600
	Lathe machine	16,22	88,78
	Milling machine	4,62	311,69
G	Power Hacksaw	2,32	620,69
	Lathe machine	16,37	87,96
	Milling machine	4,56	315,79
	Bench work	7,4	194,59

The next step is the calculation of material requirements for each component for each stage of the process, with the defects assumed as 0.5% on power hacksaw, 1% on lathe machine, 1% on drilling machine and 0.5% on bench work. The calculations are solved by (9) (Tompkins, White, Bozer, Frazelle, Tanchoco, & Trevino).

$$\text{Pn} = \frac{\text{Pg}_\text{n}}{1-\text{Pd}_\text{n}\%} = \frac{demand}{1-\text{Pd}_n\%} = \frac{100}{1-0{,}5\%} \tag{9}$$

The stages of this solution sequentially refer to the illustration as shown in Figure 2. Figure 2 is the flow diagram for an example of the material requirement calculation for top side component.

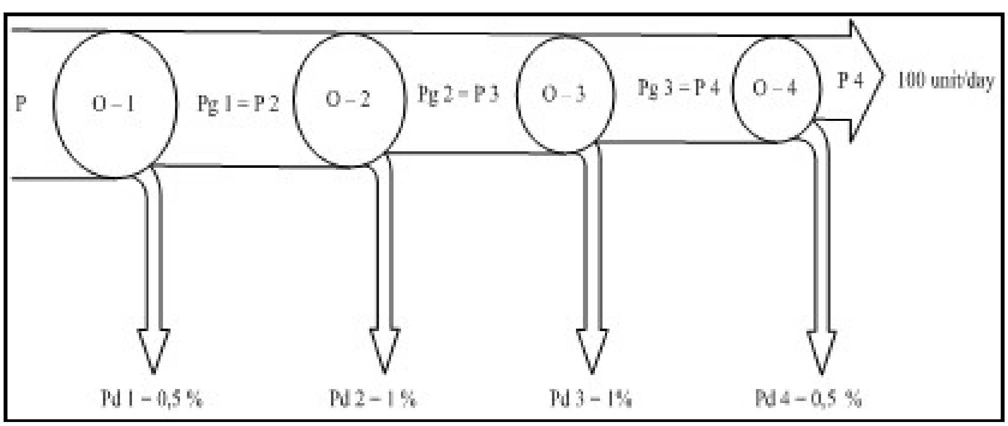

Figure 2. Flow diagram of the material requirement for top side

Based on the calculation of Tm estimation for each component, there are obtained the OS values for each machine and production facility. Further, from the calculation of the need of material, there are obtained the value of material requirements for each process (P) on each machine and production facilities. Based on this data, the estimated calculation of the need for the number of production machines (N) for each component can be determined by (10) [8].

$$N1 = \frac{P_1}{OS_1} \tag{10}$$

So that, the results of all calculations of N for each component can be shown in Table 2. In Table 3, there is the total calculation of the need for the machine to produce all components of the nut releaser tool for car wheel with the demand of 100 units/day.

Tabel 2. The calculation results of the need for the number of machine for each component

Part	Machine	ST (min/unit)	OS (unit/day)	Defect of product (% Pd)	Product Prepared (P) (unit/day)	Number of machines (N)
Top Side	Power hacksaw	8,98	161,98	0,5	106	0,65
	Lathe machine	28,52	50,49	1	105	2,08
	Drilling machine	12,92	111,46	1	103	0,92
	Bench work	37,50	38,40	0,5	101	2,63
Bottom Side	Power hacksaw	8,98	160,36	0,5	106	0,65
	Lathe machine	28,52	50,49	1	105	2,08
	Drilling machine	14,62	98,50	1	103	1,04
	Bench work	37,50	38,40	0,5	101	2,63
Connector	Power hacksaw	3,20	450	0,5	529	1,18
	Lathe machine	12,06	119,4	1	526	4,41
	Drilling machine	8,31	173,28	1	520	3,00
	Bench work	11,5	125,22	0,5	514	4,10
	EDM	1,88	766,50	2	511	1,50
Sub Gear	Power hacksaw	3,87	372,09	0,5	526	1,41
	Lathe machine	17,89	80,49	1	523	6,40
	Drilling machine	8,02	179,55	1	517	2,80
	Milling machine	18,41	78,22	1,5	511	6,53
	Bench work	8,00	180	0,5	503	2,79
Main Gear	Power Hacksaw	4,53	317,88	0,5	108	0,34
	Lathe machine	20,57	70,00	1	107	1,53
	Milling machine	46,02	31,29	1,5	105	3,36
	EDM	6,99	206	2	103	0,50
Main Shaft	Power Hacksaw	2,4	600	0,5	105	0,18
	Lathe machine	16,22	88,78	1	104	1,17
	Milling machine	4,62	311,69	1,5	102	0,33
Shock Shaft	Power Hacksaw	2,32	620,69	0,5	520	0,84
	Lathe machine	16,37	87,96	1	517	5,88
	Milling machine	4,56	315,79	1,5	511	1,62
	Bench work	7,40	194,59	0,5	503	2,58

Tabel 3. The total need of machine for all components

Machine	Part Number							Total machine	Grand Total
	A	B	C	D	E	F	G		
Power Hacksaw	0,65	0,65	1,18	1,41	0,34	0,18	0,84	6,98	7
Lathe machine	2,08	2,08	4,41	6,4	1,53	1,17	5,88	26,88	27
Drilling machine	0,92	1,04	3,00	2,80	-	-	-	7,76	8
Milling machine	-	-	-	6,53	3,36	0,33	1,62	11,84	12
EDM	-	-	1,50	-	0,50	-	-	2,00	2
Bench work	2,63	2,63	4,10	2,79	-	-	2,58	14,73	15

From the Table 2 and 3, it appears that lathe machine is the most needed type of machine in the manufacturing process of the nut releaser tool for car wheel with the demand of 100 units/day, with a total of 27 units. The amount is followed by bench work facilities (15 units) and milling machines (12 units) as the most needed machines. EDM which is a type of very expensive price-machine has the smallest need of 2 units. These results indicate that the planned estimates have a good efficiency as well as the high economic side.

4. CONCLUSION

In this study, it can be concluded that the number of machines and facilities needed to produce 100 units of the nut releaser tool for car wheel is 7 units of power hacksaw, 7 units of lathe machine, 8 units of drilling machines, 12 units of milling machines, 2 units of EDM machines and 25 units of bench work facilities. However, further study needs to make a more effective planning according to the modernization of machine and facilities.

ACKNOWLEDGEMENTS

The author would like to thank Department of Mechanical Engineering, Universitas Indonesia for valuable support to conduct this study.

REFERENCES

[1] E.-Y. Heo, D.-W. Kim, B.-H. Kim, and F. F. Chen, "Estimation of NC machining time using NC block distribution for sculptured surface machining," *Robotics and Computer-Integrated Manufacturing*, vol. 22, pp. 437-446, 2006.

[2] L. Skoczylas, K. Skoczylas, and D. Wydrzyński, "The standard milling time of flat surfaces without outline restrictions," *Advances in Science and Technology Research Journal*, vol. 10, 2016.

[3] R. T. Coelho, A. F. de Souza, A. R. Roger, A. M. Y. Rigatti, and A. A. de Lima Ribeiro, "Mechanistic approach to predict real machining time for milling free-form geometries applying high feed rate," *The International Journal of Advanced Manufacturing Technology*, vol. 46, pp. 1103-1111, 2010.

[4] H. A. Youssef and H. El-Hofy, *Machining technology: machine tools and operations*, CRC Press, 2008.

[5] H. Jutz, *Westermann Tables For The Metal Trade*, New Age International, 2006.

[6] J. R. Walker, *Machining Fundamentals: From Basic to Advanced Techniques*, Inc., USA: Goodheart-Wilcox Company, 2004.

[7] S. Wignjosoebroto, *Factory Preposition and Material Translocation* (in Bahasa), Surabaya: Penerbit Guna Widya, 1996.

[8] J. Tompkins, J. White, Y. Bozer, E. Frazelle, J. Tanchoco, and J. Trevino, *Facilities Planning*, Inc. 2nd edition. USA: John Wiley& Sons, 1996, pp. 36-47.