



Implementation of Group Technology in The Manufacturing Process of Disk Mill Machine

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ABSTRACT

The disk mill machine is a size reducing machine that functions to reduce material. Disk mill machines are often used to process food ingredients such as coffee. Seeing this potential encourages manufacturers to mass produce disk mill machines. The manufacturing system that can be applied in this case is Group Technology. Group Technology is a concept that identifies similarities in components in terms of shape and production process. The aim of implementing Group Technology on disk mill machines is to obtain part families using the classification & coding method. The part family is used to obtain Part Numbering which can show the sequence of component machining processes so that you can compile a process sheet and find out the time needed to produce a disk mill machine. The results of this research obtained 5 part families and part numbering for each component. Part numbering also shows the sequence of machining processes for the 35 components made and the cycle time calculation results show an estimate of the time needed to make a disk mill machine of 10.46 hours.

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Keywords: (Group Technology, Manufacturing, Disk Mill).

1. Introduction

Group Technology is a concept in manufacturing systems, namely identifying and exploiting similarities in components both in terms of design and machining processes [1], [2]. Seeing this, Group Technology can be applied to various manufacturing fields [3]. One example that is relevant to the topic of discussion is the disk mill machine manufacturing process.

The disk mill machine is a size reduction equipment which functions to reduce food ingredients to a certain size [4], [5], [6]. In Indonesia, disk mill machines are widely used to process food ingredients such as coffee, so these machines have quite a large quantity of demand [7], [8]. This encourages manufacturers to mass produce disk mill machines.

Implementation of Group Technology in the disk mill machine manufacturing process by analyzing work drawings [9], [10]. Analysis of the working

drawings aims to identify the machining processes required to produce each component of the disk mill machine [8], [11]. Then, the identification results can be used as a reference in compiling part numbering for each component [12]. After obtaining the part number for each component, a process sheet for each component can be compiled to find out how long it takes to produce a disk mill machine [13], [14], [15].

Based on the description that has been described, this research has the following objectives : analyzing the process of implementing Group Technology on disk mill machines, analyzing the classification and coding process on disk mill machine components to obtain part numbering, analyzing process sheets for disk mill machine components, analyzing time required. needed to produce disk mill machines using the Group Technology method [16], [17].

2. Methodology of Research

This research design requires a process at the data collection stage that is used to obtain optimal results. The methods of this research are:

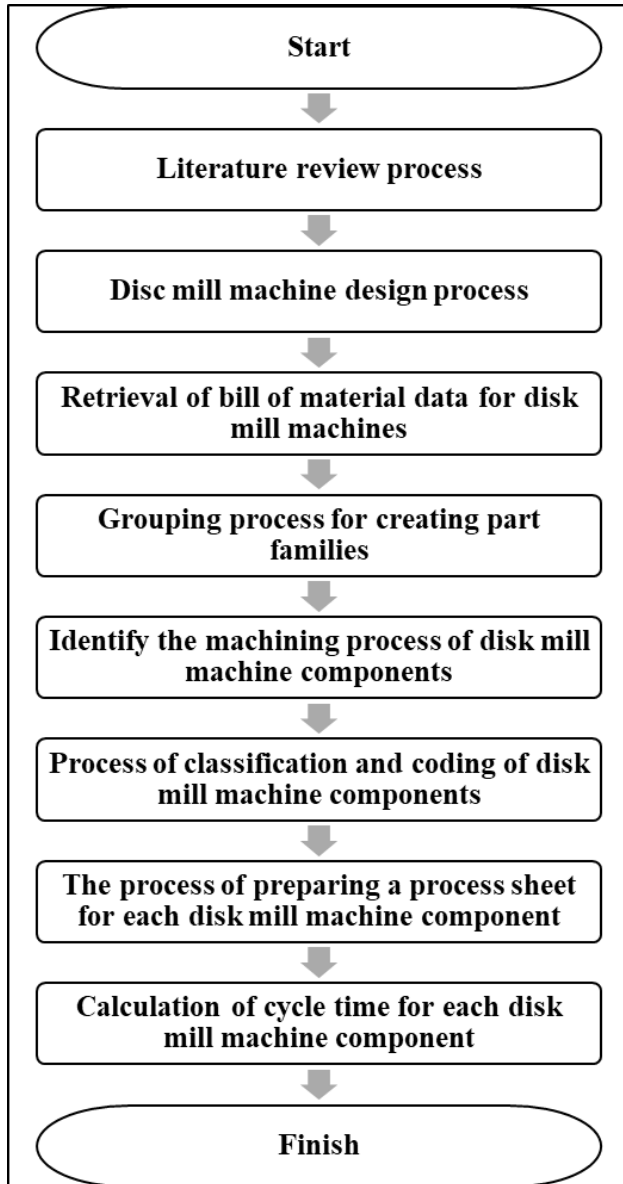


Figure 1. Research flow chart

1 Dependent variable

The dependent variable used in this research is as follows : Disk mill machine components, machining process for disk mill machine components and sequence of machining process for disk mill machine components

2 Independent Variable

The independent variables in this research are as follows: • Composition of codes for disk mill machine components and sheet processes

3 Research Tool

Design the disk mill components using Autodesk Inventor Proportional 2021 software. Part family analysis, classification, coding and sheet process using Microsoft Excel 2021 software

3. Result and Discussion

1. Disk Mill Machine Design

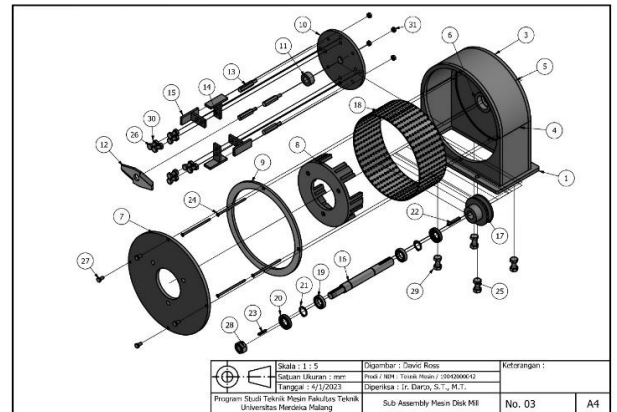


Table 1. Bill of material sub-assembly disk mill machine.

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
1	Main Body of Disk Mill Machine Bottom Panel	1	JIS G 4305 Plate	Make
2	Main Body of Disk Mill Machine - Front Panel	1	JIS G 4305 Plate	Make
3	Main Body of Disk Mill Machine - Rear Panel	1	JIS G 4305 Plate	Make
4	Main Body of Disk Mill Machine - Side Panel	2	JIS G 4305 Plate	Make
5	Main Body of Disk Mill Machine - Top Panel	1	JIS G 4305 Plate	Make
6	Main Body of Disk Mill Machine - Shaft Housing	1	JIS G 4303 Round Bar	Make
7	Disk Mill Machine Door	1	JIS G 4305 Plate	Make
8	Stator Plate	1	JIS G 4303 Round Bar	Make

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
9	Lid Body Disk Mill	1	JIS G 4304 Plate	Make
10	Disk	1	JIS G 4305 Plate	Make
11	Bosch Disk	1	JIS G 4303 Round Bar	Make
12	Disk Mill Blade	1	JIS G 4051 S50C Flat Bar	Make
13	Impactor Hexagon	4	JIS G 4303 Hexagon Bar	Make
14	Impactor T	4	JIS G 4305 Flat Bar	Make
15	Hammer Impactor T	4	JIS G 4305 Flat Bar	Make
16	Disk Mill Shaft	1	DIN 17100 ST37 Round Bar	Make
17	Pulley V belt N2	1	JIS H 4000 Round Bar	Make
18	Mesh 120	1	Flour Sieve Diameter 0.125 mm	Buy
19	Bearing Ball Disk Mill Shaft	2	JIS B 1521 - 6804 20x32x7	Buy
20	Lip Seal	2	JIS B 2402 - 20 35 7 A	Buy
21	Snap Ring	2	JIS B 2804 - 20x1.2	Buy
22	Square Key Pulley N2	1	ISO 2491 - C 6 x 4 x 40	Buy
23	Square Key Disk	1	ISO 2491 - C 5 x 3 x 25	Buy
24	Disk Mill Body Lid Bolts	4	BS 4168 - M4 x 90	Buy
25	Disk Mill Body Bolts - Frame	4	ISO 4017 - M10 x 25	Buy
26	T Impactor Bolt	8	ISO 4017 - M8 x 20	Buy
27	Disk Mill Machine Door Bolts	4	ISO 4017 - M6 x 12	Buy
28	Disk Lock Nut	1	ISO 4032 - M16	Buy
29	Disk Mill Body Nut - Frame	4	ISO 4032 - M10	Buy
30	T Impactor Nut	8	ISO 4032 - M8	Buy
31	Hexagon Impactor Nut	4	ISO 4032 - M6	Buy

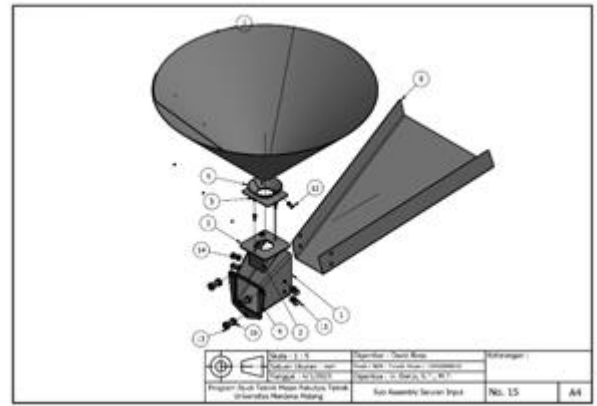


Figure 3. Input channel sub-assembly

Table 2. Input channel sub-assembly bill of materials

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
1	Input Channel	1	JIS G 4304 Sheet Metal 3 mm	Make
2	Hopper Input Channel	1	JIS G 4304 Sheet Metal 3 mm	Make
3	Close the Hopper Input Channel	1	JIS G 4304 Sheet Metal 3 mm	Make
4	Input Channel Plate - Disk Mill Door	1	JIS G 4304 Sheet Metal 3 mm	Make
5	Hopper Connector Base	1	JIS G 4304 Sheet Metal 2 mm	Make
6	Hopper Connector	1	JIS G 4304 Sheet Metal 2 mm	Make
7	Hopper	1	JIS G 4304 Sheet Metal 1 mm	Make
8	Input Container	1	JIS G 4304 Sheet Metal 1 mm	Make
9	Rivet	3	ISO/R 1051 - 2 x 6	Buy
10	Input Channel Plate Bolt - Disk Mill Door	3	ISO 4017 - M10 x 25	Buy
11	Input Channel Bolt - Input Receptacle	4	ISO 4017 - M8 x 16	Buy
12	Hopper Input Duct Cover Bolt -	5	ISO 4017 - M5 x 12	Buy

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
	Hopper Connector Base Hopper Bolt			
13	Input Channel Plate Nut - Disk Mill Door	3	ISO 4032 - M10	Buy
14	Input Channel Nut - Input Receptacle	4	ISO 4032 - M8	Buy
15	Hopper Nut	3	ISO 4032 - M5	Buy

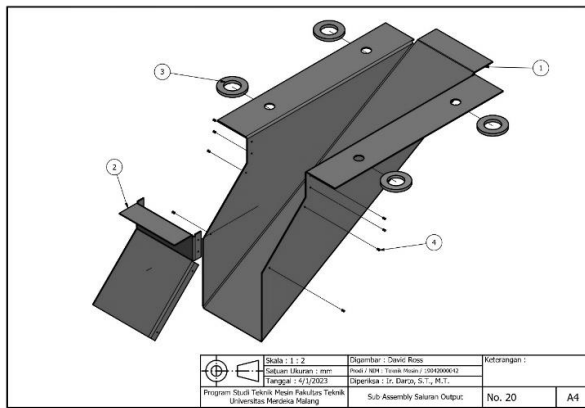


Figure 4. Output Channel Sub-Assembly

Table 3. Bill Of Material Sub-Assembly Output

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
1	Output Channel	1	JIS G 4304 Sheet Metal 1 mm	Make
2	Close Output Channel	1	JIS G 4304 Sheet Metal 1 mm	Make
3	O Ring	4	ISO 7089 - 16	Make
4	Rivet	8	ISO/R 1051 - 1 x 4	Buy

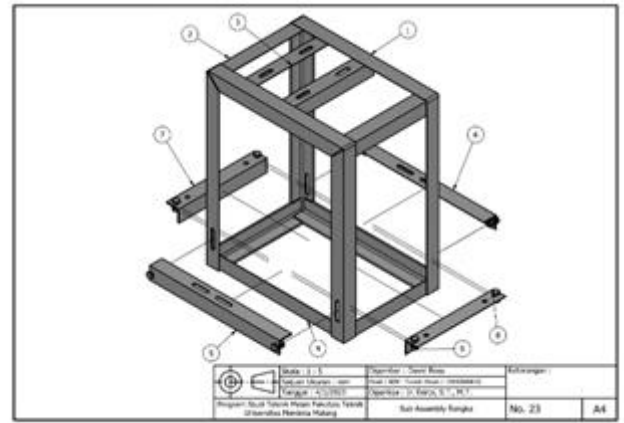


Figure 5. Frame sub-assembly

Table 4. Frame sub-assembly bill of materials

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
1	Frame 1535	2	L Profile Steel 40x40x3 Length 1535 mm	Make
2	Frame 292	4	L Profile Steel 40x40x3 Panjang 292 mm	Make
3	Frame 292 - Hole	2	L Profile Steel 40x40x3 Length 292 mm	Make
4	Frame 421	2	L Profile Steel 40x40x3 Length 421 mm	Make
5	Frame 421 A - Hole	1	L Profile Steel 40x40x3 Length 421 mm	Make
6	Frame 421 B - Hole	1	L Profile Steel 40x40x3 Length 421 mm	Make
7	Frame 286	2	L Profile Steel 40x40x3 Length 286 mm	Make
8	Frame Bolts 1535 - Frame 421 Frame Bolt Holes 421 Hole -	8	ISO 4017 - M10 x 20	Buy

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
	Frame 286			
9	Frame Nuts 1535 - Frame 421 Hole Frame Nuts 421 Lubang - Rangka 286	8	ISO 4032 - M10	Buy

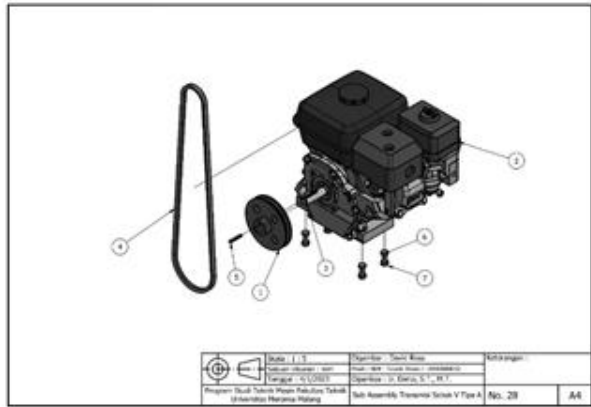


Figure 6. Frame sub-assembly

Table 5. Bill of materials sub-assembly transmission V belt type A

<i>Bill of Material</i>				
No.	Component Name	Qty.	Information	Action
1	N1 V Belt Pulley	1	JIS H 4000 Round Bar	Make
2	Drive Motor	1	Power 5 kw, 2500 rpm	Buy
3	Drive Motor Shaft	1	DIN 17100 ST37	Buy
4	Type A V Belt	1	Rubber	Buy
5	Key Square Pulley N1	1	ISO 2491 - C 6 x 4 x 40	Buy
6	Drive Motor Bolt - Frame	4	ISO 4017 - M10 x 30	Buy
7	Drive Motor Nut - Frame	4	ISO 4032 - M10	Buy

2. Grouping Process for Making Part Families

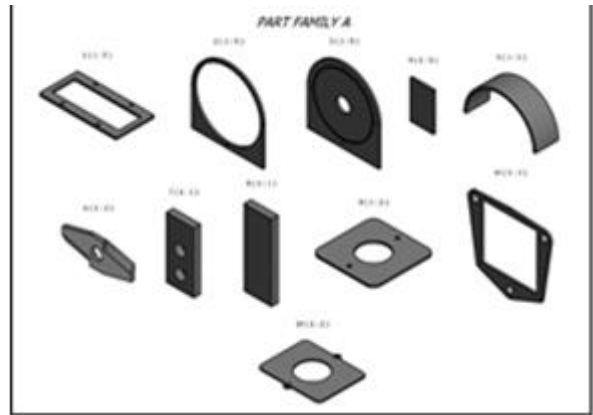


Figure 7. Part family A square

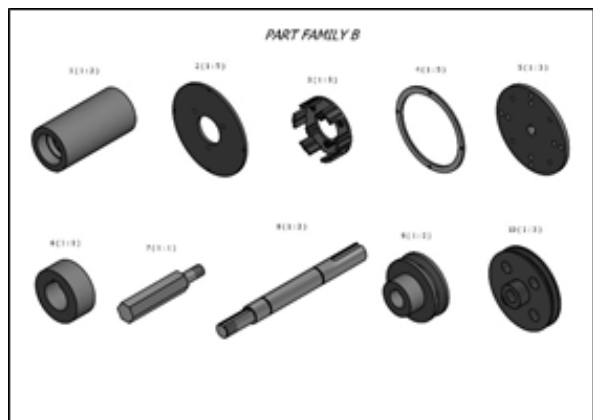


Figure 8. Part family B cylindrical

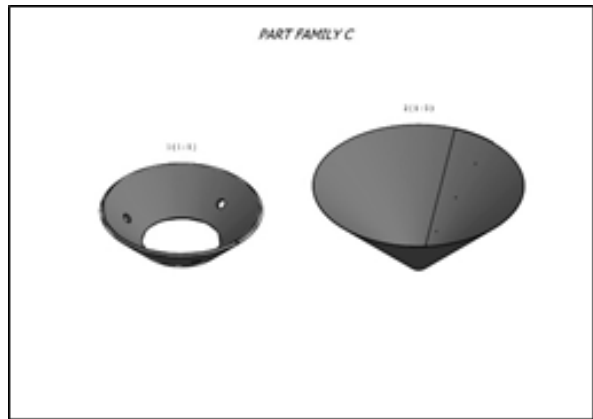


Figure 9. Part family C conus

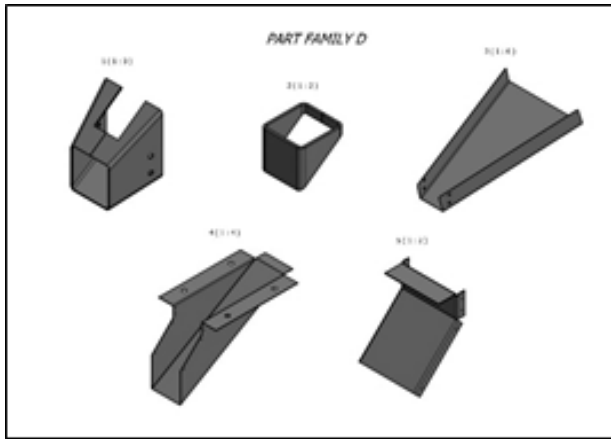


Figure 10. Part family D bending plate

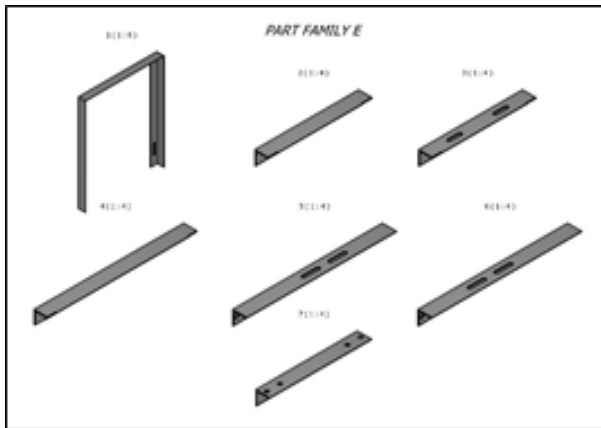


Figure 11. Part family E structure profile

Table 6. Part families

Part Families					
No.	Part Family A Persegi	Part Family B Siliindris	Part Family C Konis	Part Family D Pelat tekuk	Part Family E Profil Struktur
1	Body Utama Mesin Disk Mill - Panel Bawah	Body Utama Mesin Disk Mill - Rumah Poros	Konektor Hopper	Saluran Input	Rangka 1535
2	Body Utama Mesin Disk Mill - Panel Depan	Pintu Mesin Disk Mill	Hopper	Saluran Input Hopper	Rangka 292
3	Body Utama Mesin Disk Mill - Panel Belakang	Pelat Stator		Wadah Input	Rangka 292 - Lubang
4	Body Utama Mesin Disk Mill - Panel Samping	Lid Body Disk Mill		Saluran Output	Rangka 421
5	Body Utama Mesin Disk Mill - Panel Atas	Disk		Tutup Saluran Output	Rangka 421 A - Lubang
6	Pisau Disk Mill	Bosch Disk			Rangka 421 B - Lubang
7	Gagang Impactor T	Impactor Hexagon			Rangka 286
8	Hammer Impactor T	Poros Disk Mill			
9	Tutup Saluran Input Hopper	Pulley Sabuk V N2			
10	Pelat Saluran Input - Pintu Disk Mill	Pulley Sabuk V N1			
11	Alas Konektor Hopper				

3. Identification of the Machining Process of Disk Mill Machine Components

Table 7. Machining process code

Machining Process Name	Machine Number
Marking Out	1
Plasma Cutting	2
Circular Saw	3
Jigsaw	4
Turning	5
Drilling	6
Milling	7
Broaching	8
Tap Threading	9
Die Threading	10
Press Brake	11
Roll Bending	12
Nut & Bolt	13
Rivetting	14
GMAW Welding	15

Table 8. Part family A machining process

		Part Family A														
No.	Komponen	Proses Pemesinan														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Body Utama Mesin Disk Mill - Panel Bawah	█	█				█									█
2	Body Utama Mesin Disk Mill - Panel Depan						█			█						
3	Body Utama Mesin Disk Mill - Panel Belakang															
4	Body Utama Mesin Disk Mill - Panel Samping															
5	Body Utama Mesin Disk Mill - Panel Atas															
6	Pisau Disk Mill															
7	Gagang Impactor T															
8	Hammer Impactor T															
9	Tutup Saluran Input Hopper															
10	Pelat Saluran Input - Pintu Disk Mill															
11	Alas Konektor Hopper															

Table 9. Part family B machining process

		Part Family B														
No.	Komponen	Proses Pemesinan														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Body Utama Mesin Disk Mill - Rumah Poros	█	█	█	█	█										█
2	Pintu Mesin Disk Mill	█	█				█									
3	Pelat Stator			█	█		█	█								
4	Lid Body Disk Mill	█	█													
5	Disk	█	█				█			█						
6	Bosch Disk	█	█													
7	Impactor Hexagon	█	█									█				
8	Poros Disk Mill	█	█													
9	Pulley Sabuk V N2	█	█													
10	Pulley Sabuk V N1	█	█													

Table 10. Part family C machining process

		Part Family C														
No.	Komponen	Proses Pemesinan														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Konektor Hopper	█	█													
2	Hopper	█	█				█							█		█

Table 11. Part family D machining process

		Part Family D														
No.	Komponen	Proses Pemesinan														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Saluran Input	█	█													
2	Saluran Input Hopper	█	█													
3	Wadah Input	█	█													
4	Saluran Output	█	█													
5	Tutup Saluran Output	█	█													

Table 12. Part family E machining process

		Part Family E														
No.	Komponen	Proses Pemesinan														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Rangka 1535	█	█													
2	Rangka 292	█	█													
3	Rangka 292 - Lubang	█	█													
4	Rangka 421	█	█													
5	Rangka 421 A - Lubang	█	█													
6	Rangka 421 B - Lubang	█	█													
7	Rangka 286	█	█													

4. Process of classification and coding of disk mill machine components

Table 13. Component design information code

Component Design Information		Letter Code					
		A	B	C	D	E	F
Component Action	Make	█					
	Buy		█				
Part Family	Square	█					
	Cylindrical		█				
	Konis			█			
	Bending Plate				█		
	Structural Profile					█	
Sub-Assembly	Disk Mill Machine	█					
	Input Channel		█				
	Output Channel			█			
	Frame				█		
	Type A V Belt Transmission					█	
Form of Raw Material	Plate	█					
	Sheet Metal		█				
	Round Bar			█			
	Flat Bar				█		
	Hexagon Bar					█	
	Profil L						█

Table 14. Part number component created

Part Number Component Created		
No.	Component Name	Part Number
1	Main Body of Disk Mill Machine - Bottom Panel	AAAA5M12615E0000
	Main Body of Disk Mill Machine - Front Panel	AAAA6M126915E000
3	Main Body of Disk Mill Machine - Rear Panel	AAAA7M1267915E00
	Main Body of Disk Mill Machine - Side Panel	AAAA8M1215E00000
5	Main Body of Disk Mill Machine - Top Panel	AAAA9M121215E000
	Main Body of Disk Mill Machine - Shaft Housing	ABAC10M13515E000
7	Disk Mill Machine Door	ABAA11M126E00000
8	Stator Plate	ABAC12M1357E0000
9	Lid Body Disk Mill	ABAA13M1267E0000
10	Disk	ABAA14M12568E000

<i>Part Number Component Created</i>		
No.	Component Name	Part Number
11	Bosch Disk	ABAC15M1358E0000
12	Disk Mill Blade	AAAD16M14678E000
13	Impactor Hexagon	ABAE17M13510E000
14	Impactor T	AAAD19M13615E000
15	Hammer Impactor T	AAAD20M1315E0000
16	Disk Mill Shaft	ABAC21M1357E0000
17	N2 V Belt Pulley	ABAC22M1358E0000
18	Input Channel	ADBB25M1261115E0
19	Hopper Input Channel	ADBB26M121115E00
20	Close the Hopper Input Channel	AABB27M126915E00
21	Input Channel Plate - Disk Mill Door	AABB28M12615E000
22	Hopper Connector Base	AABB30M12615E000
23	Hopper Connector	ACBB31M1261215E0
24	Hopper	ACBB32M1261214E0
25	Input Container	ADBB33M12611E000
26	Output Channel	ADCB35M1261114E0
27	Close Output Channel	ADCB36M12614E000
28	Frame 1535	AEDF39M13471115E
29	Frame 292	AEDF40M1315E0000
30	Frame 292 – Hole	AEDF41M13715E000
31	Frame 421	AEDF42M1315E0000
32	Frame 421 A – Hole	AEDF43M13713E000
33	Frame 421 B – Hole	AEDF44M13713E000
34	Frame 286	AEDF45M13613E000
35	Translation results Translation result N1 V Belt Pulley	ABEC47M13578E000

Example of component part number reading:

Part Number **AAA5M12615E0000**

- First digit (A): indicates the component was made.
- Second digit (A): indicates part family a square shape.
- Third digit (A) : indicates the origin of the sub-assembly namely a disk mill machine.
- Fourth digit (A): indicates the form of the material raw, namely plates.
- Fifth digit (5): indicates the sheet number on shop drawing.

- Sixth digit (M): shows the information code component design has been completed.
- Digits after M: indicate the process code systematic machining.
- Digit E0000: indicates the end of the information code and generalization number of code digits.

Table 15. Part number component purchased

<i>Part Number Component Purchased</i>		
No.	Component Name	Part Number
1	Mesh 120	BA1MH120E0000000
2	Disk Mill Shaft Ball Bearings	BA2BRGPDE0000000
3	Lip Seal	BA2LIPSLE0000000
4	Snap Ring	BA2SNPRGE0000000
5	Square Key Pulley N2	BA1PPPN2E0000000
6	Disk Key Square	BA1PSKPDE0000000
7	Disk Mill Body Lid Bolts	BA4BLBDME0000000
8	Disk Mill Body Bolts - Frame	BA4BBDMRE0000000
9	T Impactor Bolt	BA8BIMPTE0000000
10	Disk Mill Machine Door Bolts	BA4BPMDME0000000
11	Disk Lock Nut	BA1MRPDKE0000000
12	Disk Mill Body Nut - Frame	BA4MBDMRE0000000
13	T Impactor Nut	BA8MRIMTE0000000
14	Hexagon Impactor Nut	BA4MRIMHE0000000
15	Rivet	BB3RIVETE0000000
16	Input Channel Plate Bolt - Disk Mill Door	BB3BPSIPE0000000
17	Input Channel Bolt - Input Receptacle	BB4BSIWIE0000000
18	Hopper Input Duct Cover Bolt - Hopper Connector Base Hopper Bolt	BB5BTSBHE0000000
19	Input Channel Plate Nut - Disk Mill Door	BB3MPSPDE0000000
20	Input Channel Nut - Input Receptacle	BB4MSIWIE0000000
21	Hopper Nut	BB3MRHPRE0000000
22	O Ring	BC4ORINGE0000000
23	Rivet	BC8RIVETE0000000
24	1535 Frame Bolts - 421 Hole Frame 421 Hole Frame	BD8B1R42E0000000

<i>Part Number Component Purchased</i>		
No.	Component Name	Part Number
	Bolts - 286 Frame	
25	Frame Nut 1535 - Frame 421 Holes 421 Hole Frame Nut - 286 Frame	BD8M1R42E0000000
26	Drive Motor	BE1MP5KWE0000000
27	Drive Motor Shaft	BE1PMTRPE0000000
28	Type A V Belt	BE1SVTPAE0000000
29	Square Peg Pulley N1	BE1PPPN1E0000000
30	Drive Motor Bolt - Frame	BE4BMPKRE0000000
31	Drive Motor Nut - Frame	BE4MMPKRE0000000

Example of Part Number Reading for components purchased:

Part Number **BA2SNPRGE0000000**

- First digit (B): indicates the component purchased.
- Second digit (A): indicates the origin of the sub assembly, namely the disk mill machine.
- Third digit (2): indicates the number of components in the sub-assembly.
- SNPRG: shows the component abbreviation, namely snap ring.
- E0000000 : indicates the end of the code information and equalizes the number of code digits.

5. *Process for preparing a process sheet for each component of a disk mill machine*

In this section, the process sheet listed can be seen in the attachment section. Examples of process sheets are taken from each part family.

Table 16. Recapitulation of cycle time for each disk mill machine component

Recapitulation of Cycle Time for Disk Mill Machine Components		
No.	Component Name	Cycle Time (min)
1	Main Body of Disk Mill Machine - Bottom Panel	23,99

Recapitulation of Cycle Time for Disk Mill Machine Components		
No.	Component Name	Cycle Time (min)
2	Main Body of Disk Mill Machine - Front Panel	29,55
3	Main Body of Disk Mill Machine - Rear Panel	36,37
4	Main Body of Disk Mill Machine - Side Panel	17
5	Main Body of Disk Mill Machine - Top Panel	24
6	Main Body of Disk Mill Machine - Shaft Housing	30,54
7	Disk Mill Machine Door	10,46
8	Stator Plate	50,03
9	Lid Body Disk Mill	15,38
10	Disk	29,08
11	Bosch Disk	15,7
12	Disk Mill Blade	15,92
13	Impactor Hexagon	11,2
14	Impactor T	6,89
15	Hammer Impactor T	5,57
16	Disk Mill Shaft	23,5641
17	N2 V Belt Pulley	19,7219
18	Input Channel	23,23
19	Hopper Input Channel	16
20	Close the Hopper Input Channel	14,06
21	Input Channel Plate - Disk Mill Door	17,22
22	Hopper Connector Base	12,05
23	Hopper Connector	17,08

Recapitulation of Cycle Time for Disk Mill Machine Components		
No.	Component Name	Cycle Time (min)
24	Hopper	21,38
25	Input Container	10,19
26	Output Channel	21,6
27	Close Output Channel	17,05
28	1535 Frame	15,3235
29	292 Frame	5,735
30	292 Frame – Hole	10,465
31	421 Frame	5,735
32	421 A Frame – Hole	10,555
33	421 B Frame – Hole	10,555
34	286 Frame	9,095
35	N1 V Belt Pulley	25,4934
	Total (min)	627,78
	Total Cycle Time (hr)	10,46
	Manufacturing Lead Time (Tolerance 20%) (hr)	12,56

4. Conclusion

Based on the results of the discussions that have been carried out, several things can be concluded, namely as follows: implementation of group technology on disk mill machines can be done by paying attention to parameters such as the final shape of the component, the shape of the raw material, and machining processes. The classification & coding process on a disk mill machine can be carried out by analyzing work drawings which produce 5 part families. Process sheets for disk mill machine components can be prepared by taking into account the machining

processes for each disk mill machine component. The time required to produce a disk mill machine can be obtained from the cycle time of each component of the disk mill machine, namely 10.46 hours.

5. Acknowledgement

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