DEVELOPMENT OF EFFECTIVE PRODUCTION PLAN FOR A SAND MIXER

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ABSTRACT

Today manufacturing competitiveness demands the need for cheapest and fastest production process with their goal of safety and quality.

In this study, process design of locally fabricated 30 kg capacity sand mixer was developed. The conventional procedure of product analysis;, process identification and selection; and operation determination were performed. A make or buy decision was done based on ease of production or availability of production system. Process determination of the 'Make Parts' was developed based on availability of machinery and cost of materials. The standard time to produce each component part was determined using Metric Time Measurement Standard (MTM) approach.

Twenty-one (21) component parts were identified with fourteen (14) being made and seven (7) as bought. Machining and welding are basic manufacturing process to be employed. An effective process and assembly charts were developed. Also an economic production time of 4 hrs 20 minutes per sand mixer was determined. The study provides aan effective production system for economic manufacturing of sand mixer and allied equipment for foundry technology development.

Keywords: Sand Mixer, Process Design, Production Time, Production Capacity

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INTRODUCTION

Process design may be defined as a common task that consists of the determination of manufacturing operations, which required transforming a part from a rough to the finished state specified on engineering drawing (1and 2).

The position of process design in manufacturing of a product goes a long way in determining how well other factors in manufacturing like operation design are fully implemented. In today's competitive environment production process are becoming more dynamics as technological advancements are occurring at faster rate, resulting in new product innovations and improvements in production processes. Thus there is need to find the cheapest and fastest way to convert raw materials into products taking into consideration various constraints such as product quality, process safety and environment. These require stepwise procedures to avoid waste of human and material resources as well as time (3). These will not only ease production process but ultimately brings about a reduction in cost of production. Most process design literature has focused on route sheet with respect to production forecast volume require finishing and product cost, with sole aim of using processes of least feasible cost through certain decision criteria (3). However, the production of each component part requires a stepwise approach so as to minimize not only production volume, but facilities, production system and above all the production time of the whole assembly which translate into cost.

Therefore in this study, a process work plan for an existing 30kg capacity sand mixer was designed and developed with view of optimizing production time, maximizing production rate and optimizing the production cost.

METHODOLOGY

The conventional process design methodology was employed to the 30kg sand mixing machine previously designed in (4). In particular, the following were carried out

1. A detailed engineering drawing of the sand mixer
2. Assembly drawing on the sand mixer
3. Identification of all sub-assemblies and other independent parts
4. Listing of sub-assemblies and independent parts identified in step 3
5. Numbering of each part per product with alpha-numeric coding
6. List material type for each identified part
7. Draw a product tree structures chart
8. Conducting a make or buy analysis
9. Prepare a bill of material (BOM) for the machine
10. Prepare operations process chart
11. Prepare the machine assembly chart

THE PROCESS DESIGN OF 30 KG CAPACITY SAND MIXER

Following the procedure above, the 30kg capacity sand mixer was analyzed into sub-assemblies taken into consideration the function of each sub-assembling unit. The resulting Tree Structure Diagram (TSD) is shown in Fig. 1

The issue of producing all needed production parts by the product manufacturer needs to be explicitly analyzed due to the increased demand for quicker production method and lower cost of production of the products (3). Therefore, a good make or buy decision activity will bring under light the component parts that should be made and those to be contracted out or bought off/lease so as to achieve the optimum use in resources allocation and utilization. The two general techniques that are used for analysis of make or buy decision are quantitative and qualitative techniques as previously employed by (3).

Afterwards, the bill of materials (BOM) file was developed which carries the component name, the coding, the number of quantity required, the dimensions, the material to be used and the description of the parts required for the machine assembly.

The result of make or buy decision together with the BOM is shown in Table 1.

Determination of the different work activities to be carried out on each part identified in the two previous phases- the product analysis and product selection were carried out. This involves the procedure for identifying the set of man machine tasks, the skill, work content, tooling etc. required to accomplish a set of processes and assembly of an entire product.

The operation mainly carried out on the manufacturing of a sand-mixing machine are sawing, turning, milling, drilling, welding, thread- cutting, folding and other auxiliary operations. The operation per process of a component part, its sequence of operation process chart and assembly chart produced the resulting process chart are shown in Fig. 2 and Fig. 3 respectively.

Based on the identified operations, the production time which consists of the sum of set-up time, machining time, auxiliary time and delay time was determined..

Machining time was determined for each operation using standard formulae reported in (5, 6, 7 and 8) for given the speed of the job (N), feed (S) and length of the job. The resulting production time was estimated as shown in Table 2.

The operation process chart gives the detailed information, specification and manufacturing procedure of each component part of the machine and how they are assembled together to make up the entire machine.

RESULTS AND DISCUSSION

The sand mixer was divided into four main assemblies: drum, main shaft, muller and support (Fig 1). These were also divided into main body, top cover, bottom outlet, main shaft, main arm, main bearing, muller bearing, muller hallow shaft, bolts, base support, electric motor stand, brace support, electric motor support and frame support.

Based on the identified quantities, the bill of material (BOM) was prepared using alphanumeric coding system. The BOM was developed based on the availability of machinery and cost of procurement of each material required for production of each part.

In determining the production time, twenty percent provision was made for delays to make allowance for contingency, especially on the parts of the operators. It was found that the total set up time is 24.84 minutes, total operation time is 171.44 minutes; assembly time is 15.12 minutes, the delay time of 42.28 minutes to achieve the probable total production time of 4hrs 13.68minutes.

CONCLUSION

- It can be concluded that about 3 machines could be manufactured daily.
- The process design will in no doubt provide optimum production procedure for sand mixer manufacturing industry.

However, the costs were based on standard value, as the effect of inflation was not considered. Also the ergonomic consideration of the mixer was not investigated.

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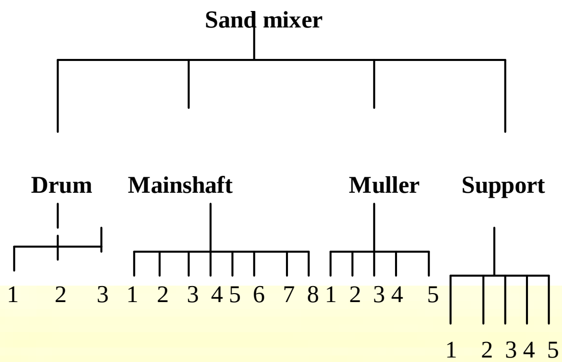

Fig 1: Tree structure diagram for sand mixer

Drum : 1.Main body 2.Top cover 3.Bottom outlet

Muller: 1. Muller 2. Muller shaft 3. Muller bearing 4. Muller hollow shaft 5. Bolts

Main shaft: 1.Main shaft 2.Main arm 3.Main bearing 4.Pulley 5.Belt 6.Scrapper 7.Main hollow shaft 8.Bearing house

Support:1.Base support 2. Electric motor stand 3. Braced support 4. Electric motor 5. Frame support

Table 1: Bill of Engineering Measurement and Evaluation

Item No	Component Name	Part Code Number	Units Required	Material Description	Dimension (mm)	Make/Buy
1	Main body Drum	SMM10101	1	Mild Steel	2130*630*2	Make
2	Top Cover	SMM10102	1	Mild Steel	ϕ675	Make
3	Bottom Outlet	SMM10103	1	Mild Steel	ϕ670	Make
4	Main Shaft	SMM10201	1	Steel	ϕ40*615	Make
5	Main arm	SMM10202	2	Mild Steel	ϕ40*180*5	Make
6	Main bearing	SMM10203	2	High Carbon Steel	ϕ40*50	Buy
7	Pulley	SMM10204	1	Cast Iron		Buy
8	Belt	SMM10205	1	Fabric Rubber		Buy
9	Scrapper	SMM10206	2	Mild Steel	252*50*4	Make
10	Main hollow shaft	SMM10207	1		ϕ51*270	Make
11	Bearing house	SMM10208	1	Mild Steel		Make
12	Muller	SMM10301	2	Cast Iron	ϕ250*60	Buy
13	Muller shaft	SMM10302	2	Steel	ϕ30*120	Make
14	Muller bearing	SMM10303	4	High Carbon Steel	ϕ25*30	Buy
15	Muller hollow shaft	SMM10304	2	Steel	ϕ41*75	Make
16	Bolts	SMM10305	6	Mild Steel	ϕ10*50	Buy
17	Base support	SMM10401	3	Mild Steel	500*50*4	Make
18	Electric motor stand	SMM10402	1	Mild Steel	400*50*4	Make
19	Braced support	SMM10403	2	Mild Steel	360*50*4	Make
20	Electric motor	SMM10404	1	Mild Steel		Buy
21	Frame support	SMM10405	2	Mild Steel Mild Steel	280*50*4	Make

Table 2: Estimation of Production Time

ITEM	PART NAME	SET-UP TIME	OPERATION TIME	ASSEMBLY TIME
1	BODY	1.48	14.55	0.20
2	TOP COVER	1.58	6.00	0.16
3	HANDLE			0.50
4	BOTTOM OULET	2.16	18.86	0.40
5	DISCHAGE LEVER			0.30
6	MAIN SHAFT	1.44	17.16	0.34
7	MAIN HALLOW SHAFT	1.05	7.59	0.34
8	BOLTS			0.20
9	MAIN ARM	2.38	22.12	0.26
10	SCRAPPER	1.58	10.70	0.26
11	BEARING HOUSE	1.31	6.54	0.30
12	MAIN BEARING			0.26
13	MULLER SHAFT	2.77	19.24	0.34
14	MAIN MULLER SHAFT			0.34
15	MULLER BEARING			0.26
16	MULLER			0.34
17	BASE SUPPORT	1.94	16.46	0.26
18	ELECTRIC MOTOR STAND	3.27	14.45	0.30
19	ELECTRIC MOTOR			0.30
20	BOLTS			0.20
21	PULLEY			0.40
22	BELTS			0.34
23	BRACED SUPPORT	0.83	1.53	0.26
24	FRAME SUPPORT	1.31	10.73	0.26
25	LUBRICATION			2.00
26	PACKAGING			2.50
27	INSPECTION			3.50
28	TOTAL	24.84	171.44	15.12

Production cycle time = 211.40 minutes

Delay (20% of 211.40) = 42.28minutes

Total machine cycle time = 253.68min.

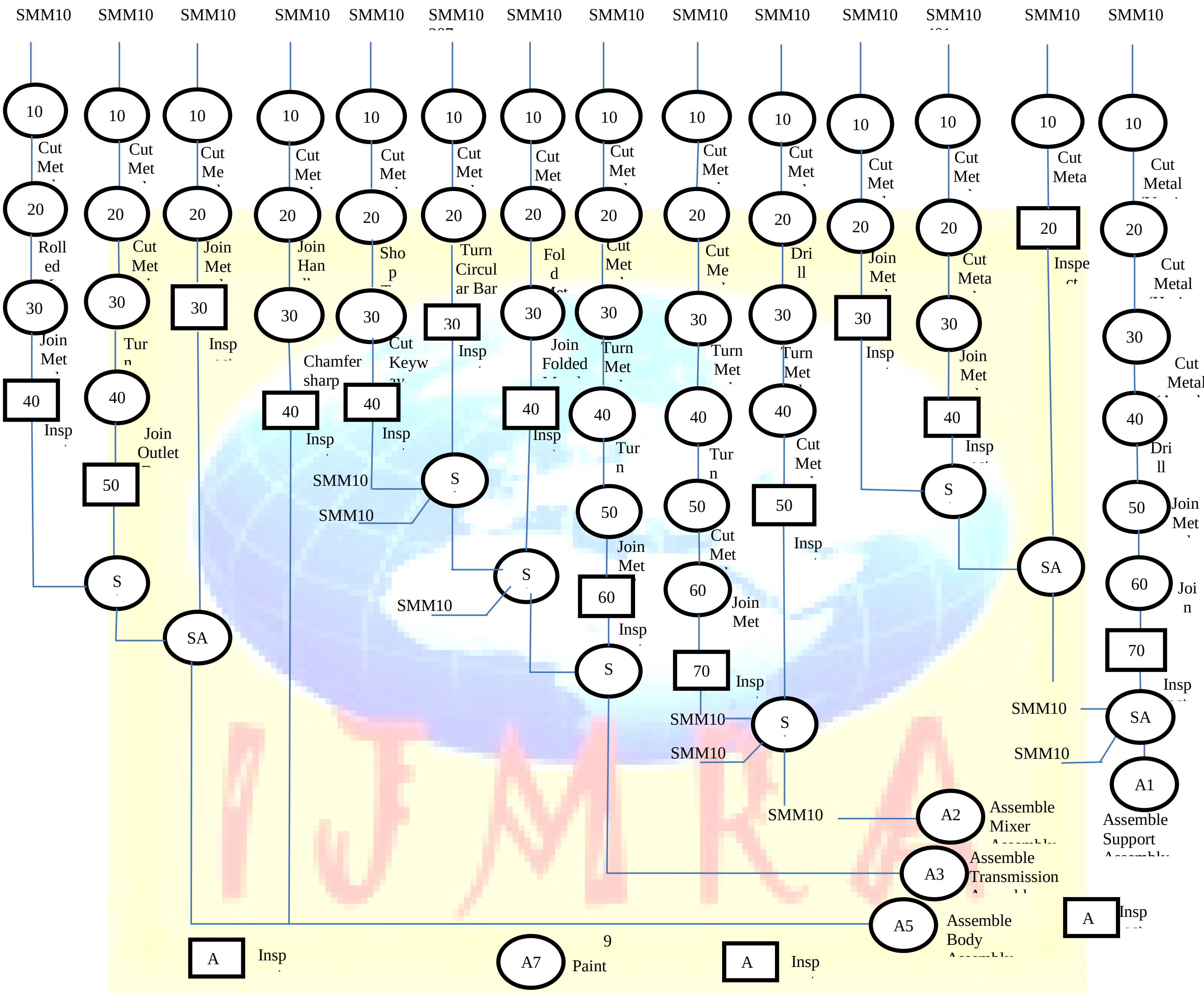

Figure 3: Operation Process Chart of a Sand Mixer

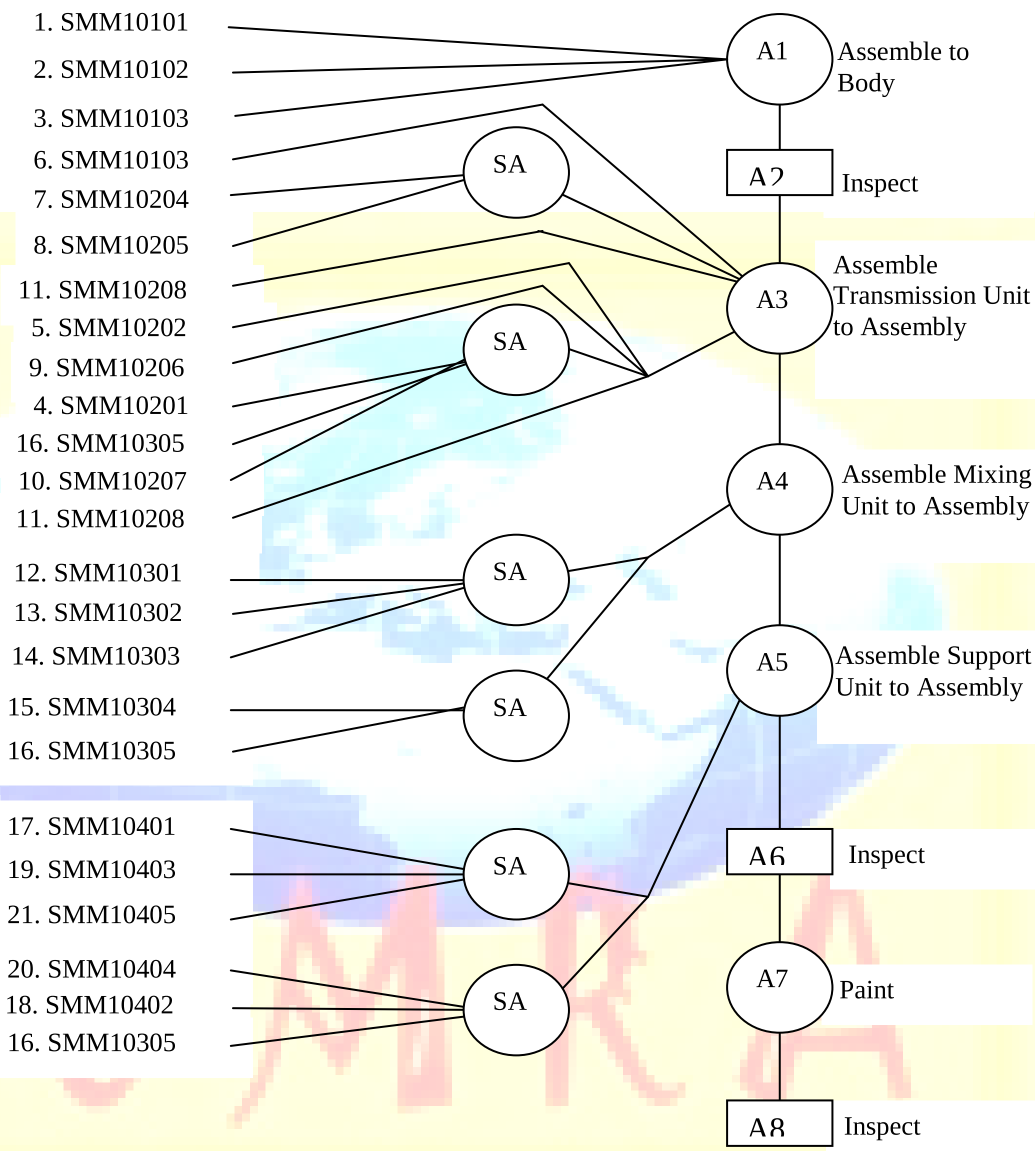

Fig. 2: Assembly Process Chart of a Sand Mixer