

PRODUCTIVITY ASSESSMENT OF UTENSILS MANUFACTURING UNIT: A CASE STUDY

Kapil Deo Prasad¹, Sanjay Kumar Jha², Ritesh Kumar Singh³

Assistant Professor, Dept. of Production Engg., BIT Mesra, Patna Campus, India¹

Associate Professor, Dept. of Production Engg., BIT Mesra, Ranchi, India^{2,3}

Abstract: Production process and technology practiced in utensils manufacturing units of Jharkhand is age old and there has been no initiative to analyze and incorporate modern technological development. The rudimentary production process is resulting in high percentage of defective utensils. These utensils manufacturer have to compete with the manufacturer in organized sector using modern manufacturing techniques. The quality / productivity achieved by bigger utensils manufacturer is quite high compared to the rural artisans. Therefore, there is a need to explore and identify appropriate technologies, adaptation of which could ensure improvement in level of quality/productivity achieved. The objective of this study is to know and identify areas with low productivity level in the utensils manufacturing units of Jharkhand.

Key Words: Productivity, quality, utensils manufacturing.

I. INTRODUCTION

Brassware manufacturing units have existed in India since ancient times, practiced mostly by tribal people. Brassware manufacturing is an integral part of rural industrial activity of the country. These units' production activities are labour oriented. They contribute significantly towards industrial employment and also as our link to ancient heritage and culture. They contribute about 15% of total output of small-scale industries, employing about 40% of the total workforce in this sector. These units are based on traditional skills and simple manufacturing processes that are carried mostly by hand tools and in few cases by simple machines. Lack of mechanization and technology adaptation are putting these utensils manufacturing units into disadvantageous position vis- a-vis industries in organized sector. This is threatening the very existence of these units. Being labour intensive, these utensils manufacturing units are employment generating, capital saving and capable of operating on a decentralized basis in rural areas. Increase of productivity is important in developing countries because of higher population growth, higher interest burden, international competition, scarcity of raw materials, balance of payment problem etc. Some of these problems can be overcome by paying greater attention to managing productivity.

The cluster development approach can play a vital role in the development of the micro, small and medium enterprises (MSMEs) in India. The cluster of the brass utensils manufacturing units at Jariagarh (Khunti), Jharkhand is one of the several clusters.

II. A CASE STUDY

A case study has been undertaken to explore the productivity analysis. The brass & bronze utensils manufacturing clusters are located in the village Jariagarh (Khunti), Ranchi. The village Jariagarh (Khunti) is situated at Karra sub division of Ranchi Distt., Tehsil – Khunti (PIN – 835 234). It is about 50 K.M. away from Ranchi in the West-South direction. This the oldest and prestigious industry cluster in Jharkhand. The main product of this unit is brass and bronze utensils like, Thali, Lota, Bhagauna, Kathot, Kalchul, Karahi, Katora, Glass, Kathot, Tastari etc.

Present Technology and Process

The present technology of the manufacturing process of brass & bronze utensils is shown in Process Flowchart (Figure 1). The process of manufacturing utensils is completely done by manual technique and traditional practice.

The complete process for the range of product consists of mainly five stages:

- Melting of scrap metal.
- Casting of metal block.
- Hammering of blocks in to circles.
- Trimming and cup Drawing.
- Scraping and Design making.

	RESOURCES			
	QUANTITY	LABOUR	TIME	OTHERS
SCRAP MELTING	9.0 Kg of BRASS / BRONZE SCRAP	1 MAN	1 X 1/2 = 30 MINS	-
CASTING OF METAL BLOCK	9 PIECES TOTALING 9.0 Kg	1 MAN	1 X 1/2 = 30 MINS	SOLIDIFICATION TIME IS 1 Hr
HAMMERING OF BLOCK FOR MAKING CIRCULAR SHEET	-	5 MEN	5 X 3 = 15 Hrs	HEAT ING OF BLOCKS INCLUDED
END TRIMMING OF SHEET FOR SIZING THE SHEET CIRCLE	-	1 MAN	1 X 1 = 1 Hr	SCRAP GENERATED
HAMMERING FOR PROVIDING CUP DRAWN / DESIRED SHAPES	-	5 MEN	5 X 2 = 10 Hrs	-
CLEANING / WASHING	-	1 MAN	1 X 1 = 1 Hr	-
SCRAPPING & DESIGN MAKING	-	1 MAN	1 X 2 = 2 Hrs	-
TOTAL			30 Hrs	

Fig 1: Process Flowchart 1(flow chart of manual process of brass utensils manufacturing)

a) Melting of Scrap Metal

Brass or bronze scrap is melted in the pit furnace called "Bhatta" (Figures 2 & 3) in colloquial language. Wooden coal is used in the pit furnace and hand driven blower is used for melting of scrap. The brass scrap is kept in a crucible of varying capacity as per requirement and heated in the furnace at about 800° C with the help of

blower & wooden coke. There is no temperature control device for melting furnace and the temperature of furnace is maintained on experience by the worker who is melting.



Fig 2 : Melting Pit Furnace ("Bhatta")



Fig 3: Melting of Scrap

b) Casting of Metal blocks

When the brass scrap is converted in to molten metal and pouring temperature is obtained then the molten metal is poured in to the mould called "saancha"(Figures 4 & 5) to produce blocks of different disc round shapes (from 500 gram to 5Kg). The mould "saancha" is made with ground fine dust ("mitti") & paddy husk ("dhaan ka bhusa") and baked like brick . It works as a good permanent mould made of ceramic materials. Quality & property of the ceramic material like refractoriness, permeability, hot strength, etc. are not considered while preparing the mould and that is totally dependent on the worker's skill. Many times it happens that while pouring the molten metal , the mould is cracked which causes metal spillage and therefore there is a lot of wastage of metal and human effort.



Fig 4 : Mould ("Saancha")



Fig 5: Metal block in the Mould

c) Hammering of blocks into circles

Metal blocks are manually hammered by the simultaneous effort of four to five workers at a time on a single piece. One person holds the metal block with tongs("Sandasi")and rotates the block very slowly and uniformly and other four persons hammer the block one after another with iron hammer ("hathauda") in a very rhythmic way to convert into circular shape. Between hammering the job is heated periodically in a separate furnace meant for heat treatment (Figures 6 & 7), to make the job soft and easily workable. The blocks are not quenched

in water or oil for cooling but are directly kept on the anvil for manual hammering process. By adding one after another 4-5 metal blocks are hammered in group for circular plates at a time. This process continues until 4-5 circular plates of desired size (diameter from 10cm to 70cm) obtained. There is no facility to control & observe the furnace temperatures and to check thickness of the circular plate. This check is performed manually by experience.



Fig 6 : Furnace for heat treatment



Fig 7: Furnace in use

d) Trimming and Cup Drawing

In case the circular sheet gets torn on the edges or contains uneven edges, then the edge is trimmed using chisel ("Chheni") and small iron hammer ("Chhota hathaura"). The circular sheets are again heated in the furnace and hammered further for giving cup shape. One person holds the sheets with tools and rotates the sheets very slowly and uniformly and other four persons hammer to give the shape of "Thaali".

e) Scrapping and Design making

After the product of required shape and size is obtained the inner surface is scrapped manually using a metal scrapper ("Nehdi") to obtain a shiny finish (Figures 8 & 9). Also designs are made on the product by the Nehdi as per requirement of the customer. A big rectangular wooden block called "Papara kaath" is used for sharpening "nehdi".



Fig 8 : Scrapping



Fig 9: Scrapping and designing

III. PRODUCTIVITY ANALYSIS

The existing level of productivity is measured using technique of productivity measurement, termed as Performance Objectives – Productivity (PO-P). Developed by Vrat, Prem et.al. [1] PO-P approach lays stress on the aspects of Copyright to IJIRSET

identification of areas with low productivity so as to bring about improvements. Its basic philosophy lies in the belief that input resources of an organization cannot be viewed in isolation. A methodology has been presented to help in identification of key performance areas, performance objectives and their weightage.

PO-P model

Under PO-P approach productivity index for the system is built up in stages from the productivity indices of the sub-systems constituting the system. Productivity index of a sub -system is in turn built up from the productivity indices of the Key Performance Areas(KPA's) of that sub-system.

A flow chart for the procedure for use of PO-P approach for productivity measurement has been given in fig. 10.

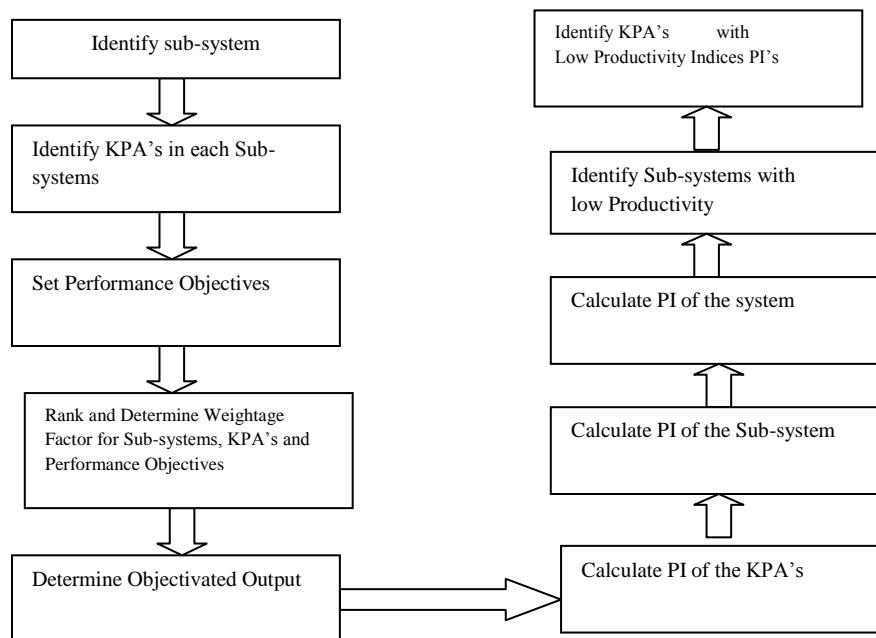


Fig. 10 : Flow chart for the procedure for use of PO-P approach for productivity measurement

A. Identification of Sub-systems

The concerned small scale brass utensil manufacturing industry can be considered to operate as a system with following sub-systems:

1. Production sub-system (A)
2. Technology sub-system (B)
3. Material sub-system (C)
4. Goals and values sub-system (D)
5. Marketing sub-system (E)
6. Ergonomics sub-system (F)

B. The following KPA's fall under considered sub-systems

The KPA's under each sub-systems have been listed in Table 1.

Table 1 : KPA's under considered sub-system

SUB-SYSTEM	KEY PERFORMANCE AREA (KPA)
1.Production sub-system (A)	1.Manpower Utilization
	2. Assets Utilization
	3.Quality of Production
2.Technology sub-system (B)	1.Design & Development
	2.R&D /Innovation
3.material sub-system (C)	1.Storage Management
	2.inventory control
4.Goals and values sub-system (D)	1.Employee Satisfaction
	2.Customer Satisfaction
	3.Societal Goals
5.Marketing sub-system (E)	1. Sales
	2. Market Research
	3. Sales promotion and publicity
6.Ergonomics sub-system (F)	1. personal capability
	2. working condition
	3. others

C. Weightage of sub-systems

Method of Paired Comparison: In this methodology, each objective is compared to every other objective and weightage (Of relative importance) allocated on scale of 1- 3 as under (Table2).

- 3- Allocated when there is a Major difference of relative importance
- 2- Allocated when there is a Medium difference of relative importance
- 1- Allocated when there is a Minor difference of relative importance

Table 2 : Allocation of relative importance of objectives

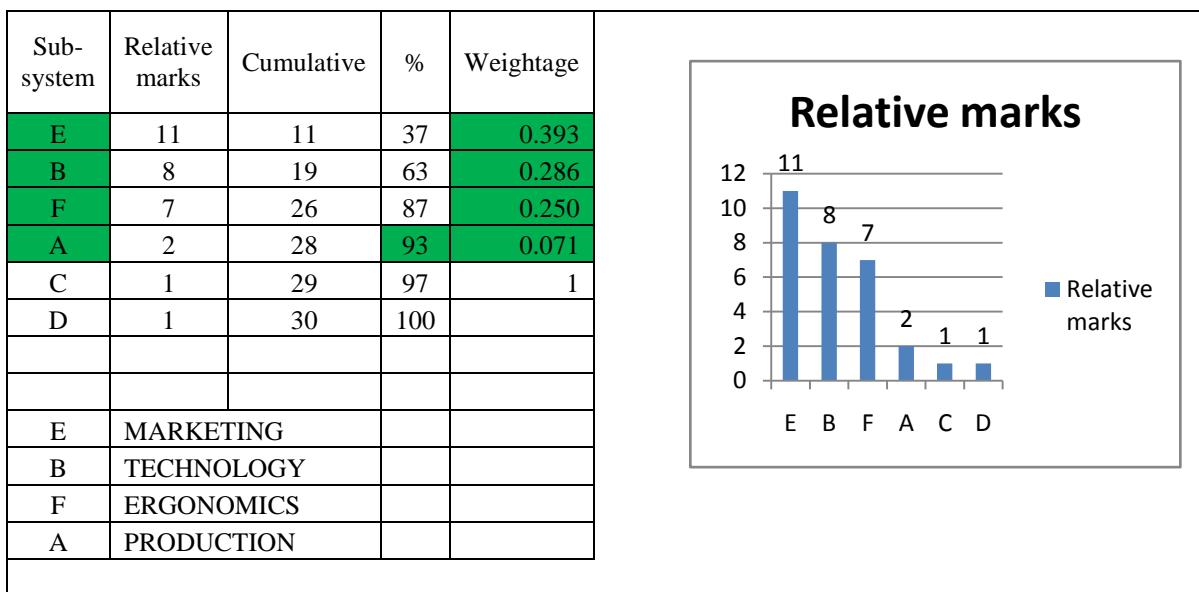
	B	C	D	E	F
A	B-2	A-2	D-1	E-3	F-2
	B	B-3	B-2	E-1	B-1
		C	C-1	E-3	F-3
			D	E-3	F-2
				E	E-1
					F

Weights against each of the objective is then expressed as a fraction of total weights (Table 3)

Table 3 : Allocation of weights to objectives

CODE	SUB SYSTEMS	RELATIVE MARKS	WEIGHTAGE	SUB-SYSTEMS	RELATIVE MARKS	WEIGHTAGE
A	production	2	0.067	production	2	0.071
B	technology	8	0.267	technology	8	0.286
C	materials	1	0.034			
D	goals & values	1	0.034			
E	marketing	11	0.367	marketing	11	0.393
F	ergonomics	7	0.234	ergonomics	7	0.250
	TOTAL	30	1		26	1

On the basis of relative marks derived from Table 3, Pareto analysis has been done to find potential sub-systems (80-20 Rule) as mentioned in Fig. 11.


Fig 11. - Pareto Analysis for finding main problem areas

D. Weightage of KPA's (key performance areas)

Method of Direct Scaling: In this method the weighing is done directly. The evaluators are asked to decide upon the relative weight of each of the subordinate elements representing relative importance for the utility of the associated element on the next level of hierarchy. The sum of the total weights of all elements is identified as hundred (Table 4).

Table 4 : Allocation of weights to KPA's

SUB SYSTEM	KEY PERFORMANCE AREA (KPA)	RELATIVE WEIGHT	WEIGHTAGE FACTOR
production	1. manpower utilization	50	0.5
	2. assets utilization	30	0.3
	3. quality of production	20	0.2
	TOTAL = 100		
technology	1. design & development	60	0.6
	2. R&D /innovation	40	0.4
	TOTAL = 100		
Marketing	1. Sales	40	0.4
	2. Market Research	40	0.4
	3. Sales promotion and publicity	20	0.2
	TOTAL = 100		
Ergonomics	1. personal capability	40	0.4
	2. working condition	30	0.3
	3. others	30	0.3
	TOTAL = 100		

E. Analysis of performance index

Now, the calculation of PI of KPA's & sub-systems has been done using Table 5, and finally PI of the system has been determined (Table 6).

Table 5 : Analysis to determine PI of KPA's & Sub-systems

SUB SYSTEM	KEY PERFORMANCE AREA (KPA)	PERFORMANCE OBJECTIVE	WF	OV	AV
Production	1. manpower Utilization	1. direct labour utilization : standard hrs recovery/ direct labour attendance Hrs	0.5	0.793	0.751
		2. cost effectiveness: standard hrs recovery/ personnel expenses	0.5	0.0448	0.0405
		3. Is the brassware manufacturing unit uses locally available man power for its operations		1	0.8
	2. assets utilization	1. capacity utilization: standard hrs recovery/ personnel expenses	1	0.0448	0.0405
	3. quality of production	1. index of defect free production: value of defect free production/value of total production	1	1	0.98
Technology	1. design & Development	1. Is the brassware manufacturing unit uses locally available low cost technology (intangible 0-1) intangible (scale 0-1)		1	0.8
		2. Are brassware manufacturing unit aware of the locally available technologies intangible (scale 0-1)		0.7	0.6
		3. is the design getting approved before production run		0.4	0.3
		4. is there any CAD facility?		0	0
		5. Are there any traditional drafting practices after finalization of design		0	0

		6.Are there any process of verification and validation of design	0.1	0
		7. Is there a system to acquire and assimilate a new technology?	0.1	0
2.R&D /innovation	2.R&D /innovation	1 Has the gap analysis of the present and required technology level done intangible (scale 0-1)	1	0
		2 does brassware manufacturer take corrective action when key customer requirement are not met?	0.4	0.3
		3.does brassware manufacturer have quality manual?	0.1	0
		4. does the brassware manufacturing unit uses SWOT analysis from time to time for fixation of the future strategies?	0.1	0
Marketing	1. Sales	1. Sales: absolute monetary	0.4	38937600
		2. profitability: profit/sales	0.6	0.166
	2. Market Research	1. Is production capability a limiting factor	1	0.8
		2.Is demand a limiting factor	1	0.8
		3.are customers satisfied with the quality and price of the products?	0.7	0.5
	3. Sales promotion and publicity	1.Do schemes of government and NGO help in creating demand for brass ware	0.1	0
		2.Is there any group effort on behalf of the manufactures to market their product?	0.7	0.5
		3. Are brassware exported ?	0.1	0
		4. does government, provide financial assistance for marketing activities?	0.1	0
Ergonomics	1. personal capability	1. Is the experience required for the work up to mark?	0.7	0.6
		2.Is there Lack of interest among the workers to do the job?	0.4	0.3
		3. Are the manpower properly trained to use the existing level of technology?	0.7	0.6
		4. Do the workers meet the adequate physical characteristics requirements to do the work (postures, strengths etc.) intangible (scale -1)	0.7	0.6
	2. working condition	1. Are the facilities properly laid out to assist the worker in doing the work?	0.7	0.6
		2. Are the tools upto date ?	0.1	0
		3. Is the environment around the work area satisfactory intangible (scale 0-1)	0.4	0.3
		4. IS the work load properly distributed among the workers? intangible (scale 0-1)	1	0.8
	3. others	1. are there any rules regulations and policies regarding the work culture	0.4	0.3
		2. Are any measures taken to overcome mental distraction (drugs, poor diet, lack of sleep, family problem etc.) intangible (scale 0-1)	0.1	0
		3. IS work schedule and rotation among the workers properly carried out intangible (scale 0-1)	1	0.9
		4. Are the workers subjected to unusual environmental stress intangible (scale 0-1)	0.7	0.6

Where, WF: Weightage Factor, OV: Objectivated Value, AV: Actualvalue

Table 6 : Calculation of PI of the system

Sub-system	Weightage factor	KPA(Key Performance Activity)	Weightage factor	PI of KPA	PI of Sub-system
Production	0.071	Manpower Utilization	0.5	0.9255	0.9300
		Assets Utilization	0.3	0.9040	
		Quality of production	0.2	0.9800	
Marketing	0.393	Sales	0.4	0.9923	0.7496
		Market research	0.4	0.7637	
		Sales promotion & Publicity	0.2	0.2357	
Technology	0.286	Design & development	0.6	0.4814	0.3639
		R&D/Innovation	0.4	0.1875	
Ergonomics	0.250	Personal capability	0.4	0.8304	0.7007
		Working condition	0.3	0.6018	
		Others	0.3	0.6268	

Productivity Index of the system = $(0.9300*0.071) + (0.7496*0.393) + (0.3639*0.286) + (0.7007*0.250) = \mathbf{0.63}$

IV. CONCLUSION

The existing level of productivity is measured using technique of productivity measurement, termed as Performance Objectives – productivity (PO-P). PO-P approach lays stress on the aspects of identification of areas with low productivity so as to bring about improvements. Its basic philosophy lies in the belief that input resources of an organization cannot be viewed in isolation. A methodology has been presented to help in identification of key performance areas, performance objectives and their weightages. To include performance objectives of qualitative nature's questionnaire is used. For productivity measurement four sub – systems mainly 'Technology', 'Production', 'Market' and 'Ergonomics' have been identified where improvement in productivity is needed by using latest findings in the area of multi-objective decision making in order to remove the subjectivity and biasness of the decision makers and to improve the productivity of the utensils manufacturing industries.

REFERENCES

1. Vrat, Prem., Sardana, G.D,& Sahay, B.S, 1998. Productivity Management-A System Approach, Narosa publishing house, New Delhi..
2. Jha, S. K. & Kumar, S., 2006. Assessment of Productivity of Items Manufactured by Rural Artefacts Community – With Special Reference to Jharkhand State (India), The International Journal of Applied Management and Technology, Vol 4, Num 2, pp. 288 – 320.
3. "Job Quality and Productivity in Small and Micro-enterprises", EDA Rural Systems Pvt Ltd, March 2002.