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WASTE REDUCTION IN THE PRODUCTION PROCESS PLATE PRODUCT TYPE PC 27 C USING VALUE STREAM MAPPING METHOD PT. XYZ

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ABSTRACT

PT. XYZ is a ceramic or porcelain manufacture. One product that is made is the plate with type PC 27 C. One problem that occurs is the detection of high waste by increasing the amount of WIP inventory (products white body), so the analysis using value stream mapping in order to identify the waste that occurs in the manufacture of ceramic production activity with 27 C-type PC and the ratio of value added analysis. The result showed that the value of an increase in the ratio of value added is from 12:10% to 70.93%.

Keywords : Value Stream Mapping, ratio of value added

1. INTRODUCTION

1.1. Background

PT. XYZ is a ceramic or porcelain manufacture. To produce the products according to customers requirements, it is very important to ensure any activity that occurs in the production activities carried out effectively and efficiently. It required an approach that can identify and eliminate waste activities.

Waste that occurs in PT XYZ was never properly taken into account because companies only focus on the use of gas fuel system for the kiln. Efficient use of gas for the production of excessive corporate conduct without taking into account the cost savings arising from excessive WIP storage.

In an effort to identify and eliminate waste, there are several types of waste that is disguised or interconnected with other waste within or between the various processes and activities although some waste is another fairly easy to recognize and measure. Therefore, efforts to eliminate a particular type of waste sometimes even improve other types of waste. Problems of this kind are sometimes causes difficulty identifying and eliminate waste.

1.2. Purpose

- To identify waste in the production process of ceramic
- To analysis the ratio of value added

2. THEORETICAL BACKGROUND

2.1. Lean management

Lean is a business philosophy, not just techniques or tools. Lean means doing things in a simple way and efficient as possible, but still provide the best quality and very fast service to customers. Management of the organization needs to absorb Lean thinking It needs to be invested in the form of culture, measures, policies, procedures and in the end is on the tools or techniques of lean. The basic concept of lean manufacturing are: identify waste, pull *production,* standardize processes, quality at the source, continues flow and continues improvement.

Lean Production means "doing more and more with less and less". Application of Lean Production will create the production process flows are drawn and controlled in accordance with customer requests and to eliminate excess inventory.

2.2. Value stream mapping

Before discussing value stream mapping as the primary method, need to be discussed first basic concept of waste. Conceptually, waste is all the activities and events within the value stream classified as non-value added. This classification refers to the categorization of activities within a company by Hines and Taylor (2000) which classifies the organization's activities into three categories. (1) value added, (2) non value added but necessary, and (3) non value added and not necessary. Activity is called

value added if it adds value for the end consumer, whereas if it does not add value for the end consumer then the activity classified as non-value added. Between the two groups there is the last group that does not add value but is required (non-value added but Necessary) for example material handling. According Gaspersz (2012), the non-value added but necessary, though not necessarily immediately, as much as possible reduced or eliminated while the non-value added and not Necessary should be prioritized to be eliminated. Based on the Toyota production system, there are seven kinds of waste are as follows : w*aste of Over production, waiting time* (*delay*), *excessive transportation,* Inappropriate processing, *excessive inventory, unnecessary* motion, d*efect.*

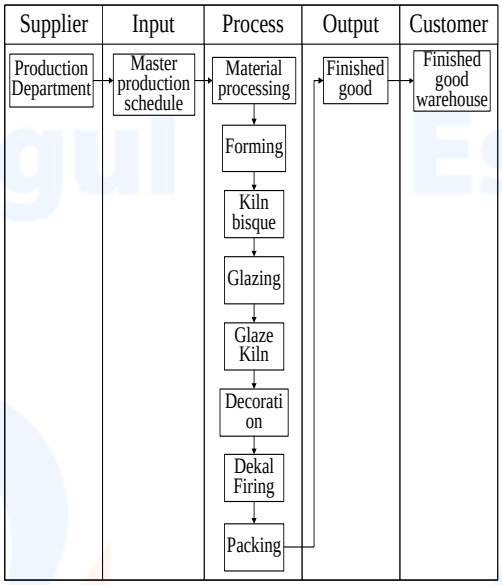
3. RESULT AND DISCUSSION

3.1. Data Processing

To determine the flow of information through which the material in the production of porcelain plates with the type of PC 27 C, we can use the SIPOC Chart (Supplier, Input, Process and Output Customer) as shown in Table 1.

SIPOC chart in Table 1 illustrate that to produce a plate product with type PC 27 C occurred approximately 8 major processes that must be passed. That is material processing, forming processes, process bisque kiln, glazing process, the process of decoration, decal firing process, and the final packing process. Observations will be conducted at 8 activity contained in the main process.

Table 1 Supplier Input Process Output Customer (SIPOC)



3.2. Detail Mapping

Based on observations of activity in 8 major processes (SIPOC diagram), then created detailed maping using map Process activity mapping can be seen in Table 2.

Table 2. Process Activity Mapping

NO	ACTIVITY	TIME (in sec)				MECHINE /TOOLS		QTY OF LABOR	WITHIN (meters)
		O	T	I	S	D			
1	Transportation of raw materials warehouse to the weight		133.2				Forklift	1	112.48
2	weighing process	124.3					Weight	2	
3	Transport from the weight to materials / milling process		121.5				Cargo lift & lorries	2	18.5
4	Materials wait in front of the machine Ball Mil					86,400			
5	Ball Mill processing	28,800					Ball Mill	3	
6	Mixing process	86,400					Mixing machine		
7	filter press machine disassembly	367.4					Filter Press machine	2	
8	Transportation from filter press machine to pallet cake line		54.0				Hand Lift	1	25.3
9	Stored cake in cake area				86,400		Pallet		
10	Transportation from cake line to extruder machine		59.1				Hand Lift	1	21.4
11	Extruder process	17.5					Extruder	2	
12	Store londrong in londrongan area				311.2		Lorries		
13	Transportation from londrongan area to forming machine		69.6				Hand Lift	1	1.2

Table 2. Process Activity Mapping

NO	ACTIVITY	TIME (in sec)				MECHINE /TOOLS		QTY OF LABOR	WITHIN (meters)
		O	T	I	S	D			
14	Forming process	23.7					Forming	1	
15	Drying process	1,380					Dryer		
16	Kerik process	22.1					Cuter	1	
17	Green ware finishing process	11.6					Finishing machine	1	
18	Transportation to kiln bisque machine		26.6				Conveyor		20.2
19	Loading green ware to the train		25.8				Train	4	2
20	Waiting for kiln bisque process					43,962.5			
21	kiln bisque process	48,000					Kiln machine	1	
22	Waiting to unloading bisque from train					1,182.5			
23	unloading bisque		429.2					3	1.7
24	Bisque inspection			18.94				2	
25	Store bisque impermanent				86,400				
26	Transportation to spray process		64.8				Hand Lift	1	5
27	Spray process	7.4					Compressor	1	
28	Transportation from sprayer to glaze process		44.8				Conveyor		17
29	Glaze process	7.9					Liquid glaze	1	
30	Transportation to glaze kiln machine		27.0				Conveyor		11
31	loading bisque to the train		40.0				Train	4	1.3
32	Waiting to glaze kiln process					1,260			
33	glaze kiln process	18,480					Kiln machine		
34	Cooling process of glaze kiln	420					Fan		
35	unloading white body to the train		109.4					2	1.3
36	Grinder process	5.1					Grinding machine	1	
37	Transportation to quality inspection process		441.0				Conveyor		27.7
38	Waiting for inspection process					791.8			
39	Quality inspection process			7.0				1	
40	Transportation from inspection process to loading area		58.0				Conveyor		4
41	Moved to other conveyer		43.0				Conveyor	1	3.6
42	loading white body to train	17.6					Train	3	
43	Transportation to white body warehouse		47.7				Hand Lift	2	4.4
44	unloading & loading white body from train to pallet	1,839.3					Pallet	2	
45	Store white body in white body warehouse				2,592,000				
46	Transportation to decoration process		292.3				Hand Lift	2	14
47	decoration process	43.7						1	
48	Loading plate to train		321.8				Firing train	1	3
49	Firing process	10,800					Firing train		
50	unloading plate from train	207.2						1	
51	Transportation to decoration area		53.0				Conveyor	2	16
52	Store in decoration area				28,800				
53	Transportation from decoration area to packaging section		300.3				Hand Lift	2	23
54	Prepare packaging cardboard	34.1						2	
55	Packaging process	11.2							
56	Transportation to finished good warehouse		216					1	45
Total		197,020.07	2,978.01	25.94	2,793,911.23	133,596.83	**3,127,532.08**		

Table 3. Value Added Activity

Value added		
1	weighing process	124.3 Sec
2	Materials wait in front of the machine Ball Mil	86,400.0 Sec
3	ball mill processing	28,800 Sec
4	Mixing process	86,400 Sec
5	filter press machine disassembly	367.4 Sec
6	Stored cake in cake area	86,400 Sec
7	Extruder process	17 Sec
8	Forming process	23.7 Sec
9	Drying process	1,380 Sec
10	Kerik process	22 Sec
11	green ware finishing process	11.6 Sec
12	*kiln* bisque process	48,000 Sec
*13	Store bisque impermanent	10,800 Sec
14	Spray process	7.4 Sec
15	Glaze process	7.9 Sec
16	glaze *kiln* process	18,480 Sec
17	Cooling process of glaze *kiln*	420 Sec
18	Grinder process	5.1 Sec
19	Decoration process	44 Sec
20	Firing process	10,800 Sec
21	Packing process	11 Sec
	TOTAL	**378,521.78 Sec**

3.3. Analysis

To facilitate the identification of waste the 56 activity in process activity mapping activities are grouped into value added, non-value added activities and non-value added activities but Necessary**.**

In table 3 (value added activity), 21 activities with the time it takes 378,521.78 seconds. At number 13, the activity retention time required to avoid defects in the next process is 3 hours, or 10,800 seconds.

Table 4 (non-value added activity but Necessary) as 30 activities with the time required is 78,424.91 seconds and Table 5 (non-value added activity and not Necessary) as 6 activity with the time required is 2,670,585.39 seconds.

Activity number 13 in Table 3 and number 2 in table 5 is the same activity. Stored time required to avoid defects in the subsequent process is 3 hours. In fact, the storage activity performed during 1 day (24 hours). So that activities are divided into value added and non-value added, 3 hours being value added activities while the next 21 hours as a non-value added activities.

Table 4. Non Value Added Activity But Necessary

***Non value added but* Necessary**			
1	Transportation of raw materials warehouse to the weight	133.2	Sec
2	Transport from the weight to materials / milling process	121.5	Sec
3	Transportation from filter press machine to pallet cake line	54	Sec
4	Transportation from cake line to extruder machine	59.1	Sec
5	Transportation from londrongan area to forming machine	69.6	Sec
6	Transportation to kiln bisque machine	26.6	Sec
7	Loading green ware to the train	25.8	Sec
8	Waiting for kiln bisque process	43,962.5	Sec
9	Waiting to unloading bisque from train	1,182.5	Sec
10	Unloading bisque	429.2	Sec
11	Bisque inspection	19	Sec
12	Transportation to spray process	64.8	Sec
13	Transportation from sprayer to glaze process	44.8	Sec
14	Transportation to glaze kiln machine	27	Sec
15	Loading bisque to the train	40	Sec

Table 4. Non Value Added Activity But Necessary

	***Non value added but* Necessary**		
16	Waiting to glaze kiln process	1,260	Sec
17	Unloading white body to the train	109.4	Sec
18	Transportation to quality inspection process	441	Sec
19	Quality inspection process	7	Sec
21	Transportation from inspection process to loading area	58	Sec
21	Loading white body to train	17.6	Sec
22	Transportation to white body warehouse	47.7	Sec
23	Transportation to decoration process	292.3	Sec
24	Loading plate to train	321.8	Sec
25	Unloading plate from the train	207.2	Sec
26	Transportation to decoration area	53	Sec
27	Store in decoration area	28,800	Sec
28	Transportation from decoration area to packaging section	300.3	Sec
29	Prepare packaging cardboard	34	Sec
30	Transportation to finished good warehouse	216	Sec
TOTAL		78,424.91	Sec

Table 5. *Non value added* Activity *and not necessary*

	Non value added and not Necessary	
1	Store londrong in londrongan area	311.2Sec
2*	Store bisque impermanent	75,600Sec
3	Waiting for inspection process	791.8Sec
4	Moved to other conveyer	43Sec
5	unloading & loading white body from train to pallet	1,839.3Sec
6	Store white body in white body warehouse	2,592,000Sec
	TOTAL	**2,670,585.39Sec**

From Table 3-5, the time requires by the product of the material delivered to the warehouse until the product can be stored in the warehouse of finished goods or Process lead time can be calculated as follows :

- Process Lead Time

  PLT = VA + NVA
  = 378,521.78+78,424.91**+**
  2,670,585.39
  = 3,127,532.08

Value Process lead time required by the material sent from the warehouse to the product can be stored in the warehouse of finished goods to be sent to the Customer is 3,127,532.08 seconds.

By knowing the value of process lead time it can be calculated ratio value added as follows :

- Ratio Value added

  RVA = $\frac{VA}{PLT}$ = $\frac{378{,}521.78}{3{,}127{,}532.08}$ = 12.10 %

Value added ratio shows the percentage of time spent in adding value to a product is a 12:10%.

3.4. Analysis of Current state *VSM*

To increase the value of the ratio of value added and reduce non-value added value, it's necessary improvement actions by reducing waste that occurs during the production activity. Analysis using value stream mapping are known to occur several waste that result in a waste that should be and can be reduced.

The greatest waste and give effect to the other waste is overproduction which can be described as shown below.

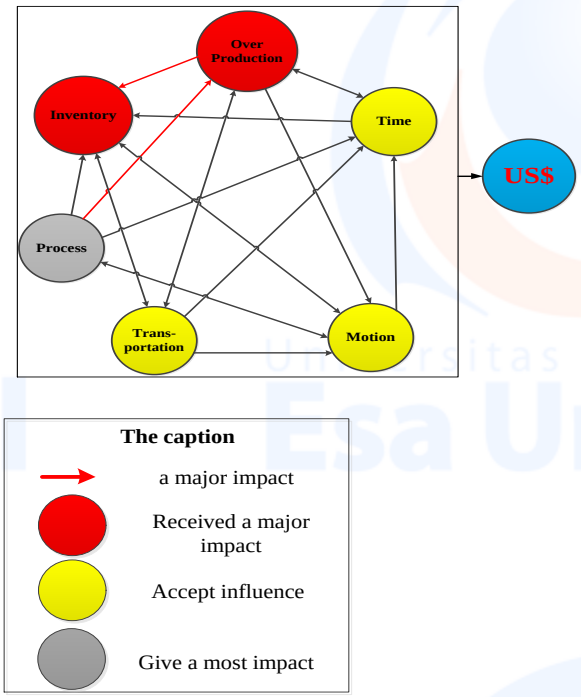


Figure 1. The level of influence of waste to other waste

From the figure 1 it can be seen that the waste of Overproduction occurs due to excess production in the work process kiln machine, which uses a large lot size production so the company took this policy to produce with the maximum capacity. It is done without taking into account the mature waste that would result.

Policies for excess production that result in high levels of inventory, especially in semi-finished goods inventory, it's shown in Table 6. Waste of Overproduction greatly affect the occurrence of a high level of inventory both in row material inventory and work in process inventory at the product.

The process is not exactly a major impact on the waste of Overproduction where the company produces the whole ability to optimize resources (machines) which resulted in the excess production.

Table 6 the data in and out of the warehouse white body (in pieces)

Date	In	Out	Stored
22-Apr-13	39,012	34,729	4,283
23-Apr-13	39,215	35,870	3,345
24-Apr-13	38,828	34,281	4,547
25-Apr-13	38,593	33,021	5,572
26-Apr-13	38,468	34,996	3,472
27-Apr-13	39,249	35,037	4,212
28-Apr-13	38,584	33,274	5,310
29-Apr-13	39,092	31,750	7,342

Table 6 the data in and out of the warehouse white body (in pieces)

Date	In	Out	Stored
30-Apr-13	38,690	32,373	6,317
02-May-13	38,404	32,807	5,597
03-May-13	38,980	31,928	7,052
04-May-13	38,854	32,215	6,639
05-May-13	38,361	30,800	7,561
06-May-13	38,387	34,441	3,946
07-May-13	38,677	31,444	7,233
08-May-13	38,858	34,513	4,345
09-May-13	38,860	32,677	6,183
10-May-13	38,698	34,796	3,902
11-May-13	38,788	32,755	6,033
13-May-13	38,746	34,872	3,874
14-May-13	39,242	33,005	6,237
15-May-13	39,101	33,860	5,241
16-May-13	38,867	33,508	5,359
17-May-13	39,025	34,519	4,506
18-May-13	38,555	34,553	4,002
19-May-13	38,899	34,216	4,683
20-May-13	38,568	33,163	5,405
21-May-13	38,697	33,261	5,436
22-May-13	38,440	32,491	5,949
TOTAL	1,163,850	1,003,940	159,910

To reduce the waste that has occurred it is necessary to know the cause of the waste. From the picture 1 it is known that waste of overproduction is affected by inappropriate process that occurs when a process kiln with a lot size that exceeds the actual capacity demand, it's resulting in unnecessary inventory.

One way to reduce this waste is produced in accordance with customer orders or produce according to the forecasting results. Waste will not be generated until the next process, that influence the level of waste can be deducted as shown below.

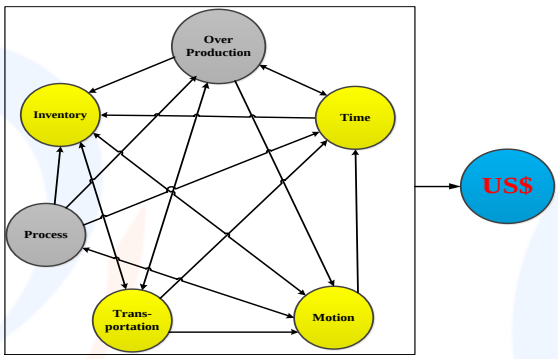


Figure 2. Effect of waste to other waste reduction

Thus, the activity of which can be reduced as follows:

1. Reduction of waste of overproduction with the value that can be reduced as shown in Table 7
2. Eliminating the intermediate product storage activity (activity 45 in Table 2). Because they are made products to meet all customer needs so that there is no semi-finished products to be stored. Moreover, it can save the cost savings and saves storage space
3. Company automatically eliminate transportation to the warehouse a half finished (activity 43 in table 2) for semi-finished products are not stored. Some processes can be eliminated. Activity eliminated is the activity 43th until 45th in Table 2. From these data the company saving processing time for 2,593,887 seconds.
4. In addition to saving as points 2 and 3, if withdrawn the previous activity then the savings are as follows:
   - Reducing the frequency of transportation of raw materials warehouse to weigh as 8 times per day
   - Reducing the use of ball mill machine as many as 135 machines per month
5. On the 25th of activity in the table 2, It can reduce savings time and reducing the use of pallet.
6. In a material transfer activity between the conveyor (41 activities in Table 2) can be reduced by making improvements layouts that can accommodate the needs of the operator QC
7. The process of unloading and loading (activity 44 in Table 2) can be reduced by replacing the use of lorries with pallet, so that material handling can run smoothly without any handover process and re-calculation

Table 7. Material Requirements appropriate production capacity vs Production on demand (pieces)

Date	production capacity		Production on demand	
	Production capacity	Materials needs	Production on demand + defect 3.872%	Materials needs
22-Apr-13	40,320	40,860	36,042	36,525
23-Apr-13	40,320	40,860	37,227	37,725
24-Apr-13	40,320	40,860	35,578	36,054
25-Apr-13	40,320	40,860	34,270	34,729
26-Apr-13	40,320	40,860	36,320	36,806
27-Apr-13	40,320	40,860	36,362	36,849
28-Apr-13	40,320	40,860	34,532	34,995
29-Apr-13	40,320	40,860	32,951	33,392
30-Apr-13	40,320	40,860	33,597	34,047
02-May-13	40,320	40,860	34,048	34,504
03-May-13	40,320	40,860	33,136	33,579
04-May-13	40,320	40,860	33,433	33,881
05-May-13	40,320	40,860	31,965	32,393
06-May-13	40,320	40,860	35,744	36,222
07-May-13	40,320	40,860	32,633	33,070
08-May-13	40,320	40,860	35,818	36,298
09-May-13	40,320	40,860	33,913	34,367
10-May-13	40,320	40,860	36,112	36,596
11-May-13	40,320	40,860	33,994	34,449
12-May-13	40,320	40,860	34,025	34,481
12-May-13	40,320	40,860	34,025	34,481
13-May-13	40,320	40,860	36,191	36,676
14-May-13	40,320	40,860	34,253	34,712
15-May-13	40,320	40,860	35,141	35,611
16-May-13	40,320	40,860	34,775	35,241
17-May-13	40,320	40,860	35,825	36,304
18-May-13	40,320	40,860	35,860	36,340
19-May-13	40,320	40,860	35,510	35,986
20-May-13	40,320	40,860	34,417	34,878
21-May-13	40,320	40,860	34,519	34,981
22-May-13	40,320	40,860	33,720	34,171
Total	**1,209,600**	**1,225,800**	**1,041,909**	**1,055,863**
Total per year	**14,515,200**	**14,709,600**	**12,502,908**	**12,670,358**

After the reduction of the waste, it can be made a map of the future state VSM. So it can be compared to the ratio between the current state and future state.

- *Process lead time (Current state)*
  PLT = VA + NVA
  = 378,521.78+78,424.91
  + 2,670,585.39
  = 3.127,532.08

- Ratio value added (Current state)
  RVA = $\frac{VA}{VLT}$

  = $\frac{378,521.78}{3,127,532.08}$ = **12.10 %**

- Process lead time (Future state)
  PLT = VA + NVA
  = **533,645.08**
- *Ratio Value added (Future state)*
  RVA = $\frac{VA}{PLT}$

  = $\frac{378,521.78}{533,645.08}$ = **70.93 %**

4. CONCLUSION

From the analysis carried out by using value stream mapping waste that occurs is unknown waste processing resulting in waste of overproduction. Waste of overproduction result in unnecessary inventory.

To eliminate waste production activity is carried out at the request of the customer or according to the forecasting results from the production planning.

value added at current state VSM is *12:10%.* In the event of elimination / reduction of the waste then the current state value added ratio would increase to *to 70.93%.*

5. REFERENCES

(a) Gaspersz, V. (2012). *Production and Inventory Mamagement* Vinchistro Publication
(b) Jay Heizer, B. R. (2007). *Operation Management : Student Lecture Guide.* Pearson Prentice Hall.
(c) Liker, J.K and Meier D. (2006). *The Toyota Way Fieldbook.* US: McGraw-Hill. Mekong Capital. (2004). *Introduction to Lean Manufacturing.* Vietnam.
(d) Rother, M dan Shook, J. (2003). *Learning to See, Value Stream Mapping to Create Value and Eliminate Muda.* The Lean Enterprise Institute, Inc.