

Production Process Investigation of Write Books Hard Cover with Stream Mapping Value for Minimize Waste Case Study in Surabaya

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ABSTRACT

“X” PT, Company, operates in the field of paper product goods, namely written books hard cover as a superior (champion) product. In production process, “X” PT use production types as make to order, same with consumer demand. This production process often get lately, because lead time of production process is too long. With length of lead time, flexibility of company to customer service with good service will found difficulties problem, then. So, required to make a reason act to overcome its, namely make shorter lead time. Attention to customer will quickly and productivity get rise, if lead time be shortened. With a proposal use a VSM (Value Stream Mapping), this research be expected can map a production process which result in wasting, and then can be excided and minimized waste in accident. The result of research analysis show these process which result in waste and from identification result, lead time duration on production process of written books hard cover, such as : transportation, waiting and unnecessary inventory. This improvement proposal made based on priority waste happen and waste which will be improvement that’s transportation and waiting. For finished this problem, so carried out improvement proposal through make transferring design work in process, use by railway and trolley. The improvement result get decreasing production time, from 66 hours 49 minutes 40 second become 30 hours 59 minutes 16 second.

Keywords : VSM, Waste, Hardcover.

1. INTRODUCTION

In technology era which are very easy connected by all social stratum, for paper industry represent heavy chalange, because, there are part of activity, formerly always need paper with progress technology, but, now, not more need paper, in fact there are not need paper. As a file or documents, have many saved in soft form into flashdisk or bank memories which can save many file or documents not use paper.

Based on condition be mentioned above its, researcher carry out research on written book company, located in surabaya. This company give service to domestic market. Short of production process which be used as make to order. The service to customer ordering, often get lately, because duration lead time is too long. Because of production process is too long, so, flexibility and company speed for response to customer will get trouble and last, customer get run away, above all, competition level of paper product are very tight. In this connection, required an effort to speed up and make a shorter lead time of production.

To solve problem as mentioned its, at previous carry out observation going deep and investigation to purpose look to see what everythings waste which cause production process is too long. Lean manufacture is a process management philosophy came from Toyota Production system (TPS) which well known (famous) because emphasize on decreasing waste, to direction for rising customer satisfaction for all its (liker 2004). On lean manufacture befound a method which function to map each production activities which useful as a tool to detect existance waste. Value stream mapping is a mapping all actions needed to produce a product, same with important prime flow for all products. (Rother and Shook, 1999).

By using value stream mapping be expected can seen wasting accident and reduce a waste, so that company can pressure production cost, to increase productivity and can increase market share of company.

2. LIBRARY REVIEW

Ramesh and Friends (2008) use stream mapping value for research with applicate flow chart to each process, material flow, information flow, process element which relation to transformation. This research focussed on machining center, condition drafting of beginning stream mapping value with base element, direction column of cross flow, shift head and table. Further more, this research identify any process be able by subcontractor which not give added value. The result which be obtained from this research to decrease set up time and cycle time.

Chen and Meng (2010) carry out a research of using value stream mapping based on lean production system. The application to purpose to companies in China. On research be known that application of lean production fail to fulfill prime target (quota), because companies be mentioned its start to develop lean production from tool level and not understand flow of realize prime value from their business. This comprehension represent important thing for company, if want to applicate lean production to settle develop.

With value stream mapping application based on lean production will help understand and develop

process flow in a systematic manner. Certainly, an efficiency will be get through drafting of value stream mapping. The wasting identified as a seven waste and then carried out mapping in a detail manner with Value Stream Analysis Tools (VALSAT) and analyzed to the bottom cause. Based on data processing be found 4 scores highest average, that is waiting (29,17%), defect (21,87%), Unnecessary motion (20,83%) and Unnecessary Inventory (16,67%).

Average score of wasting be mentioned its be times with multiplier factor of detail mapping, so be found detail of dominant mapping tools, that is mapping activity process 33, (31%) and chain response matrix supply (25,64%). Lead time of paper product amount of 162 minutes, after improvement proposal carried out, be found lead time reduction amount of 72 minutes. So, lead time obtained amount of 90 minutes, in a reduce waiting time at the moment that arrival of raw material till process of bottom production. Improvement proposal also on Inventory using ROP will decrease stock out of raw material amount of 750 kgs.

3. METHODOLOGY of RESEARCH

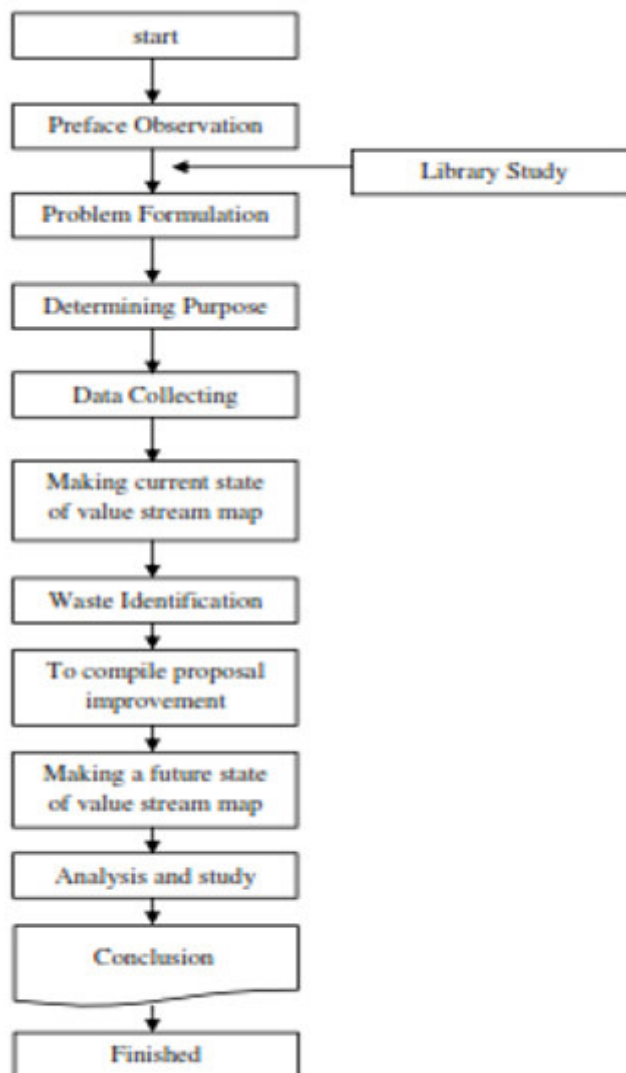


Figure 1. Research Flow Chart

4. DATA and RESULT ANALYSIS

The activity which carried out on Production Process of Hard Cover book can be seen on the table.

Table 1. Production Activity Fill Section of Hard Cover Book

Nr.	ACTIVITIES	Description
1.	Inspection material it's coming	Inspection
2.	Carrying paper in raw material warehouse	Inventory
3.	Transfer paper to fill line machine	transportation
4.	Fill line process	Operation
5.	Waiting material handling tools	Waiting
6.	Transfer fill line product to work in process warehouse	transportation
7.	Carrying for a while	Inventory
8.	Transfer fill line paper to cutting machine	transportation
9.	Cutting process	Operation
10.	Waiting material handling tools	Waiting
11.	Transfer to bundle machine	transportation
12.	Bundle process	operation
13.	Waiting material handling tools	waiting
14.	Transfer to glue tight process	transportation
15.	Glue tight process	operation
16.	Drying process	operation
17.	Slice process	operation
18.	Waiting material handling tools	Waiting
19.	Transfer to chest installing process	transportation
20.	Installing process spine chest	Operation
21.	Waiting material handling tools	waiting
22.	Transfer to drying process	transportation
23.	Drying process	operation
24.	Transfer to cutting machine	transportation
25.	Waiting material handling tools	waiting

Table 2. Production Activity Cover Section of Hard Cover Book

Nr.	ACTIVITIES	Description
1.	Inspection material it's coming	Inspection
2.	Carrying paper in raw material warehouse	Inventory
3.	Transfer cartoon to cutting machine	Transportation
4.	Transfer cover to cutting machine	Transportation
5.	Processing cut out cartoon	Operation
6.	Processing cut out outside cover	Operation
7.	Transfer to cover unification process	Transportation
8.	Process unification cover and cartoon	Operation
9.	Drying process	Operation
10.	Transfer to fill installing process	Transportation

Table 3. Unification Activity Cover and Fill of Hard Cover Book

Nr.	ACTIVITIES	Description
1.	Processing install fill	Operation
2.	Processing tight finished	Operation
3.	Transfer to Drying Process	Transportation
4.	Drying process	Operation
5.	Sorting	Inspection
6.	Transfer to spine tight process	Transportation
7.	Processing tight spine	Operation
8.	Processing set motif	Operation
9.	Waiting material handling tools	Waiting
10.	Transfer to packaging machine	Transportation
11.	Packaging process	Operation
12.	Transfer to finished goods warehouse	Transportation

4.1. Computation Standard time of Production Process

Computation standard time used for detect working each operation on production process. In this research, for obtain standard time on production activity used stopwatch time study method. Furthermore, conducted uniformity test and sufficiency data test.

1. Uniformity Test

Uniformity test conducted by using control map. The bellow, more steps used in uniformity test

Table 4. Time data of Fill Line Process

Nr	Days					Amount	Average
	1	2	3	4	5		
1	8	12	8	12	8	48	9.6
2	7	11	10	12	7	47	9.4
3	12	9	7	7	9	44	8.8
4	9	10	8	8	11	46	9.2
5	7	9	12	11	10	49	9.8
6	7	8	12	7	9	43	8.6
Total Amount						277	55.4

- a. Count the Total Average Value R and x :

$$\bar{R} = \frac{\sum_{i=1}^k R_i}{k} = \frac{27}{6} = 4,5 \text{ detik}$$

$$\bar{\bar{x}} = \frac{\sum_{i=1}^k \bar{x}_i}{k} = \frac{17}{6} = 2,93 \text{ detik}$$

- b. Count the value of up and under limit :

$$BKA = \bar{\bar{x}} + A_2 \bar{R} = 2,93 + (0.577 \times 4,5) = 4,568$$

$$BKB = \bar{\bar{x}} - A_2 \bar{R} = 2,93 - (0.577 \times 4,5) = 1,2985$$

- c. The data Result on Control map

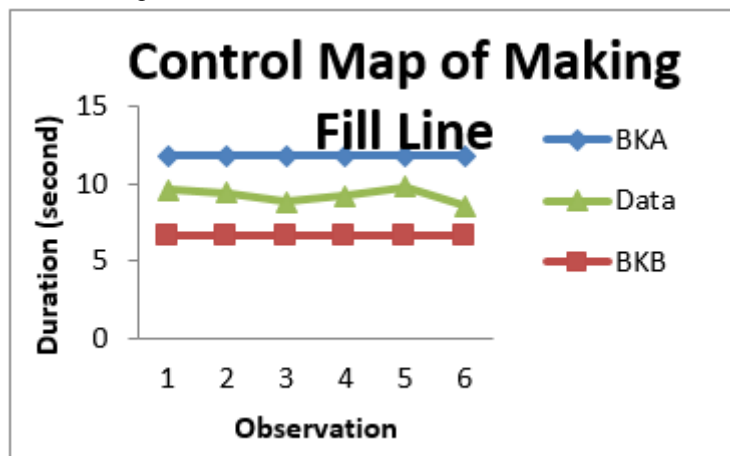


Figure 3. Control Map Time Data of Making Process Line

Based on figure 3, showed that data are among up and under limit, untill can be said that data be mentioned its are uniform. For the table and graphic of processing result in other activities can be seen on summary from processing data uniform, shown on enclosure 2.

2. Test of Completely Data

Test of completely data can carried out by using formula as follows :

$$N' = \left[\frac{\frac{k}{s} \sqrt{N(\sum x_i^2) - (\sum x_i)^2}}{\sum x_i} \right]^2$$

$$= \left[\frac{\frac{1.96}{0.05} \sqrt{30(559595) - (4039)^2}}{4039} \right]^2 = 3,2 \approx 4 \text{ observation}$$

Because $N' < 30$, so these data have enough. For test of completely data on other activities can be seen on enclosure 3. On step next, to determine performance operator rating by using the westing house system method.

1. Process for Making Fill Line

Table 5. Performance Rating of Process For Making Fill Line

Factor	Class	Symbol	Rating	Indication
Skill	Excellent	B1	0,11	Operator can work so good with good quality too, because have experienced
Effort	Good	C1	0,06	Work speed is good and can defended
Condition	Poor	F	-0,07	Work place condition not ergonomic
consistency	Good	C	0,01	Working Result is Stable
Total			0,11	
Performance Rating			1,11	

After conducted performance rating for operator of each production process operation, furthermore will determined Laxness factor for work operation.

1. Process For Making Fill Line

Table 6. Performance Rating of Process For Making Fill Line

Factor	Job	Laxness
Power Turn Out	Power Turn out is midle	15%
Work Attitude	Stand on two Leg	2%
Work Motion	Work motion limited on certain work motion	1%
Eye strain	Continuous job with fluctuate focus	12%
Condition of work place temperature	Normal Temperature (28 – 38°C)	5%
Atmosphere condition	Atmosphere condition not so good	5%
Area condition	Area condition are very buzzing	2%
Personal need		1%
Total		43%

From result of allowance determination on process for making fill line based on condition its determined an allowance amount of 43%.

After got performance rating value and allowance, the conducted computation normal time and standard time. This follows are example computation of normal time and standard time for process for making fill line.

1. Normal Time (NT)

$$TN = \text{Average time} \times \text{performance Rating}$$

$$= 9,23 \times 1,11$$

$$= 10,429 \text{ detik}$$

2. Standard Time (ST)

$$\text{Standard Time} = \text{normal time} \times \frac{100\%}{100\% - \% \text{allowance}}$$

$$= 10,429 \times \frac{100\%}{100\% - 43\%}$$

$$= 17,82 \text{ second}$$

On table 5.7 be shown result of computation normal time and standard time for each operation and production process of hard cover book.

The result of weightenung questionnaire be done on 14 respondent on each process of hard cover book. From table 5.9 can be seen that most be happened on production process of hard cover book are waiting, excess,

unnecessary inventory, defect, over production, in appropriated and unnecessary motion.

Identification Cause of Waste Happened on Production System of “X”, PT.

The step analysis which carried out to current state map are as follows :

1. To group activities included value added (VA), Non Value Added (NVA) and Non Value Added but Necessary (NVBN)

In this step will grouped activities included into value added and non value added. Grouping activities carried out since at beginning until ending production process.

Information about amount or time of value added time of value added time and non value added time gotten from current state map.

Grouping activities divided become 3, that are :

Making Fill Activities

Table 10. The Activities of Value Added, Non Value Added and Necessary But Non Value Added on Fill Section of Hard Cover Book.

Nr.	ACTIVITIES	Time	Description
1.	Carrying paper in raw material warehouse	86,400	NVA
2.	Transfer paper to fill line machine	1,819.47	NVA
3.	Fill line process	17.82	VA
4.	Transfer Fill line paper to cutting machine	1,036.93	NVA
5.	Cutting process	5.73	VA
6.	Transfer to bundle machine	1,291.30	NVA
7.	Bundle process	18.45	VA
8.	Transfer to tight glue process	1,453.9	NVA
9.	Tight Glue Process	15.44	VA
10.	Drying Process	26,052	VA
11.	Transfer to slice process	1,199.97	NVA
12.	Slice process	22.13	VA
13.	Transfer to install chest process	1,004.9	NVA
14.	Install spine chest process	66.27	VA
15.	Drying process	26,382	VA
16.	Transfer to cutting machine	1,043.30	NVA
17.	Cutting finished process	12,02	VA
18.	Transfer to install fill process	1,846.00	NVA

Table 11. The Activities of Value Added, Non Value Added and Necessary But Non Value Added on Fill Section of Hard Cover Book.

Nr.	ACTIVITIES	Time	Description
1.	Carrying paper on raw material warehouse	86,400	NVA
2.	Transfer cartoon to cutting machine	1,365	NVA
3.	Transfer cover to cutting machine	1,759.133	NVA
4.	Cutting cartoon process	4.76	VA
5.	Cutting outside cover process	10.27	VA
6.	Transfer to unification cover process	1,231.466	NVA
7.	Unification cover and cartoon process	89.73	VA
8.	Drying process	87,020	VA
9.	Transfer to install fill process	1,669.333	NVA

Table 12. Activities of Value Added, Non Value Added and Necessary But Non Value Added on Fill Section of Hard Cover Book.

Nr.	ACTIVITIES	Time	Description
1.	Install fill process	92.91	VA
2.	Transfer to tight finished process	17.93	NVA
3.	Tight finished process	37.73	VA
4.	Transfer to drying process	17.93	NVA
5.	Drying process	18,844.00	VA
6.	Sort	19.60	NBNV
7.	Transfer to tight spine process	1,178.30	NVA
8.	Tight spine and set motif process	10.82	VA
9.	Transfer to packaging machine	1,706.00	NVA
10.	Packaging process	19.39	VA
11.	Transfer to finished goods warehouse	2,0121.70	NVA

After collected activities where which included value added and Non value added, furthermore will prepared time between value added and non value added for each component which to enter total value of value added and non value added for to see enlargement of waste be happened. Preparation between value added and non value added activities can be seen on Figure 5.13-5.15, as follows :

Figure 5 : Preparation time for each activity on fill section of hardcover book

Source : "X", PT.

Figure 6 : Preparation time for each activity on section of section of book cover

Source : "X", PT.

Figure 7 : Preparation time for each activity on unification cover and fill of hard cover book.

From current state map can be known that total lead time of production at "X", PT are 353.203,9 second with details of time for value added activities as long as 158.721,47 second, non value added activities as long as 194.462,83 second and necessary but non value added as long as 19,6 second. For deducted computation in total days, so to devise carrying time in 24 hours, so be gotten result of 4,088 days.

2. Waste Analysis be happened

In this step are represent of step used to determine everything activities which can cause a waste happen, so, can cause lead time get more long. An analysis conducted to identify waste happen are an analysis in descriptive manner. Based on observation result an interview with company sides, so, be obtained waste formula happen at company, such as :

1. Waiting

Waiting waste be happened on :

- a) A presence product waiting of processing result to fulfill of Total Lot. The cause happen are each 1 pcs of product be processed finished, must wait for to finished amount of 1 lot of product, that are amount of 700 pcs, up to waiting time its are 699 fold from process time of that own product.
- b) Waited for worker activities, because working equipment be available yet this worker activities caused by wait for arrival equipment for they process. Cause of delay are :
 1. Not can dispatch product yet, because must wait for be finished total of 1 (one) lot from processing before, although actually waiting product be mentioned its already can carried out on next processing.
 2. Waiting for material handling tools which are using by other division.
- c) Such are waiting activities for using forklift as a tool of material handling. This waiting activities accomplished, because total forklift amount of 1 unit used together with other section. For each process, waiting for more less than 15 until 20 minutes for use forklift.

2. Transportation

This waiting have happened near at all section. Problem of transportation which happened that are an operator lifting himself a working things to process, this matter been result because waiting forklift are too long.

3. Unnecessary Inventory

Sort of inventory waste happened on :

- a) Work in process inventory too high.
Cause of happened are :
 - 1.Total lot for each process are high
 - 2.Waiting forklift activities
- a) Such are finished goods inventory not sales yet.
Cause of happened :
 - 1.Market demand are fluctuation
 - 2.Such are forecast error from PPC

b) The constraint of place identification from WIP.

Cause of happened :

1. Not such are administration system in a clear manner yet about WIP Site.
2. Careless supervision on administration

System

3. The mistake of communication about finishing and laying WIP

4. Defect

Sort of Inventory waste happened on making books with total amount on August, 2014 untill January, 2015 can be seen on Table 5.13

Month	Defect Amount	Product amount	Percentage
August	1.532	187.500	0,82%
September	1.597	187.500	0,85%
October	1.543	187.500	0,82%
November	1.532	187.500	0,82%
December	1.641	187.500	0,88%
january	1.684	187.500	0,90%

Source : "X", PT.

Based on Analysis on current state Map, known that waiting time have happened between production process on making hard cover book which cause lead time become long.

This waiting time been result because amount of lot and activities waiting forklift before product send to processing next.

Based on this analysis, so, improvement recommendation conducted for decrease happened a waiting for product and waiting for forklift.

4.5. Improvement Result Analysis

Improvement proposal be applied on future state map plan that are with using a railway, enough to succeed for decrease a waste shaped waiting material for be process.

Decreasing waiting time have an impact to decreased added time on production of hard cover books. On table 5.16 can be seen difference of value added time and non value added time between current state map with future state map have conducted application of improvement proposal. And for decreasing a waste concerning to cost used, can be seen on table 5.17

Table 14. Difference of Value Added Time and Non Value Added Time Between Current State with Future State Map on Production of Hard Cover Books.

Nr.	Activities	Time Before	Time After	Description
1	Carrying paper on raw material warehouse	86.400	86.400	NVA
2	Transfer paper to fill line machine	1.819,47	302.47	NVA
3	Fill line process	17.82	17.82	VA
4	Transfer fill line paper to cutting machine	1.036,93	62.93	NVA
5	Cutting process	5,73	5.73	VA
6	Transfer to bundle machine	1.291,30	43.30	NVA
7	Bundle process	18,45	18.45	VA
8	Transfer to tight glue process	1.453,93	41.93	NVA
9	Tight glue process	15,44	15.44	VA
10	Drying process	26.052	26,052	VA
11	Transfer to slice process	1.199,97	42.97	NVA
12	Slice process	22,13	22.13	VA
13	Transfer to install chest process	1.004,93	54.93	NVA
14	Install spine chest process	66,27	66.27	VA
15	Drying process	26.382	26,382.00	VA
16	Transfer to cutting machine	1.043,30	41.30	NVA
17	Cutting finished process	12,96	12.02	VA
18	Transfer to install fill process	1,846	62.03	NVA
19	Carrying paper on raw material warehouse	86,400.00	86,400.00	NVA
20	Transfer cartoon to cutting machine	1365.2	308,7	NVA
21	Transfer cover to cutting machine	1759.133333	303.13	NVA
22	Cutting cartoon process	4.76	4.76	VA
23	Cutting outside cover process	10.27	10.27	VA

24	Transfer to unification cover process	1231.466667	52.46	NVA
25	Unification cover and cartoon process	89.73	89.73	VA
26	Drying process	87,020.00	87,020.00	VA
27	Transfer to install fill process	1669.333333	65.33	NVA
28	Install fill process	92.91	92.91	VA
29	Transfer to tight finished process	17.93	17.93	NVA
30	Tight finished process	37.73	37.73	VA
31	Transfer to drying process	17.93	17.93	NVA
32	Drying process	18,844.00	18,844.00	VA
33	Sort	19.60	19.60	NBNV
34	Transfer to tight spine process	92.91	42.27	NVA
35	Tight spine and set motif process	10.82	10.82	VA
36	Transfer to packaging machine	1,706.00	75.00	NVA
37	Packaging process	19.39	19.39	VA
38	Transfer to finished goods warehouse	2,021.70	308.70	NVA

From the table above its, can seen that lead time before conducted improvement amount of 240.581,470 second with details of time for operation during 9.235,68 second, transportation during 1.904,29 second, waiting during 187.479,9997 second, Inventory during 39.959,700 second and Inspection during 2001,8 second.

Furthermore also be known that lead time after conducted improvement that are 111.377,956 second with details of time for operation during 9.235,68 second, transportation during 1.805,96 second, waiting during 58.374,81 second, inventory during 39.959,7 second and inspection during 2001,8 second.

Base on data be mentioned its, so, can known that get decreasing time of production, from 240.581,470 second become 111.377,956 second.

For conducted computation into total days, so, with divide of carrying time in 24 hours and transportation time, operation, waiting and inspection in 8 hours. So gotten a result, that are 7,36 days on long time, and 2,94 days on result of improvement MAP.

Based on decreasing time be mentioned its can be said that decreasing time amount of 60% from time, before conducted an improvement. Map of future state map have be made with doing an improvement proposal not represent of ending result is the best in decrease a waste on company.

Future state map are represent of part of continuous improvement, so that after improvement condition be suggested on future state map have reached, company need to map again company condition as a current state map become better again. This matter same with one of Toyota Principle to continuous improvement.

5. CONCLUSION

Cause of waste which can be identified resulted in long lead time on production process of hard cover books, such as :

1. Waiting

Waiting waste happened on :

- Such are product waiting of process result for fulfill total lot
- The activities to wait worker, because working equipment which not available yet
- Such are waiting activities for use forklift as a material handling equipment.

2. Transportation

This waste happened near on all company section. Problems of transportation which happened that are operator lifting himself a working things to process. This matter caused waiting forklift are too long.

3. Unnecessary Inventory

Sort inventory waste happened on :

- The height work in process (WIP) inventory
- The obstacle identification site of WIP

Improvement proposal made based on dominant waste happened. In here, waste which will conducted improvement that are transportation and waiting for finish problem be mentioned its, so, conducted improvement proposal with make design transferring work in process by using railway and trolley. Based on improvement result, so, gotten decreasing time of production, from 66 hours 49 minutes 48 second became 30 hours 56 minutes 24 second.

6. LIBRARY LIST

- Ariani, Dorothe Wahyu. 2004. "Statistics Quality Control", Jogjakarta : ANDI Jogjakarta.
- Berry, William L., et al. 2002. "Learn Manufacturing : A Mapping of Competitive Priorities, Initiatives, Practices, and Operational Performance in Danish Manufactures.

- [3] Fanani, Zaenal, Singgih, Moses Laksono. 2011. Implementasi *Lean Manufacturing* Untuk Peningkatan Produktivitas (Studi Kasus Pada Pt. Ekamas Fortuna Malang). *Prosiding Seminar Nasional Manajemen Teknologi XIII Program Studi MMT-ITS, Surabaya 5 Pebruari 2011*
- [4] Gasperz, Vincent. 2007. *Lean Six Sigma For Manufacturing and Service Industry*. Jakarta: PT Gramedia Pustaka Utama.
- [5] Hines, P., and D. Taylor.2000. *Going Lean*, Lean Enterprise Research Center, Cardiff Business School.
- [6] Liker Jeffrey k. *The Toyota Way*, McGraw-Hill. 2004.
- [7] Chen, Lixia, Meng, Bo. 2010. *The Application of Value Stream Mapping Based Lean Production System*. International Journal of Business and Management Vol. 5, No. 6; June 2010
- [8] Monden, Yasuhiro. 2000. *Sistem Produksi Toyota, Suatu Ancangan Terpadu Untuk Penerapan Just-In-Time*. Jakarta: Penerbit PPM.
- [9] Rother, Mike & Shook, John. 1999. *Learning To See Value Stream Mapping To Create Value and Eliminate Muda*. Massachusetts: Lean Enterprise Institute.
- [10] Ramesh, V, dkk. 2008. *Implementation of a Lean Model for Carrying out Value Stream Mapping in a Manufacturing Industry*. *Journal of Industrial and Systems Engineering* Vol. 2, No. 3, pp 180-196 Fall 2008
- [11] Sitalaksana, Iftikar Z. 1979. *Teknik Tata Cara Kerja*. Bandung: Departemen Teknik Industri Institut Teknologi Bandung.
- [12] Wignjosoebroto, Sritomo. 2008. *Ergonomi Studi Gerak dan Waktu*. Surabaya: Guna Widya.