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A CASE STUDY OF KAIZEN IMPLEMENTATION IN SMI

A.P. Puvanasvaran[1], Robert S.T. Kerk[1] and A.R. Ismail[2]

[1]Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka (UTeM)
Ayer Keroh, 75450 Melaka, Malaysia
E-mail: punesh@utem.edu.my
[2]Faculty of Mechanical Engineering, Universiti Malaysia Pahang
26600 Pekan, Pahang, Malaysia
Phone: +609-4242268, Fax: +609-4242202
Email: arasdan@gmail.com, rasdan@ump.edu.my

ABSTRACT

Kaizen is a concept that focuses on improving a work area or an organization in incremental steps. Many organizations have begun to incorporate the philosophy of kaizen through the use of kaizen methodology. The first well-known and most frequently cited proponent of kaizen was Imai, who wrote KAIZEN – The Key to Japan's Competitive Success (1986). He outlined the concept, its core values and principles, its relation to other concepts and the practices used in the improvement process. This paper illustrates about kaizen case study in Small Medium Industries (SMI) Company that is ABC Company, which produce machines spare part and food processing machines. This case study is focused on reducing lead time of sales order processing. Kaizen steps are used as guidelines and PDCA Cycle is choosing as problem solving approach to conduct the case study. The properly tools and techniques such as 5why, Work Instruction Sheet, Pareto diagram, Process Mapping, PDCA Cycle and brainstorming were used. The kaizen implementation has reduced the percentage of time losses which is 48.44%. More than that, sales order processing lead time was reduced about 6.98% and production lead time reduced about 14.93%. These results have proved the effectiveness of kaizen methodology.

***Keywords*:** Kaizen, Continuous Improvement, PDCA Cycle, SMI.

INTRODUCTION

Kaizen is a concept that focuses on improving a work area or an organization in incremental steps by eliminating waste. Kaizen can be applied to any area in need of improvement. Industries especially manufacturing is currently faced with the conflicting pressure to improving customer satisfaction and service as well as pressures of cost reduction, reducing lead time, and quality improvement in order to get better results. This study is thoroughly focus on reducing time losses while at the same time reducing the lead time of sales order processing in ABC Company and indirectly improves customer satisfaction. Three objective of the study is set which to identify time losses at production area, identify opportunities for kaizen improvement using a problem solving approach and describe the effects of the improvement using time measurements.

LITERATURE REVIEW

Kaizen was created in Japan following World War II. The word Kaizen means "continuous improvement". It comes from the Japanese words "kai" which means "change" (to correct) and "zen" which means "good" (for the better). Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization (Venkatesh, 2007). The author also said that the kaizen is opposite to big spectacular innovations and requires no or little investment. The principle behind is that a large number of small improvements are more effective in an organizational environment than a few improvements of large value.

Kaizen philosophy embraces three main principles proposed by Imai (1986) which are process orientation, improving and maintaining standard and people orientation. All principles are significant in order to implement the kaizen. Imai (1986) stated that kaizen is process-oriented. Before results can be improved, processes must be improved, as opposed to result-orientation where outcomes are all that counts. Berger (1997) added to what Imai said that the principle has at least two practical consequences for the improvement process. First, management's main responsibility is to stimulate and support the effort of organizational members to improve processes. Second, process-orientation calls for evaluating criteria. Furthermore, Imai (1986) said "There can be no improvement where there are no standards" which in essence denotes the relation between kaizen and maintaining standard procedures for all major operations (Standard Operating Procedures (SOPs)) (Berger, 1997). The PDCA (Plan-Do-Check-Action) problem-solving format is used to support the desired behaviors. It is a quite simple framework for using the different quality tools which make the improvement process both visible and measurable while also serving as the main link between improvements and standardized routine work (Berger, 1997). In an article by Thomas et al. (2003), they are used the PDCA Cycle as a model to illustrate the process of adopting and using continuous quality improvement at the clinical research site to enhance ethical, quality benchmarking activities. Westbrook (1995) also using the PDCA cycle in cases improvement at large Japanese companies. Similar as Berger (1997), Thomas et al. (2003) and Westbrook (1995), Shamsuddin and Masjuki (2003) also suggested using Deming's PDCA which is an excellent technique in monitoring and problem solving for continuous quality improvement where any bright ideas of individuals can be accommodated.

In the third principle as summarized in Berger (1997) which kaizen also is people-oriented and should involve everyone in the organization from top management to workers at the shop floor. Berger stated there are three types of kaizen activities which are Management- oriented kaizen, Group-oriented kaizen and Individual-oriented kaizen. Recently, kaizen has been adopted by many organizations in various scopes as a ways for an improvement and is providing many opportunities for significant step change improvements. Chen et al. (2000) has been used step-by-step of kaizen approach in a pull cell design in their research. In kaizen approach steps, one alternative was chosen from several alternatives for prototyping and simulation because of the highest score in decision matrix. Besides, Masud et al. (2007) adopted the third pillar of TPM which is Kobetsu Kaizen (Focused Improvement) to use in their case study at Ready Made Garments (RMG) sector. This pillar is aimed at reducing losses in the workplace that affect the efficiencies. In term of TQM, here was reviewed one case study which conducted by Gondhalekar et al. (1995). In their case study, kaizen was identified as appropriate and various experiments have been carried out to lead the organization

towards TQM. The authors describe how the dynamics of kaizen process helps the company towards this goal.

Kaizen also becomes an important and widely used in various industries and field especially in manufacturing area. Refer to study of Brunet and New (2003); Nippon Steel Corporation (NSC) is used as a base model to compare with the data from other companies. The researchers noted that each phase of kaizen was named in a way that set it apart from purely quality-driven activities. The emphasis is on teams being responsible for every aspect of their output and not just responding to daily-quality emergencies. They also found that kaizen activities extend beyond working hours. A study also found that Kaizen was used by Boeing Commercial Airplane Company as a strategy to reduce operational cost and improve efficiency (Modarress et al., 2005). Another approach is shown in Bhuiyan and Baghel (2006) researches, the methodology was called Achieving Competitive Excellence (ACE) that used in aerospace company becomes beneficial to the company. Carrying out with continuous improvement (CI) in large organizations can prove to be successful in establishing a culture of development and constant learning and this contrast to the small company. Small firms often need external support if they want to implement new concepts, for example quality management. Alstrup (2000) in their research, was adapted the continuous improvement (CI) concept to the particular situation of the three small enterprises which involved. The objective of the study was to investigate the possibilities of using in small enterprises, techniques that are known from CI activities in large organizations, in order to gain longer-term effects than are usually seen after external support in small firms. Findings from the study can be conclude as the concept of CI in small enterprises with unskilled workers is possible to use and maybe a good approach but the consultant must realize that the activities will develop in many different ways.

In view of the findings and discussion of literatures, it seems that also found some possible barriers or challenges of kaizen initiative during the application effort in organizations. When implementing the Kaizen approach, much of the responsibility lies with upper management. Pitfalls include the tendency of upper management to micromanage the teams and a lack of initial training in teamwork effectiveness (Chen et al., 2000). Besides, a lack of communication and coordination between departments also appeared (Garcia et al., 2008). Academic organizations are parallel to any other organization in that it can be hard to obtain broad-based participation in formal process improvement activities especially when the tools or methods are unfamiliar (Emiliani, 2005). Out of all the above it may conclude that the literature review have develop a good working knowledge of the study in a particular area. The reviews also give an idea of the study of kaizen implementation that has been carried out in SMI Company, preparing the reader for the study that is to follow.

METHODOLOGY

The kaizen step is the method (refer Figure 1) to develop Kaizen projects, and follows PDCA approach. All improvement projects, despite of their nature (costs, quality, safety, ergonomics, environment, logistics, etc.) must follow specific guidelines which are defined within kaizen step. Guidelines mean what project type, operating steps and tools to be used and way of using them.

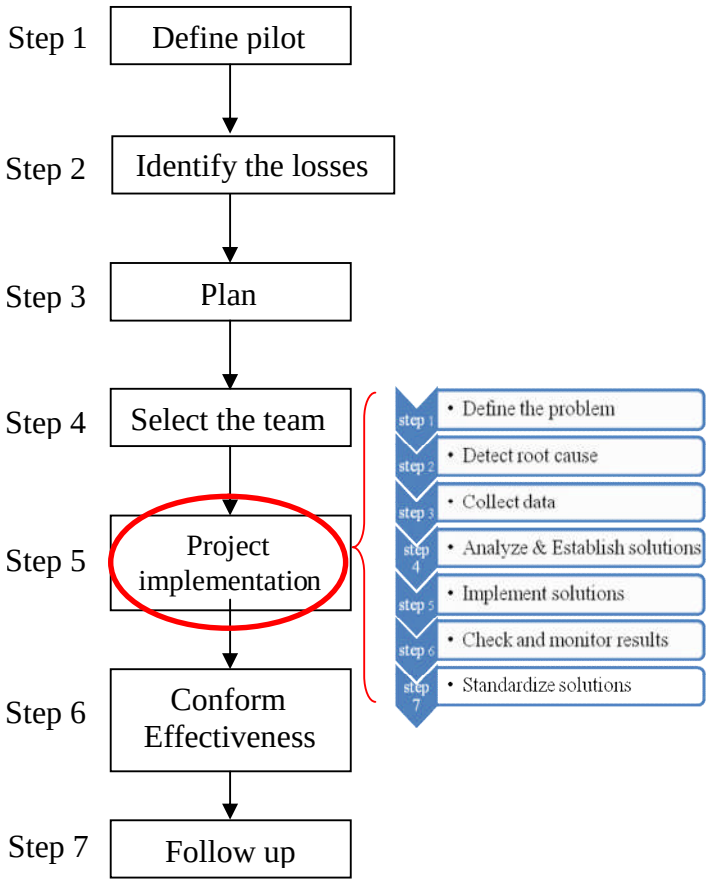

Figure 1: Kaizen methodology

RESULTS AND DISCUSSION

Step 1: Define Pilot Area

Define pilot area is the first step towards ongoing with the improvement activities. Bottleneck processes are commonly defined the pilot area. In order to find the bottleneck process, the business general procedures as well as sales order processing flow is mapped starting from order enter until delivery and payments from customer. In the process mapping of sales order processing (Refer appendix A), step 14 which is production run are mapped separately in order to get real time of existing processes in production (appendix B). From the process mapping of the sales order processing, total lead time is 169.81 hours. Noticed, that the processes have bottleneck at production process which is 60.97 hours. So, the pilot area is defined at production.

Step 2: Identify Losses

Basically, losses are identified from abnormality. In this project, we choose to focus on total loss of time. This is the problem that we observed in the line. Other losses are not visible. This is because the company is project type based. So, times are most significant due to on time delivery mission. In order to identify the time losses, time of each step in process mapping of production processes are categorize to Value Added

(VA) and Non Value Added (NVA). A brainstorming session was held with industrial supervisor to classify it. Table 1 shows the value added and non value added time of each process.

Table 1: VA and NVA for production operations

Step	Event	Time(h)	Category
1	take raw materials from store	0.33	NVA
2	setup cutting machine	0.08	NVA
3	Cutting the raw materials based on each size of part (15 pcs) (hollow part for body)	7.5	VA
4	setup welding machine	0.17	NVA
5	Welding hollow part (body of machine)	4	VA
6	waiting for new drawing	1.5	NVA
7	go to management to get new drawing from designer	0.25	NVA
8	open the hollow part that had weld before	2	NVA
9	cutting the hollow part based on new height(6pcs)	3.3	NVA
10	welding back the hollow part as body machine	3.8	NVA
6	Welding m/steel plat at machine body	0.58	VA
7	prepare m/steel plat and welding (as cover)	2.5	VA
8	Combine 2 pcs plat and bush.	0.75	VA
9	screw drill at funnel	0.58	VA
10	attach funnel at ensile	0.67	VA
11	Allen screw M8 at m/steel	0.33	VA
12	insert pin 10mm at m/steel	0.25	VA
13	attach solid shaft/polish shaft (weld)	0.67	VA
14	attach s/steel shaft (weld)	0.65	VA
15	attach m/steel polish shaft (weld)	0.6	VA
16	prepare iron angel and m/steel (motor base)	2	VA
17	attach motor	1.2	VA
18	attach belt and pulley	2.5	VA
19	attach worm gear	2	VA
20	waiting for raw material stock from supplier (plat bar & rod bar black m/steel)	3	NVA
21	prepare plat bar m/steel (cutting)	0.7	VA
22	prepare m/steel rod bar black (cutting)	0.67	VA
23	attach plat bar m/steel & m/steel rod bar black (weld) (for pan holding)	3	VA
24	Attach bolt and nut at plat bar and pipe m/steel	1.5	VA
25	bush, tapping and hole at plat bar	2	VA
26	waiting for welding machine available	0.58	NVA
27	setup welding machine	0.17	NVA
28	welding m/steel solid and m/steel plat bar (for kitchen part)	3	VA
29	attach m/steel plat,m/steel bar and hollow pipe(pin m8)	4	VA
30	attach blade at center s/steel rod	0.42	VA
31	attach wheel - 4pcs	0.75	VA
32	grinding surface	2	VA
33	testing	0.67	VA
34	fill form of testing information	0.3	NVA

As mentioned before, total observed time of all processes is 60.97 hours. From the category which classified, total time for each category are summarize in Table 2.

Table 2: Summary of VA and NVA total time

Category	Total time
VA	45.49
NVA	15.48

From the total VA time and NVA time, time losses are calculated as followed:

Actual Time = VA Time
= 45.49 hours

Time Losses = Observed Time - Actual Time
= 60.97 – 45.49
= 15.48 hours (NVA Time)

Step 3: Plan Preparation

Scheduling the project is planned for 4 months. Step by step of kaizen must be followed to get the actual result of kaizen steps effectiveness. In project schedule, each steps or activities is perfectly allocated its duration. This project schedule consist 11 activities which had to finish in 14 weeks of duration time.

Step 4: Organizing Team

The next step in Kaizen will be organizing the Project Team. The team are put together and expected to come up with a solution to a problem and success in the project conducted. Target is set due to project planning and project schedule. Specifically, target of the project is to reduce lead time of sales order processing processes at least 5%.

Step 5: Project Implementation

At this step, PDCA Cycle was used as problem solving approach. Problems are solved more effectively when used the systematic approach. In PDCA approach, there have 7 steps that need to follow. Step by step was followed without skip.

Define the problem

From the time losses that have been calculated, the times are divided by problems. Figure 2 shows the percentages of time losses by problems. From that, can be seen that major contributors of time losses is 'Rework or Redesign part' problems which is 58.79 %. Therefore, this problem has chosen to attack.

Detect root cause

Why analysis is used to detect the root cause of the problem. The root cause is procedure of company not appropriate to follow by management and customer, and there also not have customer approval. Thus, a countermeasure that proposed is change the company procedures of sales order processing and provide a customer approval to fit with and solve the problem faced.

Data collection

Data already collected before started kaizen steps. From countermeasure are proposed in why-why analysis, each current procedures of sales order processing flow are studied.

One process flows are created to make it visible (refer to Appendix C). Each process is studied to understand the real function.

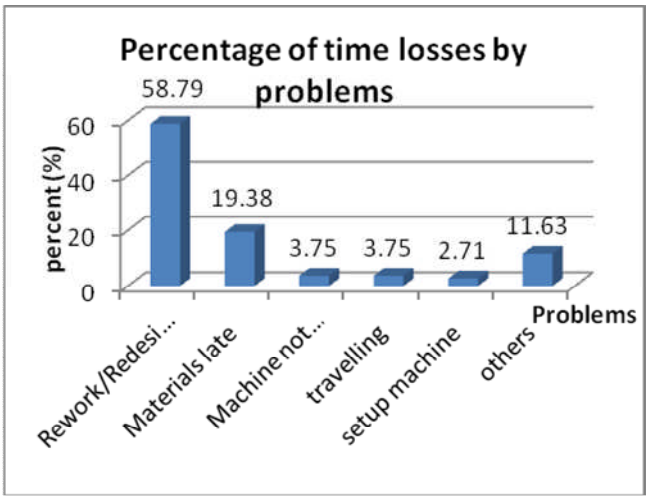

Figure 2: Percentages of Time Losses by Problems

Analyze and Establish solution for the problem

From the countermeasure that proposed and the process description, Value Added Analysis have used to come out with solution. First of all, a brainstorming session was done among team members. During brainstorming, each process of sales order processing flow are discussed and evaluated in order to categorize the process to Value Added (VA), Non Value Added (NVA) and Necessary Non Value Added (NNVA). Results from brainstorming session, Table 3 are created which each process placed in respective category and some processes are break into details process. So, in Value Added Analysis, 13 main processes are break become 17 processes.

From Table 3, there have two processes that classified into Non Value Added (NVA) and three processes are classified into Necessary Non Value Added (NNVA). Those processes will go through in deep. Firstly, the three NNVA processes is a quite same process which is discussion process. The team viewed, it will be saving the time if those three processes are combined together. That mean, only one meeting to discuss with customer will be held involving the management, production and designer. Besides, the two NVA processes are supposed to eliminate from the process flow. For quotation process (process no.4) because there have two process that a same function, thus, decision are made to focus on one times only which is at process 2. That's mean, at the same time of filling the form; quotation will be issued directly to the customers. Thus, quotation processes no need for two times. For non value added process number 9, which is materials conformation by production also, need to remove from the process flow. This is because; management itself can conform the materials and order from supplier. In other side, materials can be already conforming as well as each section which is management; production and designer is seat together with customers in first meeting as proposed. Other than that, at the process number 7 which is AutoCAD drawing, will be provided customer approval form in order to avoid from customer change the design after fabrication start. If customers have satisfied with the drawing

that designed, customers will fill the form to approve the design drawing. By that way, customers will truly conform the design before approve it.

Table 3: VA and NVA for production operations

Step	Event	Time (hour)	Category
1	Discussing about materials use and cost	1.5	NNVA
2	Fill form 'quotation & enquiry'	0.25	VA
3	Paying deposit (50%)	8	VA
4	Quotation	0.5	NVA
5	Job Order	0.17	VA
6	Discussing about design and specification	1.5	NNVA
7	AutoCAD Drawing	24	VA
8	Discussing with production about drawing and explanation the materials use	0.5	NNVA
9	Materials conformation by production (Req. Form Mat.)	0.25	NVA
10	Sending materials order to supplier	0.17	VA
11	Receive invoice from supplier	4	VA
12	Payment to supplier	2	VA
13	Materials received	16	VA
14	Production run	60.97	VA
15	Delivery	24	VA
16	Sending invoice to customer	2	VA
17	Customers payment	24	VA

On the discussion, team also decided to provide warranty system to avoid from any customers issue after delivery such as return back cases. 1 year warranty for body and 6 month warranty for motor are provided. From the analysis, a new procedures of sales order processing are made. The new processes are shorter and lead times for processing the sales order have been reduced. Appendix D shows the new procedures of sales order processing.

Implement Solutions

In order to implement the new process flow, all employees have involved. This is a key for the success. Meeting is held and all workers are informed. The new process flow is explained and training is provided. The process can be used for all projects. But, time are different depends on project. Workers are train to perform the task based on new process flow without skips. Each related workers must truly understand the process and customers also need to follow the new operations procedures to ensure the effectiveness.

Check and Monitor Results

The Check activity clarifies the gap between the plan and actual achievement. After implementation, operations are functioning sufficiently using the methods currently adopted. However, there are some employees who do not understand procedures. But,

this problem have solve immediately by provided more training. The details results are shown in conform effectiveness step.

Standardize solutions

Standardization enables high quality production of goods and services on a reliable, predictable, and sustainable basis. In this step, two methods were used which is documentation and training. For example, work instruction sheet are used in order to help employees to perform the new task and as a direction in the case of unusual conditions. This is important to reduce variation in work and standardize the work. This effort of standardization is making sure that important elements of a process are performed consistently in the most effective manner.

Step 6: Conform Effectiveness

In this step, the effectiveness of kaizen steps and problem solving approach is defined by using comparisons between before and after implementation. Time taken with the project conducted without rework or redesign part.

Production lead times comparison

According to the Figure 3, the total lead time of the production processes before improvement is 60.97 hours. After improvement, problems of rework or redesign part were eliminate. Thus, lead times were reduced as much as 9.1 hours become 51.87 hours. This means that, 14.93% of lead times have been reduced. This improvement will save the cost, time and make advantage to company. An increased in the percentage value reflects the production processes is running smoothly as schedule and processes is operating at optimum and effective level. The improvement plans was a success due to the lead time reducing as in the figure.

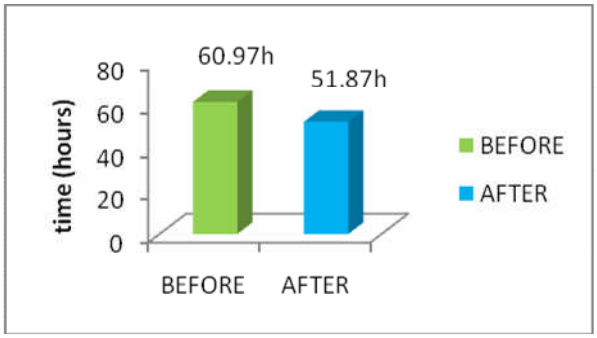

Figure 3: Production lead time comparison before and after improvements

Sales order processing lead time comparison

Figure 4 shows the comparison of sales order processing lead time before and after improvement. As be seen, the results show a reducing the lead time of 6.98% which is from 169.81 hours become 157.96 hours. That's mean as much as 11.85 hours have been reduced. If we look at the hours reduced, it is a small value compared to overall

time which is 169.81 hours. But, 11.85 hours time is more than one day because of 8 hours working time. That's a long time to waste.

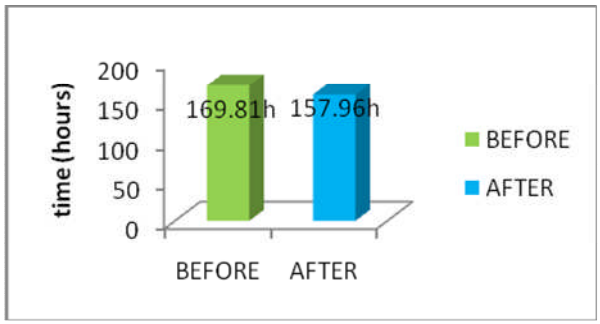

Figure 4: Sales order processing lead time comparison before and after improvements

Time losses comparison before and after improvements

Figure 5 shows the percentage of time losses comparison before and after improvements. Follows is the calculations of the percentages:

Before: $\frac{15.48 \text{ hours}}{60.97 \text{ hours}} \times 100 = 25.39\%$

After: $\frac{6.38 \text{ hours}}{51.87 \text{ hours}} \times 100 = 12.3\%$

Before improvements shows the time losses is 25.39% and the time losses after improvements is 12.3%. Thus, 48.44% have been reduced.

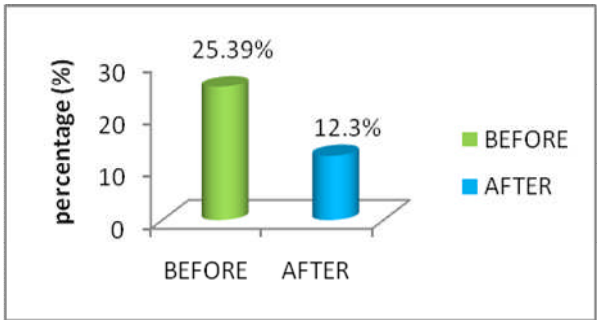

Figure 5: Percentages of time losses comparison before and after improvements

Value added, non value added and necessary non value added time comparison before and after improvements

As can be seen on the figure, value added time are not changed. That's proved that value added processes cannot be eliminates because of their contribution to finished the operations is significant. For necessary non value added, it recognizes the reducing of 9.85 hours which is from 16.23 hours become 6.38 hours while for non value added reduced 2.0 which is from 3.5 hours become 1.5 hours. These results show that kaizen steps also useful to eliminate or at least reducing the operations which do not add value.

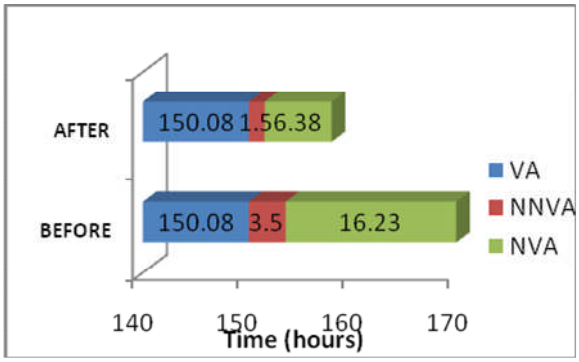

Figure 6: VA, NNVA and NVA comparison before and after improvements

Step 7: Follow Up

In this section, in order to make sure the processes are operating at normal condition even after implementations, some actions have been taken. The actions taken will provide stability and reliability to the improvements that have been carried out. We have specified 3 main actions that can be taken to avoid the problems from recurrence happening. The actions are based on brainstorming among members and also discussion among the workers itself. The actions taken are as follows:

Check sheet

The list contains the important steps that must be follows without skipping. The check sheet will be move together with processing flow processes. Each process that have been done must mark at the check sheet as token had elapsed that process. This item is necessary to be added in this step because it acts as a guideline to prevent any skipping due to human error.

Workers involvement

One of the essential aspects in preventing previous false to happen again is by co-operation from co- workers. Workers are highly responsible for the task given. The time spent for processing the sales order and the level of workers involvement in the process are crucial for contributing on time delivery and increasing the customer satisfaction. An employee is responsible to follow the correct work sequences and ethics.

Top management strict enforcement

Enforcing the right work attitude is necessary for the positive outcome from the improvements done. Top management staffs must co- operate and enforce the law and ensure the workers are performing the work as in the instruction manual. Fine or equivalent terms of punishment should be imposed for errant workers.

CONCLUSION

The case study conducted at ABC Company is successful. Firstly, the time losses at production was identified which is 15.48 hours. Then, by using PDCA Cycle and some

tools, the root cause was identified and improvement solution was proposed. Finally, the effect of improvement was measured by comparison of lead time before and after improvement. Sales order processing lead time was reduced about 6.98% and production lead time reduced about 14.93%. So, all objective were achieved. Kaizen plays an important role in eliminating losses and waste either in production or non-production. A slight improvement of 1% is considered a good improvement in workplace. The most important thing in kaizen is make the improvement continuously. To make the continuous improvement in company, firstly is to set the right mindset. Some of kaizen mindset are such think that everything is can and should be improve, and also should emphasis on process which establish a way of thinking oriented at improving processes, and a management system that supports and acknowledges people's process-oriented efforts for improvement. Besides, to gain success in any Kaizen activities, involvement of top management and workers are very significant as illustrated by this paper. An implementation is worthless if workers don't utilize the full potential of it and also if top management doesn't support any of ideas. A clear and sound target to achieve is lit up first following by steps to achieve it, that's kaizen improvement method. Apart from being a well- known improvement method in Japanese firms, Kaizen is gaining attention from all industries internationally for their companies to strive and maintaining zero waste policy. Kaizen generates breakthrough improvements quickly, without huge capital investments and or extensive commitments of employ time. Company using kaizen find that they not only reduce waste and see immediate results; they also increase productivity, lower costs, and energize employees. Overall, Kaizen project conducted on sales order processing processes at ABC Company have been a success and it contributes for the reduced lead time.

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APPENDIX A
Process Mapping of Sales Order Processing

General Mapping of Sales Order Processing

Part: 'Dodol' Machine			**Present**	**Proposed**	**Difference**
Operation:					
Operator : 4					
Method :	**Type :**				

Step	**Event**	**Symbol**	**Time(h)**	**Remark**
1	discussing about materials use and cost		1.5	
2	fill form 'sebut harga & pertanyaan'		0.25	
3	paying deposit (30%)		8	estimation based on average time
4	Quotation		0.5	
5	Job Order		0.17	
6	discussing about design and specification		1.5	
7	AutoCAD Drawing		24	estimation based on average time
8	Discussing with production about drawing and explanation the materials use		0.5	
9	Materials conformation by production(Req. Form Mat.)		0.25	
10	sending materials order to supplier		0.17	
11	receive invoice from supplier		4	
12	payment to supplier		2	
13	materials received		16	estimation based on average time
14	production run		60.97	refer process mapping of production process
15	delivery		24	estimation based on average time
16	sending invoice to customer		2	
17	customers payment		24	estimation based on average time
TOTAL TIME			169.81	

APPENDIX B
Process Mapping of Dodol Machine

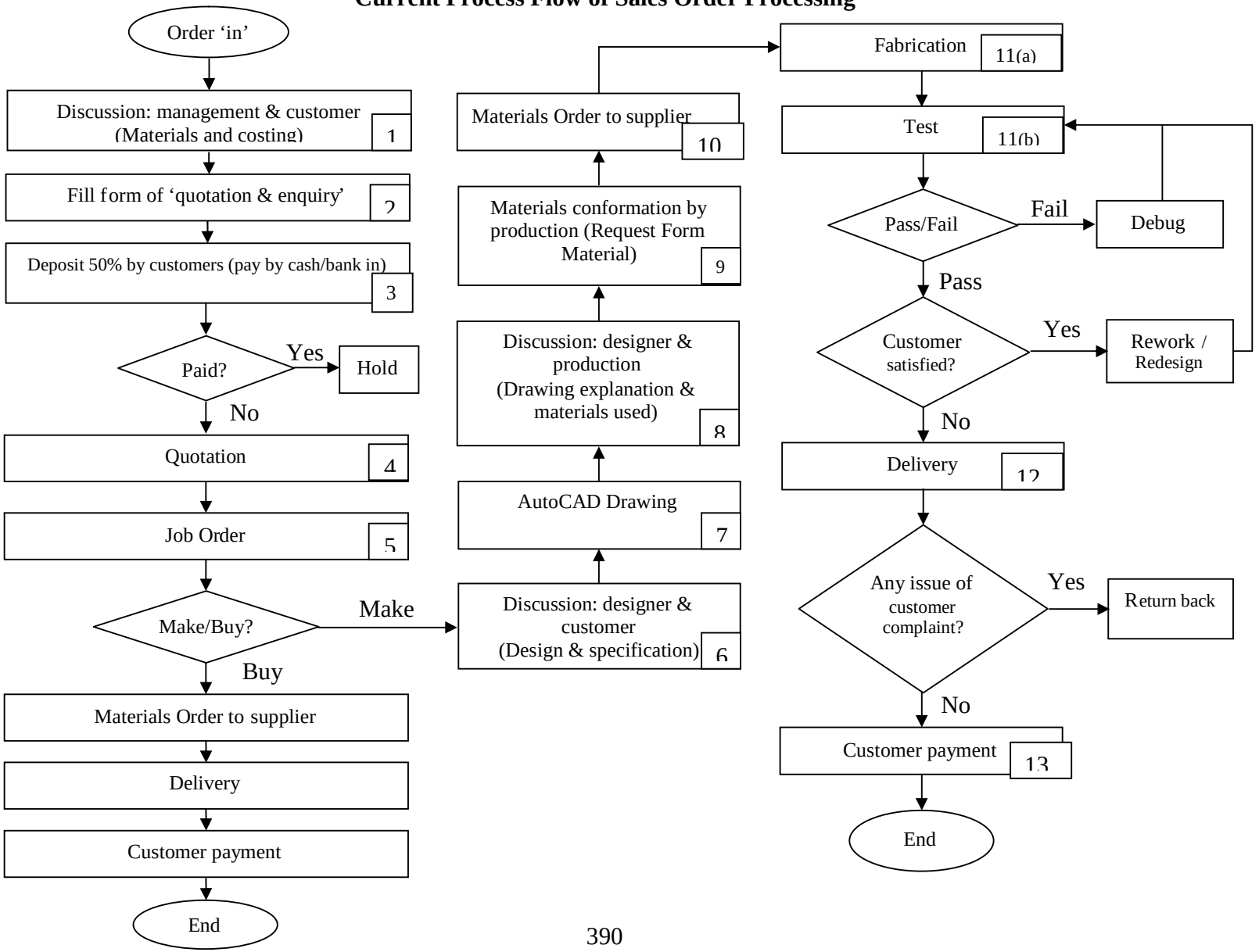
Part: 'Dodol' Machine							**Present**	**Proposed**	**Difference**
Operation:									
Operator :									
Method :		**Type :**							
Step	**Event**	**Symbol**					**Time(h)**	**Remark**	
1	take raw materials from store						0.33		
2	setup cutting machine						0.08		
3	Cutting the raw materials based on each size of part (15 pcs) (hollow part for body)						7.5		
4	setup welding machine						0.17		
5	Welding hollow part (body of machine)						4		
6	waiting for new drawing						1.5	have some changes of the specification(reduce height of the body machine)	
7	go to management to get new drawing from designer						0.25		
8	open the hollow part that had weld before						2	under rework process	
9	cutting the hollow part based on new height(6pcs)						3.3	under rework process	
10	welding back the hollow part as body machine						3.8		
6	Welding m/steel plat at machine body						0.58		
7	prepare m/steel plat and welding (as cover)						2.5		
8	Combine 2 pcs plat and bush.						0.75		
9	screw drill at funnel						0.58		
10	attach funnel at ensile						0.67		
11	Allen screw M8 at m/steel						0.33		
12	insert pin 10mm at m/steel						0.25		
13	attach solid shaft/polish shaft (weld)						0.67		
14	attach s/steel shaft (weld)						0.65		
15	attach m/steel polish shaft (weld)						0.6		
16	prepare iron angel and m/steel (motor base)						2		
17	attach motor						1.2		
18	attach belt and pulley						2.5		
19	attach worm gear						2		
20	waiting for raw material stock from supplier (plat bar & rod bar black m/steel)						3		
21	prepare plat bar m/steel (cutting)						0.7		
22	prepare m/steel rod bar black (cutting)						0.67		
23	attach plat bar m/steel & m/steel rod bar black (weld) (for pan holding)						3		

CONT'…

24	Attach bolt and nut at plat bar and pipe m/steel	○	⇨	□	D	▽	1.5	
25	bush, tapping and hole at plat bar	○	⇨	□	D	▽	2	
26	waiting for welding machine available	○	⇨	□	D	▽	0.58	machine are used by other worker
27	setup welding machine	○	⇨	□	D	▽	0.17	
28	welding m/steel solid and m/steel plat bar (for kitchen part)	○	⇨	□	D	▽	3	
29	attach m/steel plat,m/steel bar and hollow pipe(pin m8)	○	⇨	□	D	▽	4	
30	attach blade at center s/steel rod	○	⇨	□	D	▽	0.42	
31	attach wheel - 4pcs	○	⇨	□	D	▽	0.75	
32	grinding surface	○	⇨	□	D	▽	2	
33	testing	○	⇨	□	D	▽	0.67	
34	fill form of testing information	○	⇨	□	D	▽	0.3	
TOTAL TIME							60.97	

APPENDIX C

Current Process Flow of Sales Order Processing



APPENDIX D
New Process Flow of Sales Order Process