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Internal Quality Defect Reduction at PT ITI

Indra Indra* and Mursyid Hasan Basri

School of Business and Management, Institut Teknologi Bandung, Indonesia

Email: indra_mba2019@sbm-itb.ac.id

Abstract–**In FY 2020, PT ITI's internal defect rate could not reach the set target of 1% or less. This results also increasing other costs (hidden costs) that follow, such as segregation and rework costs. Currently, this quantity of segregation and rework is about 14% of total production. Under such conditions, it is estimated that total costs incurred will be around USD 1 million in FY 2020.**
This study aims to assist PT ITI in reducing the level of internal defects. Root cause analysis method used by the author is current reality tree (CRT). The results of this CRT analysis are four main root causes.These root causes involve humans, machines/equipment, and procedures.
Author used Analytical Hierarchy Process (AHP) method to select the alternative solutions for each root cause. The proposed solutions are expected to help ITI reduce its costs which are estimated to reach 50% of current total costs (around USD 500,000 per year).

Keywords - **high internal quality defect, internal quality cost, high precision manufacturing, parts manufacturing, human-capital-based quality solution**

I. INTRODUCTION

Current global business conditions are in the era of VUCA (volatility, uncertainty, complexity, and ambiguity). Rapid development of digitalization technology has forced business or company to adapt to these fast changes. Companies could not survive if they adapt too late in this industrial revolution 4.0 era. Especially with the Covid 19 pandemic, companies are facing many difficultiesonly to survive. Therefore, companies must be able to analyze its strengths and weaknesses to make the right business strategy. Companies must do a thorough evaluation of company's performance, especially to reduce its cost so it can increase company competitiveness to survive in the industry.

PT ITI, as a manufacturing company, is also experiencing and facing the same problem. ITI can feel that internal and external problems and challenges they are facing are getting heavier. Even ITI financial performance is not in a big problem, ITI must be able to improve its performance, especially in cost reduction, to have a sustainable competitive advantage.

Although ITI's financial performance is not a big problem, but some of other performances are still missed-attention by management so it is feared that in the future it will become a big problem. From the author's daily observations working at ITI, there are still problems that occur in company operations. Operational management problems are improper customer claims handling, high internal defect rate, poor inventory management, and unagile production systems. The most serious one is internal quality defect problem.

The data from the beginning of fiscal year, April 2020, to December 2020 (Fig. 1.1) shows that the internal quality defect could not reach company's target, which is maximum of 1%. The following graph and table show the internal quality defects in fiscal 2020 until 3rd quarter.

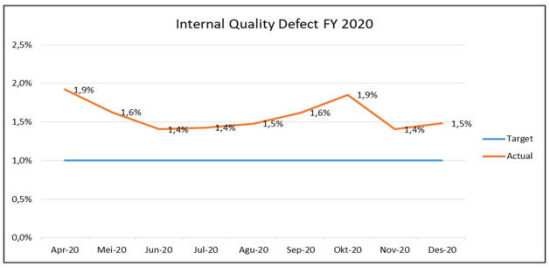

Figure 1: PT ITI Internal Quality Defect Rate FY 2020

TABLE 1: PT ITI INTERNAL QUALITY DEFECT IN PERCENT AND AMOUNT (USD) FY 2020

Internal Defect	Apr-20	Mei-20	Jun-20	Jul-20	Agu-20	Sep-20	Okt-20	Nov-20	Des-20	Total
Target	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%
Actual	1,9%	1,6%	1,4%	1,4%	1,5%	1,6%	1,9%	1,4%	1,5%	1,5%
Target (in USD)	52.173	37.726	59.084	48.565	46.897	39.312	52.279	85.998	88.437	510.472
Actual (in USD)	67.751	36.043	64.468	91.284	94.656	103.805	107.903	119.711	121.815	807.437
Balance (in USD)	-15.578	1.683	-5.384	-42.719	-47.760	-64.493	-55.624	-33.713	-33.377	-296.964

Source: Product Quality Report PT ITI FY 2020

Table 1 shows that until end of 3rd quarter (Q3), the internal quality defect has reached 1.5% or equivalent to USD 807,437 of the maximum target of 1% (USD 510,472), so there is a loss of USD 296,964. If this condition continues in Q4 then total loss can be projected to be USD 395,952. Costs or losses that arise due to internal quality defect problems can increase if other activities are included which aim to prevent defect goods from being delivered to customers, e.g. 100% inspection process and rework. Currently, about 23% of production output is checked 100% and 14% of production output is carried out by rework process. It takes 72 employees to carry out a 100% inspection and rework process at a cost of around USD 36,000 per month or USD 432,000 per year. If the opportunity cost of decreased productivity due to making defective goods, is calculated, the loss caused by this high internal defect problem could reach about USD 1 million in this fiscal year 2020.

II. BUSINSESS SITUATION AND ROOT CAUSE ANALYSYS

A. Business Situation Analysis

One of the fundamental problems in company is the problem of quality of goods or services that are not in

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accordance with desired or standard. This problem creates a cost called quality cost. Basically, quality cost consists of prevention costs, appraisal costs, and failure costs or known as F-cost (Heizer, 2017, p.218). Failure cost consists of internal failure cost and external failure cost.

Failure costs are costs arising from products or services that have been made but does not meet the desired standards. Failure costs fall into the internal and external categories. Internal failure costs are costs of failure that occur when goods or services are being made or before they are delivered to customers. Example of internal failure costs are cost of defect goods (scrap cost), re-inspection, and rework. External failure costs are costs that occur after the product or service is delivered to customer. External failure cost includes follow-up fees for customer complaints, customer returns, and product recalls. The total quality cost is sum of all costs above, which represents difference between calculated costs where there is no cost due to product does not meet the standards, and the actual cost.

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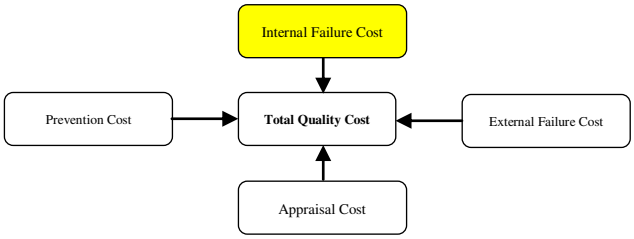

Figure 2: Total Quality Cost

Internal failure cost is caused by a defect (scrap cost), re-inspection, and rework. However, when viewed as a whole, there are other hidden costs, e. g. costs incurred by engineering time, management time, increased inventory, shop and field downtime, decreased capacity, delivery problems, and lost sales.Because the costs incurred are in fact higher than what is usually calculated, company must always make improvements to reduce, even eliminate, this failure cost. Companies must be able to analyze the causes of these internal failure costs and conduct countermeasure for this problem.

Factors affecting internal failure cost caused by quality defect begin when product development is carried out. In a manufacturing company, customer requests are represented in the form of a drawing accepted by the marketing department. Drawing is studied by the product development team, which consists of engineering department, quality assurance department, production department, and others related department. Purpose of product development is to find ways to make goods according to customer request, usually in terms of QCD (quality, cost, and delivery). Product development is carried out in preparation for mass production. Problems may arise in mass production will be low if product development is done well. But on the contrary, there will be many problems in mass production stage.

Quality management is a very important activity in every company, including ITI. Based on ITI procedure, the process begins after drawing, as customer want and are willing to pay for, and letter of intent (LOI) between ITI and customer is receipt. Next step is to form a new product development team whose task is to prepare everything, in this case related to quality, for mass production (quality planning). After that, the team assess and mitigate quality risks, standardize all the activities related to produce this product (quality assurance). In mass production stage, quality department then monitors internal quality defects (quality control). During mass production stage or product development stage, quality improvement is conducted.

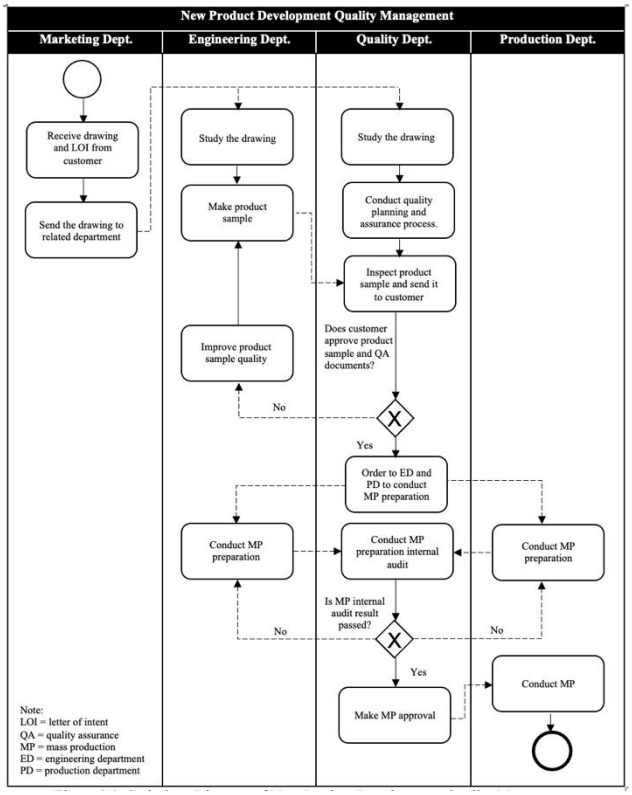

Figure 3: Swimlane Diagram of New Product Development Quality Management
Source: ProsedurPengembanganProdukBaru PT ITI

After Production Part Approval Process (PPAP) document is approved by customer, mass production preparation is conducted (PT ITI, 2017, p. 28). If this preparation considered to be completed, an internal audit is carried out by quality department. When internal audit found some items did not match mass production standard or preparation is insufficient, engineering and production department must conduct an improvement. But actually, often when internal audit find insufficiency in mass production preparations and an improvement has not been completed, mass production must be underway because the predetermined schedule cannot be postponed. This caused many problems on mass production.

When mass production started, quality control process and quality improvement activity begin. Quality control department immediately monitored internal quality defect which its data is obtained from two sources, first from production department and from its in-process inspection carried out by quality control inspectors. Internal defect evaluation by quality department is carried out weekly. If internal defect rate exceeds target, quality control department will conduct a meeting with production department and issue corrective action request (CAR) to make countermeasure to the problem. Production department can ask for assistance to engineering department if the problem is related to production process capability. Production department (and/or engineering department) performs an analysis to find root causes and then perform corrective actions using PDCA (plan, do, check, action) cycle.

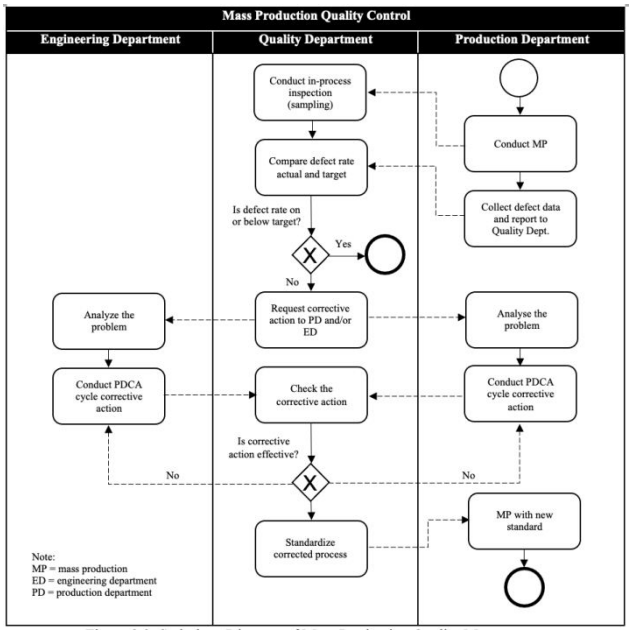

Figure 4: Swimlane Diagram of Mass Production Quality Management
Source: ProsedurProduksi Massa PT ITI

For critical specifications, ITI applies three inspection frequency categories during mass production: loose, normal, and tight inspections. Basis for application of these three categories is process capability or customer claims. For dimension specifications, if process capability index (Cpk)≥1.3 then inspection frequency is loose inspection category (one piece per day or one piece per shift). If 1≤Cpk<1.3 then inspection frequency is normal inspection category (one piece per 2 to 4 hours). Meanwhile, if Cpk<1 then inspection frequency is tight inspection category (one piece per 25 pcs until 100% inspection).

During conducting countermeasures to overcome quality problems, this inspection frequency change is often conducted. If there is a quality problem in production line and permanent counter measure is not yet conducted, inspection frequency is tightened to prevent defects sent to next process or to customer. The improper counter measure of the quality problem caused checking frequency remains tight and can even be checked 100%. Additional costs, categorized as prevention cost, will arise due to inspection frequency increasing.

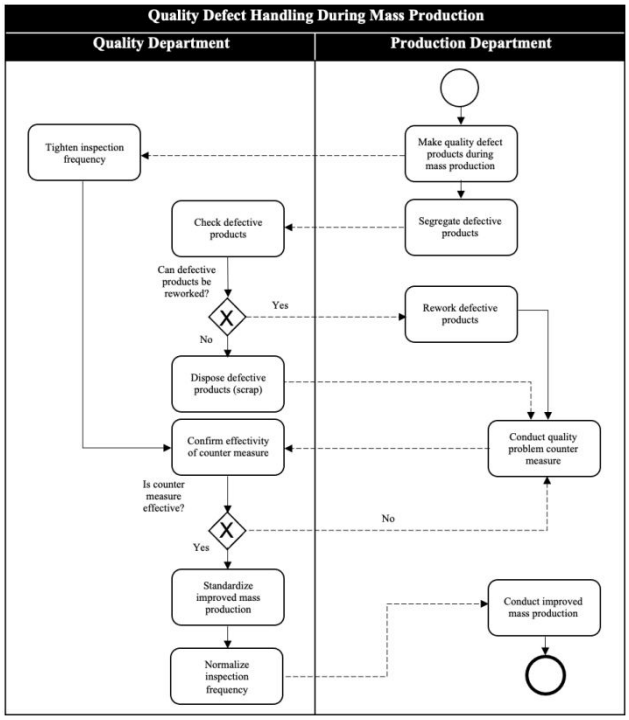

Figure 5: Swimlane Diagram of Quality Defect Handling During Mass Production
Source: ProsedurPengendalianKualitasSelama Produksi Massa PT ITI

In addition, ITI also has comparative data between process stability and machine and equipment age. The data show that the process stability of machines and equipment over 20 years old is so low that it can affect the internal defect rate. Currently, about 36% of the machines and equipment in ITI are over 20 years old. (Table 6)

B. Root Cause Analysis

To identify the right solution, a process is needed to find root cause of the problem. It is known as root cause analysis. Basic assumption of root cause analysis is it will be more effective to prevent and resolve underlying problems systematically than to simply treat symptoms and extinguish fires. Some of tools in root cause analysis are fishbone diagram, 5 Whys, and current reality tree (CRT).

This analysis process begins with direct observation in the field (production line), internal defect and fault cost data checking, machines and equipment data checking, and direct interviews with the person in charge until production operators and quality inspectors. Then, conducted discussions with ITI experts (local and Japanese staffs) in the fields of production, quality,

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engineering, and human resources. The results of the observations and opinions of the experts are presented in the following CRT diagram.

Before written in the chart form, author verified the data twice, especially regarding to relationship between the age of machines and equipment and product quality. The author also conducted re-interviews and discussed with the person in charge to ascertain the root cause of this high internal defect rate problem.

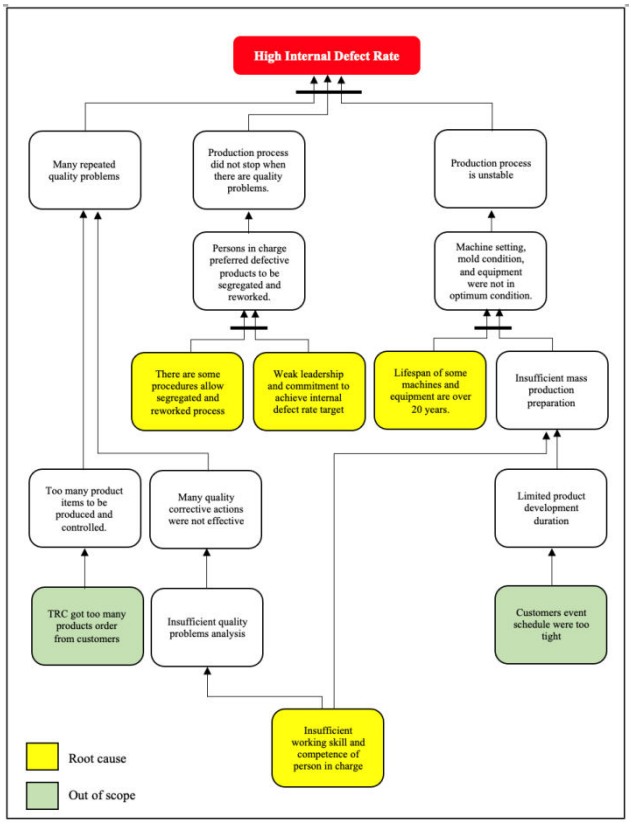

Figure 6: Current Reality Tree (CRT) of High Internal Defect Rate Problem

From the current reality tree above, there are several root causes of this high internal defect rate problems:

1. Weak leadership and commitment to achieve internal defect rate target. Leadership is a management function to influence, direct, motivate, and supervise others to complete various tasks have been planned. The objective is to achieve company goals. So weak leadership, starting from unit head to department head, caused internal quality defect rate target of 1% set by company could not be achieved. The commitment of related organizations, such as engineering departments, quality departments, and production departments, to carry out quality management steps starting from quality planning, quality assurance, quality control, and quality improvement, in this case, in order to achieve internal defect rate target were also weak.
2. There are some procedures allow segregated and reworked process. Figure 5 shows that there is an ambiguous procedure when production department makes defective products at mass production stage. This procedure allows production department to continue despite a large number of defective products because these products can be separated and reworked. Under this condition, production department can continue to produce even though internal defect rate is high. Along with weak leadership and commitment to achieve internal defect rate target, this condition will make internal defect rate becomes worse.
3. Lifespan of some machines and equipment are over 20 years. Data of comparison between process stability against age of machine and equipment obtained that process stability were low for machines and equipment over 20 years even though preventive maintenance have been carried out. Low process stability of these 36% from total machines and equipment caused high internal defect rate.
4. Insufficient working skill and competence of person in charge. As described in previous sub-chapter, there are many product and quality specifications must be controlled. Meanwhile, the time available for these activities is very limited. This requires a person in charge who has high engineering and management skills, and can work well under pressure. Currently, condition of quality person in charge at ITI has not yet reached this level due to insufficient of working skill and competency.

Otherwise, there were 2 causes that were not included in scope of this study, “ITI got too many products order from customers” and “Customer event schedule was too tight”. Both causes were excluded from this study because they were not in operations management matter but in business strategy. “ITI get too many products order from customer” is related to ITI business strategy, meanwhile “Customer event schedule is too tight” is related to the authority of customer. ITI can do nothing about it because they can find other suppliers who are able to match their event schedule.

C. Alternative Solutions

Several management meetings were held to find the best solution to solve these problems. These meetings determined objective, criteria, and looked for solution options to meet these criteria.

For weak leadership and commitment to achieve internal defect rate target problem, meeting results stated that the objective is to make persons in charge have strong leadership and commitment based on the following criteria:

1. high integrity, accountability, confident, and commitment,
2. high emotional intelligence and good communication skill,

3. good decision-making ability, optimistic, creative, and innovative.

To get person in charge leadership and commitment level as determined by these above criteria, there are several solution alternatives as follow:

a. High-impact leadership training to person in charge.High impact leadership training is more expensive than regular leadership training but usually the results are more than adequate. But ITI management does not yet know whether the effects of this training will be consistent in the long term.
b. Organizational structure change. Every year, ITI always changes the organizational structure from unit to department head level, but only minor changes. For this special organizational structure change, major changes must be made. Person in charge with weak leadership and commitment will be replaced by the better one. But there will be resistance possibility from the person in charge being replaced, and perhaps even interference with the new person in charge which will disturb his/her job.
c. Hire new employee to be change agent.This option is to recruit new employees to be change agents at every level of the organization, from unit to department head. The new employees must be able to persuade and influence old employees to leave their comfort zone. But recruiting employees with this kind of ability is difficult and takes more time.

For there are some procedures allow segregate and rework process problem, management determined that the objective is to decrease segregated and reworked process based on the following criteria:

1. uninterrupted delivery,
2. optimum inventory,
3. low production lost time.

Based on experience, production and engineering departments want sufficient time, around 5 days, to conduct counter measure in case of quality problem.Therefore, options to solve the problem when there is quality problem:

a. production stops, safety stock for 5 days of delivery, must increase warehouse area, need to increase working capital, the production and engineering department can guarantee all quality problems will be solved within 5 days,
b. production stops, safety stock for 3 days of delivery, warehouse area is still sufficient, need to increase working capital, production and engineering department cannot guarantee all quality problem can be solved within 3 days,
c. production does not stop, dispose defective products as scrap, resubmit product price quotation (cost up) to customer including this defect rate,
d. continue current conditions that production does not stop when there is quality problem, allow segregate and rework process.

For lifespan of some machines and equipment are over 20 years problem, meeting result stated that machines and equipment must have performance level with the following criteria:

1. stable production process,
2. optimum maintenance cost,
3. optimum electric and consumable cost.

To achieve the objective of having machines and equipment performance level as above criteria, solution options are:

a. massive machines and equipment overhaul and upgrade: cheapest cost but performance cannot be returned as new and, based on experience, this constant performance life time maximum 3 years,
b. buy used (max 10 years old) machines and equipment: cheap investment but performance cannot be returned as new and this constant performance life time maximum 5 years,
c. buy new machines and equipment: expensive investment but good performance lifetime is more than 10 years.

For insufficient working skill and competency problem, meeting results stated that person in charge and related members (engineering and quality staff) must have working skills and competence level with the following criteria:

1. good process knowledge and knowhow,
2. good engineering and management skill,
3. good mental and moral strength.

To get working skill and competency level as determined by the criteria, there are several solution alternatives as follow:

a. Coaching, knowledge and knowhow of person in charge and related members are sufficient but they need coaching only to get the desired working skill and competence.
b. Production process and engineering skills trainings.Production process training can be requested from machine makers. They can teach employees how to make products with optimum machine settings so production process is more stable. They can also teach good trouble shooting and maintenance so it can support more stable production process.
c. Benchmarking.This benchmarking aims to provide employees with lessons from seeing how other companies operate and then compared to operations in their own factories. Employees can get tips, tricks, and know-how about the production process, engineering, etc., directly from the workplace.

From the description above, it can be seen that to improve high internal defect rate problem, there are 4

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alternative solutions. To choose best suit solutions from those alternatives, the analytical hierarchy process (AHP) method is used.

There are 4 objectives to solve high internal defect problems which each objective has criteria and options:

1. Objective: make persons in charge have strong leadership and commitment.
   Criteria:
   1) high integrity, accountability, confident, and commitment (code: C11),
   2) high emotional intelligence and good communication skill (code: C12),
   3) good decision-making ability, optimistic, creative, and innovative (code: C13).
   Options:
   a) organizational structure change (code: O11),
   b) high impact leadership training to person in charge (code: O12),
   c) hire new employee to be change agent (code: O13).

2. Objective: decrease segregate and rework process.
   Criteria:
   1) uninterrupted delivery (code: C21),
   2) optimum inventory (code: C22),
   3) low production lost time (code: C23),
   Options:
   a) production stops, safety stock for 5 days of delivery, but warehouse must increase the area, but must increase working capital, the production and engineering department can guarantee all quality problems will be solved within 5 days (code: O21),
   b) production stops, safety stock for 3 days of delivery, warehouse area is still sufficient, but need to increase working capital, but production and engineering department cannot guarantee all quality problem can be solved within 3 days (code: O22),
   c) production does not stop, disposed defective products as scrap, resubmit product price quotation (cost up) to customer including this defect rate (code: O23),
   d) continue current conditions that production does not stop and allow segregate and rework process (code: O24).

3. Objective: have good performance of machines and equipment.
   Criteria:
   1) stable production process (code: C31),
   2) optimum maintenance cost (code: C32),
   3) optimum electric and consumable cost (code: C33).
   Options:
   a) massive machines and equipment overhaul and upgrade: cheapest cost but performance cannot be returned as new and, based on experience, this performance life time maximum for 3 years (code: O31),
   b) buy used machines and equipment: cheap investment but performance cannot be returned as new and, based on experience, this performance life time maximum 5 for years (code: O32),
   c) buy new machines and equipment: expensive investment but good performance lifetime is more than 10 years (code: O33).

4. Objective: Good working skill and competence
   Criteria:
   1) Good process knowledge and knowhow (code: C41).
   2) Good engineering and management skill (code: C42).
   3) Good mental and moral strength (code: C43).
   Options:
   a) Coaching (code: O41).
   b) Production process and engineering skills training (code: O42).
   c) Benchmarking (code: O43)

The next step in AHP is weighting the criteria and options, based on the Saaty fundamental scale of importance (Saaty, 1987, p. 163). Weighting of the criteria and options is conducted by interviewing ITI top management. Those interviewed had worked in a factory for at least 20 years, consisted of Indonesians and Japanese. The final weighted score is the adjusted average score of each person interviewed.

AHP calculation results:

1. For strong leadership and commitment person in charge objective, the priority vector table shows that option with code O12 (score: 0.53) has the highest score. Therefore, for the problem of weak leadership and commitment, the solution is high impact leadership training to person in charge.

TABLE 2: PRIORITY VECTOR OF STRONG LEADERSHIP AND COMMITMENT PIC OBJECTIVE

Option	Criteria			Result
	C11	C12	C13	
O11	0.22	0.59	0.59	0.36
O12	0.67	0.29	0.29	0.53
O13	0.11	0.12	0.12	0.11

2. For decrease segregated and reworked process objective, the priority vector table shows that option with code O21 (score 0.60) has the highest score. Therefore, for the problem of there are procedures allow segregate and rework process, the solution is production stops, safety stock for 5 days of delivery, warehouse increase the area, increase working capital, the production and engineering department can guarantee all quality problems will be solved within 5 days.

TABLE 3: PRIORITY VECTOR OF DECREASE SEGREGATE AND REWORK PROCESS OBJECTIVE

Option	Criteria C21	C22	C23	Result
O21	0.68	0.59	0.59	0.60
O22	0.23	0.29	0.29	0.28
O23	0.10	0.12	0.12	0.11
O24	0.14	0.20	0.20	0.19

3. For having good performance of machines and equipment objective, the priority vector table shows that option with code O31 (score 0.59) has the highest score. Therefore, for the problem of lifespan of some machines and equipment are over 20 years, the solution is to buy new machines and equipment.

TABLE 4: PRIORITY VECTOR FOR GOOD PERFORMANCE OF MACHINES AND EQUIPMENT OBJECTIVE

Option	Criteria C31	C32	C33	Result
O31	0.65	0.59	0.59	0.59
O32	0.13	0.29	0.29	0.28
O33	0.22	0.12	0.12	0.13

4. For good working skills and competence objective, the priority vector table shows that option with code O43 (score 0.48) has the highest score. Therefore, for the problem of insufficient of working skills and competence, the solution is benchmarking.

TABLE 5: PRIORITY VECTOR FOR GOOD WORKING SKILLS COMPETENCE OBJECTIVE

Option	Criteria C41	C42	C43	Result
O41	0.08	0.17	0.17	0.15
O42	0.54	0.33	0.33	0.37
O43	0.38	0.50	0.50	0.48

III. RESULTS

After going through the process of root cause analysis, determining alternative solutions, alternative solutions analysis using AHP, the business solutions for high internal defect rate problems are as follows:

1. high impact leadership training to person in charge to overcome their weak leadership and organizational commitment,
2. change the procedure that allow segregate and rework process so when there is quality problem, the new procedure is production stop, production department must increase safety stock for 5 days of delivery, and the production and engineering department must guarantee all quality problems will be solved within 5 days,
3. buy new machines and equipment for replacing current machines and equipment which their lifespan are more than 20 years,
4. benchmarking to overcome insufficient working skill and competence of person in charge and related members.

V. CONCLUSION

It has been determined that business solutions for the high internal defect rate problems are high impact leadership training, change the procedure that allow segregate and rework process, buy new machines and equipment, and benchmarking.

For the four business solutions above, identification of required activities is needed. In order to get effective results, these activities must comply with PDCA cycle (plan, do, check, action) and POAC (planning, organizing, actuating, controlling) base.

A. Required Activities and Improvement Plan

The activities must be conducted by ITI for high impact training solution are:

1. Find training institutions that can provide high impact leadership training. Because usually this training is carried out semi-military, ITI must seek training institutions that have access to military institution. In addition, because there are several outdoor training sessions, the implementation must be able to adjust to health protocols and other rules during the Covid 19 pandemic,
2. Determine who the person in charge from which level will attend the training. Determination method is based on the results of the annual assessment which also represents the results of key performance indicator (KPI). Management decided that this training would be attended by 5 department heads, 13 section heads, 7unit heads, and 5 staffs from production departments, quality department, and engineering department,
3. Because this training cost is expensive, management must measure the effectiveness of the training by comparing the conditions before and after the training. To measure this training effectivity must be checked: reactions of training participants (positive or negative reaction), seriousness during training, changes in behavior, business impact (decrease of internal defect rate), and return on investment (ROI) of this training.

Second business solution is to change the procedure that allows segregation and rework process. So, the production must be stopped when a quality problem occurs. But it is necessary to increase finished goods safety stock from 1 day to 5 days of daily delivery quantity. Also, production and engineering departments must be able to solve quality problem in a maximum of 5 days. Therefore, the required activities are:

1. increase capacity of the finished goods warehouse,
2. increase inventory (increase working capital),

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3. prepare human resource, equipment, and others to support person in charge to achieve the target of a maximum of 5 days of solving quality problems,
4. in the long term, the day target for solving quality problems will be decreased, for example to 4 or 3 days so it can reduce safety stock.

Required activities for third business solution is to buy new machines and equipment as a replacement for those which have 20 years old or more are:

1. make a list of machines and equipment that are 20 years old or more with data on their quality performance,
2. determine the number and brand of machines and equipment to be replaced,
3. calculate the amount of investment required,
4. if the amount of investment is very large, a priority must be made regarding the machines and equipment that will be purchased in this fiscal year,
5. order machines and equipment to the maker and determine when they arrive at the factory,
6. prepare infrastructure before new machines and equipment arrive at the factory,
7. set up new machines and equipment,
8. mass production with new machines and equipment.

To make this fourth business solution, benchmarking to similar factory or company, gives an effective result, required activities are:

1. selecting similar companies or factories with better performance, engineering skills and technology (compared to ITI),
2. determine what will be used as the benchmark theme regarding the working skills and competence,
3. determine who will participate in this benchmark activity,
4. measure the level of working skills and competence before and after benchmarking by evaluating it every 6 months.

After identifying activities required for the four business solution results to be effective, the next step is to create an implementation plan and the section or department in charge for these activities.

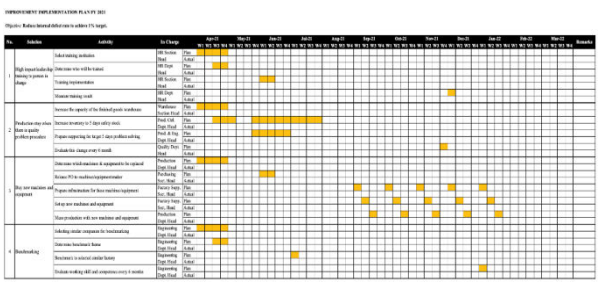

Figure 7: Gantt Chart of Implementation Plan
Source: PT ITI, Improvement Implementation Plan FY 2021

B. Resource Requirement

To implement the four business solutions described in the previous sub-chapter, the required resources to be prepared are:

1. human resources: each department or section head that responsible for implementing this business solution prepares its human resources. There are no additions or structural changes that specifically handle this implementation, only additional functional assignment to persons in charge.
2. additional working capital and investment: increasing safety stock (inventory) requires additional working capital. ITI sales per day is around USD 180,000, so with 83% cost of goods sold, the inventory price for one delivery day is USD 149,400. An increase in safety stock to 5 days requires an additional working capital of USD 597,600. Investment needed to replace old machines and equipment is calculated as in next tables.

TABLE 6: MACHINE LIST, AGE, AND PERFORMANCE

No.	Machine	Machine Age (years)	Q'ty (units)	Performance		Maintenance Cost	Consumable Cost
				Quality	Productivity		
1	CNC Lathing	0-20	54	Normal	Normal	Normal	Normal
		> 20	18	Low	Low	High	High
2	Centerless Grinding	0-20	12	Normal	Normal	Normal	Normal
		> 20	14	Low	Normal	High	High
3	Cylindrical Grinding	0-20	7	Normal	Normal	Normal	Normal
		> 20	10	Low	Normal	Normal	Normal
4	Plastic Injection	0-20	71	Normal	Normal	Normal	Normal
		> 20	34	Low	Low	High	High
5	Rubber Press	0-20	8	Normal	Normal	Normal	Normal
		> 20	4	Low	Low	High	High
6	Open Mill	0-20	0				
		> 20	2	Normal	Low	High	Normal
7	Kneader	0-20	0				
		> 20	2	Normal	Normal	High	Normal
	Total	0-20	152	64%			
		> 20	84	36%			

Source: PT ITI, Machines and Equipment List FY 2020

TABLE 7: EQUIPMENT LIST, AGE, AND PERFORMANCE

No.	Equipment	Equipment Age (years)	Q'ty (units)	Performance			Maintenance Cost
				Dimension	Standard	Actual	
1	Waater Chiller	0-20	6	Temperature	18^0-23^0 C	21^0-23^0 C	Normal
		> 20	2			24^0-26^0 C	High
2	Air Compressor	0-20	8	Air pressure	7-8 atm	7-8 atm	Normal
		> 20	3			5-6 atm	High
3	Water Boiler	0-20		Temperature and pressure	150^0, 5 atm		
		> 20	1			150^0 C, 4 atm	Normal

Source: PT ITI, Machines and Equipment List FY 2020

The decision to select machines and equipment to be bought in this fiscal year (priority) are made based on quality criteria, not productivity nor maintenance cost. If the machine quality performance is low, it will be preferable to be purchased in this fiscal year. Likewise, if equipment performance is below standard, it will be prioritized to be purchased in this fiscal year.

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TABLE 8: TOTAL INVESTMENT OF MACHINES AND EQUIPMENT RENEWAL

No.	Machine/ Equipment	Brand	Type	Price/unit (USD)	Buy Plan (units)	Total Amount	FY 2021 Buy Plan	Total Amount
1	Plastic Injection	Fanuc	30-50T	80,000	20	1,600,000	5	400,000
			100-150T	120,000	8	960,000	3	360,000
			220-350T	200,000	6	1,200,000	2	400,000
2	CNC Lathing	Star	SB 10	50,000	4	200,000	0	0
			SB 16	70,000	7	490,000	0	0
			SB 20	80,000	5	400,000	5	400,000
			SB 30	120,000	2	240,000	0	0
3	Centerless Grinding	Micron	S 14	60,000	7	420,000	1	60,000
			S 18	80,000	7	560,000	0	0
4	Cylindrical Grinding	Palmary	GC 18	30,000	10	300,000	4	120,000
5	Press Rubber	Tung Yu	100T	50,000	1	50,000	0	0
			200T	75,000	3	225,000	1	75,000
6	Open Mill	Tung Yu	D70	120,000	2	240,000	0	0
7	Kneader	Tung Yu	60L	150,000	2	300,000	0	0
8	Water Chiller	Kanetsu	1000MS	35,000	2	70,000	2	70,000
9	Air Compressor	Hitachi	Middle	45,000	3	135,000	0	0
10	Water Boiler	Miura	M39A	40,000	1	40,000	0	0
	Total					7,430,000		1,885,000

Source: PT ITI, Investment of Machines and Equipment FY 2021

ITI use its internal funding of USD 598,000 for the additional working capital. Meanwhile, for the investment to buy new machinery and equipment amounting to USD 1,885,000, around 80% is funded by debt of USD 1,500,000, and the rest is from internal funds of USD 385,000. So, ITI must prepare a total internal fund of USD 983,000 and look for financial institutions to get long-term debt of USD 1,500,000.

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