Reducing Time in Estimating Production Cost without Decreasing the Accuracy in Order to Avoid Loss at PT. XY Indonesia

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An Internship Report submitted to the Faculty of Engineering President University in partial fulfilment of the requirements of bachelor's degree in engineering Major in Industrial Engineering

2019

ACADEMIC ADVISOR
RECOMMENDATION LETTER

This internship report is prepared and submitted by **Ivena Noviany Kurnia** in partial fulfillment of the requirements for the degree of bachelor's degree in the Faculty of Engineering has been reviewed and found to have satisfied the requirements for a report fit to be examined**.**

Cikarang, Indonesia, August 30th, 2019

Ir Adi Saptari, M.Sc., Ph,D

COMPANY'S SUPERVISOR
RECOMMENDATION LETTER

Ivena Noviany Kurnia has performed and completed an internship in **PT. XY** from 18th March to 31th August 2019, in partial fulfillment of the requirements for degree of bachelor's degree in faculty of Engineering. I therefore recommend this report to be examined.

Cikarang, Indonesia, August 30th, 2019

MAL

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Approved By

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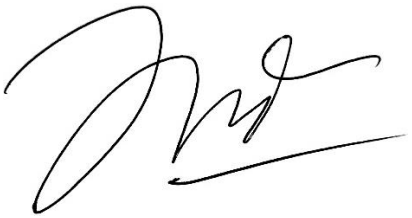

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ABSTRACT

As a leading toy manufacturing company, PT. XY Indonesia must be able to fulfill the demand without decreasing the quality of the product. All process should go to every process to reach the quality. All processes must be effective to reduce production cost and fulfill the target or demand. The PDCA method is implemented in this research to find the proper solution of the root cause problems. In the case the problem is process in making cost estimation for production. Company should estimate and make budgeting cost to control the production cost. This problem is happened in development phase so that is hard to estimate the cost and if the simulation run before simulation cost will become unnecessary expenses. So that in estimating cost easier by formed the cost model. Cost model uses the all data needed in production line by engineer. Including material, labor needed, labor hour, machine rate, MAOH, FGAO, etc. then the system will be estimating cost automatically. This case will make the cost model for DIJ process.

Keyword: Cost model, DIJ, FGAO, MAOH, PDCA

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Cikarang, August 30th, 2019

Ivena Noviany Kurnia

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LIST OF TERMINOLOGIES

DIJ	:	One of painting process used ink jet machine, used to paint head and head
FGAO	:	Stand for Finish Goods Add On. Subtracting the cost of goods sold from the total goods available for sale. This will give you the total value of finished goods at the end of the year.
HDP	:	HDP stands for head and decoration process, such as: create lips, eye, nose and teeth.
Injection Molding	:	The shaping of rubber or plastic articles by injecting heated material into a mold.
LOR	:	Light out rotocast is process with automation in making head
MAOH	:	Stand for Material Overhead. Material overhead is such of mark up of material cost.
Painting	:	A painting is an image (artwork) created using pigments (color) on a surface (ground) such as resin for doll. The pigment may be in a wet form, such as paint, or a dry form, such as pastels. Painting can also be a verb, the action of creating such an artwork
Rotocast	:	Process for making doll head. is a method for forming thermoplastic resins where the molten material solidifies in and conforms to the shape of the inner surface of a heated, rapidly rotating container
Torso Assembly	:	In this stage all torso parts will be assemble became one complete toy.

CHAPTER 1
INTRODUCTION

1.1 Problem background

Fulfilling demand is one of requirement from successful company, but one of consideration for fulfilling demand is budgeting production in order to control the expenses and to determine how much profit will be. The production should be running on budget and it must be stable. So that the budget will be analyzed by the engineers to breakdown cost before it's committed.

XY Inc. is world's top toy manufacturing company, which has grown rapidly. As top manufacturer demand of toy in XY Inc. is increasing day by day, to satisfy all the demand around the world, XY Inc. has subsidiaries around the world which produces the toys and distributes it around the world. Since 2019, around more than a thousand of toy will be produce.

Because a lot of variance of product and high demand month by month, the production has no stop in producing. Before it, there is phase called product development. In product development processes affects much about how production will run then. The problem in costing when development phase is cost engineering should make estimation cost and it becomes based for production whether plant will get saving or lost. Because the first cost or budget have to be done before production running, it's hard to make estimation cost with high accuracy. This research will find the solution for most contributed reason due to make a budgeting cost in order to estimated the cost and make a plant saving for future production. Overall the PDCA method is implemented in order to solve the simulation(budgeting) production cost. The result of solution will be used for future costing planning in order to know the fastest and accuracy method to make it.

1.2 Problem Statement

This research is done to answer these following questions:

1. How the budgeting is managed by cost engineering department?
2. What is the proper method as solution to make an accurate budget production cost?
3. What is the result of implementation of solution?

1.3 Objectives

There are several objectives that need to be achieved which are:

1. Identify the rule and flow how cost engineering department managed the budgeting cost.
2. Develop a method how to make the budget production cost with accuracy.
3. Analyze the result of implementation solution.

1.4 Scopes

Due to the limited time and resources in doing this research, there will be some scopes in this observation:

1. The research is done in cost engineering department
2. The data of budget cost is for 2019 final and 2020 initial rate.
3. The data and results are from DIJ process

This research implementation of improvement will be used starts from July 2019.

1.5 Assumptions

The assumptions from this research are:

1. Scrap and markup are not considered.
2. The situation of company is stable.

1.6 Research Outline

Chapter I	**Introduction** This chapter consists of problem background of the project, problem statement, objectives of the project, scopes, assumptions and research outline.
Chapter II	**Literature Study** This chapter delivers the explanation of previous study of Cost Engineering and PDCA theory method.
Chapter III	**Research Methodology** This chapter consists of the flow of project that is carried out by the researcher.
Chapter IV	**Company Profile and Project** This chapter consists the explanation about the company's history, vision, mission, organizational structure and products of the company.
Chapter V	**Data Collection and Analysis** This chapter consists of all the data gathered from observation. The researcher will explain more detailed analysis to support finding a solution.
Chapter VI	**Conclusion and Recommendation** This chapter delivers the conclusion of analysis data that support the research. Recommendation for future research is also delivered.

CHAPTER II
LITERATURE STUDY

2.1 Cost Engineering

Cost engineering is a combination of cost and engineering, with the main purpose of this department is to set standard cost of every material and labor hours that being used to develop toys. Beside the main purpose, this department also has their own goal, that is to create standard cost that is the same with the budgeted one, or even lower than the budgeted one.

In specific Cost can be divided into two:

- Overhead: such as water, electricity, etc.
- Direct Cost: direct cost can be classified into two, they are:
    - Labor means how much time (hours) needed in doing the process of developing or manufacturing toys. There are two kind of hours they are machine hours and labor hours.
    - Material means goods that being used in the developing or manufacturing process. One way to maintain efficiency of material usage is to minimize scrap and shrinkage.

The explanation below will be shown what kind of stuff will be related in cost engineering in order to make budgeting cost in development process:

- Information such as Target Ex-factory
- Product Model 3D
- Product definition
- Purchased items
- Packaging
- Soft goods, etc.

From data above, the elaboration will result four kind of cost which is: basic cost, ex-factory cost, hard cost and product cost. So, the first cost is the first step which is making a budgeting and it’s in this phase.

2.2 PDCA Method

(Kholif, Hassan, Khorshid, Elsherpieny, & Olafadehan, 2018) Plan Do Check Act (PDCA) is an iterative four-step management method used in business processes for control and continuous improvement of processes and products The PDCA Cycle is a systematic series of steps for gaining valuable learning and knowledge for the continual improvement of a product or process. PDCA is an iterative four-step quality improvement and productivity improvement process typically used for the better of the business strategy. (AnupamaPrashar, 2017) PDCA is a successive cycle which starts off small to test potential effects on processes, but then gradually leads to larger and more targeted change. Though the method is applicable to process, business and organization as generally utilized by the industry, but this is an attempt to try and adopt the same at an individual level to bring productivity improvement in individuals which will trigger an improvement in process and quality for the organization at a bigger level. How this method would help an individual to become more accountable which will ultimately enable a group, a product line and an organization to be able to make a difference in improving the overall quality. The method tries to bring in changes to the traditional ways how an individual does an activity and with few improvements, the overall productivity can be increased that will ultimately benefit the organization. (AnupamaPrashar, 2017) The four phases contained in the PDCA are:

2.2.1 Plan

Identifying and Analyzing problems. The purpose of this phase is to investigate the current situation, fully understand the nature of any problem to be solved, and to develop potential solution to the problem that will be tested.

1. Identify and prioritize quality improvement opportunities: Usually a team will find that there are several problems, or quality improvement opportunities, that arise when programs or processes are investigated. A prioritization matrix may help in determining which one to select. Once the quality improvement opportunity has been decided, articulate a problem statement. Revisit and, as appropriate, revise the problem statement as one move through the planning process.

2. Develop an AIM statement: that answers the following questions: a. What one is seeking to accomplish? b. Who is the target audience? c. What is the specific, numeric measure(s) the company is seeking to achieve? d. The measurable improvement objective is a key component of the entire quality improvement process. It's critical to quantify the improvement you are seeking to achieve. Moreover, the entire aim statement also will need to be revisited and refined as you move through the planning phase.

3. Describe the current process: Surrounding the problem in order to understand the process and identify areas for improvements. Flow charts and value stream mapping are two examples of methods to accomplish this.

4. Collect data on the current process: Baseline data that describe the current state are critical to further understanding the process and establishing a foundation for measuring improvements. A host of tools are available to collect and interpret data on the process, such as Pareto charts, histograms, run charts, scatter plots and control charts. The data collected must be aligned with the measures listed in the aim statement.

5. Identify all possible causes of the problem and determine the root cause. While numerous causes will emerge when examining the quality improvement opportunity, it is critical to delve in and carefully identify the underlying, or root cause of the problem, in order to ensure that an improvement or intervention with the greatest chance of success is selected. Brainstorming is a useful way to identify possible causes and a cause and effect/fishbone diagram and the 5 Whys are useful for determining the actual root cause.

6. Identify potential improvements to address the root cause, and agree on which one to test. Once the improvement has been determined, carefully consider any unintended consequences that may emerge as a result of the implementing improvement. This step provides an opportunity to alter the improvement and/or develop counter measures as needed to address any potential unintended consequences. Revisiting the aim statement and revising the measurable improvement objectives are important steps at this point.

7. Develop an improvement theory. An improvement theory is a statement that articulates the effect that you expect the improvement to have on the problem. Writing an improvement theory crystallizes what you expect to achieve as a result of your intervention and documents the connection between the improvement you plan to test and the measurable improvement objective.

8. Develop an action plan indicating what needs to be done, who is responsible, and when it should be completed. The details of this plan should include all aspects of the method to test the improvements – what data will be collected, how frequently data are collected, who collects the data, how they are documented, the timeline, and how results will be analyzed.

2.2.2 Do

The purpose of this phase is to implement the action plan. 1. Implement the improvement. 2. Collect and document the data. 3. Document problems, unexpected observations, lessons learned, and knowledge gained. It's time to get hands-on, executing what was determined in the previous step:

- Practice the method
- Execute
- Make changes
- Don't need to strive for perfection, just look for what can be done in a practical way
- Measure and record the results

2.2.3 Check

This phase involves analyzing the effect of the intervention. Compare the new data to the baseline data to determine whether an improvement was achieved, and whether the measures in the aim statement were met. Pareto charts, histograms, run charts, scatter plots and control charts are all tools that can assist with this analysis.

1. Reflect on the analysis and consider any additional information that emerged as well. Compare the results of your test against the measurable objective.

2. Document lessons learned, knowledge gained, and any surprising results that emerged. It is one of the most important steps that define the PDCA concept cycle.

2.2.4 Act

This phase marks the culmination of the planning, testing, and analysis regarding whether the desired improvement was achieved as articulated in the aim statement, and the purpose is to act upon what has been learned. Options include:

1. Adopt: Standardize the improvement if the measurable objective in the aim statement has been met. This involves establishing a mechanism for those performing the new process to measure and monitor benchmarks on a regular basis to ensure that improvements are maintained. Run charts or control charts are two examples of tools to monitor performance.

2. Adapt: The team may decide to repeat the test, gather different data, revise the intervention, or otherwise adjust the test methodology. This might occur, for example, if enough data that can't be gathered, circumstances have changed (e.g., staffing, resources, policy, environment, etc.), or if the test results fell somewhat short of the measurable improvement goal. In this case, adapt the action plan as needed.

3. Abandon: If the changes made to the process did not result in an improvement, consider lessons learned from the initial test, and return to the ―Plan‖ phase. At this point the team might revisit potential solutions that were not initially selected or delve back into a root cause analysis to see if additional underlying causes can be uncovered, or even reconsider the aim statement to see if it's realistic. Whatever the starting point, the team will then need to engage in the Plan cycle to develop a new action plan and move through the remaining phases.

PDCA offers a data-based framework based on the scientific method. This simple yet powerful format drives continuous and ongoing efforts to achieve measurable improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality in services or processes which achieve equity and improve the manufacturing industry.

2.3 Fishbone Diagram

Fishbone or fishbone diagram is one method / tool in improving quality. Also, often this diagram is called the Cause effect diagram. The inventor was a Japanese scientist in the 60s. Named Dr. Kaoru Ishikawa, a scientist born in 1915 at Tikyo Japan who is also an alumnus of chemical engineering at the University of Tokyo. So, it is often also called the Ishikawa diagram. The method was initially used more for quality management. Which uses verbal (non-numerical) data or qualitative data. Dr. Ishikawa was also suspected as the first person to introduce 7 quality control tools or methods (7 tools). Namely fishbone diagrams, control charts, run charts, histograms, scatter diagrams, pareto charts, and flowcharts.

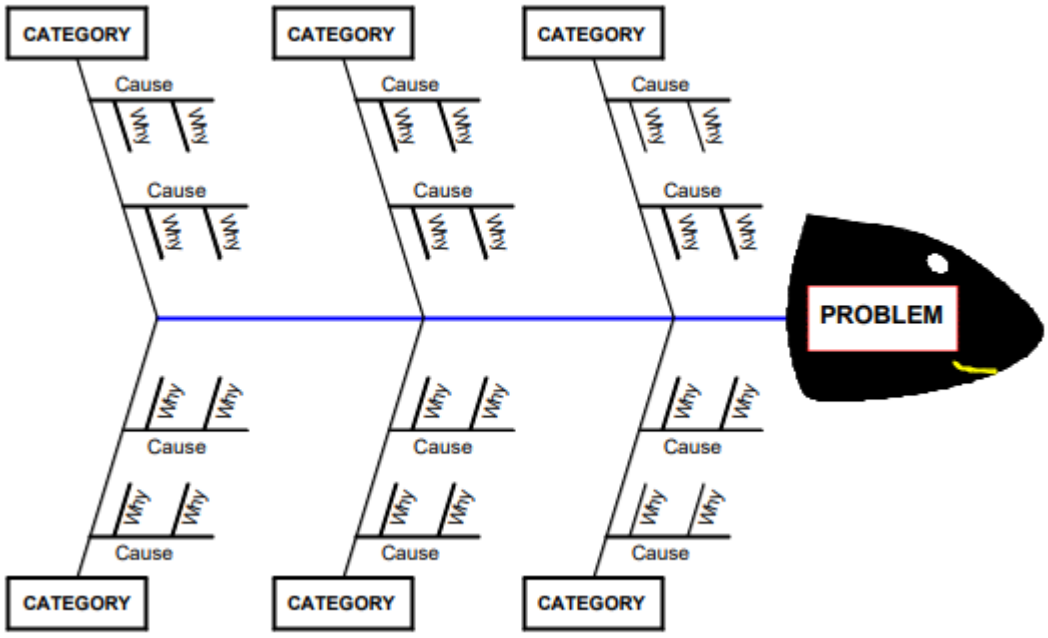


Figure 2. 1 Example of Fishbone Diagram Template

(Application of Quantitative Fishbone Diagram for Investigation of Erosion Defect in CI Casting Produced by Sand Casting Process, 2019) It is said the Fishbone Diagram because it is indeed shaped like a fish bone that has a muzzle facing its right head. This diagram will show an impact or a result of a problem, with various causes. The effect or effect is written as the muzzle of the head. Whereas fish bones are filled with causes according to the approach of the problem. Cause and Effect diagrams are said because

the diagram shows the relationship between cause and effect. Regarding statistical process control, causal diagrams are used to show the causal factors (causes) and quality characteristics (effects) caused by the causal factors.

With this Fishbone diagram gives a lot of advantages for the business world. In addition to solving quality problems that are important concerns of the company. Other classic problems were also resolved. Classical problems that exist in the manufacturing industry especially include: a) delays in the production process, b) the level of product defects (high defects), c) production machines that often experience trouble, d) unstable production line output that results chaotic production plan, e) productivity that does not reach the target, f) complaints from customers who keep repeating.

(Coccia, 2017) However, basically Fishbone diagrams can be used for the following needs: a) Helps identify the root causes of a problem, b) Helps generate ideas for solutions to a problem, c) Helps in further investigation or fact finding, d) Identifies action (how) to create desired results, e) Discuss issues in a complete and neat manner, f) Produce new thoughts. So, the discovery of the Fishbone diagram makes it easy and an important part of solving problems that arise for the company. The application of Fishbone diagrams can help us to be able to find the root of the "causes" of problems, especially in manufacturing industries where the process is famous for the large variety of variables that have the potential to cause problems. If "problems" and "causes" are known with certainty, then corrective actions and steps will be easier to do. With this diagram, everything becomes clearer and allows us to be able to see all possible "causes" and look for the "root" of the real problem

CHAPTER III
RESEARCH METHODOLOGY

This chapter consists of procedure and the phases of the entire process in completing this research. The flow process in this chapter will become a guidance.

3.1 Research Framework

In general, the whole research is visually summed up through a brief framework.

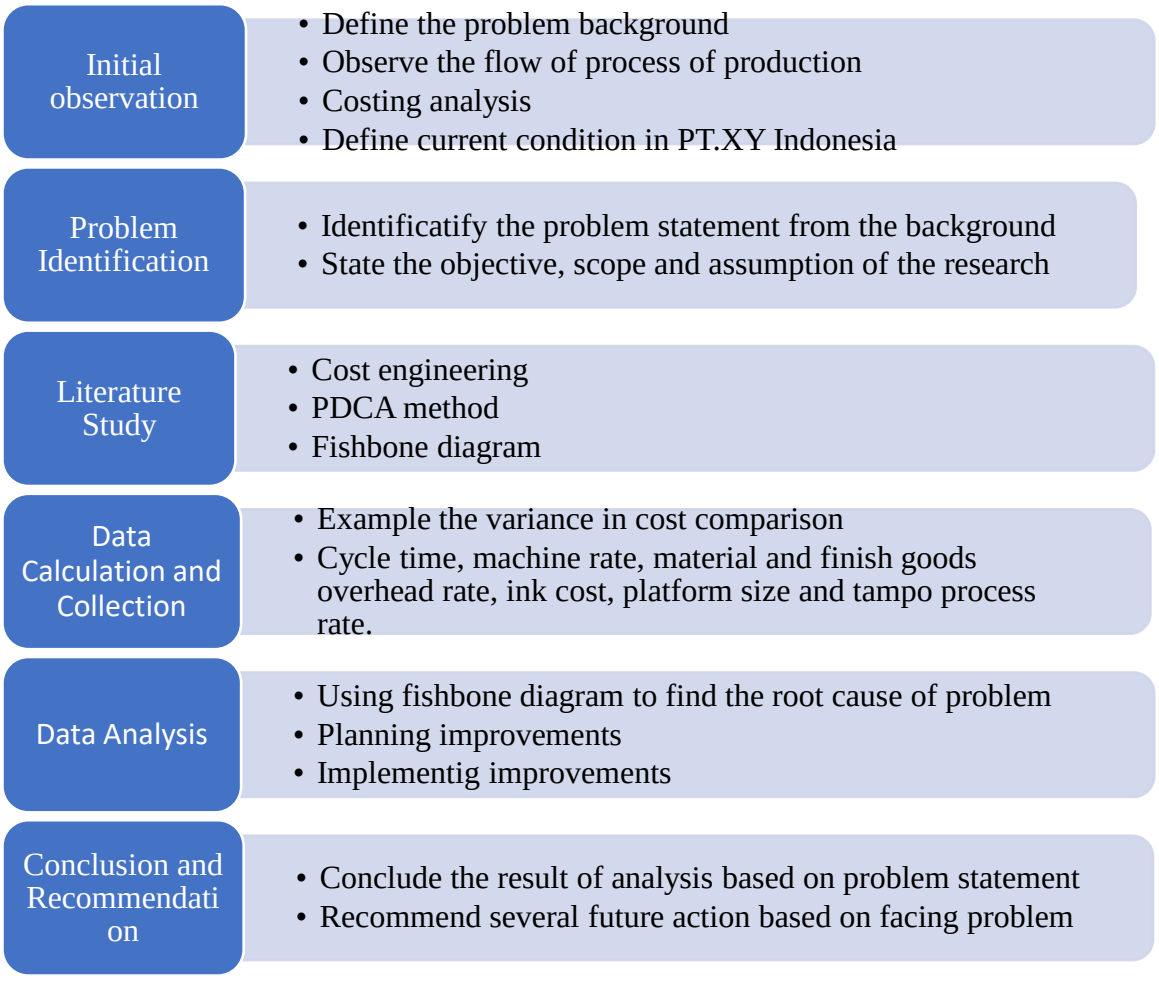


Figure 3. 1 Research Framework

3.2 Theoretical Framework

This chapter consists of procedure and the phases of the entire process in completing this research. The flow process in this chapter will become a guidance.

3.2.1 Initial Observation

The first thing to do in this research is initial observation. Intial observation is done to identify the problem. The observation was done by analyzing the historical data of cost comparison calculation from April 2019 until July 2019. The current condition of company has explained briefly in previous chapter in order to make reader understand. In this phase, data historical of cost comparison calculation started to observe. Not only cost comparison but observe the flow of production process.

3.2.2 Problem Identification

Identifying problem in the beginning of the research is the important aspect so that the accurate research could be done. The problem is carried out based on the initial observation. In inital observation the problem was work system in cost engineering department.

The research focused on identifying and analyzing the problem which has much impact to the working system in cost engineering department. The problem should be observe because it affects the future result of cost analysis. The mess of this problem can affect the currently income and future income to the company. Furthermore, the objectives of research are constructed in order to keep the research on track:

- Identify the source of the problem, the interview was done to know the location of problem.
- Determine the most rational and worst problem that can be solved.
- Determine the proper method to do improvement.
- Define the solution to determine working system problem.
- Propose the solutions to company, implement it and see the result.

After identifying problem of the research, the objective, scope and assumptions can be determined. The scopes are the historical data from April 2019 until July 2019, and implementation will be starts from August 2019. The assumptions will be the scarp is not considered and company in good condition.

3.2.3 Literature Study

Literature study is needed as the basic theory of this research. Sources of literature are taken from several books, journals, and websites. Theories used include:

- Definition of cost engineering
- PDCA method
- Fishbone diagram

3.2.4 Data Collection Analysis

3.2.4.1 Data gathering and analysis

After the data and observation results collected, the further data analysis is conducted, which are:

- The observation of the process of making first cost, CR cost and FPR cost.
- The process of making those simulation cost.
- The interview result analysis. Not all of result from resource can be used in this research, for the example for carryover toy because it has been producing in previous period.
- Cycle time, machine rate, finish goods add-on, material overhead, ink cost, platform size, and tampo rate process in concern machine area

3.1.4.2 Data tabulation

After data collection is finished, as this research using PDCA Cycle, the data that collected for this research are the company background, cycle time, machine rate, finish goods add-on, material overhead, ink cost, platform size, and tampo rate process. The data that has been collected and calculated will be used for further action which are

analysis and improvement. Data calculation conducted base on business process improvement methodology.

3.2.5 Conclusion and Recommendation

The final step of the research is to draw the conclusion from the data calculation and analysis result obtained to achieve the research's objectives. Recommendation will be constructed after the conclusion is done. The recommendation can be used for next observation that will be constructed (with similar topic), so the improvement of observation can be done.

CHAPTER IV
COMPANY PROFILE AND PROJECT

4.1 Company Profile

4.1.1 History

PT XY Indonesia is subsidiary company from XY Inc. which is at United States as the center. PT XY was established on 1992. The business field of PT. XY Indonesia is doll fashion, especially concern for B doll and the doll will be distributed around the world. PT. XY has two plant which located on Jababeka Industrial Estate, Cikarang, Bekasi and has employees total around 4000-13,000 every year.

XY Inc is a private company at United States that as a pioneer of child's toy business. The company was found in 1945 by EH and HM with headquarters in El Segundo, California. Due to poor health, HM sold his share to EH. Then EH took RH, his wife to replace HM position. With low experience and capital in the business, a virtual toyless after World War II give them unique opportunity and the company was off to a winning start in their first year with the nett profit $30,000. A miniature of plastic ukulele is the first hit product of XY Creation in 1947 followed by an all-plastic piano with raised black keys in 1948. At the same time, the company began developing a music box employing a unique mechanism and beat their Swiss competition.

In 1955 the company introduced another hit named BG and decided to sponsor a 15-minute segment of Walt *Disney's Mickey Mouse Club and began a marketing revolution in the toy industry.* In 1957 the company, exploiting the popularity of television westerns, introduced toy replicas of classic western guns and holsters. In 1959, B doll was debuted and become the best-selling toy in the history. Inspired by her daughter, RH designed a teenage fashion doll and the result become a famous. The name of B doll was adopted from the nickname of their daughter. An official fan club was built across the US with a total membership 1,500 million by 1968. Soon after that RH become the president of E Inc. and get credits with the creation of B doll product line for the company. In 1961 the boyfriend of B doll was introduced named K doll

which adopted from their son's name. In 1963 the company was listed in the New York Stock Exchange. Throughout the 1960s the company continued to introduce popular toys such as the first walking dolls and a live-action dolls. By the end of decade, the company become the world's number one toy maker. In 1980 EH and RH end their involvement in the company because of financial issues and misleading financial reports at the time. RH then start a new business that produce a prosthetic breast for mastectomy patients. Nevertheless, XY Inc. always be the front runner in the toy industry and grow by creating various new innovative product.

4.1.2 Business Operations of PT. XY Indonesia

PT. XY Indonesia is one of the subsidiaries of XY Inc. that produces fashion dolls, HW car, and B doll. PT. XY Indonesia established in October 1991. It is located 50 km from Jakarta. Right now, PT. XY Indonesia has two plants, which are:

- West Plant (Plant I):

West plant is the first plant was built in Indonesia and it started the production activity in June 1992. The area of West Plant is 48.000 m2 and located in Jababeka 1 - Industrial Estate Cikarang. This plant is used for HW car toy.

- East Plant (Plant II)

East Plant is the second plant was built in September 1996 and it started the production activity in October 1997. The total area of East Plant is 77.500 m2 and located at Jababeka 2 – Industrial Estate Cikarang. This plant is concentrated for the production of dolls and management activities.

4.1.3 Company Vision and Mission

As one of the biggest toy manufacturers in the world, XY Inc. has purpose, promise and values, such as:

Purpose

We inspire wonder in the next generation to shape a brighter tomorrow.

Promise

We create the experiences that capture kids' hearts, open their minds and unlock their potential through play.

Values

- **W**hat if? Why not?
    - Challenge the status quo and let kids inspire endless creativity
- **O**ne team
    - Have fun and win together
- **N**imble
    - Embrace speed and agility
- **D**riven
    - Be tenacious in achieving bold goals
- **E**ntrepreneurial
    - Take ownership and channel inner your inner garage spirit
- **R**espectful
    - Celebrate every voice, everywhere, and commit to unwavering integrity

4.1.4 Organizational structure

PT. XY Indonesia has several departments. There are Fashion Dolls Manufacturing, Die Cast Manufacturing, Finance & IT, Human Resources, Materials & Lean, Quality, Engineering, EHS & Compliance Assurance. The figure below is the organization structure of PT. XY Indonesia, the highest position is GM VP or President Director of PT. XY Indonesia. Cost engineering is under manufacturing fashion dolls senior director

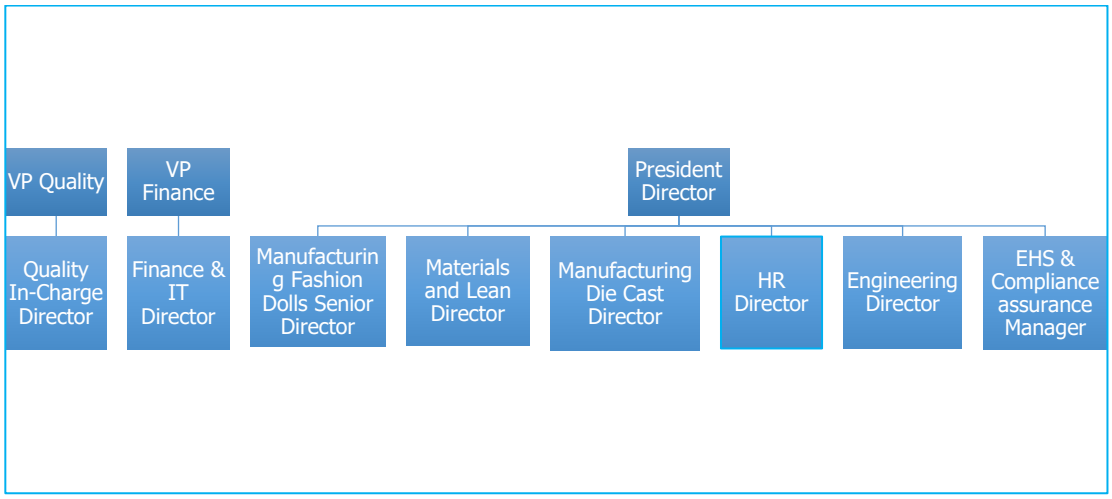


Figure 4. 1 General Organization Structure of PT. XY Indonesia

4.2 Production System

4.2.1 Production Process

The activities in PT. XY Indonesia are the processes manufacturing in production area, these processes are classified into primary process and secondary process. Primary process contains Rotocast, Injection Molding, Painting, and Torso Assembly. This process relates with the process of raw material into work in process. Secondary process contains Die Cut, Sewing, Rooting, Grooming and Pack Out. This relates with the process into final products. The flow process can be seen in the Figure below:

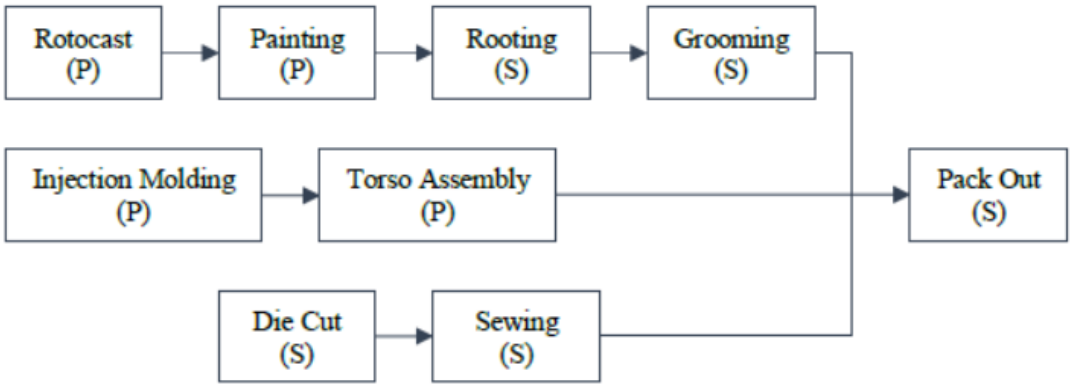


Figure 4. 2 PT. XY Indonesia Production Floor

The main parts breakdown is body, head, hair and fabric/soft good. The explanation about those 4 (four) parts will be shown below.

1. Head

   In this process of forming the head of toy using a process called Rotocast and LOR. The difference between these two processes is only the way in which is light out Rotocast has used automation more than Rotocast process. Basically, this process heats the plastisol until with a specific temperature and changes it in form of fluid. Before infusing the fluid plastisol to the form head, shape should be tidied up first by shooting the compressed air firearm. The fluid plastisol then infused to the form. The shape is put into the machine to solidify the plastisol. After the head is shaped and the temperature turn into normal the head will be taken using pliers. After head has its shape, the next process called HDP.

2. Hair

   For hair process there are two main processes which are rooting and grooming. Rooting is process adding hair on head, almost of this rooting process using auto rooting. For grooming process is managing the hair, starts from comb the hair until bride the hair if it's needed. The additional process such as curling is used when the engineer decides to make curly hair design.

3. Body

   Material used for body is resin. The colorant will be added in this process to determine the color of toy itself. Material will be processed in injection molding process. The material will be heated until it changes become liquid then inject to the mold. After all component of torso is completed, torso is going to assemble using glue and connector. After body and head have done, they will be assembled.

4. Soft good/ fabric

   In making soft good there are two main processes which is cutting and sewing. For cutting there are die cutting and laser cutting. And for sewing there are machine sewing and hand sewing. After soft good has been cut and sewn, there will be hand finishing.

5. Packout

   All parts will be assembled in pack out line area. The toy must be packaged into individual packaging and put it into master carton. All part will be assembled in pack out line area.

4.3 Projects

As the cost engineer, during 5 months of internship the intern is expected to give an improvement for the company. There are several projects assigned to the author during this internship program. The projects are:

- Plant costing: in plant costing project, I assigned to control the production cost when the product is started. Doing cost comparison, rolling up, maintaining cost, and breaking down cost.
- Updating databased of new and carryover toy.
- Checking databased hours for making weekly report.
- Making system with VBA macro in excel for generating the labor needed based on the latest update in PT. XY Indonesia AS400. Also providing system for collect and summarize material and labor hours.

CHAPTER V
DATA COLLECTION AND ANALYSIS

5.1 Data Collection

In this chapter, the analysis of business process is conducted in cost engineering department. Looking for problems and their causes and suggesting improvements. The process of analysis used, and the proposed improvement is given based on the data collection.

In DIJ process is used in painting 3 (three) kind of parts such as: others/ accessories, painted head and painted head millie. The machines used for this process which is A3 and A2 tray with 2 type of passes such as 8 and 16 passes. There are several data collected such as: rate of machines, ink cost, overhead rate, etc. the summarize of data is show below.

Table 5.1 Table of Data Cycle Time of DIJ Process

Passes	CT (min)	Information
16	12.32	A3
16	14.50	A2
8	9.60	A2 painted head

Table 5.2 Machine Rate of DIJ Process

Rate DIJ Process	
2019 final	$5.588
2020 initial	$5.699

Table 5.3 Table of Material and Finish Goods Overhead Rate

	MAOH	FGAO
2019 final	7.102%	4.453%
2020 initial	7.102%	4.453%

Table 5.4 Table of Ink Cost

INK COST	Accessories	Painted head
2019 final	$ 0.191	$ 0.111
2020 initial	$ 0.195	$ 0.113

Table 5.5 Table of Platform Size

Platform Size		
MIMAKI UJF-3042-(A3 size)	300	420
MIMAKI UJF-6042-(A2 size)	600	420

Table 5.6 Table of Tampo Rate Process

Rate Tampo Process	
2019 final	$ 3.461
2020 initial	$ 3.530

There are several conditions for DIJ process, those things are:

- For others/ accessories use machine with tray for A3 and A2 with 16 pass
- For painted head and painted head millie just use tray A2 with 8 pass
- Assuming formula for total part/ tray is A2=2A3, size is all for printing there's no spaces
- Calculation for painted head non millie is followed A2 accessories

5.2 Data Analysis and Improvement

After getting the data from other department, the next step is to develop the right solution to solve the above problem. Do, Check, and Act are the next steps to process data and further develop potential solutions. Below is flow step of this applied PDCA method.

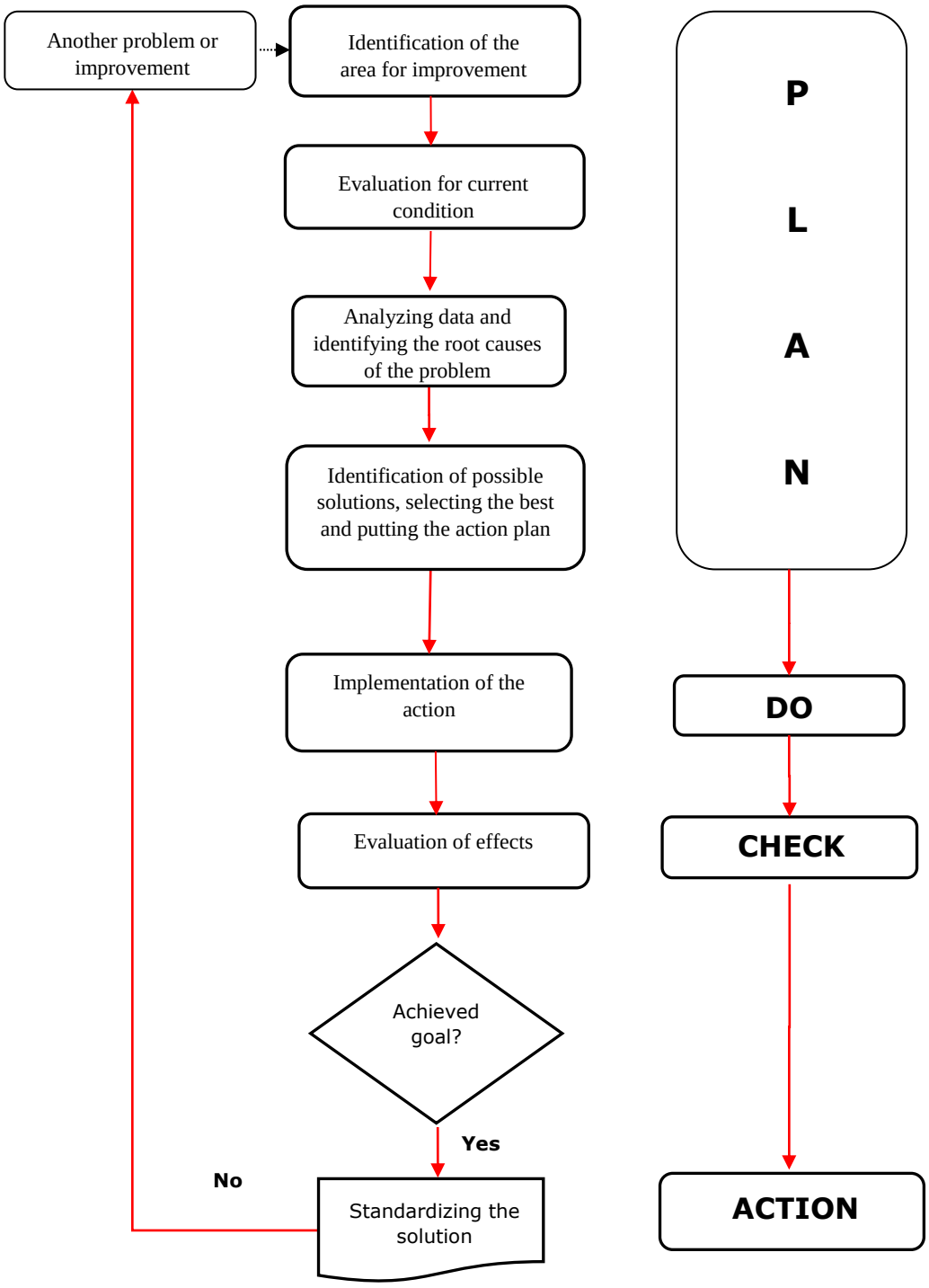


Figure 5. 1 Steps in PDCA Method

In plan phase, which there are several objects to be observed for evaluating the current condition. Such as: data collection, selection of critical problem, defining the reason of improvement, and evaluating the effectiveness and efficiency of current process condition. Besides in plan phase, there are several concerns in checking phase. Such as: collection of data after applying the improvement, analyzing data after improvement, evaluating the effectiveness and efficiency after improvement process condition, the last is comparing result between before and after improvement.

5.2.1 Plan

Identifying problem and analyzing the problems. Based on data, there's target and budget cost. This budget cost will determine how the product will be produced in production line. After committed the budget cost cannot be changed, so that if the expenses are higher than budget cost, plant should cost itself means loss. And if the budget cost is higher than target while it can be used as a plat saving. In fact, the budget is excessive because the basic of budget cost is estimating.

Develop and Testing the potential solution: first step to solve the problem is by find the root of the problem with fishbone diagram. Fishbone diagram can help to identify the significant factors which give effects toward an event. It can be seen from the figure below. There are 4 majors cause inaccurate budget cost

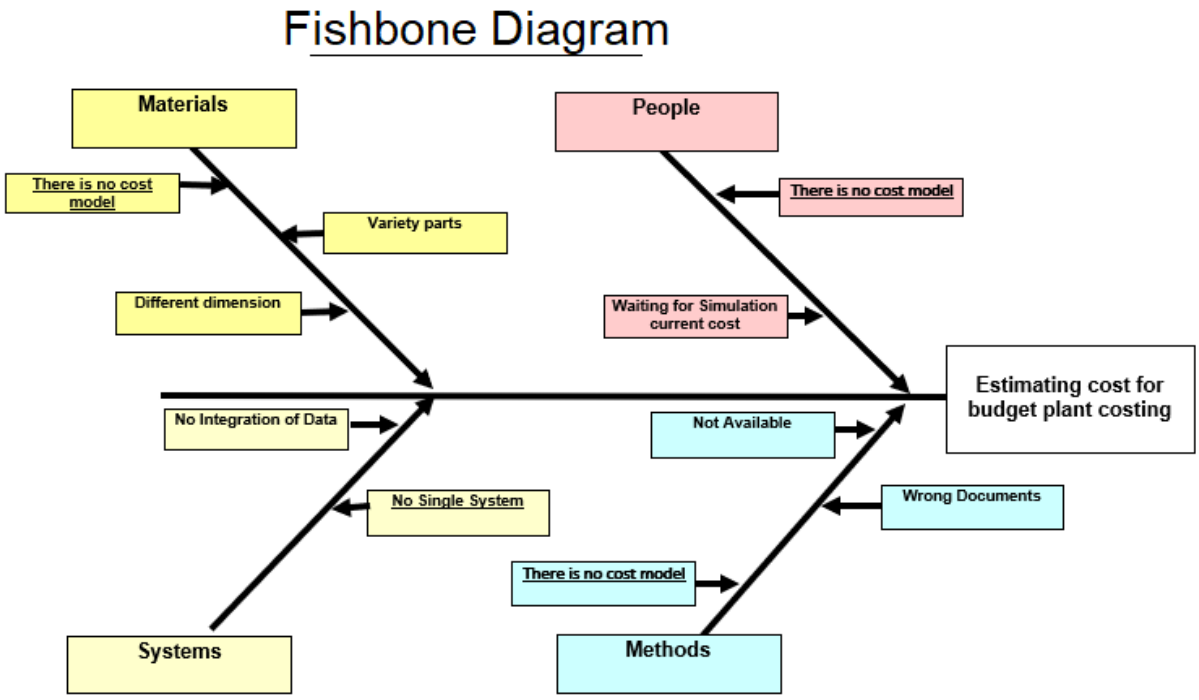


Figure 5.1 Fishbone Diagram of Estimating Cost for Budget Plant Costing

After making a fishbone, the root causes of estimating cost for budget plant costing can be shown clearly. The conclusion in this phase is to get the root causes problem to find and choose the proper solutions to solve it. Based on fishbone the solution is to create a new cost model and new system to avoid wrong estimation cost and get shorten process to do estimating cost. Table 5.9 is an explanation of fishbone on Figure 5.1.

Table 5. 1 Fishbone Diagram Explanation

Problem	Cause Categories	Why 1	Why 2	Why 3	Summary
Estimating cost for budget plant costing	People/ Man	Waiting for simulation current cost	There is no cost model		Make a new cost model for speeding process.
	Materials	Different Dimension	Variety parts	There is no cost model	Make a new cost model that can be used for variety parts.

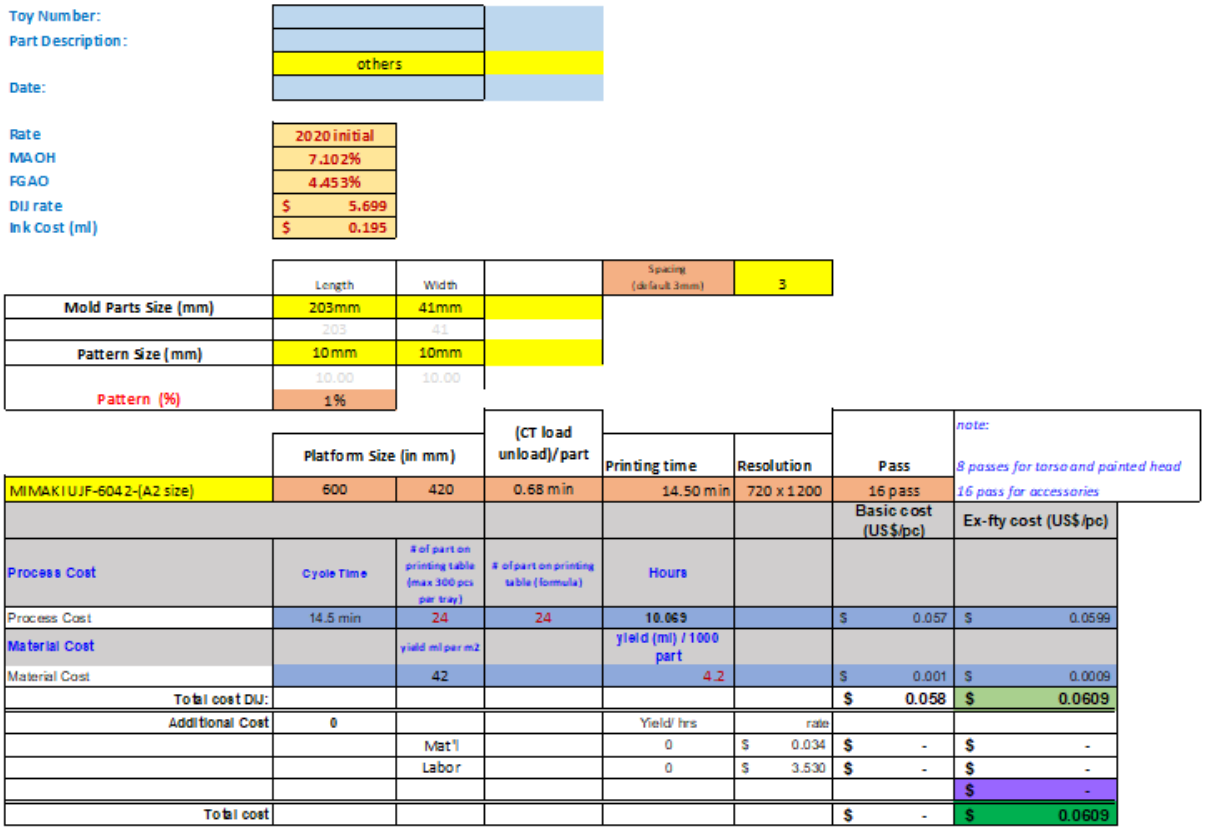
	Systems	No integration	No single systems		Make a new system as a based.
	Methods	Unavailable	Wrong documents	There is no cost model	Make a new cost model as a fixed method.

5.2.2 Do

Measure how effective the solution is and analyze whether cost model is enough accurate or not. Making a cost model with several requirement, specification and assumption. And at the final the temporary fixed data:

- In DIJ process only focus on accessories and painted head (millie and non-millie).
- Tray A2 only use for painted head while accessory is both either A2 or A3.
- For painted head there is additional cost which is tampo crown.

The result of cost model is shown below.



Toy Number:		
Part Description:		
	others	
Date:		

Rate	2020 initial
MAOH	7.102%
FGAO	4.453%
DIJ rate	$ 5.699
Ink Cost (ml)	$ 0.195

	Length	Width		Spacing (default 3mm)	3
Mold Parts Size (mm)	203mm	41mm			
	203	41			
Pattern Size (mm)	10mm	10mm			
	10.00	10.00			
Pattern (%)	1%				

	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-6042-(A2 size)	600	420	0.68 min	14.50 min	720 x 1200	16 pass	8 passes for torso and painted head 16 pass for accessories
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	14.5 min	24	24	10.069		$ 0.057	$ 0.0599
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		4.2		$ 0.001	$ 0.0009
Total cost DIJ:						$ 0.058	$ 0.0609
Additional Cost	0			Yield/ hrs	rate		
		Mat'l		0	$ 0.034	$ -	$ -
		Labor		0	$ 3.530	$ -	$ -
							$ -
Total cost						$ -	$ 0.0609

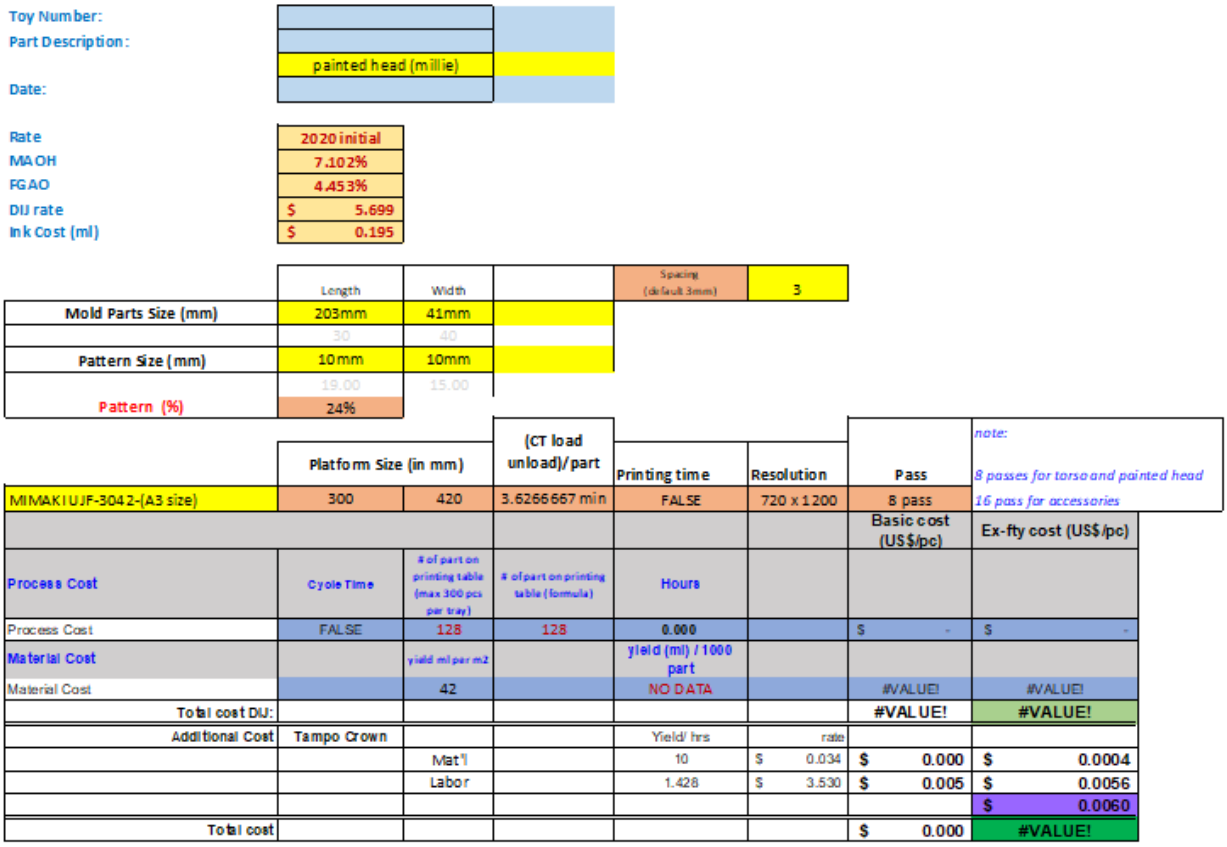
Figure 5.2 Result of "others" with A2 Size

In figure 5.2, the condition in 2020 initial rate the product and category others with those dimension needs cost in amount of $0.0609. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. There is no additional cost from tampo crown because tampo crown just for head category.

Toy Number:							
Part Description:							
	others						
Date:							
Rate	2020 initial						
MAOH	7.102%						
FGAO	4.453%						
DIJ rate	$ 5.699						
Ink Cost (ml)	$ 0.195						
	Length	Width		Spacing (default 3mm)	3		
Mold Parts Size (mm)	203mm	41mm					
	203	41					
Pattern Size (mm)	10mm	10mm					
	10.00	10.00					
Pattern (%)	1%						
	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-3042-(A3 size)	300	420	0.34 min	12.32 min	720 x 1200	16 pass	8 passes for torso and painted head 16 pass for accessories
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	12.32 min	12	12	17.111		$ 0.098	$ 0.1019
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		4.2		$ 0.001	$ 0.0009
Total cost DIJ:						$ 0.098	$ 0.1028
Additional Cost	0			Yield/ hrs	rate		
		Mat'l		0	$ 0.034	$ -	$ -
		Labor		0	$ 3.530	$ -	$ -
							$ -
Total cost						$ -	$ 0.1028

Figure 5.3 Result of "others" with A3 Size

In figure 5.3, the condition in 2020 initial rate the product and category others with those dimension needs cost in amount of $0.1028. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. There is no additional cost from tampo crown because tampo crown just for head category.



Toy Number:							
Part Description:	painted head (millie)						
Date:							
Rate	2020 initial						
MAOH	7.102%						
FGAO	4.453%						
DIJ rate	$ 5.699						
Ink Cost (ml)	$ 0.195						
	Length	Width		Spacing (default 3mm)	3		
Mold Parts Size (mm)	203mm	41mm					
	30	40					
Pattern Size (mm)	10mm	10mm					
	19.00	15.00					
Pattern (%)	24%						
	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-3042-(A3 size)	300	420	3.6266667 min	FALSE	720 x 1200	8 pass	8 passes for torso and painted head
							16 pass for accessories
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	FALSE	128	128	0.000		$ -	$ -
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		NO DATA		#VALUE!	#VALUE!
Total cost DIJ:						#VALUE!	#VALUE!
Additional Cost	Tampo Crown			Yield/ hrs	rate		
		Mat'l		10	$ 0.034	$ 0.000	$ 0.0004
		Labor		1.428	$ 3.530	$ 0.005	$ 0.0056
							$ 0.0060
Total cost						$ 0.000	#VALUE!

Figure 5.4 Result of "painted head (millie)" with A3 Size

In figure 5.4, the condition in 2020 initial rate the product and category others with those dimension needs cost zero or in the other side error. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. The result is error because there is no process for A3 size for painted head millie.

Toy Number:							
Part Description:	painted head (millie)						
Date:							
Rate	2020 initial						
MAOH	7.102%						
FGAO	4.453%						
DIJ rate	$ 5.699						
Ink Cost (ml)	$ 0.195						
	Length	Width		Spacing (default 3mm)	3		
Mold Parts Size (mm)	203mm	41mm					
	30	40					
Pattern Size (mm)	10mm	10mm					
	19.00	15.00					
Pattern (%)	24%						
	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-6042-(A2 size)	600	420	3.6266667 min	9.60 min	720 x 1200	8 pass	8 passes for torso and painted head 16 pass for accessories
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	9.6 min	128	128	1.250		$ 0.007	$ 0.0074
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		12.0		$ 0.002	$ 0.0026
Total cost DIJ:						$ 0.009	$ 0.0100
Additional Cost	Tampo Crown			Yield/ hrs	rate		
		Mat'l		10	$ 0.034	$ 0.000	$ 0.0004
		Labor		1.428	$ 3.530	$ 0.005	$ 0.0056
							$ 0.0060
Total cost						$ 0.000	$ 0.0160

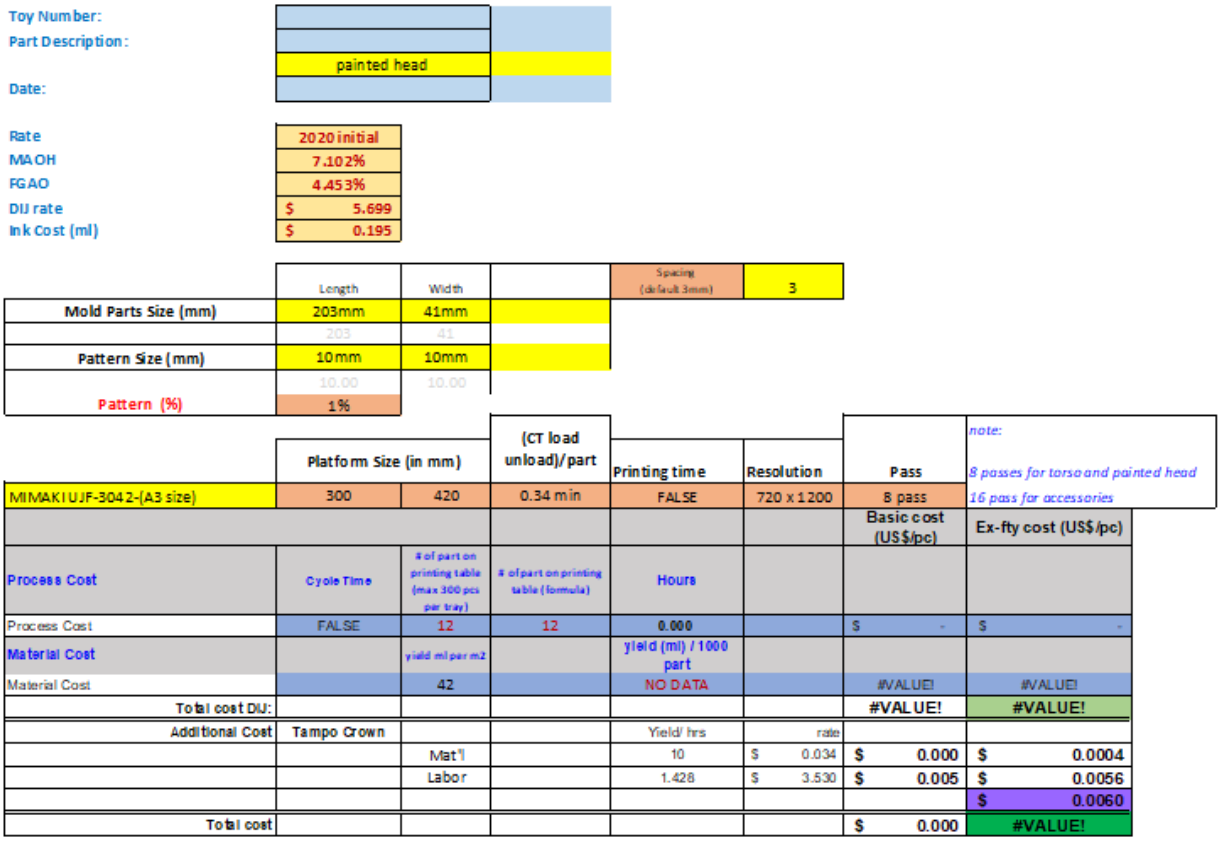
Figure 5.5 Result of "painted head (millie)" with A2 Size

In figure 5.5, the condition in 2020 initial rate the product and category others with those dimension needs cost in amount of $0.0160. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. There is additional cost from tampo crown because tampo crown needed for head category.

Toy Number:							
Part Description:	painted head						
Date:							
Rate	2020 initial						
MAOH	7.102%						
FGAO	4.453%						
DIJ rate	$ 5.699						
Ink Cost (ml)	$ 0.195						
	Length	Width		Spacing (default 3mm)	3		
Mold Parts Size (mm)	203mm	41mm					
	203	41					
Pattern Size (mm)	10mm	10mm					
	10.00	10.00					
Pattern (%)	1%						
	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-3042-(A3 size)	300	420	0.34 min	FALSE	720 x 1200	8 pass	8 passes for torso and painted head
						16 pass for accessories	
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	FALSE	12	12	0.000		$ -	$ -
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		NO DATA		#VALUE!	#VALUE!
Total cost DIJ:						#VALUE!	#VALUE!
Additional Cost	Tampo Crown			Yield/ hrs	rate		
		Mat'l		10	$ 0.034	$ 0.000	$ 0.0004
		Labor		1.428	$ 3.530	$ 0.005	$ 0.0056
							$ 0.0060
Total cost						$ 0.000	#VALUE!

Figure 5.6 Result of "painted head" with A3 Size

In figure 5.6, the condition in 2020 initial rate the product and category others with those dimension needs cost zero or in the other side error. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. The result is error because there is no process for A3 size for painted head.



Toy Number:							
Part Description:							
	painted head						
Date:							
Rate	2020 initial						
MAOH	7.102%						
FGAO	4.453%						
DIJ rate	$ 5.699						
Ink Cost (ml)	$ 0.195						
	Length	Width		Spacing (default 3mm)	3		
Mold Parts Size (mm)	203mm	41mm					
	203	41					
Pattern Size (mm)	10mm	10mm					
	10.00	10.00					
Pattern (%)	1%						
	Platform Size (in mm)		(CT load unload)/part	Printing time	Resolution	Pass	note:
MIMAKI UJF-3042-(A3 size)	300	420	0.34 min	FALSE	720 x 1200	8 pass	8 passes for torso and painted head
							16 pass for accessories
						Basic cost (US$/pc)	Ex-fty cost (US$/pc)
Process Cost	Cycle Time	# of part on printing table (max 300 pcs per tray)	# of part on printing table (formula)	Hours			
Process Cost	FALSE	12	12	0.000		$ -	$ -
Material Cost		yield ml per m2		yield (ml) / 1000 part			
Material Cost		42		NO DATA		#VALUE!	#VALUE!
Total cost DIJ:						#VALUE!	#VALUE!
Additional Cost	Tampo Crown			Yield/ hrs	rate		
		Mat'l		10	$ 0.034	$ 0.000	$ 0.0004
		Labor		1.428	$ 3.530	$ 0.005	$ 0.0056
							$ 0.0060
Total cost						$ 0.000	#VALUE!

Figure 5.7 Result of "painted head" with A3 Size

In figure 5.7, the condition in 2020 initial rate the product and category others with those dimension needs cost zero or in the other side error. the platform type will affect the size of platform and affect directly to the cycle time and hour needed to print all parts. The result is error because there is no process for A3 size for painted head.

For part "others" means accessories. Length and width are the dimension of part and the pattern size will affect the used yield. The rate will affect material overhead, FG overhead, machine rate, and ink cost. Platform size for A2 is 600x420 in mm. For printing time is known, CT load unload is assumption. For process cost, the cycle time will be based on cycle time load unload or printing time. If cycle time load unload > printing time, there is an additional time on tray so that the cycle time load unload will be used. On the other side, if cycle time load unload < printing time means load unload process can be done while printing so that printing time will be used.

There are several conditions for calculating number of parts on printing table, such as:

- If part is “painted head (millie)” then the number is constant which is 128 parts.
- If the part is “others’ then the calculation is
    - Choose the highest result of
        - $\frac{300}{length\ of\ molded\ size+spacing} \times \frac{420}{widht\ of\ molded\ size+spacing}$

        OR

        - $\frac{420}{length\ of\ molded\ size+spacing} \times \frac{300}{widht\ of\ molded\ size+spacing}$

        The formula above only applies for size A3, if the size is A2 the formula is 2 x A3’s calculation.
- For material cost, the formula is shown below
    - $\frac{length\ of\ pattern\ size}{1000} \times \frac{width\ of\ pattern\ size}{1000} \times yield\ ml\ per\ m^2 \times 1000$

      This formula applies for both of type whether painted head and others.
- For additional cost which is tampo crown only for painted head calculation
    - $Basic\ cost = yield \times rate$; yield and rate has been known

5.2.3 Check

Implementing a whole of improved solution in simulation to see whether the model is work with accurate or not. In this case the simulation using accessories which is cellphone and snowboard. The result of current situation of simulation is shown below.

Table 5.7 Result of Actual Output

Toy	**All Cellphone**	**Snowboard FXD83**
Qty/A2	640 pcs	24 pcs
Loading	1100 s	150 s
Print	870 s	827 s
Unloading	30 s	30 s
Output	1150 /jam	85 /jam
Hours	**0.868**	**11.765**

The criteria dimension of those accessories:

- Cellphone: 13 x 23 mm
- Snowboard: 203 x 41 mm

And the result of cost model calculation and actual simulation solution comparison is:

Table 5.8 Comparison between actual and Cost Model

	Actual		CM simulation	
Toy	**All Cellphone**	**Snowboard FXD83**	**All Cellphone**	**Snowboard FXD83**
Qty/A2	640 pcs	24 pcs	576 pcs	24 pcs
Loading	1100 s	150 s	-	-
Print	870 s	827 s	-	-
Unloading	30 s	30 s	-	-
Output	1150 /jam	85 /jam	-	-
Hours	**0.868**	**11.765**	**0.491**	**10.069**
CT 1 tray A2 (s)	**2003**	**1016**	**1017**	**870**

5.2.4 Act

After doing cost model trial, the result of comparison table above such as:

- Total of snowboard part in CM simulation already exactly same with the actual simulation situation
- Total of cellphone part in CM simulation is less than the actual simulation situation, possible reason after discussing is in actual the spacing is not 3 mm because the part is too small
- For snowboard hours approximately actual hours.
- CM is using printing time for calculating hours (notes: still considering load/unload with standard 1.7s per part).
- Assume there is no reject part
- For cell phone data hours still in checking process because the longest time in actual max is 1100s.

So based on the comparison result, the cost model can be used but still need improvement to approach the actual condition. Because there are several conditions that can’t applied in it, the proper assumption should meet the actual condition.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

PDCA method is used in this research and every step is follow to guide to the main root cause. The finding root cause is based to choose a right solution. In this case, following observation is done at PT. XY Indonesia. The main problem in cost engineering department in product development costing is hard to make estimation cost quickly and accurate. The solution is making a new cost model as a system and method. This cost model is assuming several actual conditions, such as:

- Scrap is not considered
- There is no machine break and downtime

The variance total produced part happened may cause of the actual terms and condition. For example, if the based material left over that can be reused for several part. So that, the number output becomes higher than total output by cost model. On the other side, if there is scrap the total output will be lower than expected output. So that, the total cost from cost model will be marked up in amount of 20% to cover it.

In the conclusion, based on the comparison result of total output of part number obviously approximate to the actual output. The difference can be caused of several actual condition that cannot be applied in cost model.

6.2 Recommendation

For recommendation future research, this cost model could determine the cost with other consideration. The scrap and markup will be shown directly then will make a cost analyst easier to determine the budget and costing. Zero loss for increasing profit also make a proper allowance so that the estimation cost will be planned well.

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APPENDIX

Description										Remarks
	Mat'l	Labor	Total	Mat'l	Labor	Total	Mat'l	Labor	Total	
	$ 0.215	$ 0.365	$ 0.580	$ 0.192	$ 0.342	$ 0.534	$ 0.023	$ 0.023	$ 0.045	
	$ 0.010	$ 0.026	$ 0.036	$ 0.023	$ 0.019	$ 0.042	$ (0.012)	$ 0.007	$ (0.006)	
	$ 0.162	$ 0.160	$ 0.322	$ 0.207	$ 0.130	$ 0.337	$ (0.045)	$ 0.031	$ (0.015)	(-) packg
Basic Cost	**$ 0.386**	**$ 0.551**	**$ 0.938**	**$ 0.421**	**$ 0.491**	**$ 0.913**	**$ (0.035)**	**$ 0.060**	**$ 0.025**	
X-Fact	**$ 0.432**	**$ 0.576**	**$ 1.008**	**$ 0.471**	**$ 0.513**	**$ 0.985**	**$ (0.039)**	**$ 0.062**	**$ 0.023**	

Figure A. 1 Example of Cost Comparison Summary

Description										Remarks
	Mat'l	Labor	Total	Mat'l	Labor	Total	Mat'l	Labor	Total	
	$ -	$ -	$ -	$ -	$ -	$ -	$0.000	$0.000	$0.000	
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	$ 0.213	$ 0.378	$ 0.591	$ 0.164	$ 0.368	$ 0.532	$ 0.049	$ 0.010	$ 0.060	
	$ 0.017	$ 0.030	$ 0.047	$ 0.045	$ 0.027	$ 0.072	$ (0.028)	$ 0.003	$ (0.025)	
	$ 0.165	$ 0.163	$ 0.328	$ 0.207	$ 0.129	$ 0.336	$ (0.042)	$ 0.034	$ (0.008)	
Basic Cost	**$ 0.395**	**$ 0.571**	**$ 0.966**	**$ 0.416**	**$ 0.524**	**$ 0.940**	**$ (0.021)**	**$ 0.047**	**$ 0.027**	
X-Fact	**$ 0.442**	**$ 0.596**	**$ 1.039**	**$ 0.465**	**$ 0.547**	**$ 1.012**	**$ (0.023)**	**$ 0.049**	**$ 0.026**	

Figure A. 2 Example of Cost Comparison Summary (2)

Description										Remarks
	Mat'l	Labor	Total	Mat'l	Labor	Total	Mat'l	Labor	Total	
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	$ 0.222	$ 0.333	$ 0.556	$ 0.215	$ 0.319	$ 0.534	$ 0.007	$ 0.014	$ 0.022	
	$ 0.004	$ 0.026	$ 0.029	$ 0.006	$ 0.014	$ 0.020	$ (0.002)	$ 0.011	$ 0.009	
	$ 0.159	$ 0.157	$ 0.316	$ 0.207	$ 0.130	$ 0.337	$ (0.048)	$ 0.027	$ (0.021)	
Basic Cost	**$ 0.385**	**$ 0.516**	**$ 0.901**	**$ 0.428**	**$ 0.464**	**$ 0.892**	**$ (0.043)**	**$ 0.053**	**$ 0.009**	
X-Fact	**$ 0.431**	**$ 0.539**	**$ 0.970**	**$ 0.479**	**$ 0.485**	**$ 0.963**	**$ (0.048)**	**$ 0.055**	**$ 0.007**	

Figure A. 3 Example of Cost Comparison (3)

Agile Part No:

Revision

Ex-Fty Summary

Current	Target	Diff	% of Target Cost
$5.388	$5.400	$0.012	99.8%

Scenario Details

Milestone:	
Toy year:	
Toy Brand:	
Toy Category:	
Source:	
Currency:	
Quota:	
Published Date:	
Modified Date:	
Modified By:	

Cost Distribution

Cost Elements	Material		Labor		Total	
Tool Plan	$0.541	(10.0%)	$0.480	(8.9%)	$1.021	(19.0%)
Deco	$0.000	(0.0%)	$0.150	(2.8%)	$0.150	(2.8%)
Assembly	$0.000	(0.0%)	$0.229	(4.3%)	$0.229	(4.3%)
Electronics	$0.000	(0.0%)	$0.000	(0.0%)	$0.000	(0.0%)
Packaging	$1.069	(19.8%)	$0.827	(15.4%)	$1.896	(35.2%)
Purchase Parts	$0.006	(0.1%)	$0.000	(0.0%)	$0.006	(0.1%)
Softgoods	$0.763	(14.2%)	$0.670	(12.4%)	$1.433	(26.6%)
Hair	$0.135	(2.5%)	$0.507	(9.4%)	$0.642	(11.9%)
Inter Source	$0.011	(0.2%)	$0.000	(0.0%)	$0.011	(0.2%)
Total	$2.525	(46.9%)	$2.863	(53.1%)	$5.388	(100.0%)

Figure A. 4 Example of Cost Sheet