Root Cause Analysis using Cause and Effect Diagram to Identify Application Requirement

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Abstract. One of the ways to solve a problem is to identify the problem and its causes using root cause analysis method. The main problem discussed in this research is the ineffective business process used to handle service order from a customer. The method used in identifying the problem and finding the solution is Cause and Effect Diagram. This diagram is used because it may help to illustrate the causal factors of a problem and to determine which factors have the most significant contribution towards the main problem. The result of the problem analysis in the business process is used to determine the best solution that will be implemented into the mobile application that will be built. Thus, the built application may adjust the needs of the company and address its problems. This research concludes that the root causes of the problem are the process and human factors. Therefore, the solution implemented into the application focus on the business process improvement that can facilitate and prevent the users from making mistakes during the process.

Keywords: Root Cause Analysis, Cause and Effect Diagram

1 Introduction

Developers will use specific method while developing an information system or application. It is done so that the developer may have a guide or reference; then the development process can be more systematic. Furthermore, each method has its advantages and disadvantages. Therefore the developer may choose which method fits best the system. A case study that is discussed in this research is about the mobile application used to order a house-cleaning service provided by *CV Kualitas Hidup* Sejahtera. This application is built using Rapid Application Development method. This method is chosen because the application has small-scale and time required to develop is limited. Thus this method fits the best.

Rapid Application Development (RAD) method has four core steps; they are system requirement planning, system design, system development and implementation (Pressman, 2010; Sommerville, 2011; Kosasi and Yuliani, 2015). On the first step, the developer will meet the client or end-user to discuss and identify the goals, project scope, and requirements of the application. The goal in this step is to solve the problems happen in the company.

To solve the problem, then both developer and end-user need to know what problem is happening inside the business process. When the problem is identified, then the best solution may be generated. This will also support the purpose of the RAD process which is to accelerate the development process. It is because the application is developed based on the scope without adding unnecessary components. Furthermore, Rad process helps the developer

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to limit the user's expectation specifically towards the application. By designing the solution that fits best the problem, then the developer may do that easily because the user has already understood what they need based on the problem they are facing.

One of the ways to analyze a problem is by using the Cause and Effect Diagram or more commonly known as the Fishbone Diagram. Called as Fishbone Diagram, because it consists of a box representing the fish head containing the main problem, and lines representing the fish bones containing the causes of the problem. The Fishbone diagram is an analysis tool that provides a systematic way of looking at effects and the causes that create or contribute to those effects (Chang and Lin, 2006; Ilie and Ciocoiu, 2010; Wong, 2011). Fishbone Diagram usually used in system analyzing in the operation management to express the relationship of causes and effects between various factors and the problem qualitatively (Luo et al., 2007). The purpose of this diagram is to do reparation and improvements (Doshi et al., 2012). By knowing the causes then the best solution may be generated because it focuses on its causes.

The Purposes of this research are to analyze the causes of the problem happening inside the business process study case small enterprise and to determine the application requirement based on the problem. Therefore the application can provide the best solution to the problem.

This research is limited only to discuss the process of cause analysis of the problem in the business process, and the result of the analysis is implemented to determine the solution in the form of application requirements.

2 Research Method

Our research framework described as shown in Figure 1. According to Figure 1, our framework consists of four stages. There are root cause analysis, cause and effect diagram, application requirement, and business process stage.

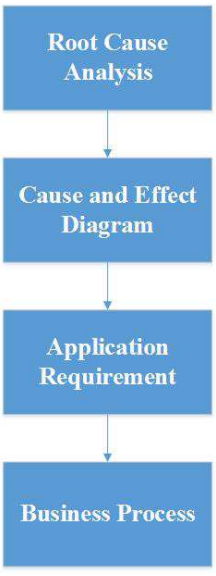

Figure 1. Research Framework

2.1 Root Cause Analysis

Root Cause Analysis is a process meant to identify the root causes of a specific problem which leads to disadvantages and to develop team countermeasures (Center for Medicare & Medicaid Services). Another definition said root cause analysis is the task of identifying root causes as well as the components they affect (Julisch, 2003; Carroll et al., 2002; Wilson, 1993). More details, Root cause analysis is the process or methodology of identifying causal factors using a structured approach with techniques designed to provide a focus for identifying and resolving problems (Doggett, 2004; Rosenfeld, 2013). By using RCA, the team will be able to identify the breakdowns happen in a process or system which cause a problem and how to address them. RCA's purpose is to define what is happening, why is it happening, and what changes to do.

RCA has four processes, such as the following (Tomic and Brkic, 2011).

a. Data Collection

The first step of the analysis process is to collect the data about the problem.

b. Causal Factor Charting

Causal factor charting provides a structure for the investigating team to analyze the gathered information. This step starts by creating a fishbone diagram contained by relevant data. When all the cases have been charted, the analysts can determine which case contributes the most towards the problem, later called as a causal factor. These factors are the contributors which when addressed may solve the main problem.

c. Root Cause Identification

After all the causal factors have been identified, the analysts will start to define the root causes. At this step, the analysts will identify the reason why those factors appear or happen. This identification will help them to know why those factors happen so they can formulate the best solution.

d. Recommendation Generation and Implementation

The next step is the formulation of recommendation or solution for the problem. This recommendation is based on the root cause identification step.

2.2 Cause and Effect Diagram

Cause and Effect Diagram or commonly known as Ishikawa or Fishbone Diagram (as shown in Figure 2) is the cause and effect analysis developed by Dr. Kaoru Ishikawa which illustrates a problem and its causes in the form of fish bones (Asmoko, 2013). The design of this diagram is the following.

a. The main problem is placed on the head of the fish on the right of the diagram.
b. The possible causes of the problem are placed on each fish bones on the left of its head.

This diagram can also be used in the system or process changing or improvement (Asmoko, 2013). This diagram can also be used in the system or process changing or improvement (Asmoko, 2013). This diagram has advantages and disadvantages. Based on WBI Evaluation Group (2007), the benefits are: (1) this diagram enables the analysis towards any possible causes to the problem; (2) This technique is easy to implement and produce the visual representation of the causes, cause categories, and the easy-to-understand needs which have to be fulfilled in order to solve the problem; (3) By using this diagram, the team can focus on the cause of the problem. While the disadvantages are its simple design can make it difficult to represent the connection between a problem and its causes on the complex situation.

The steps to create a fishbone diagram are as follows (Kusnadi, 2011; Asmoko, 2013).

a. Make a diagram structure

Fishbone diagram structure consists of a fish head which placed on the right of the diagram. This fish head will have a role to show the main problem. The second part is the fins which have a role to show the categories of the main causal factors. The last part is the fish bones which has a role to show the causes. The following image is the illustration of a fishbone diagram structure.

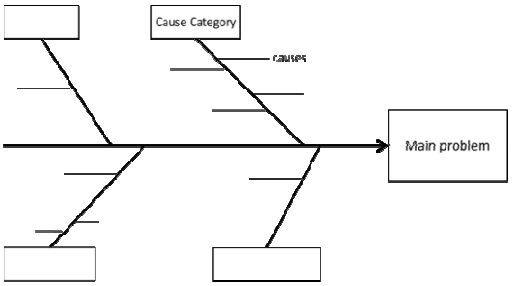

Figure 2. Fishbone Diagram

b. Define the main problem

c. Formulate the main causal factors

This step can be done by brainstorming. On this step, the team will define the categories of the causes. These categories are placed in the fin. The common categories usually are people, process, methods, etc.

d. Define the possible causes of each factor

At this step, the team will define the causes on each category and place them as fish bones on each fin.

e. Illustrate the problem and its causes in the fishbone diagram.

2.3 Application Requirement

Application requirement is the requirement of the application system domain and reflects the domain characteristic. There are two kinds of requirement, such as:

a. Functional requirement

Functional requirements are the definition of the services the system has to perform and how the system should react towards the input and what the system should do in certain situations.

b. Non-functional requirement

The non-functional requirement covers the condition that determines the quality of the application such as speed, security, user-friendliness, etc.

2.4 Business Process

Business process run in handling orders from customer consists of four steps including service initiation and introduction, service purchase, service schedule execution, and payment.

a. Service initiation and introduction

In this step, the company's customer service team will explain the services provided by the company. If the customer agrees to purchase then the process is continued to the next step.

b. Service purchase

Before purchasing the service, the customer will have to give information about their house or place to be cleaned. Afterward, the customer may choose service type, assign service schedule, and define the tasks that will be given to the team in Surat Perintah Kerja (work order).

c. Service schedule execution

The team will come to customer's location on the scheduled date to give the service. If the customer wishes to reschedule or cancel it, they have to inform the company about it no later than seven days before the schedule. Otherwise, the company will assume that the schedule is done and the customer will still have to make the payment.

d. Payment

After all the schedule has done, the customer has to make the payment by transfer or cash.

3 Results and Discussion

Based on the business process explained in the previous section and the result of discussion with the company, there is the main problem that is the ineffective procedure to handle service purchase orders. In order to find a solution, it is best to know the causes first. Afterward, then the problem can be solved by eliminating the causes. The causes identified are as follow:

a. Service scheduling is done manually where before assigning it, the management has to check each cleaning team's schedule to find their free time. It makes the customer has to wait for the confirmation from management about the schedule.
b. After assigning the schedule and team, there are possibilities the customer will wish to reschedule or cancel the service. Based on the company's policy, if the customer wishes to do it, then they have to inform the company no later than seven days before the assigned date. However, sometimes customer forgets to do it which will give a disadvantage to them because they still have to make the payment.
c. Before giving services to the customer, the management team needs to get the information about the condition of customer's house or mansion, its location, prioritized rooms, etc. in order to get that information; the team will ask the customer whether or not they are willing to take the survey. However, not every customer wants to do it because it needs more time allocation.
d. Cleaning team works under contract and Surat Perintah Kerja (work order). This letter is printed and given to the customer on every schedule.
e. The customer can order the service through telephone, SMS, Whatsapp, Facebook, and website. Unfortunately, the customer can only fill the service request form, but for the confirmation, scheduling, and SPK assigning are still done through telephone or e-mails.
f. The company still has a limited human resource (20 people) which causes limited capability to handle more orders.

The points of causes mentioned in the previous table then are grouped into several main causes. They are process, documentation, stakeholders (people involved in running the business process), and the technology used during the business process. The grouping details are in Table 1. The table also consists the level of influence of each cause towards the problem. By determining the level of influence, we may know which causes are the root causes of the problem. The cause which has the highest level of influence is the root cause. In this case, we have several root causes.

Table 1. Root Cause Determination

No	Cause	Sub Cause	Level of Influence
1	Process		
1.1		Manual Scheduling Method	High
1.2		The customer has to wait for schedule confirmation	Low
1.3		Confirmation is given to customer one by one	Low
1.4		Ineffective survey method	High
2	Documentation		
2.1		SPK (work order) which must be printed	Low
3	Stakeholder		
3.1		Limited human resource	High
3.2		Not all of the customer is willing to be surveyed	Low
3.3		Customer forgets to confirm schedule cancellation or rearrangement	High
4	Technology		
4.1		The company website is not fully functioned	Low

After grouping the causes, then each point can be drawn into the Fishbone Diagram in Figure 3.

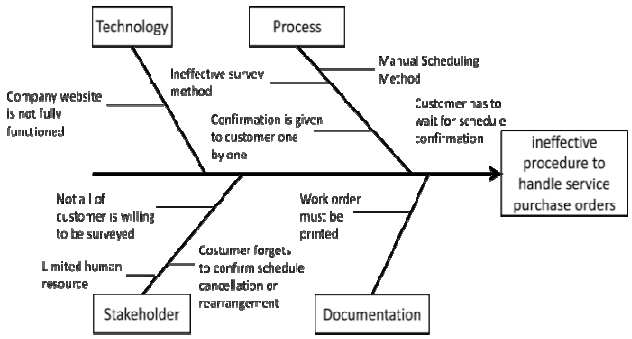

Figure 3. Fishbone diagram for the problem happening in the business process of Sapulidi professional and its causes

3.1 Problem Solving

Based on previous analysis, there are four root causes which contribute the most towards the problem. The root causes are the manual scheduling method, customer's survey, schedule cancellation or rearrangement confirmation, and the lack of human resource. In order to eliminate those causes, the proposed solutions are as follows. These solutions (except the forth) will be implemented on the application.

a. Scheduling Method

On the current business process, the services are scheduled manually where the management team has to check whether there is any available employee on the expected date or not. The solution for this cause is by making the scheduling runs automatically by the system. Therefore, before customer gives their expected date for the service, they can choose any available date displayed on the application. The available dates are the dates when there are at least two employees available or are not assigned to any schedule. After that, the management team will be able to determine whether to accept the request or not and assign employees to the selected dates. By using this method, it will guarantee the availability of the dates displayed as available. It is beneficial for the management team so they can schedule the service effectively.

b. Customer's Survey

Customer's survey is meant for getting the information also needed for making work orders (Surat Perintah Kerja). The solution for this cause is by making a form that has to be filled by the customer before submitting a service request on the application. The form will collect information such as the customer's location, prioritized areas to be cleaned, its condition, forbidden areas to enter, and tasks that will be given to the cleaning team. By surveying the form, it will eliminate the time and team needed to hold the survey.

c. Confirmation of Schedule Cancellation or Rearrangement

Sometimes the customer forgets to confirm the company that they want to cancel the schedule or rearrange it. The solution of this cause is by giving a reminder notification to the customer on seven and one days before the assigned date.

d. Lack of Human Resource

The solution of this cause is by increasing the number of employees which meet the qualification. By having more employees then the number of requests that can be handled will be increased too.

3.2 Application Requirements Identification

In formulating the requirements for the application, we need to identify the application scope, functional requirements, and non-functional requirements. The scope of this app covers service request and its handling, service scheduling, schedule execution, and post-service activities. Each main business function is broken down into several sub-functions explained in Table 2. The table also assigns which actor doing which function.

Table 2. Functional Requirements

No	Sub-function	Actor	Explanation
1	Registration functions		
a.	Account registration	Customer	Register in order to get a new account
b.	Login	Customer, Admin, Cleaning Team	Access the system by doing login
2	Service Request functions		
a.	Choose the type of service	Customer	Choose service type
b.	Choose available date	Customer	Choose the available date displayed on the app
c.	Create Work Orders (SPK)	Customer	Explain what tasks to be given to the cleaning team
d.	Submit request	Customer	Submit the request after completing all of the previous steps
e.	Cancel the request	Customer	Customer may cancel the submitted request as long as it has not been validated by the administrator
f.	Service request validation	Admin	Validate the information about the incoming request
g.	Request acceptance confirmation	Admin	Confirm whether the request is accepted or not to the customer
3	Scheduling functions		
a.	Schedule allocation	Admin	Accept the submitted date or allocate a new date for the

			schedule
b.	Cleaning team allocation	Admin	Allocate the employees that will be assigned to the schedule
c.	Get reminder notification	Customer	Get the notification about the allocated schedule
d.	Review the schedule	Customer	Review the unfinished schedules
e.	Change the schedule	Customer	Change the unfinished allocated schedule if needed
4	Schedule Execution functions		
a.	Access customer's location	Cleaning team	Preview customer's location by using Global Positioning System (GPS)
b.	Work orders checklist	Customer	Check which task is finished by the cleaning team
5	Post-service functions		
a.	Complaint claim	Customer	Report any kinds of complaint about the given service

4 Conclusion

Based on the root cause analysis, we found out that the causes which contribute the most towards the problem are the ineffective process and human errors. Therefore, the solution which is implemented is focused on the quality improvement of the business process so the new business process can facilitate the service request handling in the company and avoid any kinds of error caused by users. However, the effectiveness of this solution is still normatively determined. It is because the application has only been internally tested during its development and not yet implemented on the real business process.

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