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# Designing Progress Tracking System for Laboratory to Promote Effectiveness in Providing Information to Customers

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**ABSTRACT**

The main objective of this research is to improve the current flow of information in the laboratory as it is found to be ineffective to reach the customers. This research is necessary and demanded to be finished as soon as possible as it may affect the product development in Toy Manufacturing company. To solve the information flow problem, it is then initiated the idea to develop a new progress tracking system, which is supposed to be able to provide real-time information to customers and make them able to react faster to problems. Lack of information in the problem could lead to longer development lead time. T The research conducted during the project was basically involving literature review, online journals review, questionnaire, case study, and discussion. This research covers the whole development process of the system, up to the implementation and evaluation. The result shows that there is improvement of 42.47% in delivering tracking information to the customers.

**Keywords:** *Progress Tracking System, Database, System Development, Information flow, Tracking Information, Effectiveness.*

**ABSTRAK**

Tujuan utama dari riset ini adalah meningkatkan keefektifan aliran informasi ke pelanggan di suatu laboratorium. Riset ini sangat mempengaruhi proses pengembangan produk pada perusahaan manufacktur boneka. Sebagai langkah penyelesaian untuk memperbaiki aliran informasi, maka dilakukan pengembangan suatu *progress tracking system* yang baru. Sistem ini diharapkan mampu menyediakan informasi *real-time* sehingga pelanggan mampu segera bertindak jika ada masalah. Penelitian ini Kurangnya informasi dapat mengarah pada lamanya waktu pengembangan produk. Penelitian ini terdiri dari beberapa tahap, mulai dari perancangan, pengembangan, implementasi dan evaluasi dari sistem. Hasil dari implementasi sistem baru ini adalah perbaikan sebesar 42.47% dalam *tracking information* kepada pelanggan.

**Keywords:** *Progress Tracking System, Database, System Development, Information flow, Tracking Information, Effectiveness.*

## 1. Introduction

This research was done in a multinational company which manufactures children toys. The company has the commitment to deliver their products to the customer with good quality. In order to deliver the products with good quality, this company established a quality assurance laboratory in order to assure their products to conform the required quality. One of laboratories, called Quality and Assurance (QA) mechanical laboratory, has no such system that keeps records of the current sample which is being tested automatically. All the records were kept manually, using pen-and-paper. This method is proved to be inefficient as the record may be lost and also less practical for use. Moreover, using this system means that only the people that are performing the test may know the current progress of the sample, while in fact laboratory customers also need to know the current status of their sample. Laboratory customers may vary from the development team to the laboratory itself. The development team itself consists of some people that each of them may submit different types of sample.

Currently, the sample tracking system is done manually by the technicians who performed the test. Therefore, only the responsible technicians that has the information about the current progress of the sample while the customers do not know anything about the progress of their sample. Based on the real-time observation from 40 samples that are being submitted to the laboratory in one day, customers know barely anything about their own sample. It makes the customer often calls the technician through phone calls, emails or came by their own to the laboratory and asks the technicians directly. From the technicians' opinion, they find it to be distressing as it is difficult for them to perform the testing. In addition, it is

difficult for them to provide such an accurate data for the sample progress as the manual system does not provide accurate information.

In general, the characteristics of good information are accurate, relevant, up-to-date, and comprehensive (Mai, 2013) Moreover, Post (2005) stated that an information system should be able to provide additional value to its users. And to be able to do so, it is necessary to identify who the users are and in what way the information system will help them. However, the current system cannot deliver the information that has the characteristic of good information. Most of the time, customers call the technician to ask for tracking information from the laboratory, meaning that they have no idea about what is currently going in the laboratory. This showed the current system cannot deliver up-to-date tracking information. The tracking system needs to be improved because customer needs the information as quick as possible, as it may affect the lead time of new product development. For the testing procedure in the laboratory, it cannot be modified anymore as it follows the standard which has been established, therefore, the purpose of this research is to develop a better system and method of sample tracking as there are problems regarding the flow of tracking information in the laboratory.

The definition of accurate here is defined by calculating the number of rhetorical questions that are asked by the customers to the technicians. The system itself should be able to deliver the information of the sample, without requiring the customers. Therefore, it is expected for the system to be able to answer "how", "who", "when", "where", and "what". "Why" question is considered as an eligible question as it requires reasoning and logic combined to answer, and might also be too complicated for a system or program. What makes it interesting is that mostly half of the customers asked about such rhetorical questions to the technicians. Based on the reasoning above, it is concluded as ineffectiveness in the current tracking system. In the table below, the data of phone calls that shows the ineffectiveness of the current tracking system is shown as Table 1.

**Table 1.** Total Number of data for Ineffective Phone Calls

| Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total number of phone calls | 14 | 12 | 15 | 21 | 8 | 10 | 11 | 12 | 16 | 13 |
| Ineffective phone calls | 5 | 6 | 5 | 12 | 3 | 4 | 6 | 4 | 7 | 9 |

Based on the data in Table 1, it can be concluded that there are many customers that does not know anything about their sample. That implies the current system that is not effective in delivering the information to the customers. Furthermore, deeper observation shows that the current system in fact does not deliver any information to the customers, makes them always asking the technicians for the current situation of their sample. Although the point of delivering the information to the customers seems to be insignificant, it could change the flow of the product development, especially the time spent for developing the product.

When the customer can retrieve the information about their sample faster that means the production of the new product can be started sooner, and the company could have shorter time to reach the market with new product. The shorter lead time of the new product launching is one indicator of a good organization performance. Thus, providing the real time information brings an impact to the good company performance (Bejjar and Younes, 2013).

For increasing a good company performance that relates to shorter lead time of new product launching, this research was initiated as a response for encountering problems about the sample tracking. One of the worst problems was when the customer once rushing to submit the sample for testing. The customer asked for the test to be prioritized as the deadline for the mass production schedule is near. The laboratory often has high workloads; and therefore the newly submitted sample cannot be processed unless the current samples have been finished. At that time, the customers force the technicians to work on their sample first and therefore the current projects may be delayed until the new sample is tested.

Therefore, the purpose of this research is to develop a progress tracking system using Microsoft Excel. With this system, it is expected that the customer does not need to contact the technicians anymore to retrieve information about the current progress of their sample. In addition, the progress tracking can be recorded, and able to provide information for both laboratory and customers, which can be monitored by associated parties. Besides that, this new system removes the element of manual reporting, increases productivity and allows access to retrospective data for analysis for associated parties (Nyasulu et al, 2014)

## 2. Methods

### 2.1 Developing a Database System

There are several steps in developing a database. There should be the preliminary process, which is the very first step. The preliminary process includes the analysis of the current system and the user's requirement. After that, the next step is to design the output, the input, and the database, respectively.

However, before the preliminary process itself started the first thing to do is to make sure that the research itself has been approved and ready to be initiated.

Post (2005) stated that an information system should be able to provide additional value to its users. And to be able to do so, it is necessary to identify who the users are and in what way the information system will help them. Most organizations perform feasibility study to see whether the project is beneficial enough or not for them. Commonly, the benefits are measured in three areas: cost, sales or revenue, and long-term benefits.

This research has fulfilled the necessary requirements to be considered as a feasible project. From the cost aspect, it is indeed a cost reduction as current manual system is eliminated and replaced with digital system. Manual system use pen and paper, which needs constant replacement and also has the risk of loss and damage. By using the system which is proposed in this research, the company does not need to prepare for constant replacement (e.g. books and pens), and also reduce the risk of data loss and damage (using backup in hard disk). The sales or revenue can also be somewhat increased, as the system may help the technicians to identify tardy jobs and therefore manage to schedule the samples to reduce the lead time, or in short increased productivity. Increase in laboratory's productivity may lead to higher workload capacity and helps the laboratory to increase its revenue. Last but not least is the long term benefit. The benefit of the system developed in this project is the efficiency that could help the technicians as well as the customer.

For developing a system, first it is necessary to understand the type of system that would be developed. Moreover, it is also needed to understand the current system being used. System analysis and design is an analysis process that is done by system analyst, that includes of analyzing the data input or data flow systematically, processing or transforming data, data storage, and information output within the context of particular business (Kendall and Kendall, 2011). Designs are needed in order to create the system to be useful later on. These designs are also known as models. According to Post (2005), a model is defined as a simplified abstraction of a real world system. There are three types of models that are commonly used to design a system, they are: process models, class or object models and event models. Process model is shown through a Data Flow Diagram (DFD) or collaboration diagram. This diagram is used to makeover the information flow within a system. Class model (or class diagram, also known as entity-relationship diagrams) are used to show the primary entities or objects in the system. The third one, event models gives the modeling of sequence and illustrates the timing between events, as well as the way of the information being delivered in the system. From the definitions, it is obvious enough that each of these models describe a system from each different aspect.

Before developing the models like stated in the previous section, several key points needed to be fulfilled first to make the design satisfies the necessary requirements (Post, 2005). Those key points are:

### 2.1.1 Analyzing Current System

The current system analysis is the deeper analysis of the problem identification. The characteristic of the current progress tracking system should all be listed and defined. It will be started by listing all the flow of entities in the laboratory itself. Later on the explanation, there will be flow of documents and flow of samples. These flows represent the testing process from the aspect of entities. The highlight point would be in the flow of documents as it will be related with the flow of progress tracking information.

### 2.1.2 Identifying User's Requirements

The purpose of designing a database system is to create a useful system that could help the user and fulfill their needs with the system. Post (2005) stated that a key step for defining the user's requirements is to interview them and observe the operations itself. It may become difficult if each user may have their own opinion and it is the task of a system designer to unify their opinions and create a system that can fulfill each user's needs.

### 2.1.3 Designing Proposed System

Designing proposed system will be started by designing the effective output for the system first, and then followed by designing the input. Last but not least is to design the database system. All the designing process must be considered based on the user requirement's analysis. The output should be made to be as provide information as complete as possible, but must not be complicated for the customer to make it reliable. Designing effective input means the processing of making inputs should be easy, as well as providing automated feature for some information to reduce the time used for making inputs. Last, designing the database system means the data should be created in a management system where the storage, the processing, and the retrieval should be made as efficient as possible.

### 2.1.4 System Implementation

The system implementation will consist of the results for the implementation of the proposed system, as well as the result before the proposed system is implemented. Moreover, it will be explained about how the implementation itself is engaged, who are involved with the implementation, and also when did the implementation takes place. The result of the implementation itself will compare the number of phone calls at the laboratory, for both before and after the implementation. The phone calls that are counted as the data are phone calls that ask about the progress tracking in the laboratory, which means that the system could not deliver the desired information to the customers.

### 2.1.5 System Evaluation

The system evaluation will consist of the analysis of the system implementation which is in the previous section. In this section, the highlight point would be the effectiveness calculation which will determine the effectiveness of the proposed system. The result based on the system implementation will also be explained further in this section. Later on, the evaluation will determine whether the system has fulfilled the objectives that have been previously stated in the early phase of the research. The effectiveness result will also play role in determining the conclusion for the research.

## *2.2* Effectiveness Calculation

In this research, the calculation performed will also include effectiveness calculation. The effectiveness will be measure by comparing the number of phone calls from the customers both before using the program and after using the program.

If the program worked well, then it is assumed that the information will flow efficiently into the customers and therefore they will no longer disturb the technicians by the phone calls. As stated previously in the problem background, the customers often disturb the technicians by asking them through phone calls which is found quite troublesome by the technicians as they have high workloads in the laboratory.

To calculate the effectiveness, first it is required to know the current number of phone calls in one day that only asks about the sample's progress before the program is implemented. After the program has been running well without technical errors (error codes, bugs, and so on), then re-assess another survey to see the number of phone calls after the program has been well implemented. That way, it is believed that the effectiveness of the program can be calculated.

After all the required data has been collected, calculate the average numbers of phone calls for both before and after the program is implemented. Assume that the average number of phone calls before the program implemented is notated as Nb, and the average number of phone calls after the program implemented is notated as Na, then to calculate the effectiveness the formula would be:

$$\frac{N_b - N_a}{N_b} \; x \; 100\% \qquad (1)$$

With the formula, then the effectiveness of the program can be calculated and further development can also be done if certain standard for the effectiveness improvement is not yet achieved.

## *2.3* Other Calculation

As stated in above, current and desired status for the table in display will also be included. Current status can be defined as the current progress of the corresponding batch that is currently tested in the lab, according to certain requested test. It gives information about the progress of the batch in percentage, compared to the overall requested tests.

Each of the tests consists of its own procedure that is built-up from several 'rundowns'. Therefore, each time one rundown has been finished; the user only needs to mark it as a sign that the activity has been finished. Each finished rundown will increase the percentage of the "current status", until all of the requested tests has been finished, thus reaching 100%. Each rundown may have different percentage proportion, even for the same test. This is because the load for each rundown may 'worth' and considered to take more time/more essential compared to the other. On the other hand, each requested test is considered to have the same weight/contribution to the status. To calculate the percentage for each finished test is shown as Equation (2).

$$P = \frac{100\%}{Number\ of\ requested\ tests} \qquad (2)$$

With:

P = the percentage that one test will contribute to the current status when it has been performed

Meanwhile, it is also needed to calculate the percentage that the rundown will contribute to the current status when it is finished using Equation (3).

$$p = Pr\ x\ \frac{1}{Number\ of\ requested\ tests} \quad (3)$$

Where:
p = percentage that the rundown may contribute to the overall current status.
Pr = proportion that the corresponding rundown holds over the corresponding test.

Finally, to calculate the current status, each percentage of the finished rundown will be accumulated, and this accumulated percentage will become the current status (in percentage) for the corresponding batch sample.
Next, after unveiling the logic for calculating the current status, the next is to unveil the calculation for the "desired status". First, it is needed to understand the definition of the desired status. Desired status is the percentage that indicates the status that is desired to be achieved at the current moment, based on the batch submission date and the estimated finished date.
Assume there are 4 stages available: Stage 1, Stage 2, Stage 3, and Stage 4. As there are differences between samples from each stage, that means the test procedure will also be different, including the estimated finish date.
To calculate the "desired status", use the formula:

$$D_{status} = \frac{Current\ Date - Submission\ Date}{Total\ Days\ of\ Estimated\ Finish}\ x\ 100\% \quad (4)$$

That is all about the literature study used by the writer as the source of knowledge and information in order to finish the research. However, some of the contents in this chapter also come from findings during the research, and not all come from experts' writing. Now, let's proceed to the next chapter, the research methodology.

## 3 Result and Discussion

### 3.1 Current System Analysis

Before proceeding to the development of the proposed system, in this section the result of the current system observation will be explained in detail. The observation's result will include the flow of goods, which can be separated into documents (information) flow, and sample (physical goods) flow. Moreover, as the system that would like to be developed is a tracking system the explanation will also include the analysis of the current tracking system. By observing the current system thoroughly, then it is expected to develop a system that can cover up the weakness of the current system.

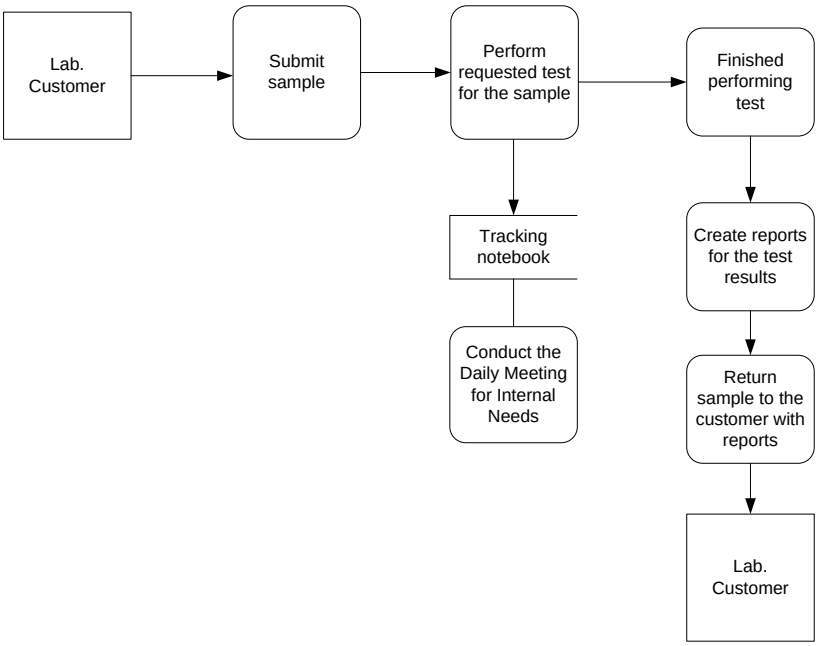


**Figure 2.** Data Flow Diagram for the Current System

The Current tracking system that is used in the laboratory still utilizes pen and paper system, which is found to be very vulnerable to loss and damage. Moreover, the current tracking system could be only updated in daily basis, which is considered as weakness for a tracking system. In actual condition, the tracking system is also required to be able to deliver the information to the customers. therefore, the goal is to develop a system that can be used to deliver the information to the customer, as well as can be updated as often as required.

### 3.2 Analyzing User's Requirements

After all the required analysis for the current system has been done, the next step is to analyze the user's requirement for the proposed system. It was initially requested that the laboratory needs to develop a system that could provide a real-time updates for the progress tracking. Moreover, the system is requested in form of a program, while the program to develop the system is can be anything as long as it can track the progress in a real-time basis. However, developing custom program needs a quite long time, while the system itself should be implemented as soon as possible. Therefore, the development of a program is initiated using available resources.

It is requested from the executive level to develop a table that consists of samples that are currently processed in the laboratory for the current moment. It is also requested to provide information about the sample, mainly the current and desired status at the moment. The main objective is to make sure that the display can be viewed by the customers as they lack of tracking information. It was also demanded the system to be automated as much as possible, so that the tracking system does not bother the technician for updates and modification.

From that point, the thought of developing a form that can update automatically is formed. Such feature can be found in Microsoft Excel. Additionally, the feature of Microsoft Excel which can be combined with Visual Basic program, developing basic software can be done with basic knowledge and skills. However, the weakness is that Microsoft Excel is not specialized for usage to develop a database program. The program that is requested to be developed should be able to hold the record of tracking data, which can be also viewed by the customers. Therefore, the request is to develop a tracking database system which can help to effectively deliver the tracking information to the customers.

### 3.3 Designing Proposed System

In order to successfully develop a good tracking system that can promote effective flow of information, it is recommended to follow the methodology of developing a database system. The method shows that to design a database system, the first thing to do is design the output. After the output has been designed, design the input and then followed by designing the database system. Designing the output needs the comprehension of understanding what the customer needs from the output of our system. While to design an effective input, the mechanism, method of input should be made as practical as possible. Last, but not least the design of the database system should be made for easy store and retrieval as well as efficient data management.

The Progress Tracking software which is developed in this research in its usage will be created as the master file, and used as multiple files as each file will hold different tracking documentation for each certain period of time. The procedure is shown in Figure 3.

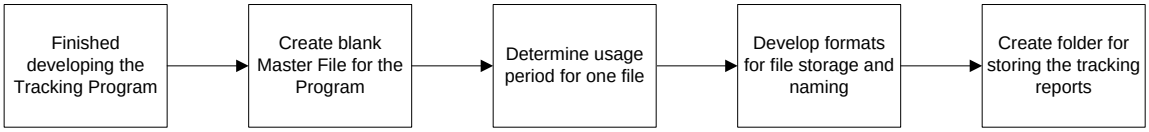


**Figure 3**. Steps of Developing the Database for Tracking Records

In the proposed system (Figure 4.), there is data flow from the laboratory into the customer's side (see the orange box). The orange box shows that there is flow from the tracking database into the laboratory customers. The flow starts from the tracking database, which means that the shared information is the tracking information that is previously added into the database by the technicians that are responsible to perform the test. As the data is stored in a database system, the data will be stored and can be retrieved for

efficient use, and will also follow the latest updates. With the new flow in the proposed system, the customers are able to have required information about the sample's track, as well as the test results for the corresponding sample. Before proceeding to the design phase, comparison between the current system and the proposed system should also be made to see the changes from the current system to the proposed system. Note that the orange rectangle specifies the difference between the current system with the proposed system.

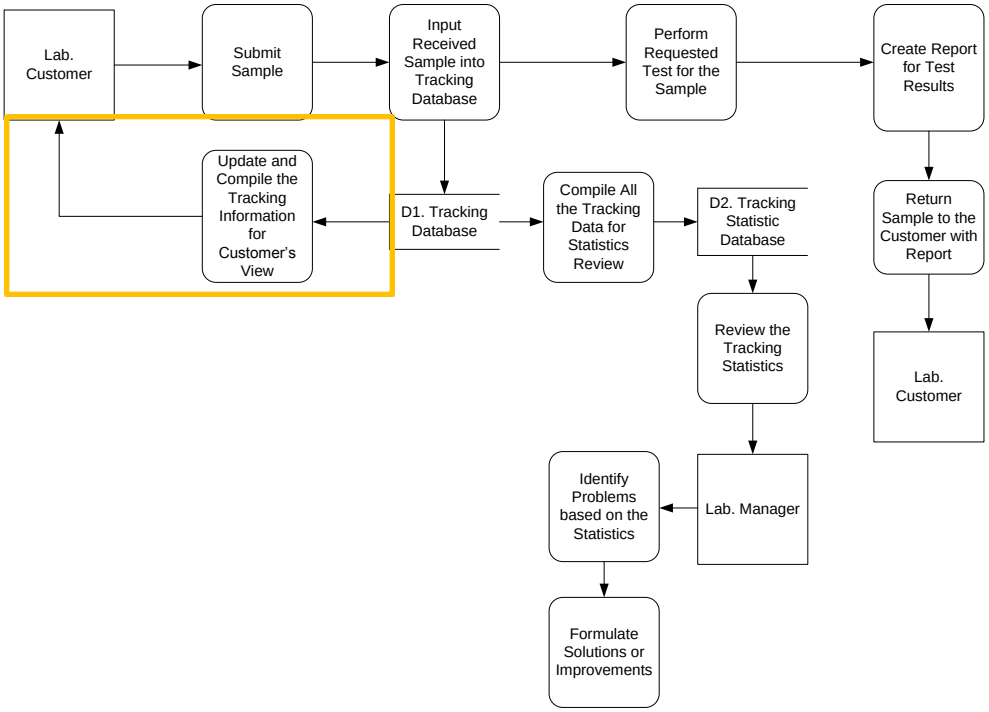


**Figure 4.** Data Flow Diagram for the Proposed System

As discussed in the chapter 1, the information flow from the laboratory to the customers may affect the flow of the new product development in the company. When the customers do not know anything about the current track of the sample, they may not know the current problems of the sample. While if they keep updated with the information, they may know the current test results, the defects found so far during the testing processes, and many more. When they know about the samples' defects, they could respond to the defects and prepare the action to counter the problems and continue the development process with fewer obstacles.

### 3.4 System Implementation

The first implementation of the system was done in two months. The time spent for developing the program itself, including the revision and debugging until the program was ready to work without major bugs and errors was approximately 1 month, with 8 hours of working day (Monday – Friday).

The implementation also involves the customer, as it is necessary to let them understand how the program itself works for them. Previously, old system cannot deliver the tracking information to them, therefore the customers always contact the technician during their working hours, and the technician themselves find it very disturbing as they do not have sufficient time for such thing as a result from heavy workloads.

Therefore, during the implementation there will be also observation for number of phone calls from the customers that are asking for tracking information. The newly implemented system will not have 100% efficiency in delivering the tracking information to the customers; hence the effectiveness will be measured by comparing the number of phone calls that asks for tracking information before the new system is implemented and after the system is implemented.

The first observation for phone calls in the laboratory was done before the implementation. The results of observed data for phone calls are shown in Table 2. While after the system is implemented, the laboratory has statistics for phone calls as seen in Table 3.

**Table 2.** Observed Data for Number of Phone Calls before the System Implementation

| Day | Number of Phone Calls | Day | Number of Phone Calls | Day | Number of Phone Calls |
|---|---|---|---|---|---|
| 1 | 5 | 16 | 6 | 31 | 2 |
| 2 | 6 | 17 | 7 | 32 | 6 |
| 3 | 5 | 18 | 8 | 33 | 1 |
| 4 | 12 | 19 | 6 | 34 | 7 |
| 5 | 3 | 20 | 4 | 35 | 3 |
| 6 | 4 | 21 | 3 | 36 | 10 |
| 7 | 6 | 22 | 5 | 37 | 8 |
| 8 | 4 | 23 | 7 | 38 | 5 |
| 9 | 7 | 24 | 10 | 39 | 4 |
| 10 | 9 | 25 | 2 | 40 | 5 |
| 11 | 6 | 26 | 6 | 41 | 8 |
| 12 | 7 | 27 | 7 | 42 | 5 |
| 13 | 6 | 28 | 4 | 43 | 6 |
| 14 | 2 | 29 | 9 | 44 | 6 |
| 15 | 5 | 30 | 3 | 45 | 9 |

**Table 3.** Observed Data for Number of Phone Calls after the Program Implementation

| Day | Number of Phone Calls | Day | Number of Phone Calls | Day | Number of Phone Calls |
|---|---|---|---|---|---|
| 1 | 5 | 16 | 2 | 31 | 4 |
| 2 | 7 | 17 | 4 | 32 | 1 |
| 3 | 6 | 18 | 4 | 33 | 3 |
| 4 | 5 | 19 | 3 | 34 | 1 |
| 5 | 6 | 20 | 4 | 35 | 0 |
| 6 | 4 | 21 | 1 | 36 | 2 |
| 7 | 4 | 22 | 2 | 37 | 4 |
| 8 | 5 | 23 | 4 | 38 | 1 |
| 9 | 5 | 24 | 3 | 39 | 3 |
| 10 | 6 | 25 | 4 | 40 | 2 |
| 11 | 7 | 26 | 0 | 41 | 3 |
| 12 | 5 | 27 | 3 | 42 | 3 |
| 13 | 3 | 28 | 2 | 43 | 2 |
| 14 | 4 | 29 | 4 | 44 | 3 |
| 15 | 0 | 30 | 3 | 45 | 2 |

### 3.5 System Evaluation

The program's evaluation will be viewed from the effectiveness perspective, as the main objective in this research is to deliver effective tracking information to the customers. Before the program itself is implemented, it was observed that there are numerous of phone calls from the customers to the technicians, asking the progress of the samples. The average of phone calls itself for each day is 5.76 phone calls (rounded up to 6 phone calls per day). These phone calls are only the phone calls that are received in the laboratory and ask about the sample's progress. After the system is implemented, the average number of phone calls is reduced to 3.31 phone calls and rounded up to around 4 phone calls for each day.

The evaluation of the new system will be measured by calculating the effectiveness that is brought by the system. And therefore the effectiveness of delivering the tracking information to the customer is:

$$\begin{aligned} \text{Effectiveness} &= (5.76 - 3.31)/5.76 \times 100\% \\ &= 2.45/5.76 \\ &= 42.47\% \end{aligned}$$

The number of phone calls before the implementation shows relatively unstable and quite high number of phone calls per day with average of 5.76 phone calls, while after the new system is implemented the average number of phone calls decreased into 3.31 phone calls. After the calculation has been performed, it is found that the proposed system has reached effectiveness of 42.47% in delivering information to the customers.

## 4 Conclusion

After the Data Calculation and Analysis has been performed, the next step is to determine the conclusion based on the system evaluation. Initially, on the research objectives there are several objectives that would like to be fulfilled to determine whether the research is successful or not. The first objective is to create a

progress tracking system that can be used to promote effectiveness in tracking the current progress of the sample being tested in the lab. The secondary objectives consists of providing up-to-date progress tracking information to those who are related with the sample testing; mostly customers. The other objective is to know the effectiveness of the tracking system proposed in the research. The results are:
1. The proposed system was responded as a better improvement for the tracking system.
2. The proposed system could provide up-to-date progress tracking information.
3. The effectiveness of delivering the tracking information to the customers itself increases up to 42.47%.

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## Attachment

**Database Model Diagram of the Proposed System**