DESIGN OF INFORMATION SYSTEM FOR QUALITY MANAGEMENT

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ABSTRACT

A quality management recently has been the concepts that using a great mass of information flow. The unique function of information in quality management has become the driver of this study. There is a need of building the model for quality management information system before designing the information system. This paper will show two points that important for the information system. The points, database model and expert system, will be explained as the part of the information system for quality management.

Keywords*:* information system, quality management, expert system, database model.

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1. INTRODUCTION

Quality has been one of the greatest trends of the industries. The changing behavior of customer has boosted this trend to the top. As one of the most important thing that customer want, quality have been built in many advance concepts. Recently, many industries have applied quality concepts in their management's line. Some of the quality concepts as Statistical Quality Control, Total Quality Management, Six Sigma and Customer Driven Quality have became the tools to enhance the quality of the products of many companies. These concepts have a good place in quality planning, quality control and quality improvement. Every concept requires a proactive attitude to almost all of the personnel of the company. The basic proactive attitude is getting data and information to start the planning, control, and improvement. Any companies that have applied the concepts will have a mass of information flows. Many companies have standardized the form of the information to provide the proper information, but the information is stored in hardcopy style. It will be a problem because of the abundant of the information. Some problem that could be noted is:

1. Data query. The data about quality of a company are very much that could fill a warehouse if the data derived in details all of the time. It will take a long time to query the data, which stored in hardcopy.
2. Data inconsistency. There were many events that more than one division needs the same data. Each of the division will prepare their own form and process for the data. The problem will be arisen when the data value for the same data type are different between two or more division. This problem called data inconsistency.
3. Data redundancy. If we write the data in one table, there may be some data that written twice or more. This kind of table will require more space to be stored. As figured below, we could see that the table 1.a contains four columns, room, capacity, class, and schedule. The room and capacity columns are written more than once for a data value; A101 is written three times and B103 is written twice, so does the capacity.

This table could be separated to two tables that would save spaces. The separated table shown below at Table 1.b. The column of capacity has eliminated. It saves more spaces than Table 1.a.

Table 1.a

Room	Capacity	Class	Schedule
A101	40	English Literature	1 pm to 3 pm
A101	40	Information System	4 pm to 6 pm
A101	40	Database	10 am to 12 am
B103	30	French Literature	2 pm to 4 pm
B103	30	Quality Management	4 pm to 7 pm

Table 1.b

Room	Capacity
A101	40
B103	30

Room	Class	Schedule
A101	English Literature	1 pm to 3 pm
A101	Information System	4 pm to 6 pm
A101	Database	10 am to 12 am
B103	French Literature	2 pm to 4 pm
B103	Quality Management	4 pm to 7 pm

There must be an information system built for this need that integrated with the company's information system. Information system for quality management will require more studies because the system will not only be a database system but also need more intelligence in the system to process the data to information (Spenger, 1999). Unfortunately, there are not too many studies about information system for quality management (Dooley, 1999). This paper will show the quality information flows intra company that explained at next chapter, and the quality process stages to build the database model for quality management, then last chapter will explain about the process of quality data to quality information that requires the expert system for those purposes.

2. QUALITY INFORMATION FLOWS

There are complicated flows for the quality information in a company. This complication caused by the amount of the person involved in these flows. Actually, we can simplify these flows to a simple model that have included the entire person. This model, as shown at figure 1, have a few entities consists of division in a company. First thing we should do is determining the entities.

For this model, the entities are:

- Top Managements. The top managements are the people that is not involved directly to the quality process but oversee the process that done by the divisions. Top managements are usually the people that give the direction to reach the achievement in the form of vision and strategies then they evaluate the process by achievement reports
- Marketing Division. As one of the most important division of the company, this division expected to derive and provide information about customer need.

- Product Development Division. Product development division would create products or services that fulfill the customer need. Every quality point that given by the marketing division expected to be available in their product regarding the vision and strategies of the company.
- Production Division. This division will be the center of the production process. The division processes the material to be products that satisfied the quality specification. From this point, the flow will separate to two flows. All of them are the tangible flow. This tangible flow contains data that will be changed to information by QC/QA division and customer. The data of the quality that available in the sample product is expected approaching the real condition of the product quality.
- QC/QA Division. The division of quality control will be the processor of the quality data that derived from production division and sales division. This division will produce information and analyze them to make decisions and suggestions. This division is very important in controlling the production and providing information for quality improvements.
- Sales Division. This division is the mediator between customer and the company. Any feedbacks from customer will be sent to this division, this feedback called quality data. The sales division could be the filter for the quality data too.

Actually, this model is designed for manufacturing companies but we could use it for service companies, with some modification of course. The model of quality information flows will be useful to construct the information system for quality management. The next step to detail the model is specifying the quality process stages.

3. QUALITY PROCESS STAGES

The quality information flows model has described the information system for quality management in modular viewpoint. The other viewpoint is the hierarchical one. The hierarchical viewpoint describes the quality management by process stages. That's why it called quality process stages. The quality process stages starts from Product/Service Design to Correction and looped to stage one again. The stages adopting the PDCA cycle in the process.

The Quality Process Stages are:

1. Product/Service Design–Quality definition and specification. This stage process is designing product and starting to define the quality point and specify it.
2. Process Design–Quality specification detail. From this stage, the specification of the qualities of a product is detailed. The detail could be a range of tolerance for a variable quality point, discrete points of an ordinal quality point, or just a go/no go decision for an attribute quality point.
3. Inspection Design–Quality measurement design. The last step of planning is inspection design. This stage will make a planning of inspection for each of the quality points that described by the previous stage. It is very important to design a good inspection or all of the stages will be spoiled. There would be much decision in this stage as designing the right check sheet and methods of data input.
4. Pre-test–Quality specification detail and measurement verification. The pre-test stage will be the corrective stage for the three stages before.

5. Production Process and Inspection–Quality measurement. At this stage, the quality point will be measured and recorded as the inspection design stage have arranged.
6. Process and Product Control–Quality analysis. The quality data that have been recorded at inspection point will be transformed into information using expert system and analyzed by the person in charge or using expert system that have been developed to make an automatic analysis then give decision / suggestion what to do next.
7. Correction–Quality improvement. The correction stage is the stages that may be need more creativity to make an improvement of quality. This stage will make the real quality closer to the target quality.

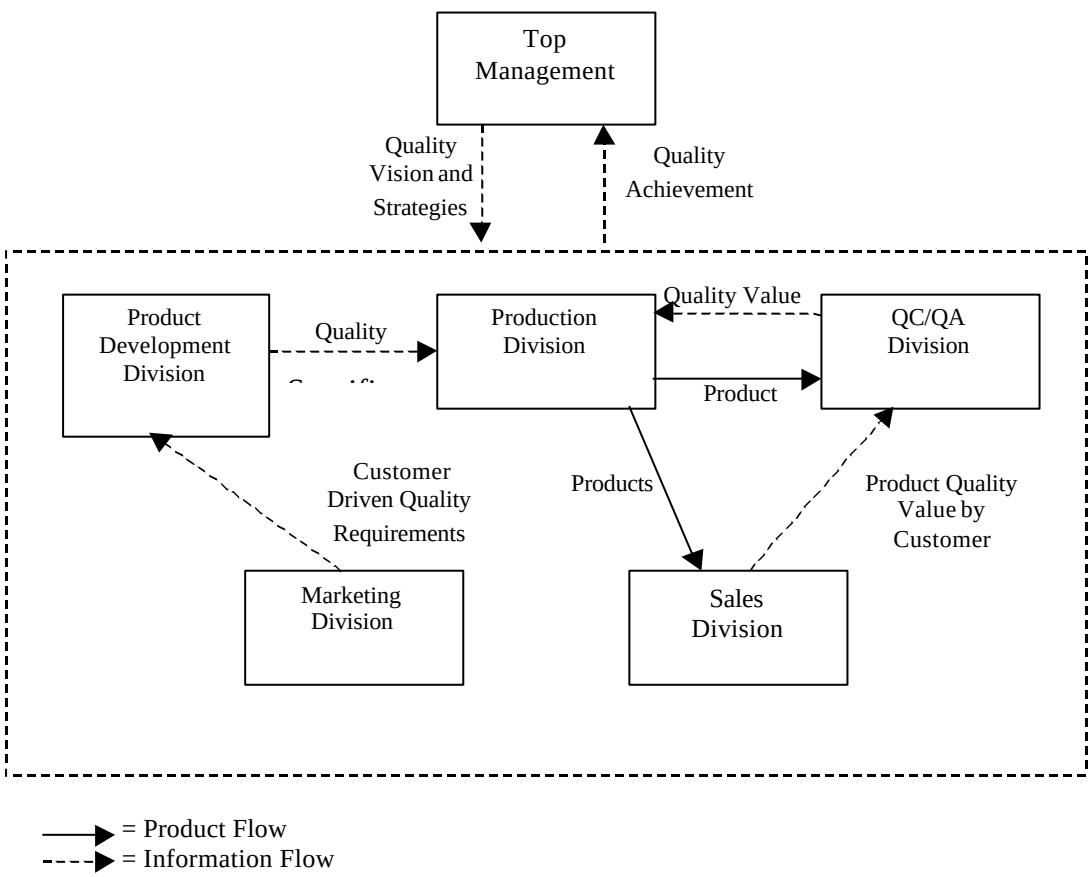

Figure 1. Quality Information Flows Model

4. DATABASE MODEL

The database model built is based on both of the viewpoints, especially the hierarchical viewpoint.

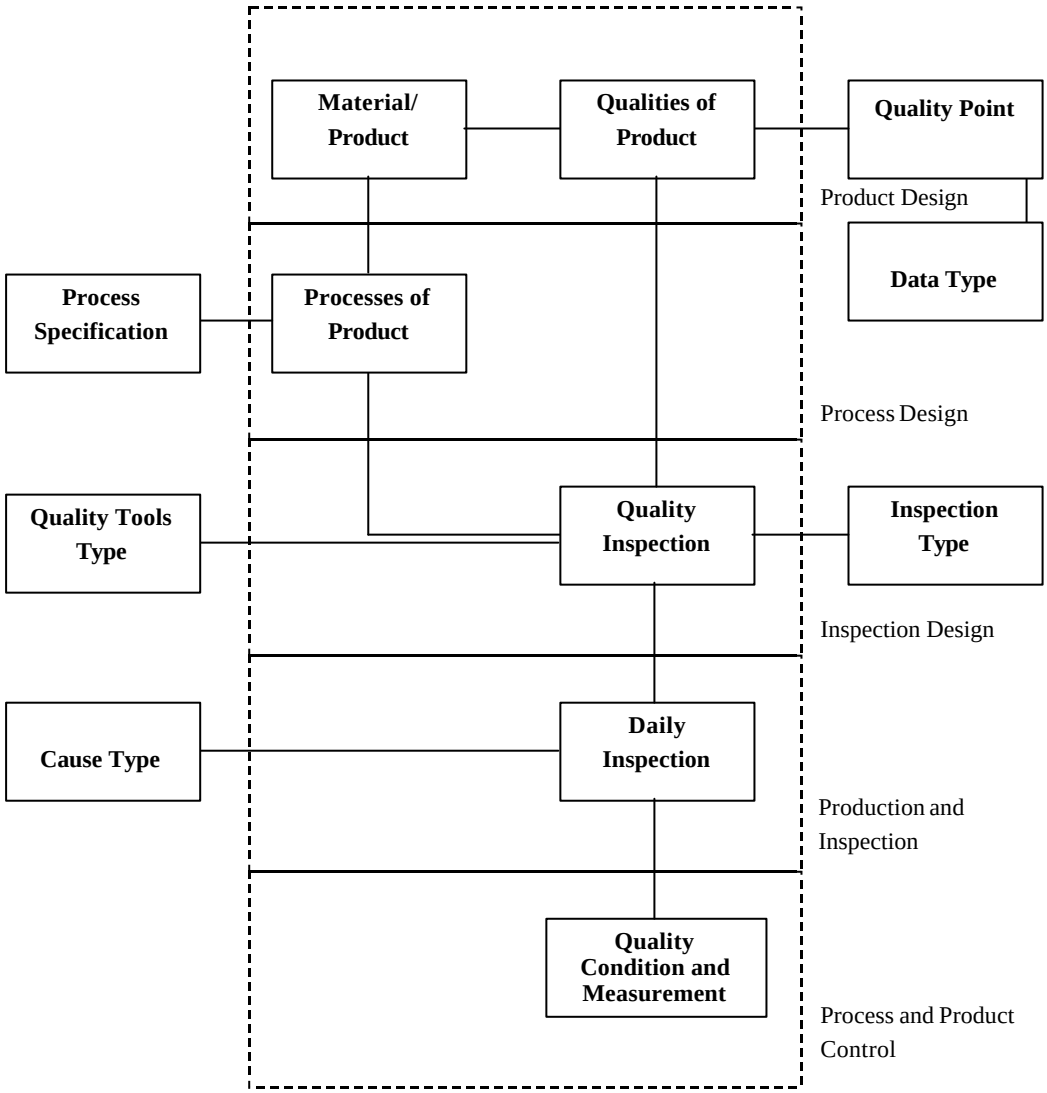

Figure 2. Database Model for Quality Information System

As shown at Figure 2, the database model has been simplified to get the big Figure of the information system of a quality management. The information system of quality management will not be stand-alone but the information system must be integrated with the whole information system of the company, especially the information system of the plant, assuming this model is developed for manufacture industry.

The database model for quality information system can be described as following:

1. Material/Product. This table contains basic data for material and product, for example: the ProductID, Product Name, Designer, Design Date, and so on.
2. Quality Point. Every data about quality point is stored here. Some fields that must be here are Dimension, Unit Measure and Data Type.
3. Qualities of Product. Almost all products have points that important to the value of the product. This table is used as the data storage for connecting between products and quality points. One product could have more than one quality points and one quality points could be used in many products. Some fields that must be here are ProductID, Dimension, and Tolerance.
4. Data Type: This table contains the list of data type like continuous data, discrete data, attribute data and so on.
5. Processes Specification: Any processes available or can be done in plants is written here. Some fields that must be here are ProcessID, Description, and Process Type (Production or Inspection).
6. Processes of Products: The sequences of the production process steps listed here. This table is the basic of the Bill of Material.
7. Inspection Type: This table is used as the list of types of inspection. Inspection could have many forms, like manual inspection, automatic inspection (by machine), online inspection, offline inspection and so on. The online and offline inspection could be explained below:
   a. Online Inspection is the inspection that giving the quality data that measured from products directly to the database. Online inspection can be done in many ways, for example: Using a manual inspection that the operator is facing the input board that sending the data directly to database or using an automatic inspection machine that directly connected to the database.
   b. Offline Inspection is the inspection that giving the quality data to the database after a delay for a few time.
8. Quality Tools Type: This table is used as the list of any quality tools that can be used to transform the quality data to quality information. Surely, every quality tools listed here can be done whether by manual or by machine.
9. Quality Inspection. The most important table is this table. This table contains the information about any decision have been made in inspection design stage such as, quality tools that used, inspection type, product quality that inspected, product process where the inspection held, and so on.
10. Cause Type. This table is listed the cause type of any defect of deviation that relatively high.
11. Daily inspection: This table will be the biggest data storage among another table because it stores all of the historical data for inspection.
12. Quality Condition and Measurement. This table contains the information about quality that transformed from the quality data. Any value store here is created from the quality tools that used for the data transformation. This data will be very important for the quality improvement evaluation and initiation.

5. EXPERT SYSTEM FOR QUALITY MANAGEMENT

Data storage is one of the most important things in information system for quality management but there is another important point. It is the data transformation that produces the information about quality condition and measuring how far the quality level has been. The data transformation could be done by an expert in quality and statistics that will be cost a lot and relatively spend a long time to get the result (Spenger, 1999) or the data transformation is done by an expert system that have a faster capability. The difference between an expert system and human expert is summarized below:

Table 2. The Difference Between an Expert System and Human Expert

	Advantages	Disadvantages
Human Expert	• Requires no initial cost • Have creativity in analyzing and solving the problem	• Limited to one person • Costs a lot of money to train an expert • Relatively longer time in analyzing and solving problem
Expert System	• Relatively faster in analyzing and solving problem • No cost in copying the expertise • Could contains knowledge from more than one human expert	• Requires a lot of money in creating the expert system • Have no creativity in analyzing and solving problem, all of the knowledge must be written before

There is much kind of methods for expert system could be made to complete the quality management system but this paper will explain some of them that have an important role in applying information system for quality management. Each of the methods is explained below:

1. Control chart, run test and pattern recognizer. As one of the seven tools, control chart have become the first thing should be remembered in controlling the process. There are many kind of control chart could be used depend on the type of the data measured.
   a. X-bar chart and R/S chart. This chart is used to control the process that produces the quality points that have variable data type.
   b. P chart and np chart. This chart is used to control the process that produces the quality points that have attribute data type. The attribute data that inspected is the defect of the product. Actually, there is no difference between p chart and np chart but usually, p chart is used for the quality points that historically have more than 1% in defect probability.
   c. C chart and u chart. This chart is used to control the process that produces the quality points that have attribute data type. The attribute data that inspected is the defective of the product. The difference between c chart and u chart is the sample size. If the sample size always changing then the u chart is used.
   d. Geometric chart: This chart is the extension of p chart. Recently, many companies have developed their quality until reaching the ppm level. This condition requires improvement in p chart. The geometric chart is focusing in the count of conforming

products, contradicts to the p chart that focused in the count of non conforming products.

The expert system is expected not only produce the chart but also analyze the chart. This analysis is using the run test and pattern recognizer. This step will help the company to place less people in controlling the process and add more quality points to control. This expert system will give an alarm when the process going out of control.

2. Quality Value. There is many ways in quantifying the quality value. There are three kind of quantification, they are:
   a. Deviation Comparison
   b. Process Capability (Cp Cpk)
   c. Sigma Quality Level

Table 3. The Advantages and Disadvantages

	Deviation Comparison	Process Capability	Sigma Quality Level
Advantage	• Simple concept • Simple computation	• considering the specification and the process • good for variable data	• good for attribute data • Can be used for variable data too • Using fresh data
Disadvantage	• Not considering the specification	• Using smooth data	• Not considering the process

3. Acceptance sampling. This method is used to control the material quality that delivered from suppliers and the product quality that would be sent to customers. The most popular acceptance sampling is the military standard and has been used widely in many companies.
4. Supplier selection. Supplier selection could be done mainly by considering the quality of the material produced by the supplier and the cost of ordering and price. Many algorithms have been written to fulfill this need and the most optimal one is using the linear/nonlinear programming.
5. Forecasting. This method usually used by a marketing division to forecast the quantity of the demand. The purpose of this method is predicting the demand at the next period. Usually, forecasting method is based on timeline.
6. Production scheduling. Production scheduling can be used to minimize the cost and time to fulfill the customer needs. The same thing with supplier selection, there are a lot of algorithms have been built with vary condition of the plants.

6. CONCLUSION

The Information System for Quality Management has wider application than just building a database system. The information system consists of the data storage, user interface and expert system. The designing of information system for quality management could be done by building the model for information system as the first step. There are two models that start from different viewpoints. The first viewpoint is modular viewpoint that translated to quality information flows model and the second viewpoint is

hierarchical viewpoint that translated to quality process stages model. The entire model is used to build the database model and designing the expert system.

The quality management is a wide concept. The final aim of quality management is quality improvement that needs the more complicated information system. The building of database system and expert system will be walk together to reach the aim.

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