DEVELOPING DECISION SUPPORT SYSTEM (DSS) AS A TOOL IN EVALUATING MINING COMPANY PERFORMANCE BASED ON QUALITATIVE PARAMETERS

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ABSTRACT

ANDES JAYARSA (2005). Developing Decision Support System (DSS) As a Tool in Evaluating Mining Company Performance Based on Qualitative Parameters. Under the supervision of KUDANG BORO SEMINAR and IDUNG RISDIYANTO.

Over the past decades, the mining industry has made a significant contribution to the development of Indonesian economy. It has been a pioneer industry for regional development, and a source of foreign exchange, direct income, jobs and business opportunities for Indonesian citizen. The development of mining industry is in line with the spirit of article 33 of the 1945 Constitution (as amended) that stipulated: “land, water and air are controlled by the state and shall be utilized for the maximum benefits of the people”. In addition, one of the key outcomes of Johannesburg commitments is to support the participation of external stakeholders, and to address the environmental, economic, health, social impacts and benefits of mining, minerals and metals throughout their life-cycles and to foster sustainable mining practices.

Recent days, the term of Good Mining Practice is repeatedly buzzed by the government particularly the Department of Energy and Mineral Resources. The utilization of mineral and energy resources will bring an optimal outcome and minimum side effect if the exploitation management or the process of mineral resources is carried out appropriately according the principle of Good Mining Practice (Propenas 2002-2004). An award to certain mining company who has already carried out good mining practice appropriately is reasonable. Objective evaluation to mining company performance can be done comprehensively regarding the way and the obedient of good mining practice aspects, transparently by involving stakeholders. Thus, an evaluation system needs to be developed to evaluate mining company performance.

The expected output of this research is a Decision Support System (DSS) tool that can be used by government, particularly Department of Mineral and Energy Resources ( Technique Directorate of Coal and Mineral) to evaluate mining companies performance regarding Good Mining Practice aspects.

The result of this research showed that the proposed system (MICES-Qual) has capability and advantages in evaluating mining company performance compared to the existing system in Technique Directorate of Coal and Mineral. MICES-Qual prototype was built as a web application and desktop application. The web application used for inputting and displaying data was designed by using PHP script, while the DSS tool to evaluate data keyed in by user was built by using a programming language.
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STATEMENT

I, Andes Jayarsa, here by stated that this thesis entitled:

Developing Decision Support System (DSS) As a Tool in Evaluating Mining Company Performance Based on Qualitative Parameters

Are results of my own work during the period of March to October 2005 and that it has not been published before. The content of the thesis has been examined by the advising committee and the external examiner.

Bogor, October 2005

Andes Jayarsa
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Welcome to the MICES-Qual program. This program will provide assistance in evaluating particular mining company performance. MICES-Qual consists of two main applications, which are web application and desktop application. Web application is used as a tool in inputting data directly through internet and also used to score particular mining company, while desktop application is used to evaluate score submitted through web application.

WEB APPLICATION

1. Main Page
   This main page will appear if the user uses internet connection by typing the website address.

2. Navigation Menu
   This navigation menu can be clicked in order to obtain information regarding each component of good mining practice.
For example, if user click K3_Programs menu, the next figure will appear on the screen.

User can select particular mining company to see their K3 Program in a certain year. Figure below shows the result of K3 Programs of PT. Newmont Nusa Tenggara in year 2000.

3. Login Menu

There are two kinds of login provide in this page, first is used by mining company if they want to submit their report and the second is used by stakeholder if they want to give score to a certain mining company.
A. Company Login

If this menu were clicked, login page for mining company will appear.

If the user name and password typed by user is correct, the next figure will appear. This page contains of good mining practice components that can be clicked in order to submit the report.

For example, if the company wanted to input their data regarding K3 Programs, they have to click K3 Program menu and the next figure will appear.
Mining company can fill their data by completing the form provided as seen in the above figure. Then, click “SAVE” button if they want to save the data.

B. User Login

If this menu were clicked, the next page will appear. The user should fill this page correctly by typing a correct username and password.

If the username and the password is correct, then the user can give score to a certain mining company by using the scoring form as shown in this figure below.
After all boxes have been filled, then the user can click “SAVE” button in order to save their score for particular mining company.

DESKTOP APPLICATION

1. Main Form

This figure below shows the main form of desktop application this form has menu on the left topside.
There are three menus available, but the most important menu is Analysis menu where consists of several sub menu, which are View Scoring Summary, Parameter Weighting and Evaluate Company Performance.

2. View Scoring Menu

If this menu were clicked, the next form will appear.

This form is used to see the score summary of a certain mining company for a certain year that has been scored by the stakeholder through the web application.
3. Parameter Weighting Menu

If this menu were clicked, the next form will appear. This form is used to derive weight for each good mining company components. Boxes available in this form can be filled by number 9, 8, 7, 6, 5, 4, 3, 2, 1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, and 1/9, 9 representing absolute importance and 1/9 the absolute triviality.
After the boxes have been filled, user can click SYNTHESIZE MATRIX to see whether our judgment regarding the priority of each component is consistent or not.

The form above shows the weighting result. It contains information regarding weight for each component, and CR (Consistency Ratio). CR should be less then 0.1, if CR more than 0.1 then our judgment should be reviewed again. The weight then can be saved by clicking “SAVE” button.

4. Evaluate Company Performance Menu

If this menu were clicked, then the next from will appear. In this form we can select company name and year that is going to be evaluated. User can choose the priority type (weight) used for evaluating mining company performance. If “Default” option were chosen, then the weight used for evaluating will be equal for each component of good mining practice. If “User Define” option were chosen, then the evaluation will use weight that has been obtained by the user from number 3 above.
The figure below shows the sample result of performance evaluation. It contains information about final score for particular mining company, and indicator to show whether that company performance is Very Good, Good, Adequate, Bad or Worse for a certain year.

The evaluation result can be saved into the database by clicking “SAVE” button. The stakeholder can see this result by using Internet.
To see the performance of particular mining company, user should click button first, then on the map, click the company that want to be seen its performance. After it has been clicked, on the information box, there will be information regarding that company.

Click “See Company Performance” to see the performance of that company. The below page will appear.
CHAPTER I
INTRODUCTION

1.1 BACKGROUND

Over the past decades, the mining industry has made a significant contribution to the development of Indonesian economy. It has been a pioneer industry for regional development, and a source of foreign exchange, direct income, jobs and business opportunities for Indonesian citizen. The development of mining industry is in line with the spirit of article 33 of the 1945 Constitution (as amended) that stipulated: “land, water and air are controlled by the state and shall be utilized for the maximum benefits of the people”. In addition, one of the key outcomes of Johannesburg commitments is to support the participation of external stakeholders, and to address the environmental, economic, health, social impacts and benefits of mining, minerals and metals throughout their life-cycles and to foster sustainable mining practices.

Recent days, the term of Good Mining Practice is often buzzed by the government particularly the Department of Mineral and Energy Resources. The utilization of mineral and energy resources will bring an optimal outcome and minimum side effect if the exploitation management or the process of mineral resources is carried out appropriately according the principle of Good Mining Practice (Propenas 2002-2004).

Through good mining practice, lavish mineral and energy resources exploration can be hindered so that optimal resources can be achieved,
environmental functions can be protected and also the safety of people who involves in it is also being guaranteed. The application of good mining practice will obstruct the emerge of environmental and community social shocked cases. Good mining practice which concern to environmental concept is carried out by giving attention to some aspects, which are Mining Occupational Safety and Health (Keselamatan dan Kesehatan Kerja – K3), environmental management and protection, the effort of increasing added value of mineral resources, and mining conservation. All of this aspect must be carried out in the frame of Indonesian laws.

An award to certain mining company who has already carried out good mining practice appropriately is reasonable. Objective evaluation to mining company performance can be done comprehensively regarding the way and the obedient of good mining practice aspects, transparently by involving stakeholders. Thus, an evaluation system needs to be developed to evaluate mining company performance.

In assessing and monitoring mining company performance regarding the obedient to good mining practice aspects, information system is one of the important factors that need to be considered. Haklay (1999) in Mulyarto (2003) stated that it’s virtually important to think about environmental research without relying heavily on digital technology. Information system casts a shadow over almost every aspects of the environment debate: research, monitoring, management, and decision-making.

The available system of reporting company performance in recent years is done manually. Each mining company will write report based on their style. There
is no standardization. This situation will bring difficulties to the government in evaluating the report. Moreover, the report is not integrated. Meaning that, each aspect of good mining practice is separated. The other disadvantage of the available system is it cannot be accessed directly by the people. Institution (Educational, Research Institution, Mining Company Association) and public (community, Observer and NGO) do not know what is going on to the company regarding its contribution to local people or their activity influence to the environment. They cannot know the history of company activities. If some shocked cases occurred, they will blame each other without knowing what is the cause of the problem.

Due to this condition, an integrated information system is needed to cover those problems. The development of this integrated information system regarding mining company performance to fulfill good mining practice aspects is expected as an input to decision support system of Mineral and Energy Resources Department in evaluating mining company performance from time to time. Mining companies can do their report directly using Internet by filling the available standardized forms. The filled forms then being converted to the information system forms at department of mineral and energy resources. At the end, the evaluated report will be released again to the Internet in order to give chance to stakeholders based on their expertise and background to evaluate and suggest given report. The Internet plays an important role in this system. Internet has become mass communication tool that is constantly changing and evolving. It has contributed greatly to the exchange of ideas and information, and creates a medium for collaboration and interaction between individuals and their computers.
without regard for geographic location. The Internet has been described as a technology that has created rapid global integration and is referred to as the “information superhighway”. Mining companies can update their reports directly through Internet, in other hand stakeholder can access the reports almost in the same time.

There are several approaches of developing information system. Two major approaches are structured and object oriented approach. This research will adopt object oriented (OO) approach because of its advantages. Object oriented technology is not a new thing as most people assume, but it is certainly an interesting topic. According to Nugroho (2002) the main factor of discovering object-oriented approach is due to the disadvantages of structured approach: the difficulties of maintenance, longer accomplishment time, high cost of software development and others. Some characteristics of object-oriented approach are big program can be divided into objects, functions that operate data is integrated in the same object, objects can communicate each other by sending messages.

The approach that has been using for years is structured programming. Structured programming is a top-down approach, which breaks a program down into components until the components cannot be decomposed anymore. In Structured programming, if the design were found to be incorrect after programming has started, then the design would have to be entirely restructured. And that would cost corporations time and money. With the object-oriented approach, the design of the whole system could be modeled at a higher level. Any potential problems with the design can be fixed at this level without having to start any programming. Also, people can easily understand the system as objects
rather than procedures since people think in objects. Since it’s more natural to think of a system in objects, it is understandable why OO technology is gaining popularity.

1.2 PROBLEM IDENTIFICATION

The current system of reporting mining company activities is done manually. The report from mining company is submitted directly to the government, in this case Department of Mineral and Energy Resources through its Directorate of Mineral and Coal Technique. There are some disadvantages found in this system, which are:

1. Format of the report is not standardized. It means that every mining company makes their report based on their style. This will bring difficulties to the government in evaluating the report.

2. The evaluation of mining company is done partially for each good mining practice components.

3. The report never been released to the public. Stakeholders as the party who are always affected by mining company activities never knows what is going on to their environment due to mining activities in their neighborhood or what is the contribution that mining companies have made to support local economic growth, etc.

4. There is no continuity of the report since every report that has been submitted can be in different form or missing.
1.3 OBJECTIVE

The expected output of this research is a Decision Support System (DSS) tool that can be used by government, particularly Department of Mineral and Energy Resources (Directorate of Mineral and Coal Technique) to evaluate mining companies performance regarding Good Mining Practice aspects. In order to achieve that, the objective of this research will be divided into three, which are:

1. To develop database system for inventorying each aspect of good mining practice parameters (Mining Occupational Safety and Health, the effort of increasing added value of mineral resources) for each mining company.

2. To develop a web that can be used by mining companies to submit their report directly through Internet. Through this web, the process will be faster and it will raise more transparency to the stakeholder since each stakeholder can see and monitor the report directly.

3. To develop decision support system tool called Mining Company Evaluation System Based on Qualitative Parameters (MICES-Qual), regarding mining companies obedient to the aspects contained in good mining practice manual.

The government, particularly Department of Energy and Mineral Resources, will use this information system to evaluate certain mining company performance. For the purpose of this research, there will be only several companies taken as sample. There are two types of mining company that are mineral mining company and energy mining company. The sample company will represent both type of mining company.
1.4 PROBLEM CONSTRAINT AND ASSUMPTION

There are 4 aspects in good mining practice that should be considered, which are Mining Occupational Safety and Health (K3), Mining Environmental Protection, Mining Added Value Improvement and Mining Conservation. These 4 aspects can be grouped into 2 main aspects, which are qualitative aspect (K3 and Mining Added Value Improvement aspect) and quantitative aspect (Mining Environmental Protection and Mining Conservation). Since each aspect consists of many parameters that should be included in evaluating mining company performance, so this research will be constrained on qualitative aspects only, which are K3 and mining added value aspect.

This research used assumption that there will be no bias value in scoring particular mining company; every evaluator will give the appropriate score to a mining company they scored. There will be no extreme condition where one evaluator gives a score contradictory to other evaluator. For example one evaluator gives 100 to particular component of good mining practice while others give 0 or 20 for the same component evaluated.

1.5 USER IDENTIFICATION

Potential users of this system which are classified as stakeholders can be grouped into 3 types, which are:

1. Actor

Actor means the main user of the system, in this case is mining companies. The actor will use this system to key in their report directly through the Internet.
2. Observer

Observer consists of institution (academic community, research institution, and mining expertise association) and public (local community, independent observer or NGO who is concerning about mining activities). Selected observer will monitor reports of particular mining company and giving value or rate regarding the report based on their own expertise.

3. Evaluator

The evaluator of this system is the Department of Energy and Mineral Resources (DESDM). The evaluator will summary all of the rated report by the observer, and giving final evaluation regarding the performance of mining companies.

1.6 THESIS STRUCTURE

The thesis is structured into five chapters. Each chapter is described as follows:

- Chapter 1 describes research background, problem identification, objective, problem constraints, and user identification.
- Chapter 2 describes literature review related to the theory of Decision Support System and multi-criteria decision making, database management system, system development life cycle (SDLC) for developing Information System, general concept of internet and at the end of this chapter describes good mining practice (GMP) components.
Chapter 3 describes research methodology in building this system. It includes data sources, tools used in the research, location, database design, information system development and decision support system development.

Chapter 4, which is Result and Discussion, describes analysis result after the system is implemented.

Chapter 5 consists of conclusion and recommendations.
A software or information system is not being made effortlessly. The making and development of software or information system often needs big amount of money and time. For that reason, the development of information system or software constitute strategic decision that must be done by top level managers in one company, based on information given by system analyst.

2.1 DECISION SUPPORT SYSTEM

What is Decision Support System (DSS)? The concept of DSS was first articulated in 1970s by Scott Morton under term management decision systems. He defined such systems as “interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems”. Another definition of DSS introduced by Keen and Scott Morton (1978) follows:

“Decision support system couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semi-structured problems.”

Moore and Chang (1980) define DSS as (1) extendable systems, (2) capable of supporting ad hoc data analysis and decision modeling, (3) oriented toward future planning, and (4) used at irregular, unplanned intervals. There are so many definitions and concepts about DSS as we can see from above description. So, at minimum we can say: A DSS is an interactive, flexible, and adaptable computer-
based information system, specially developed for supporting the solution of a non-structured management problem for improving decision making. It utilizes data, it provides easy user interface, and it allows for the decision maker’s own insight.

Aiding the deficiencies of human judgment and decision making has been a major focus of science through its history, because in many situations the quality of decisions is important, as particularly in complex systems, as management of organizational operations, industrial processes, or bidding processes (Seydel and Olson, 2001).

2.1.1 Multi-Criteria Decision Making

Project managers are faced with a complex decision environments and problems in their projects. The elements of the problems are numerous, and the inter-relationships among the elements are extremely complicated. Relationships between elements of a problem may be highly nonlinear; changes in the elements may not be related by simple proportionality. Furthermore, human value and judgment systems are integral elements of project problems (Al-Harbi, 1999). Therefore, the ability to make sound decisions is very important to the success of a project.

Multiple criteria decision-making (MCDM) approaches are major parts of decision theory and analysis. They seek to take explicit account of more than one criterion in supporting the decision process. The aim of MCDM methods is to help decision-makers learn about the problems they face, to learn about their own and other parties’ personal value systems, to learn about organizational values and
objectives, and through exploring these in the context of the problem to guide
them in identifying a preferred course of action (Al-Harbi, 1999). In other words,
MCDM is useful in circumstances which necessitate the consideration of different
courses of action, which can not be evaluated by the measurement of a simple,
single dimension.

Good Mining Practice involves integration of many criteria. These criteria
used by government for evaluating mining company performance. Criteria here
are competing with one another; criteria are both qualitative and quantitative. So
the evaluation of mining company performance is a multiple criteria decision-
making process.

Commonly used MCDM methods in decision-making are ranking and
rating. These methods lack theoretical foundation in deciding the weights. These
methods assign the weights rather arbitrarily. They don’t take comparison among
the criteria and classes into considerations. Moreover, the outcomes of such
analysis are aggregated using simple Boolean overlay or weighted aggregation.
Both the methods are supposed to yield similar results, which they never do
(Prakash, 2003). The reason is being with the logic of aggregation. The Boolean
method of characterizing the criteria is too black and white. Boolean intersection
(AND) results in a very strict output, i.e. if it fails to fulfill single criteria a region
will be excluded from the results (Black). In contrast, Boolean union (OR) will
include an area in the result if that area fulfils a single criteria (White).

wise comparison for land suitability. This method overcomes the problem of
determining the weights. But they have not taken into consideration the
hierarchical organization of the criteria, which is the basic principle of Analytical Hierarchy Process (AHP). Hence it shows that they have just used the matrix pairwise comparison as a tool to derive weights. They have not implemented the AHP as a whole for decision-making. AHP is a widely used method in decision-making and is introduced by Saaty (1977). It is developed to select the best from a number of alternatives with respect to several criteria. AHP allows for both the inconsistency in the decision and provide the means to improve the consistency. Here the decision maker or the user will perform simple Pairwise Comparison i.e. he/she will compare two elements at a time.

The values of the Pairwise Comparison are determined according to the scale introduced by Saaty. The available values for the comparison are the member of the set: \{9,8, 7, 6, 5, 4, 3, 2, 1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9\}, 9 representing absolute importance and 1/9 the absolute triviality. The AHP gained high popularity because of easiness in obtaining the weights and capacity to integrate heterogeneous data, and therefore AHP is applied in a wide variety of decision problems.

2.1.2 Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process is a widely used method in decision-making. AHP was introduced first by Saaty (1977), with the basic assumption that comparison of two elements is derived from their relative importance. As described before, some research used AHP method only to utilize the matrix pairwise comparison as a tool to derive weights. They have not implemented the AHP as a whole for decision-making. This research will use the combination of scoring and weighting method. Weighting method used for this research will
adopt Ceballos-Silva and Lopez-Blanco (2003) method, where the weighting process will use pairwise comparison matrix for each criterion.

Analytic means the separation of an entity into its constituents. This method decomposes the complex decision problems into simple groups and hierarchies. Hierarchical organization of the criteria is common in large decision problems. This is advantageous in the decision making process, where relative importance of the criteria under evaluation is to be established consciously. It is proven that the human brain is not able to process more than seven stimuli at a time (Miller, 1956 in Prakash, 2003). Besides, empirical studies showed that people couldn’t compare more than three criteria at the same time (Rommelfanger, 2003). Therefore, a hierarchical organization of the criteria helps to decompose the complex decision making processes, as suitability evaluation. A particular hierarchy or group helps to maintain the consistency among the comparisons and weightings of the criteria. Moreover, criteria that are comparable to each other are organized at the same level. Furthermore, the hierarchical structure has the ability to incorporate decisions or expert knowledge of people from various domains, especially while an environmental decision problem is an interdisciplinary terrain.

The decision-making in AHP is a continuous process starting from analyzing the decision environment to understand and arrange the criteria into different groups and levels till evaluating the criteria in its decision outputs.

The fundamental input for the AHP is the pairwise comparison matrix, which gives answers to a series of questions like: ‘How important is criterion a relative to criterion B?’ In AHP, comparisons are used to establish both weights for criteria and preference scores for classes on different criteria. The comparisons
are measured on a ratio scale. First, a decision-maker has to make comparison between each element under evaluation. Here, the comparisons are made qualitatively, for example weak preference, moderate preference etc., and are termed as Pairwise Comparisons (PCs). Later, these preferences are converted to quantitative values using the scale designed by Saaty (1977). (Table 2.1).

Table 2.1 Fundamental Scale used in Pairwise Comparison

<table>
<thead>
<tr>
<th>Intensity of Importance</th>
<th>Quality of Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal Importance</td>
<td>Two activities contribute equally to objective</td>
</tr>
<tr>
<td>2</td>
<td>Weak</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moderate Importance</td>
<td>Experience and judgments slightly favor one activity over another</td>
</tr>
<tr>
<td>4</td>
<td>Moderate Plus</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Strong Importance</td>
<td>Experience and judgments strongly favor one activity over another</td>
</tr>
<tr>
<td>6</td>
<td>Strong Plus</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Very Strong or Demonstrated Importance</td>
<td>An activity is favored very strongly over another and dominance is demonstrated in practice</td>
</tr>
<tr>
<td>8</td>
<td>Very, Very Strong</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Extreme Importance</td>
<td>The evidence favoring one activity over another is of the highest possible order of affirmation</td>
</tr>
</tbody>
</table>

Saaty developed the following steps for applying the AHP (Al-Harbi, 1999):

1. Define the problem and determine its goal.

2. Structure the hierarchy from the top (the objectives from a decision-maker's viewpoint) through the intermediate levels (criteria on which subsequent levels depend) to the lowest level which usually contains the list of alternatives. Figure 2.1 presents a simple of the hierarchy, which is commonly used in the relative measurement model.
3. Construct a set of pair-wise comparison matrices (size $n \times n$) for each of the lower levels with one matrix for each element in the level immediately above by using the relative scale measurement shown in Table 2.1. The pair-wise comparisons are done in terms of which element dominates the other. The pairwise comparison matrix (PCM) is a reciprocal matrix in which elements under its main diagonal are inverses of the upper elements. For instance, the matrix $C$ below presents a PCM obtained from pairwise comparison of the three criteria ($C_1$, $C_2$, and $C_3$) with respect to the goal.

$$
C = \begin{bmatrix}
    c_1 & c_2 & c_3 \\
    1 & 3 & 5 \\
    1/3 & 1 & 2 \\
    1/5 & 1/2 & 1
\end{bmatrix}
$$

4. There are $n(n - 1)/2$ judgments required to develop the set of matrices in step 3. Reciprocals are automatically assigned in each pairwise comparison.
5. Hierarchical synthesis is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy.

6. Having made all the pair-wise comparisons, the consistency is determined by using the eigenvalue, $\lambda_{\text{max}}$, to calculate the consistency index, CI as follows: $\text{CI} = (\lambda_{\text{max}} - n)/(n - 1)$, where $n$ is the matrix size. Judgment consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value in Table 2.2. The CR is acceptable, if it does not exceed 0.10. If it is more, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.

7. Steps 3 - 6 are performed for all levels in the hierarchy.

<table>
<thead>
<tr>
<th>Size of Matrix</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Consistency</td>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.9</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

2.2 DATABASE MANAGEMENT SYSTEM

A database is a collection of interrelated data organized in such a way that it corresponds to the needs and structure of an organization and can be used by more than one person for more than one application (Turban, 1995). The data in the database are stored together with a minimum of redundancy to serve multiple applications, so the database is independent of the computer program that uses it and the type of hardware where it is stored. A database can be defined from several perspectives (Fatansyah, 1999), such as:
Collection of data group (archives) that related each other, which is organized in such way so that in the future it can be utilized again quickly and easily.

Collection of interrelated data kept together in such a way without unnecessary redundancy, to fulfill many kinds of needs.

Collection of files/tables/archives that related each other, kept in electronic storage medium.

DBMS performs three basic functions. It enables storage of data in the database, retrieval of data from the database, and control of the database.

### 2.2.1 Storage

DBMS varies the configuration of the stored data. Mainframe systems store many large files, each containing many records, each record containing many data items, and the data items containing many characters. The systems for microcomputer offer more constrained capacities because of limited primary and secondary storage spaces. (This limitation is becoming less and less factor.)

### 2.2.2 Retrieval

The feature of DBMS most visible to the user is data retrieval. Current DBMS offer great flexibility in terms of how the information is retrieved and displayed. With a sophisticated DBMS, the user can specify certain processing of data and customize the output (e.g., reports or graphs) in terms of heading and spacing.
2.2.3 Control

Much of the control activity of the DBMS is invisible to users. The users ask for some information and receive it without knowing the process that the DBMS has performed. The DBMS can be designed to screen each request for information and determine that (1) the person making the request is indeed an authorized user, (2) the person has access to requested file, and (3) the person has access to the requested data items in the file. A mainframe DBMS might perform all the control functions very well.

There are some capabilities of DBMS in DSS (Turban, 1995), which are:

- Captures/extract data for inclusion in a DSS database
- Quickly updates (adds, deletes, changes) data records and files
- Interrelates data from different sources
- Quickly retrieves data from a database for queries and reports
- Provides comprehensive data security (protection from unauthorized access, recovery capabilities, etc.)
- Handles personal and unofficial data so that users can experiment with alternative solutions based on their own judgment
- Performs complex retrieval and data manipulation tasks based on queries
- Tracks usage of data.
2.3 INFORMATION SYSTEM DEVELOPMENT

2.3.1 Information System Definition

An Information System (IS) is a set of people and procedures, and resources (dataware, hardware, and software) that collects, transforms, maintains, and disseminates information in an organization (O’Brien, 1999). According to Altar (1992) in Kadir (2003), Information system is a combination between working procedures, information, peoples, and information technology which is organized to achieve the goal in one organization.
In the real situation, not all information system can cover all those components. For example, Personal information systems that only involve one user and computer, without occupying network facility and communication. However, workgroup information systems involve several people and number of computer and occupying network facility and communication.

2.3.2 The Stage of Information System Development

The development of information system can have two meaning; the first one is to develop new information system from the scratch, the second one is to complete the existing system to be perfect. But sometimes the development of computer based information system is carried out with motivation to utilize the computer as helping tool which is known as quick, accurate, non-tired and non-bored tool to perform user instructions.

Generally, an information system needs to be replaced or developed because some reasons (Jogiyanto, 1995 in Nugroho, 2002):

1. There is problem found in the old system.

   The problem in old system could be inaccuracy in writing the data, information that often late or difficulty in acquiring when it is needed, operational inefficiency, and the insecure of important data that can be accessed by un-authority user.

2. Organization growing

   When the organization is still small, may be everything can be done manually. However, when the organization is growing, it is not possible to do everything manually. Due to this condition, it is needed to have
automatic process for the data so that processes in the organization can run quickly and accurately.

3. To acquire opportunities

Information technology is developing rapidly. Organization realizes that information technology has to be used to improve information supplying to manager in making decisions. In the situation of competing market, rapid information sometimes determine the success of strategy and plan in acquiring opportunities.

There are some methods of developing information system introduced by several authors, but basically all of the methods follow the frame as shown in figure 2.4. The figure was taken from Object Oriented Programming With C++ book by Balagurusamy, 1999 (Nugroho, 2002).

![Figure 2.4. The framework of Information System Development (Nugroho, 2002)](image-url)
In some books, the method of developing information system as shown in Figure 2.4 is known as System Development Life Cycle (SDLC). The first stage (Investigation) is related to user needs study, feasibility study regarding technical study or technology study and also the schedule making of the development information system project. The next stage is analysis stage; in this stage we attempt to identify the entire problem found by the user, identify system components, objects, and relationship among objects. The third stage is the stage where we attempt to find solution to the problem found in analysis stage. The forth stage is implementation stage where we implement system design to the real situation. In this stage, we are dealing with selecting hardware, coding, and also testing whether the system we made is already appropriate to the user or not. If not, the next process is iteration which go back to the previous stage. The final stage is maintenance stage; where in this stage we start to operate the system and if needed we can do small adjustment.

In many cases, the traditional SDLC have to be modified because of its limitation, such as costly and time consuming, inflexible and discourage change, and ill-suited to decision making (Hoffer, 2002 in Mulyarto, 2003). One alternative approach that can be used is prototyping. According to O’Brien (1999), prototyping is the rapid development and testing of working model, or prototypes, or new application in an interactive, iterative process that can be used by both systems analysts and end user. Prototyping is an interactive process that combines stages of the traditional systems development (see Figure 2.5).

The advantages of prototyping are users are involved in design and captures requirements in concrete form (Hoffer, 2002 in Mulyarto A.R, 2003). Prototyping
makes the development process faster and easier for system analysts, especially for projects where end user requirements are difficult to define.

![Diagram of Prototyping Development Stages](image)

Figure 2.5. Prototyping Development Stages (O’Brien, 1999)

### 2.4 THE INTERNET

Information is one of the keyword nowadays. In order to obtain and generate information, computer and its technology constitute one of the most appropriate aiding tools. The demand of information needs and the increasing number of computer utilization have driven the computer network development that can serve many type of need. This type of computer network, which is so called Internet, can be accessed and utilized for any other purposes, by anyone, anywhere and anytime. Various types of Internet technology can be used; one of them is World Wide Web (WWW) that can provide information in the form of texts, image, voice as well as moving picture. By this capability, web has becoming popular and its evolvement is very rapid.
The Internet is a global communications network consisting of thousands of networks typically interconnected by fiber optic cabling. The network connects machines which support multiple users to access networked resources, which allows public and private computers to link together to exchange information.

The launching of the Internet’s World Wide Web in 1990, followed by the free distribution of Netscape in 1994 turned an established but little-known technology for the scientific community into a user-friendly Web for people (World Bank, 1999 in Voudouris 2004). This not only brought wider access at a lower cost, it also brought a whole new structure of communication allowing simultaneous transfers of information in words, numbers and images to points around the world. Today the Internet can be used to send e-mail messages, read magazines, make bank deposits, make airline reservations or find a job. The Internet is dynamic, constantly changing and evolving. Sites are added, taken down, moved, updated and revised on a constant and unpredictable basis. The Internet has shrunk the world of communications, making interaction possible at a distance in real time (World Bank, 1999 in Voudouris 2004).

Figure 2.6 Basic concepts of Browser and Server Web (Voudouris, 2004)
The Internet has contributed greatly to the exchange of ideas and information, and creates a medium for collaboration and interaction between individuals and their computers without regard for geographic location. Today, people engage more then ever in associations that span national borders, from informal networks to formal organizations (World Bank, 1999 in Voudouris 2004).

“Recent developments in the field of communications and information technology are indeed revolutionary in nature. Information and knowledge are expanding in quantity and accessibility. In many fields, future decision makers will be presented with unprecedented new tools for development. In the field of environmental management the consequences really could be revolutionary. Communications and information technology have enormous potential especially for developing countries, and in furthering sustainable development

“(United Nations Secretary General Kofi Annan, 1997).

The Internet can be particularly beneficial to the scientific community as isolated academics and scientists can easily communicate with colleagues and take part in online conferences keeping up to date with discussion and developments in their field. They can also obtain remote help using a listserv or News group function.

The Internet allows environmental professionals to use e-mail to exchange ideas and information on new technologies and to come together at a low cost to work together successfully on proposals and projects (Sabharwal and Nicholson,
Although the growth of this new information technology has been unprecedented, it is not known whether its potential has been realized today.

The information revolution has only just begun on a worldwide scale and its networks are spreading wider every day, but they are heavily concentrated in a few countries. Communications and information technology have enormous potential for developing countries.

2.5 GOOD MINING PRACTICE

Concept in general mining industry states that mineral mining industry which produces metal, industry excavation material (non-metal) and energy (coal) as well as earth heat have weighting point on the issue of “democratic, justice and even distribution” that must involve between generation and intergeneration. This concept can only be done very well if we involve stakeholder interest optimally in the form of association.

Practice paradigm in good mining practice (figure 2.7) develops civilization as a mining activity that fulfills requirements, criteria, principles and norms appropriately so that the exploitation of mineral resources can bring an optimal outcome and minimize the bad effect.
Suyartono (2003) stated good mining practice management need to be examined and developed continuously, it is expected through good mining practice lavish mineral resources and coal can be hindered, optimal mineral resources can be achieved, and environmental function can be protected as well as Mining Occupational Safety and Health (K3) of the workers.

2.5.1 Mining Occupational Safety and Health

General mining industries in Indonesia have well developed since 150 ago. On the beginning of its development, this industry was categorized as high-risk industry, particularly the safety of worker. Due to that condition, since 1930 the regulation regarding Mining Occupational Safety and Health is available in Indonesia, especially for the mining sector.

As the knowledge in geology, mining technique and working method have been developed, stigma as high-risk industry has shifted to industry with
“calculated” risk. Calculated risk means there is improvement from low stage to higher stage by comprehensive studies, such as improvement from general investigation to exploration stage, to feasibility studies stage, to construction stage, to experimental production stage and finally to fully operation stage. In each stage, economical risk as well as potential hazard is studied.

Even though there was a shifting from high-risk to calculated risk, however potential risk in certain limitation is still exist. If the potential hazard is out of control, it can endanger production, properties, and particularly human being (workers and local neighborhood). For that reason, management of potential hazards, starting from identification to prevention becomes very important and must be managed orderly and systematically.

According to Suyartono (2003), Mining safety management includes:

1. Considering and calculating potential hazards, which can endanger the workers and equipments.
2. Performing and maintaining/guarding and also controlling:
   - Mining pattern
   - Training and education
   - Mining equipment maintenance
3. Sufficient management structure to identify risk and to apply control.

There are some elements that should be included in mining safety management, which are:

1. There should be mining technique head (Kepala Teknik Tambang) who is coming from top management officer. KTT has responsibility to ensure the regulations and laws is carried out and obeyed properly.
2. There should be an organization to carry out K3 programs.

3. There should be competent person who is expert in K3, theoretically and practically to sit in K3 structure.

4. There should be an independent employee organization inside the company as a place for management to consult and giving input.

5. K3 programs consists of:
   - Program of Identifying and Controlling Danger and also Evacuation System.
   - Certification Program of Tool, Operator and Special Technique Personnel.
   - K3 Training Program, Operator and Supervisor Level.
   - Preventive and Maintenance Program for Equipments/Machinery, procurement of Self Protection Equipments.
   - Health Inspection, Check-up and Caring Program.
   - Internal Planned Inspection and Compliance Program.
   - Audit Program Periodically.
   - Government Periodical Inspection Program.
   - K3 Bench Marking Program Among Companies.

   Another important things that should be included in K3 report are mining accident report periodically and mining accident report per 1.000.000 working hour.
2.5.2 Mining Added Value Improvement

The condition of natural resource management in Indonesia, particularly mineral and coal resources are mainly exported in the form of raw materials, without any processing. In other side, industrial countries always attempt to acquire “added value benefit” from exporter countries through advance processes in their countries or their group of organizations.

This condition is occurred due to knowledge and technology of processing the raw material are dominating by industrial countries and it has not been transferred yet to developing countries. Towards the implementation of mining globalization, issue of added value becomes significantly important due to during these decades Indonesia is only as a producer or seller of mining raw material (unprocessed raw material). So it is very important to Indonesia to improve its capability in processing raw material to become more valuable so that the resources can be utilized directly for national interests, particularly the area where mining industry operates.

In this autonomy era, region and community development are very important, since local government and local community as the stakeholders are the parties who determine in the decision making of mining continuity operation, while the central government acts as facilitator in decision making.

As described in Good Mining Practice book (Suyartono, 2003), there are some factors of added value improvement that can be used to evaluate mining company performance, which are:

1. Manpower Resource Development
Another important factor in improving added value in mining company is to develop human resources.

- Human resources development is done in every level, starting from laborer level until manager level.
- Mining company must be concern with the skill improvement of their personnel.
- Development of human resources management.

2. Local Entrepreneur Partnership

Local partnership is related on how mining company to involve small local company in supporting their needs.

3. Community Development

Program of local and community development who lives around mining area can be done by local partnership. Sense improvement of participation from local community is most the important thing in local and community development.
CHAPTER III
RESEARCH METHODOLOGY

3.1 TIME AND LOCATION

The research was conducted from April 2005 to August 2005 at Department of Energy and Mineral Resources, Jakarta. For the purpose of this research, the data will be collected only from sample company which is considered can be a representation of mining companies in Indonesia, i.e. PT. Newmont Nusa Tenggara.

![Figure 3.1 Mining Company Map](image)

3.2 RESEARCH AREA

The research will be focused on the development of mining company databases, development of decision support system called MICES-Qual to evaluate mining company performance by using Analytic Hierarchy Process (AHP) and Scoring Method, and the development of web as a tool in data inputting and to release the information to stakeholders. This research will focus on two of 4 components in Good Mining Practice, which are Mining Occupational...
Safety & Health (K3) and Mining Added Value. These two components are qualitative components, and the rest which is not included in this research are quantitative component (Mining Conservation, Environmental Mining Protection). The separation between qualitative and quantitative was based on the reports submitted by mining company to government. Reports which are classified into qualitative contains description data while the quantitative contains numerical data.

3.3 DATA SOURCES

Mainly the data used for this research acquired from Directorate of Mineral and Coal Technique, Department of Energy and Mineral Resources. This data in the form of hard copy of previous mining company report.

- Mining Occupational Safety and Health (K3) data is acquired from Sub-directorate of Mining Safety and Mining Added Value data is acquired from Sub-directorate of Added Value Improvement. These two sub-directorates are under Directorate of Mineral and Coal Technique.

- Spatial data of province in which mining company is operating, which consist of administrative boundary. This spatial data is acquired from BAKOSURTANAL.

3.4 REQUIRED TOOLS

Some supporting hardware and software will be employed to accomplish this research.
Windows 9X, XP or Windows2000 operating system run on PC Pentium III class with minimum 450 MHz and 128 MB RAM or more. The requirement of the hardware is related to the making process of the system. The required specification has been tested and it runs appropriately.

Microsoft Visual Basic 6.0
This is a programming language, used to develop decision support tool.

MapServer
This open source software is used to release spatial data in form of map to the web. MapScript in this software is used integrated with PHP script.

MySQL 1.3
This is free software for database application. MySQL 1.3 will be used to store all of non-spatial data. The following table lists some examples of operating system file size limits.

Table 3.1 MySQL File-size Limit

<table>
<thead>
<tr>
<th>Operating System</th>
<th>File-size Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux 2.2-Intel 32 bit</td>
<td>2 GB (LFS: 4 GB)</td>
</tr>
<tr>
<td>Linux 2.4</td>
<td>(Using ext3 file system) 4 TB</td>
</tr>
<tr>
<td>Solaris 9/10</td>
<td>16 TB</td>
</tr>
<tr>
<td>NetWare w/NSS file system</td>
<td>8 TB</td>
</tr>
<tr>
<td>Win32 w/FAT/FAT32</td>
<td>2 GB/ 4 GB</td>
</tr>
<tr>
<td>Win32 w/NTFS</td>
<td>2 TB (possibly larger)</td>
</tr>
<tr>
<td>MacOS X w/HFS+</td>
<td>2 TB</td>
</tr>
</tbody>
</table>

Source: MySQL Reference Manual

Apache Version 1.3.23
This is free web server software, used to release the web into Internet.

This software is used to write PHP script in order to design web pages.
3.5 METHODS

3.5.1 System Development Method

As described before in literature review, the development of this system will be based on System Development Life Cycle i.e. Analysis Stage, Design Stage and Implementation Stage. The scheme of research procedure can be seen in this figure below.

![Research Scheme](image)

Figure 3.2. Research Scheme

A. User Needs Study

User need study is a part of investigation stage where in this stage we attempt what to identify the requirements conditioned by the user (Directorate of Mineral and Coal Technique Officer). Based on the interview done in research time, the Directorate of Mineral and Coal Technique needs an integrated system used for evaluating mining company performance. The system should integrate all the components of good mining practice comprehensively in evaluation process. The system should also provide a method to enable mining companies submitting their report efficiently.
B. Analysis Stage

In analysis stage, we attempt to identify the disadvantages of current system used by Directorate of Mineral and Coal Technique to monitor mining company activity (see problem identification of Chapter 1), including components of good mining practice used for evaluating the performance of mining company and also identify relationship among criteria or components. Figure 3.3 shows the current system of evaluating mining company performance.

From figure 3.3 we can see that the evaluation of mining company performance is carried out partially, every report from mining company will be directly submitted to General Directorate of Geology and Mineral Resources to be forwarded to related sub-directorate for evaluation purposes. The evaluated report then being returned back to the mining company and General Directorate of
Geology and mineral Resources as a recommendation. Note that the evaluation is result is not based on one integrated evaluation system as required in Good Mining Practice guidebook; there is no relationship among the components (Mining Occupational Safety and Health and Mining Added Value). The evaluation result could not give how good or bad is the performance of particular mining company in overall.

Qualitative components of good mining practice used for evaluating the performance as described in previous chapter are Mining Occupational Safety and Health (K3) and Mining Added Value. Each component has criteria and some criteria have sub-criteria. K3 component has 6 criteria, while Mining Added Value has 4 criteria (Figure 3.4). For K3 Programs criterion, it has 9 sub-criteria, which are:

1. Program of Identifying and Controlling Danger and also Evacuation System
2. Program of Tool, Operator and Special Technique Personnel Certification
3. Program of K3 Training for Operator and Supervisor Level
4. Program of Preventive and Maintenance for Equipments/Machinery, Procurement of Self Protection Equipments
5. Program of Health Inspection, Checking-Up and Caring
6. Program of Supervisory (Internal Planned Inspection) and Compliance
7. Periodical Auditing Program
8. Government Periodical Auditing Program
9. Program of K3 Bench Marking Among Companies
C. **User Interface Design**

For the purpose of developing decision support tool, Microsoft Visual Basic 6.0 will be utilized to design the user-friendly interface. The interface will be design such a way, so that it brings easiness to the user in operating the system. User interface refers to the way a computer program presents and receives information from the users in response to user request. It hides the complexity of the database, and lessens the chances of inadvertently degrading database integrity (Sondheim, 1999 in Nabwire, 2002).

Designing user interface is a process of defining an application visualization and interaction between user and the system. According to Flemming (1998) in Mulyarto (2003), there are seven basic principles in designing user interface includes; user in control, consistency, forgiveness, feedback, aesthetics, and simplicity.

- **User in Control.** An important principle of user interface design is that the user should always feel in control of the software rather than feeling controlled by the software.
- **Consistency.** Consistency allows user to transfer existing knowledge to new tasks, learn new things more quickly, and focus more attention on tasks. This is because they do not have to spend time to trying to remember the differences in interaction. By providing a sense of stability, consistency makes the interface familiar and predictable.

- **Forgiveness.** Users like to explore an interface and often learn by trial and error. An effective interface allows for interactive discovery. It provides only sets of choices and warns users about potential situations where they could damage the system or data, or better, makes actions reversible or recoverable.

- **Aesthetics.** Visual design is important part of an applications interface. Visual attributes provide valuable impressions and communicate important cues to the interactive behavior of particular objects. At the same time, it is important to remember that every visual element that appears on the screen potentially competes for the user’s attention.

- **Simplicity.** An interface should be simple (not simplistic), easy to learn, and easy to use. It most also provide access to all functionality of an application. Maximizing functionality and maintaining simplicity work against each other in the interface.

**Web Design**

Designing web pages is intended to create visual logic and seeks an optimal balance between visual sensation and graphic information. According to Lynch and Horton (2002) in Mulayrto (2003), there are several advises that should be
considered in designing web pages, such as visual hierarchy, consistency and page dimensions.

- **Visual Hierarchy**
  The primary task of page design is to create a strong, consistent, visual hierarchy in which important elements are emphasized and content is organized logically and predictably. Figure 3.5 shows the information hierarchy of MICES-Qual web pages

- **Consistency**
  A consistent approach to layout and navigation allows readers to adapt quickly to the design and to confidently predict the locations of information and navigation controls across the pages of your site. Commonly each page should contain a title and logo, an author, a revision date, copyright information and navigation menu. These elements should be placed consistently. Figure 3.6 shows all basic components that should exist in MICES-Qual web pages.
Figure 3.5 The Information hierarchy of MICES-Qual
Page dimensions should be considered carefully so that the user can read all the information contents. Web pages deliver primarily through computer screen where the sizes are typically smaller than most opened books or magazines.

### 3.5.2 Mining Accident Statistic

As we can see from figure 3.4, one of the criteria of K3 component in evaluating the performance of mining company is Mining Accident Report per 1,000,000 Working Hour. Based on article 47, clause (1) of SK No. 555.K/26/M.PE/1995 released by Minister of Mining and Energy, mining accident
statistic is decided every year based on rate of accident frequency and severity that occurred to the mining worker. The formula of calculating the statistic is:

1. Total of accident divided by total working hour x 1.000.000

\[
FR = \frac{\text{Total of Accident}}{\text{Total Working Hour}} \times 1000000
\]

2. Total of lost day divided by total working hour x 1.000.000.

\[
SR = \frac{\text{Total of Lost Day}}{\text{Total Working Hour}} \times 1000000
\]

### 3.5.3 Decision Support Method

The decision support method of how good is particular mining company in running on their activities according to good mining practice guidance is done by using the combination of Analytic Hierarchy Process (AHP) and scoring method. As described before, pairwise comparison matrix will be used only to obtain the priority among the parameters or to give weighting to each parameter. Figure 3.7 below will show in detail the process of DSS method.

**Scoring**

- The score of K3 programs is obtained from the total score of Program A to Program I that have been evaluated by the stakeholder, then the result will be divided into number of programs (n).

\[
K3\text{Score} = \left( \frac{\sum_{i=A}^{I=\text{Program}_i}}{n} \right)
\]

- For manpower composition, community development, local entrepreneur partnership, manpower development, K3 organization, independent employee organization, mining accident report and mining accident
report per 1,000,000 working hour, the score directly can be used since there is no sub-component of them.

- The mean score of each component is calculated by summation of each component’s score that have been evaluated by several users, then the total score is divided into number of users (m)

\[
\text{K3 Program} = \frac{\sum_{i=0}^{n} K3 Score_i}{m}; \quad \text{Mining Acc} = \frac{\sum_{i=0}^{n} \text{Mining Acc}_i}{m};
\]

\[
\text{Mining Acc2} = \frac{\sum_{i=0}^{n} \text{Mining Acc2}_i}{m}; \quad \text{K3 Org} = \frac{\sum_{i=0}^{n} K3 Org_i}{m};
\]

\[
\text{Employee Org} = \frac{\sum_{i=0}^{n} \text{Employee Org}_i}{m};
\]

\[
\text{MP Composition} = \frac{\sum_{i=0}^{n} \text{MP Composition}_i}{m}; \quad \text{Comm Dev} = \frac{\sum_{i=0}^{n} \text{Comm Dev}_i}{m};
\]

\[
\text{MP Development} = \frac{\sum_{i=0}^{n} \text{MP Development}_i}{m}; \quad \text{Local Entr} = \frac{\sum_{i=0}^{n} \text{Local Entr}_i}{m};
\]

② Weighting Sub component

Weight for each component will be obtained by using AHP method. The system will provide the user with special program designed for obtaining weighting by using Visual Basic 6.0. By this tool, user have the ability to change the weight of each components depend on the issue they are facing at that time.

Example:

Weight of K3 Program = a \quad \text{Weight of MP Composition} = f
Weight of K3 Mining Acc. = b  
Weight of K3 Mining Acc. 2 = c  
Weight of Employee Org = d  
Weight of K3 Org = e  
The total weight will be 1.

3 Weighting Main Component

Since there are only two of four main component of GMP used in this system, the weight obtaining is not difficult. This weighting process will not use AHP method.

Example:

If Weight of Mining Occupational Safety and Health = x then Weight of Mining Added Value component will be = 1 - x

4 Final Result

The final score of particular mining company can be obtained by multiplying mean score of each sub-component to their weight. This result is then being multiplied again to the weight of main component. See the example below for more details.

\[
\text{Total Score of K3} = \left( \frac{\text{K3 Prog} \times a}{\text{EmployeeOrg} \times d} + \frac{\text{Mining Acc} \times b}{\text{K3 Org} \times e} + \frac{\text{Mining Acc2} \times c}{\text{EmployeeOrg} \times d} \right) \\
\text{Total Score of Added Value} = \left( \frac{\text{MP Composition} \times f}{\text{Comm Dev} \times h} + \frac{\text{MP Dev} \times g}{\text{Local Entr} \times i} \right) \\
\text{Final Score} = (\text{Total Score of K3} \times x) + (\text{Total Score of Added Value} \times (1 - x))
\]

The final score obtained from the calculation above will be compared to the range of performance determined by Directorate of Mineral and Coal Technique. The default value of the performance range can be seen in Table 3.2 below.
Table 3.2 Range Value of Performance

<table>
<thead>
<tr>
<th>Range Value</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 90</td>
<td>Very Good</td>
</tr>
<tr>
<td>&gt; 80 And ≤ 90</td>
<td>Good</td>
</tr>
<tr>
<td>&gt; 70 And ≤ 80</td>
<td>Adequate</td>
</tr>
<tr>
<td>&gt; 60 And ≤ 70</td>
<td>Bad</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>Worse</td>
</tr>
</tbody>
</table>

Figure 3.7 DSS method of the proposed system in detailed
CHAPTER IV
RESULT AND DISCUSSION

This chapter will discuss the last part of research scheme as explained before in Chapter 3, which is implementation stage. This chapter discusses Hardware selection, Software Selection, and implementation (Coding, User Interface Design, Testing).

4.1 HARDWARE SELECTION

The minimum specifications of hardware used to support development process of MICES-Qual are:

- Personal Computer with processor Pentium IV 2.4 GHz
- RAM 256 MB
- SVGA screen with minimum resolution 1024 x 768 pixels.

The MICES-Qual was tested to run in PC with processor Pentium III 500 GHz, RAM 128 and screen resolution 1024 x 768 pixels, the result showed that the system still runs appropriately in this specification.

4.2 SOFTWARE SELECTION

There are several types of software use in developing this system. The software can be categorized into 3 groups, which are:

A. Operating System

Operating Systems (OS) used in designing this system are Microsoft windows 2000 Professional or Microsoft Windows XP Professional edition.
Apache software must be installed in this system. Apache is a web server used to for simulating the system in intranet environment.

**B. Developer Software**

There are two kinds of developer software used, which are:

- **Microsoft Visual Basic 6.0**
  
  This software is used to develop decision support system tool (desktop application) that will be used by Directorate of Mineral and Coal Technique. To connect Visual Basic 6.0 with database software (MySQL) the operating system should be installed with MyODBC-3.51.11-1-win.

- **Macromedia Dreamweaver MX 2004**
  
  This software is used to develop web pages. All PHP scripts used to develop the web page will be written by using this software.

**C. Database Software**

Database management software used for this system is MySQL 1.3. This is free software with big capacity of data storing.

**D. Browser**

Browser is used to test the web page made by PHP script. PHP script has some advantages, the main advantages of PHP script is it can run in almost every browser.
4.3 IMPLEMENTATION

The final stage of this research is to develop database based on the physical design, construct code to develop web page and coding to develop decision support system tool.

4.3.1 Process Modeling

The basic requirements of the process model are data input, processes and data stores. Data Flow Diagrams (DFD) were used to structure the components. On the first step of building DFD, data flow is presented in general together with system user identification and also the contribution and influence that the user can make to the system. This process is presented in Context Diagram (Figure 4.1). The main process of this system is the development of mining company evaluation system, where there are three groups of user:

- Directorate of Mineral and Coal Technique as the representation of Government. The role of this user is to evaluate mining company performance based in the GMP components.
- Mining Company who is the actor of the system. This user will use this system to submit their report to the government through Internet.
- Others (Observer, NGOs, Academician, Local community). The role of this user is to give input and also as mining company evaluator. This user will be bounded based on their expertise and capabilities.
After context diagram has been drawn, the next step is to draw the process, user (external entity) and data store into detail in a Data Flow Diagram Level 1 as seen in this Figure 4.2 below.

Each process in DFD Level 1 can be decomposed again into more detail processes as described in the next figure below.
Figure 4.3 DFD Level 2 – Process 1

Figure 4.4 DFD Level 2 – Process 2
4.3.2 Conceptual Model

A conceptual model describes the essential semantics of system data. A conceptual model consists of a number of symbols joined up according to certain conventions. Commonly, conceptual modeling use symbols from a modeling method known as entity-relationship analysis. This method was first introduced by Chen in 1976 and now is widely used (Hawryszkiewycz, 1994). Conceptual modeling deals with the question on how to describe in a declarative and reusable way the domain information of an application, its relevant vocabulary, and how to constrain the use the data, by understanding what can be drawn from it. Recently, a number of conceptual modeling languages has emerged as de-facto standard, in particular we mention Entity/Relationship (ER) for the relational data model, UML and ODMG for the object oriented data model, and XML, RDF(S), DAML+OIL and OWL for the web semi-structured data model (Franconi, 2003).

Entity Relationship Analysis uses three major abstractions to describe data. These are:

- **Entities**, object that have independent physical or conceptual existence.
- **Relationship**, which are meaningful interactions between the entities, and
- **Attributes**, which are the properties of the entities and relationship.

The Entity Relationship Diagram of this system is presented in Figure 4.5 below.

4.3.3 Logical Model

The logical model is the translation of the software independent conceptual model into a record structure defined in a particular Data Description Language (DDL). Nowadays the non spatial data are usually stored in relational databases
and therefore the logical modeling consists of the design of tables in correspondence with the conceptual model. According to Shekhar (1999), logical modeling phase is related to the actual implementation of the conceptual data model in database management system. In other words, we can say that in logical model, we identify data requirements in implementing the method. The logical data model of this study is illustrated in Table 4.1 below.

![Entity Relationship Diagram](image)

**Figure 4.5 Entity Relationship Diagram**

**Table 4.1 Logical Data Model**

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<tr>
<th>No</th>
<th>Category</th>
<th>Entity</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mining Occupational Safety and Health (K3)</td>
<td>K3_Program</td>
<td>Number, Company_id, Period, Prog_date, Prog_duration, Activity, Activity_Desc, PIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accident_tbl</td>
<td>Company_id, Accident_id, Accident_date, Man, Unit, Accident_Desc</td>
</tr>
<tr>
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<td></td>
<td>Accident_tbl2</td>
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</tr>
<tr>
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<td></td>
<td>Image</td>
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</tr>
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<td></td>
<td></td>
<td>Accident_Detail</td>
<td>Number, Accident_id, Name, Working_Date, Death_date</td>
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</table>
2 Mining added value

<table>
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<tr>
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</tr>
</tbody>
</table>

4.3.4 Physical Design

Physical design describes the data physically where every entity is set according to the database software that will be used in the system. The database used in this system is MySQL, so that all the attributes and data type will be set according to the MySQL format. Table 4.2 shows the physical design of the system.

Table 4.2 Physical Design

<table>
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<tr>
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<th>Column</th>
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</table>

### 4.3.5 Proposed System

The current system does not give access to the stakeholder to know the performance of particular mining company since the report never been released to the public. Stakeholder (e.g. local community) as the parties who always get suffer from bad effect of mining company activity could not monitor particular mining company activity since there is no information available for them.

As there are some disadvantages of the current system, thus the system for evaluating mining company needs to be developed. The proposed system will cover problems found in the old (current) system (Figure 4.6).
By using the new system, each mining company will directly inputting their report for each GMP components through the web. The report submitted by the mining company will be saved into DBMS and directly can be accessed by stakeholder by using internet at anywhere and anytime. Stakeholder, based on their capacity and capability (expertise) will be provided with special page on the web where they can score the report or give suggestion to the government regarding particular mining company.

Evaluators as the party who have the access in scoring mining companies need to be selected tightly according to the minimum requirements conditioned by government so that the quality of the score can be assured. Factors that should be
considered in selecting the evaluator candidate are: academic level, experiences, organization, location, current activities and others.

The evaluation result will be saved into the DBMS for evaluation purposes by using DSS tool. Final evaluated report that show the performance of particular mining company will be released back to the web as information to the stakeholder. Figure 4.7 shows general concept on how the system will work.

![Figure 4.7. System Architecture](image)

The proposed system needs to be derived again into more detail by using Event Identification Scheme. Events contains of input, decision-making, interruption, and also actions from user or external tool. Action by one object to send information is called event. The Event Identification Scheme of the system can be seen in Figure 4.8.
4.3.6 MICES-Qual Database

The physical design of each table as described in Chapter III will be translated into MySQL 1.3 Environment. The development of these tables uses PHP MyAdmin 2.2.3 which is automatically installed when we install PHP Triad. PHP My PHP Script, MySQL and Apache also will be installed automatically if we install PHP Triad since that software is one packaged. Figure 4.9 below show hot to create MySQL table in PHP MyAdmin environment. Figure 4.10 shows the created table including its SQL.
Blank boxes below “Field” column are used to specify names of column that we want to create. In the “Type” column we can choose the data type of each column we created (e.g. varchar, int, text, double). Blank boxes below “Length/Values” column are used to specify the length of each column. And there are some other properties of table that we can specify in this PHP MyAdmin, such as Null, Default Value, Index, Primary key, etc.
By using the same way of creating table as explained in above, then we create table for this research purposes. List of tables used in this research can be seen in Appendix 1.

4.3.7 Code Constructing

A. Web Page Code Constructing

Web pages as illustrated in Figure 4.11 created by coding it in a PHP programming language. PHP Script can be written by using notepad or special software design such as PHP Expert Editor, Macromedia Dreamweaver MX 2004. PHP is scripting language which is integrated into HTML page and run in server side. All the PHP syntax we coded in a page will be fully run in the server. What users see on the browser is the result of the process in the server.

Sample PHP script:

```html
<html>
<body>
<center>
<?php
echo "<font size=5 face=sans-serif><b>";
echo "This Page was created by using PHP Script";
echo "</b></font>";
?>
</center>
</body>
</html>
```

The result of the script above can be seen in Figure 4.3 below.
By referring to Figure 3.5 of Chapter III, MICES-Qual website was created by utilizing PHP Script. Figure 4.12 shows the screen shot of main page of MICES-Qual web. This main page is equipped with map to indicate the location of each mining company. Map can be released to the Internet due to the integration of PHP Script and MapServer. MapServer is software as defined by OpenSource development environment, to make interactive web map applications. It is primarily developed by The University of Minnesota with a financial support from e.g. NASA. As it is OpenSource software many other institutions and individuals participate also in the development and the programming process.
Main page allow user to explore the map just like when they are using other map viewer software. User can do zoom in and zoom out to the map, and also gathering information from the map by using information tool as describe in this figure below.

![Figure 4.13 Acquiring information from the map](image)

**B. Decision Support System Tool Constructing**

For constructing DSS tool in order to evaluate mining company performance, the capability of Microsoft Visual Basic 6.0 as programming language will be explored. The DSS toll will be a desktop application used by Directorate of Coal and Mineral Technique in evaluating the performance. This DSS toll has limited access to the user since it has equipped with the capability to add, edit and delete particular data where we cannot find this capability in the web page. Figure 4.14 below shows the main form of DSS tool that shows the information of mining company.
Figure 4.14 Main Form of DSS Tool

This DSS tool provides the capability to derive weight for every component of Good Mining Practice. This application allows Directorate of Coal and Mineral Technique officer to adjust the degree of importance for each component. The technique to derive weight for every component was adopted by using AHP method.
4.3.8 Testing

A. Data Inputting Through the Web

The testing was done by using one personal computer which will act as the server and workstation. In order to access the web, Apache server should be installed in the operating system. The address to access this web page is http://localhost/project/htdocs/. Company will be asked to enter their username and password in order to submit their report through the Internet. Figure 4.16 below shows the login page for the company. After logged-in, there will be a new page consists of several menu. If one of the menu were clicked, blank form will appear on the screen where that’s the place for mining company to input their data.
For the testing purpose, we will try to input data from PT. Newmont Nusa Tenggara for year 2000. This data will be used to evaluate this mining company performance for year mentioned.

Figure 4.16 Login Page for Mining Company

Figure 4.17 Form to input a new data
After the entire blank field has been filled, the mining can save their new report by clicking SAVE button. This data will be saved into the database in the server (see Figure 4.18). Mining company can fill another data by clicking another menus on the page.

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Company_ID</th>
<th>Period</th>
<th>Prog_Date</th>
<th>Prog_Duration</th>
<th>Activity</th>
<th>ActivityDesc</th>
<th>PIC</th>
<th>Num_Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit</td>
<td>0</td>
<td>EM1</td>
<td>Jan-March</td>
<td>4154-15-01</td>
<td>Days</td>
<td>Seminar</td>
<td>This activity is intended to aware other managers...</td>
<td>General Manager</td>
<td>23</td>
</tr>
</tbody>
</table>

Figure 4.18 Table Where the Data Saved

After all the data required for evaluating mining company performance has been keyed in to the database through the web, user (evaluator) can start to evaluate the report by logging-in first to the web. The page will be provided with a link to connect to each component of Good Mining Practice to ease the user in seeing the summary of particular mining company report. Figure 4.19 shows login page for user in order to evaluate particular mining company.

Figure 4.19 User’s Login Page
After log-on, the user can give the score to each component of Good Mining Practice. The score will be saved into the database used and will be used for another process, which is evaluation by using DSS tool that has been created.
B. Mining Company Evaluation By Using DSS Tool

This is the last step of mining company evaluation processes. Report that has been scored by the user (evaluator) will be processed in DSS tool. The first step of this evaluation process is to derive weight for each Good Mining Practice component. The deriving weight process as described before will utilize AHP method which is provided in this software. This Figure below shows for used to compare each component of Good mining Practice. User (government officer) defines the degree of importance of each component by asking how important is one component compared to another component. The degree of importance is presented in a range value from 1 to 9.

![AHP Form](image)

Figure 4.22 AHP Form

After the pair wise matrix has been filled, the software will calculate the weight for each component. To indicate whether the value inputted by the user is consistent, we need a consistency indicator called Consistency Ratio (CR). The value inputted by the user is considered as consistent if the CR less than 0.1.
Figure 4.23 Result of AHP Process

The weight derived from this process can be saved into the database to be used in second step of mining company evaluation. Final score, which is indicating mining company performance is calculated based on the method described in previous chapter. Figure 4.24 shows the final result of mining company evaluation process where for year 2000, PT, Newmont Nusa Tenggara has a very good performance.
C. Viewing Particular Mining Company Performance

The evaluation result of particular mining company done by DSS tool can be saved into the database for the purpose of releasing the result to the web. By doing so, it will ease the stakeholder to gather mining company performance information from year to year. Figure 4.25 show the example performance of PT. Newmont Nusa Tenggara from year 2000 to 2001.

![Figure 4.25 Mining Company Performance Page](image)

4.4 DISCUSSION

Based on the sample data that has been used to evaluate particular mining company performance, Mining Company Evaluation System for Qualitative parameters (MICES-Qual) has succeeded evaluate the performance. This evaluation result can be released to the Internet for enabling stakeholder in accessing the result. The main purpose why the result should be released to the Internet is in order to give information to the stakeholder about the performance.
CHAPTER V
CONCLUSIONS AND RECOMMENDATION

5.1 CONCLUSIONS

The general objective of the study was to develop a prototype information system and decision support system tool that can integrate Mining Occupational Safety and Health (K3) and Mining Added Value aspect of Good Mining Practice to provide information necessary for decision-maker in evaluating mining company performance.

- The existing system of mining company performance evaluation was analyzed and several weaknesses of the system were identified. The main weaknesses of the current system are the evaluation is done partially for each GMP component and the report never been released to the public.

- The proposed system offered more comprehensive way in evaluating mining company performance by considering every aspect of GMP component integratively. The method of evaluation system for the proposed system adopted Analytical Hierarchy Process and scoring method so that it will be more reliable.

- MICES-Qual has been tested and proved that it can evaluate mining company performance for data given and requirement conditioned by the government.

- The study revealed that it is important to release the information regarding mining company performance to the stakeholder since it will ease the task of
government in monitoring mining company activity and raise the awareness of the stakeholder.

- The study attempted to offer a new ideas and design of information system and database structure as described in Chapter III in order to ease the user in gathering information that they need for their specific purposes.
- A friendly user interface was also designed for the web to enable users to access and update data easily.

5.2 RECOMMENDATIONS

Due to the limitation of time and other resources, the study was focused only for qualitative parameters of Good Mining Practice components. There are actually four components of Good Mining Practice used integratively for evaluating mining company performance. To refine the MICES-Qual, the other components of Good Mining Practice should also be included in evaluating mining company performance so that the result will be more reliable.

Because of the data limitation, the system was tested only for three companies in one year. It is recommended to test the system for many companies to see the stabilization of the system when the database is accessed.

This system was tested in local computer where at one time only one user uses the system to access and inputting data. It has not been tested yet how the system performance if there are many users access and input the data at the same time. For the future research, it is should be included the solution if jamming occurred when there are many users access the system at the same time.
It is also recommended for the future research to provide the capability of AHP system in the DSS tool to anticipate if there is an addition parameter or decreasing parameter used to evaluate mining company performance since the current system of DSS tool is fixed only for the parameters identified now.
REFERENCE


Appendix 1. MICES-Qual Tables in MySQL

1. Accident Detail

Database GMP2 - table acc_detail running on localhost

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>accident_id</td>
<td>varchar(15)</td>
<td>Yes</td>
<td>NULL</td>
<td>NULL</td>
<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
<td>company_id</td>
<td>varchar(15)</td>
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<td>NULL</td>
<td>NULL</td>
<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>varchar(30)</td>
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<td></td>
</tr>
<tr>
<td>accident_date</td>
<td>date</td>
<td>Yes</td>
<td>NULL</td>
<td>NULL</td>
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<td></td>
</tr>
<tr>
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<td>NULL</td>
<td>NULL</td>
<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
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</table>

2. Mining Accident

Database GMP2 - table acc_tbl running on localhost

<table>
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<tr>
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<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>company_id</td>
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<td>NULL</td>
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<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
<td>accident_id</td>
<td>varchar(14)</td>
<td>Yes</td>
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<td>NULL</td>
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<td></td>
</tr>
<tr>
<td>accident_date</td>
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<td>Yes</td>
<td>NULL</td>
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<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
<td>unt_consequence</td>
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</tr>
<tr>
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</tr>
<tr>
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</table>

3. Mining Accident Per 1,000,000 Working Hour

Database GMP2 - table acc_tbl2 running on localhost

<table>
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<th>Attributes</th>
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<th>Default</th>
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<th>Action</th>
</tr>
</thead>
<tbody>
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<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
<td>year</td>
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<td>NULL</td>
<td>NULL</td>
<td>Change Drop Primary Index Unique Fulltext</td>
<td></td>
</tr>
<tr>
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</tr>
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<tr>
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</table>
Appendix 1. MICES-Qual Tables in MySQL (Continued)

4. Community Development

**Database GMP2 - table cd running on localhost**

<table>
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<tr>
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<th>Type</th>
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<th>Action</th>
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<td>id</td>
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5. Community Development Projection participating

**Database GMP2 - table cd_proj running on localhost**

<table>
<thead>
<tr>
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</tr>
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<td></td>
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</tr>
<tr>
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<td>varchar(14)</td>
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<td>NULL</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>y2003</td>
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<td></td>
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<tr>
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<td></td>
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<tr>
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<td>NULL</td>
<td></td>
<td></td>
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</tr>
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</table>

6. Company

**Database GMP2 - table company running on localhost**

<table>
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<tr>
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<th>Type</th>
<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
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</table>

With selected: Change Or Drop
Appendix 1. MICES-Qual Tables in MySQL (Continued)

7. Manpower Development

```
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</tr>
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<td></td>
<td>auto_increment</td>
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<td>varchar(10)</td>
<td>Yes</td>
<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
<td></td>
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<td>NULL</td>
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<td></td>
</tr>
<tr>
<td>train_date</td>
<td>date</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
<td></td>
</tr>
<tr>
<td>location</td>
<td>varchar(50)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>participant</td>
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<td></td>
</tr>
<tr>
<td>training_doc</td>
<td>mediumtext</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
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</tr>
<tr>
<td>grade</td>
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</tbody>
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8. Image

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<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
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<tr>
<td>company_id</td>
<td>varchar(10)</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
<td></td>
</tr>
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<td>file1</td>
<td>mediumblob</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
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<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
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</tr>
<tr>
<td>file_name2</td>
<td>varchar(64)</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
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</tr>
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</tr>
</tbody>
</table>
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9. Local Entrepreneur

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<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
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<td>member</td>
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<td></td>
<td>auto_increment</td>
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<td></td>
</tr>
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<td>varchar(10)</td>
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<td>NULL</td>
<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
<td></td>
</tr>
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<td>contractor_name</td>
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<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
<td></td>
</tr>
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<td>work_area</td>
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</tr>
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<td>status</td>
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<td></td>
</tr>
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<td>grade</td>
<td>varchar(4)</td>
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<td></td>
<td>Change, Drop, Primary Index, Unique, Fulltext</td>
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</tr>
</tbody>
</table>
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Appendix 1. MICES-Qual Tables in MySQL (continued)

10. Manpower Position

**Database GMP2 - table position running on localhost**

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
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<td>company_id</td>
<td>varchar(5)</td>
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<td>Primary Index Unique Fulltext</td>
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</tr>
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<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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</tr>
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<td>indonesian</td>
<td>int(11)</td>
<td>Yes</td>
<td>NULL</td>
<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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</tr>
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<td>expatriate</td>
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<td>Yes</td>
<td>NULL</td>
<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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<td>Primary Index Unique Fulltext</td>
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11. K3 Programs

**Database GMP2 - table prog_audit running on localhost**

<table>
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<th>Attributes</th>
<th>Null</th>
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<th>Extra</th>
<th>Action</th>
</tr>
</thead>
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<td>Primary Index Unique Fulltext</td>
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</tr>
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</tr>
<tr>
<td>Prog_Duration</td>
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<td>Activity</td>
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<td>Change</td>
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<tr>
<td>Activity_Desc</td>
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<td>Num_Participant</td>
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<tr>
<td>Grade</td>
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<td>NULL</td>
<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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</tr>
</tbody>
</table>

12. User

**Database GMP2 - table user running on localhost**

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Attributes</th>
<th>Null</th>
<th>Default</th>
<th>Extra</th>
<th>Action</th>
</tr>
</thead>
<tbody>
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<td>user_group</td>
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<td>Yes</td>
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<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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<td>user_id</td>
<td>varchar(15)</td>
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<td>NULL</td>
<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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<td>user_name</td>
<td>varchar(20)</td>
<td>Yes</td>
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<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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</tr>
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<td>Yes</td>
<td>NULL</td>
<td>Change</td>
<td>Primary Index Unique Fulltext</td>
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</tr>
</tbody>
</table>

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Appendix 2 Web Page Screen Shot

1. K3 Program Page

2. Mining Accident Page
Appendix 2 Web Page Screen Shot (Continued)

3. Sample Page for Data Inputting
of mining company operates in their area. The stakeholder together with local
government and Directorate of Coal and Mineral Technique can monitor
particular mining company performance from year to year. It is intended to raise
the awareness of the stakeholder and government regarding that mining company.
So that if something bad happen in the future, it can be predicted since the
beginning.

MICES-Qual performance has been tested by sample end user and the
representation of government officer (Directorate of Mineral and Coal
Technique). This process was done to see what is the comment of the user after
seeing and using the system. Generally, the users understand how to use web
application in order to submit their report directly thorough Internet since on the
web application is provided with common navigation menu; just like when they
open other websites on the internet. For user who uses the DSS tool in desktop
application, they satisfy with the program even though they still have a little
problem in operating the system. To cover this problem, MICES-Qual will be
equipped with help tools which consists the manual guide in operating the system.