A RISK MANAGEMENT APPROACH TO THE DEVELOPMENT OF AN EARLY WARNING SYSTEM: A CASE FOR LAKE CHINI

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***ABSTRACT**: Information Technology Risk Management (ITRM) is the use of risk management methods to manage Information Technology (IT) risks i.e. business risks associated with the use, operation, engagement and influence of IT in the organization. The purpose of this study is to address some issues of the ITRM implementation at the Lake Chini Research Centre (LCRC), Universiti Kebangsaan Malaysia (UKM). This study helps LCRC to improve and increase awareness of risk management through the success of all employee engagements in daily activities and decision-making. The analyzed data from a survey carried out on two main stakeholders showed (1) the absence of Risk Management Work Plans in LCRC, (2) the risk management concept is poorly understood by some LCRC staffs and (3) they need to promote some aspects of IT risk management policies such as developing a special risk management system or a special model for risk registration and data storage. The findings also found that LCRC top management is keen on implementing complete risk management to achieve the objectives of the research centre and those responsible for managing risks have developed plans and action plans needed to manage risks through the construction of a specific action plan for the research centre and forming an action plan. The findings of this study were also used in the development of the initial water quality warning system for LCRC and Aboriginal communities living in the vicinity of Lake Chini.*

Keywords: Lake Chini, Water Quality, Risk Management

1. INTRODUCTION

1.1 Background Of The Study

Lake Chini is the second largest natural lake in Malaysia. It extends between the coordinates of 3°24'40"N to 3°26'42"N and 102°52'18"E to 102°55'54"E to form a lentic water body from a combination of 12 open bodies of water known as 'sea' by the aborigines or local natives. The lake's estimate is estimated to be about 202 hectares of water bodies (permanent floods) and 700 hectares of freshwater swamp and swamp forest around it [1- 2].

In 2009, UNESCO accorded Biosphere Reserve Status on Lake Chini due to its rich and diverse biodiversity of flora and fauna, many endemic or unique to Lake Chini. About 800 natives from Jakun tribe made their homes in the vicinity of the lake. It is also home to 87 species of freshwater fish, 189 species of birds, 51 low forest species, 15 freshwater swamp forest species, and 25 aquatic plants [3]. The natural environment in Lake Chini that includes the flora and fauna, rivers, swamps, lowland, and hill forests, as well as the indigenous people, form a unique ecosystem. This ecosystem depends on the lake for their survival and water supply.

In the present research, we present our work in managing IT risks associated with the activities of monitoring water quality at the lake. This includes the risk associated with managing activities to record sensors' reading as well as managing the infrastructure of sampling stations. The findings of this study were also used in the development of the initial water quality warning system for Lake Chini Research Centre (LCRC) and aboriginal communities living in the vicinity of Lake Chini.

Two agencies are tasked with continuously monitoring water quality at Lake Chini, LCRC and Department of Environment (DoE). The DoE has 23 sampling stations and the sampling frequency is done once a month. Meanwhile, LCRC conducted water quality monitoring at seven sampling stations with sampling frequency done every 15 minutes. The architecture of all LCRC sampling stations is shown in Figure 1.

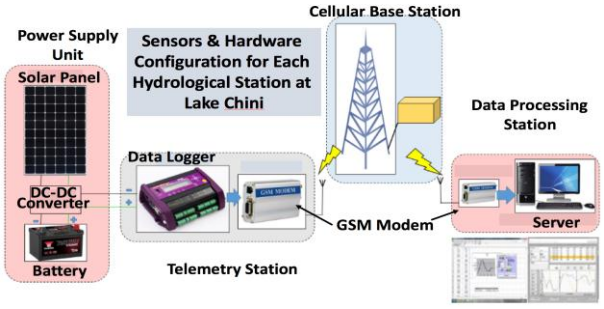

Figure 1: Architecture of LCRC Sampling Station

Water quality data reading from an external sensor recorded at 15 minutes will be sent to the data recorder or data logger to be cached. The data is sent to LCRC central database at their laboratory via a GSM network. The measurement taken is Temperature (^{o}C), Conductivity (uS/cm), Total Dissolved Solids (mg/l), pH (unit), Turbidity (NTU) and Optical Dissolved Oxygen (mg/l). Details of the parameters and methods on water analysis can be found in [4]. In addition to water quality, every station was also equipped with sensors for hydrology and climatology. These sensors share the same data logger and GSM modem.

1.2 The Need For Change

The real-time updating into a centralized database has been an invaluable task. Water quality data has been collected and recorded on LCRC information servers every 15 minutes throughout the year. However, recent climatic changes have led to frequent flooding in Lake Chini. The big flood that began in late December 2014 has totally decimated the telemetry stations and its components [5]. Floods are considered an annual natural disaster on the East Coast of Malaysia. Nevertheless, the record-setting flood of 2014 was

summed up by [6] as "the most significant and largest recorded flood in history".

The big flood completely destroyed the IT infrastructure. As the consequence of some stations being submerged and unreachable for more than a week. Due to the flood, devices vital data were not logged in the data logger and not transmitted to the server by GSM modem for a few months

The event demonstrates that the IT infrastructure at Lake Chini is unprepared for any eventuality. Risk Management was never carried out by both DOE and LCRC prior to the disaster. A study carried out by [7] carried out an IT Risk Management for the LCRC as a consequence of the flood. She observed that LCRC needs to promote some aspects of IT risk management policies such as developing a special risk management system or a special model for risk registration and data storage.

2. MATERIALS AND METHODS

We conducted a survey among two main stakeholders: LCRC researchers and the natives living within the vicinity of the lake. In addition to their demographic and basic needs, the survey also focusses on natural disasters that occur frequently at the lake as well as their suggestions on the mitigation plans that suit them. This study is entirely quantitative and qualitative. Data is measured statistically descriptive such as a percentage of a dataset.

The survey is to gain insights into the basic needs of the local natives which will form the basis for our risk management strategies. This is important since these people are the main custodian of the ecosystem which protects the valuable and diverse flora and fauna.

The risk in this study refers to any potential, positive and negative impacts of natural disasters or water quality in Lake Chini according to Malaysia classification of river and lake water quality status. In addition, the development of a risk management system can be used as a medium for the delivery of water quality information to the aborigine community using popular apps in their mobile devices [8].

Our work was divided into two phases: Conceptual and Empirical. During the Conceptual phase, we conducted the traditional literature reviews to gain insight into the gravity of the situation. Risk management can be defined as a logical and persistent process consisting of three key steps: identifying risks, selecting risk response strategies and monitoring results [9]. Figure 2 shows the risk management structure for LCRC produced after our Literature Review exercise. Detail deliberation can be found in [7]. There are five risks identified for LCRC risk management: technical risk, behaviour risk, financial risk, research risk, and avoidance risk. These risks have two dimensions: the operational risk and management risk of LCRC. LCRC's ISO 31000 Risk Register will be based on this structural data and segregated according to the risk category and water quality at Lake Chini.

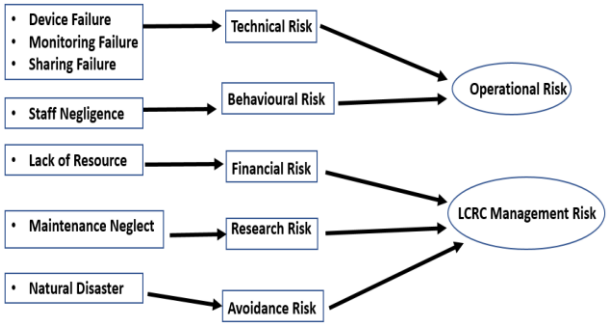

Figure 2: LCRC Risk Management Structure

A face-to-face survey with the two main stakeholders were carried out for one week in 2017. We were given the freedom to visit and meet respondents in our capacity as associate researchers at LCRC. Five LCRC staffs comprised of their head and four research officers were an interview to solicit their experience, knowledge, and expertise associated with the running of LCRC. In particular, we try to understand the situation in Lake Chini so that the needs, preferences and usability of the risk management system and plan to be developed can be accurately identified. We also need to understand the data and rules to develop an early warning system.

A total of twenty-five respondents from the aboriginal communities living within the vicinity of the lake were randomly selected. Since they depend on the quality of water provided by the lake for their daily needs and their knowledge of the needs of the flora and fauna, their views and suggestions are very vital.

In addition to conducting the survey, we also gained access to water quality parameters of an inflowing river (River Jemberau) and an outflowing river (River Chini). A lake is the retention of the body of water. Its water quality depends on the inflow river which brought water into the lake and the outflow of water from the lake. We are interested in looking at the trend of degradation or improvement of water quality over the years. From here, we solicit rules for mitigation if the parameters fall outside the permitted threshold. These rules were obtained during the interview with the two main stakeholders.

Several interview sessions were held to obtain the required information. Once the information and data were successfully collected, the needs of the risk components were identified and suitable technology and prototype design for the early warning system were determined. The requirement and specification for the risk management system and early warning were described in detail in [7]. The descriptions include the hardware and software as well as the user interface for the systems.

3. OUTCOMES

In this study, the work carried out has brought the following outcomes:

1. The senior management of LCRC always emphasizes the use and implementation of risk management in all day-to-day research centre's activities to sustain its assets and increase its reputation globally.
2. Although the basis for the implementation of risk management has not been developed, the implementation procedure requires further refinement and modification in the implementation of integrated and structured in risk for decision-making and responsibility enhancements.
3. Due to insufficient risk management practices among LCRC staff, there is a need for them to be trained and equipped with basic knowledge to identify and address risks with cost-effective measures.
4. The results of this study serve a source for the development of the Water Quality Early Warning System where risk management is part of facilitating the registering and responding of risk management information.

4. CONCLUSIONS

In conclusion, the findings of this study demonstrate achievements in fulfilling the goal of providing valuable insights for the implementation of risk management at LCRC. All coordinators and decision-makers at the research centre should take into account that the implementation of risk management is part of all their duties. By following the correct procedures for risk management, this will provide the opportunity for all LCRC staff to extend and promote an organizational culture based on an organized and orderly environment.

The study aims to provide guidelines with clear guidance and necessary improvements or changes to the implementation of risk management at LCRC. In addition, the study aims to raise awareness about risk management among all LCRC staff to improve their decisions and responsibilities. This will provide a reasonable basis for strategic planning, helping to reduce culture shock and lead to better results. The main contribution of this study is to develop clear and comprehensive risk management guidelines for water quality management of Lake Chini so that the most current and effective strategies to overcome and mitigate all potential risks can be implemented.

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