A System Dynamic Simulation Model for Managing the Human Error in Power tools Industries

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***Abstract*— In the era of modern and competitive life of today, every organization will face the situations in which the work does not proceed as planned when there is problems occur in which it had to be a delay. However, human error is often cited as the culprit. The error that made by the employees would cause them have to spend additional time to identify and check for the error which in turn could affect the normal operations of the company as well as the company's reputation. The employee is a key element of the organization in running all of the activities of the organization. Hence, work performance of the employees is a crucial factor in organizational success. The purpose of this study is to identify the factors that cause the increasing errors made by employees in the organization by using system dynamics approach. The broadly defined targets in this study are employees in the Regional Material Field team from purchasing department in power tools industries. Questionnaires were distributed to the respondents to obtain their perceptions on the root cause of errors made by employees in the company. The system dynamics model was developed to simulate the factor of the increasing errors made by employees and its impact. The findings of this study showed that the increase of error make by employees was generally caused by the factors of workload, work capacity, job stress, motivation and performance of employees. However, this problem could be solved by increased the number of employees in the organization.**

1. Introduction

In the era of modern and competitive life of today, every organization will face the situations in which the work does not proceed as planned when there is a problem occur in which it had to be a delay. When the work had delayed, it would increase the workload of the employees which in turn would influence their work's performance and normal operation of the other departments. However, the performance of employees is a major concern for all business organization. Human errors can be classified into four categories which are anthropometric factors, human sensory factors, physiological factors and psychological factors. Anthropometric factors are related to the size, shape, and strength of the person while human sensory factors are the factors concern in which the ease of which people can see, hear, touch, feel and even smell what is going on around them. In term of physiological factors, it is referred to the environmental stresses which affect human performance. Psychological human errors can be classified as those which are intended and those which are not intended. An unintended error occurs when someone does a task which he or she should be doing but does it incorrectly while an intended error occurs when someone deliberately sets out to do something but what they do is inappropriate (Angeles, Module 3: Why people commit mistakes? (Studying human errors, 2004).

In the power tools industries, there are always problem occurs in which the employees in Purchasing Department change and update the material prices and other commercial information incorrectly in the system, do not update the material prices on time and incorrectly key in the document date of good receipt in the system by employees in the Logistics Department which does not match with the date in the invoices that issued by the suppliers. This problem occurred was determined as a human error which ultimately caused the invoices being blocked for payment by the Financial Department due to the price variance where the total payment as stated in the invoices is different as recorded in the company's system. This study is conducted to identify the root causes of the error made by employees and employees work performance. The broadly defined targets in this study are employees in the Regional Material Field team from purchasing department in power tools industries.

2. Literature Review

There are several factors which could give rise to the error

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made by the employees in an organization. Job stress is one of the factors. Stress at work is a relatively common phenomenon of competitive life today. Over the last few decades, the nature of work had gone through radical changes and it is still changing at rapid speed. Stress exists in every organization have become much complex. Work place stress has significant effects on the job performance of employees and the organizations are trying to cope with this scenario (Qureshi, et al., 2013). A Higher level of stress existed with no managerial concern for solution consequently lowering the performance of employees, increasing the number of error occurs and affecting the reputation of the organization.

Another factor is workload of the employees. The workload is defined as the amount of work that is allocated to an employee to do. According to (Kun-Tsu , Tien-Hui, Wei-Jen, Wern-I, & Chich-Jen, 2010), the heavy workload can influence an employee's physical or mental health, individual performance or productivity. Heavy workloads have been shown to have a negative impact on employee's turnover and contribute to a state of stress and give rise to accident, illness, strain or error (Iverson & Pullman, 2000). In addition, skills, motivation, and attitude of employees are also the important factors to the issue of error make by the employees (Pickl & Block, 2014).

After reviewing on several kinds of literature, the problem of error made by employees has been studied through different way by using system dynamic model. System dynamics has the advantage of providing a full methodology from the system representation to the simulation model; therefore it is the best method to use in this study. Besides, the causal loop diagram (CLD) represents the system in a qualitative manner. The diagram visualizes the elements of the system and their relations. Due to the clear structure, the diagrams can be easily understood by the readers. Hence, a system dynamic model had developed in this study to explore and analyze the problem of error made by the employees in Power Tools industry.

3. Methodology

3.1 Data Collection

The questionnaire in this study was designed based on five points Likert-scales comprises of 10 questions to measure the factors that give rise to the error made by employees such as job stress, workloads, skills, and experience. The questionnaire was distributed directly to the respondents to get their thoughts about the factor that gives rise to the error made by employees. The data collected was then analyzed and implemented in the model to depict the finding of this study. The technique used in this study is to analyze the data that has been collected from respondents through questionnaire is System Dynamic Simulation Model. The model in this study was used to analyze the behavior of the variables and the results that have been analyzed were illustrated in the form of a graph.

3.2 System Dynamic Simulation Model

System Dynamics was originated from the research of Professor Jay W. Forrester at Massachusetts Institute of Technology in the late 1950s (Forrester, 1989). It is a methodology which can be used to model, present and analyze the real world behavior of the large and complex system and problems with the aid of computer modeling and simulation software in order to have a well understanding of what exactly is going on within the process (Li, 2008).

Through the developed model, the cause and effect relationships of variables can be illustrated by creating the Causal Loop Diagram (CLD). The Causal Loop Diagram (CLD) is an important tool for representing the feedback structure of the systems. The causal diagram consists of variables connected by arrows implying the causal influences among each variable. The causal loop linkage can be either positive or negative. The objects and people in a system interact through feedback mechanism with the system dynamics model, where a change in one variable will affect another variable over times which lead to the development of stock and flow diagrams.

Besides, System Dynamics also enable us to model the relationship between system variables, the rate of change over time and explicit feedback. In addition, we could understand the reason why structure produces behavior and how behavior varies under different conditions through system dynamic model. System dynamic model has been applied in many fields such as healthcare system, public management, production and manufacturing and much more. By using System Dynamics, the cause and effect of the problem of error made by the employees in Power Tools industry could be identified. This problem could be improved by adding the intervention to the system.

3.3 Stock and Flow Model

A simulation model was developed in this study by using the simulation software to develop the stock and flow diagram. This model was developed to study the factors that cause the increasing of error made by employees in this company. The stock in this model perfectly representing the number of the task assigned to the employees. The 'Task In' represent the inflow of task while the 'Task Complete Without Error' and 'Task Complete With Error' represent the outflow of the task. This means that the 'Task' would change via the 'Task

In', 'Task Complete With Error' and 'Task Complete Without Error' only.

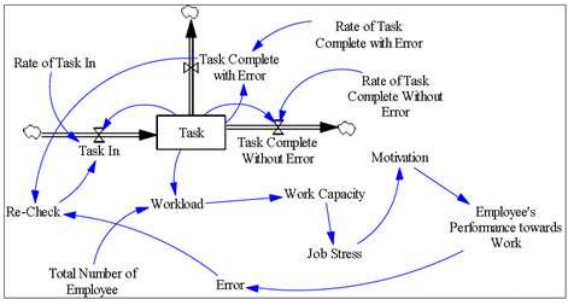

Figure 1 . Model Development for Managing the Error Make by the Employees.

The ratio of the task and a total number of employees would create the workload of the employees. As the workload of the employees increased, their capacity to do the work is decreased. When the work capacity of the employees is decreased, this would generate a high job stress to the employees and their motivation to do the task would be decreased. All of these factors would affect the performance of the employees. When the performance of the employees toward the work is affected, this would bring the impact towards the work quality where the error made by employees would be increased. When the error increased, the number of re-check task will increase. The increase in 'Task Complete With Error' would increase the 'Task In' and 'Workload' of employees thus will affect the number of 'Task To Be Re-check'.

4. Data Analysis and Result

Results indicate that there is an increasing number in task per day. A number of 'Task' increase when there is an increasing number in 'Task In'. When the numbers of 'Task' increase while the numbers of employees are constant, it will induce to increasing number of 'Workload'. From Figure2, it can be observed that graph for the result of 'Workload' increase per day within a month.

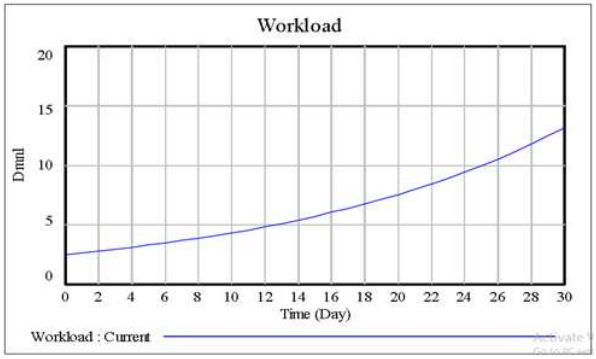

Figure 2. Result of workload

The greater the number of 'Workload', the lower the work capacity of employees. It can be said that when the employees have a lot of tasks to be handled, the capacity of employees to work on all incoming task is reduced. This situation has resulted in decreasing of employees performance in completing their task.

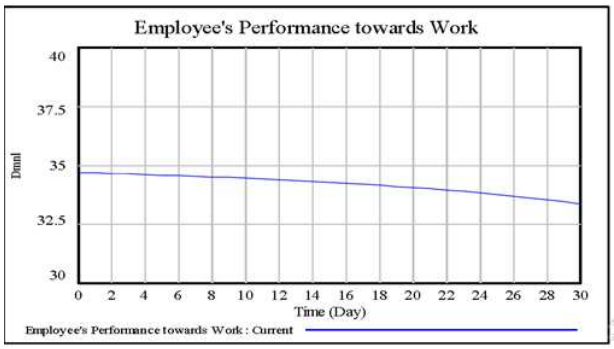

Figure 3. Employee's Performance towards Work.

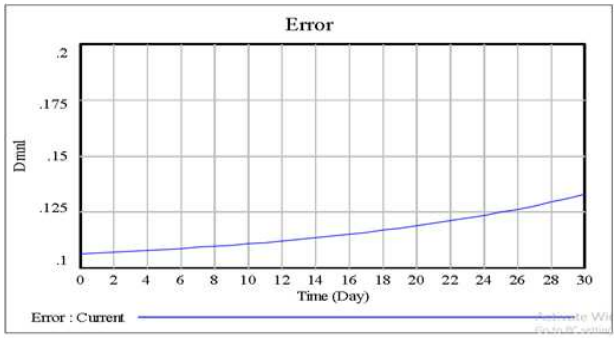

Figure 4. Result of Error Occurs

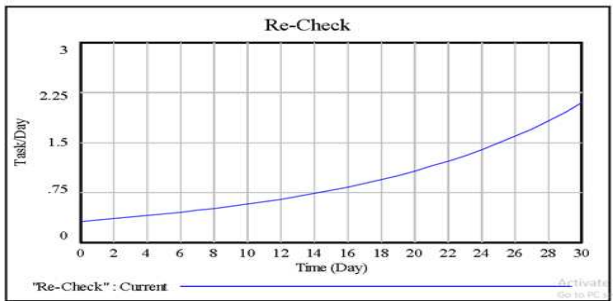

Figure 5. Result of Re-Check for the Error

Figure 3 shows an increasing number in error occurs per day. Result obtained from employee's performance towards their work and errors are shown in figure 3 and figure 4 respectively. It showed that error occurs depends on 'Employee's Performance'. Which explains an increase in 'Error occurs' will decrease the 'Employee's Performance'. Besides when 'Error' occurs, 'Re-check' process for this error are required which induced in increasing number of workload and affected their performance. Figure 5 showed an increase 'Re-check' process for error occurs per day.

5. Conclusion

In conclusion, the factors of the workload of employees, their work capacity, job stress, motivation and performance towards work had been identified as the root

causes of the errors made by employees that always occur in power tools industry.The increasing number of error occurs that resulted to the increasing number of error task that needs to re-check have brought the impact towards the workload of the employees.

Hence, in order to solve this problem, increase in the total numbers of employees in the company has been determined and proven in which it could reduce the workload of each employee. When the workload is reduced, the job stress of the employees would reduce and their work capacity, motivation and performance towards work would be an increase in which the errors made by the employees and the re-check for the error task would be decreased.

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