

Implementation of Fishbone Diagram by Cause & Effect Analysis for Construction Projects

Wdrożenie diagramu rybniej ości poprzez analizę przyczynowo-skutkową dla projektów budowlanych

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Abstract: This study aims to practice the implementation of the Fishbone Diagram for Cause & Effect Analysis and prove the validity of the technique's usability in any construction project to increase productivity for both construction managers and engineers. In every sub-branch of the given Fishbone Diagram, possible failures might be expected to occur unless necessary precautions are taken. The failures, emerge as significant problems and range from possible delays to product quality deficiencies which would affect the acceptance of the project from customers.

During the creation of the Fishbone Diagram, the obtained results show us that possible delays are co-existing among each of the 5 M's. Fishbone Diagram in the study also points out there are common issues and similarities between Men and Machine since both 2 M's lead to progress in a construction project and are interdependent.

As a result of this study, usage of Fishbone Diagram Technique demonstrated the possible connections between M's and determination of the Cause & Effect relations in a construction project. Findings of this study proved that usage of Cause & Effect Analysis in construction projects is also practical to determine the key points of a construction and interdependent factors.

Key words: Fishbone Diagram, Construction, Construction Project Management, Quality Management, Ishikawa Diagram, The 5M's

1. Introduction

The Fishbone diagram (also called the Ishikawa diagram) is a tool for identifying the root causes of quality problems. It was named after Kaoru Ishikawa, a Japanese quality control statistician, the man who pioneered the use of this chart in the 1960's (Juran, 1999).[1]

Fishbone (Ishikawa) diagram mainly represents a model of suggestive presentation for the correlations between an event (effect) and its multiple happening causes. The structure provided by the diagram helps team members think in a very systematic way. Some of the benefits of constructing a Fishbone diagram are that it helps determine the root causes of a problem or quality characteristic using a structured approach, encourages group participation and utilizes group knowledge of the process, identifies areas where data should be collected for further study.[1]

As in many different professions, civil engineering is one of the fields that apply management related techniques to increase productivity and efficiency of mainly the cost and time of a construction project. Construction project management is a known discipline which often involves working in materials, workforce, time and cost management of construction projects.

The essential factors for the survival and development of construction enterprises include focus on construction project management, improve project quality, ensure project progress, reduce project cost and improve economic efficiency. The construction market is fully open and the market competition is more

intense, so the construction enterprises should establish the cost, progress, quality of the system management concept, then systemized the enterprise cost, progress and quality management work as a project and emphasize the overall.[2]

Quality measures are a well-known part of the maintaining construction success. "Quality is one of the critical factors in the success of construction projects. Quality of construction projects, as well as project success, can be regarded as the fulfilment of expectations (i.e. the satisfaction) of the project participants." [5]

As it was pointed out in the past studies about this subject, maintaining quality standards plays a huge role for companies to achieve expectations of the customer. One of the known quality tools, fishbone diagram, will be examined in this study for usage validity.

In this study, an example Cause & Effect Analysis via Fishbone Diagram will be used to determine the possible risks for project acceptance and examine the sub information we will obtain by using the Cause & Effect Analysis. Based on the cause-effect relationships in the bones of the diagram, examination of the usefulness of Fishbone Diagram in construction projects will be made and findings and doctrines will be discussed.

This study will also include the causes of the delays in the construction projects. Delays in construction projects are known issue in the construction industries and negatively affecting the companies itself and the industry indirectly.

(Ramanathan,2012) described the negative effects of the construction project as; "To the owner, delay means loss of revenue

through non availability of production facilities and entable space or a dependence on present facilities. In some cases, delay causes higher overhead costs to the contractor because of longer work

period, higher material costs through inflation, and due to labour cost increases.” [6]

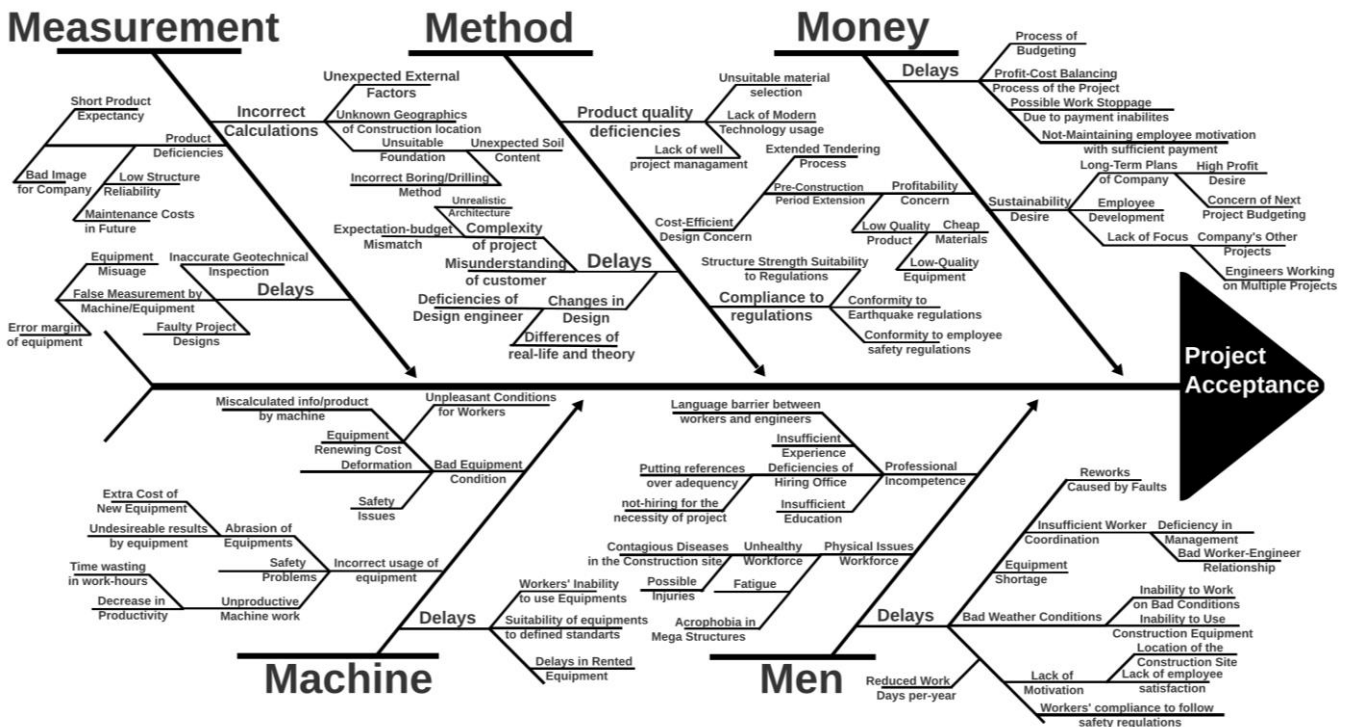


Fig. 1. Fishbone Diagram to determine possible failures to be used in an example Construction Project

2. Experimental

In this study, to prove and set an example for the applicability of the Cause & Effect Analysis in construction projects, an example Fishbone Diagram made for “Project Acceptance ” will be examined. In this imaginary presentation, The Fishbone Diagram is constructed to present to the company to identify possible problems for project acceptance and brainstorm on possible solutions. The Fishbone diagram given in Figure 1 above is made from anonymous engineering experiences to prove the applicability of the Cause & Effect Analysis in construction projects. The Fishbone Diagram is designed to present 5M’s which is Measurement, Method, Money, Machine and Men. The sub branches of each factor leads to more specific points about main factors.

In order to prove the Fishbone Diagram’s suitability for all possible occasions, the Figure 1 is designed in such a way to satisfy any possible high expectations. As is known in the civil engineering industry, the customer can be even the government itself and the project might be designed to serve the whole locals or country’s vital aspects like logistics, trade etc. In such vital projects, satisfaction of the customer is expected to be compelling and the examination of possible reasons to cause dissatisfaction should be prevented. In this study, Cause & Effect Analysis is imagined in a rigorous way to abide strict regulations and to achieve a high satisfaction level. Importance of customer satisfaction is defined by (Sami Kärnä,2004) as “Customer satisfaction has become one of the key issues for companies in their efforts to improve quality in the competitive marketplace. It can be seen as either a goal of or a measurement tool in the development of construction quality.” [7]



Fig. 2. Branches in the context of method

As it can be seen in the example sub branch, the Figure 2 above examines the possible project acceptance obstacles in the context of “Method”. “Method” in a construction project can vary from designing practices to application of regulations and management methods. The possible issues get more specified with the deepness of the bones and each upper branch comprises sub-branches. Each sub-branch is relevant to possible real-life issues that can be seen in the construction industry and written from anonymous research made from different engineers’ knowledge and past experiences.

The given issues in branches represent possible obstacles before the acceptance of the project. To achieve the purpose of this

study, examination of the given diagram and measurement of the diagram's usefulness will lead us to verify the usability of the diagram and determine the by-inferences of the diagram's usage. In this study, cause and effect analysis will focus on project acceptance over different contexts as 5 M's.

Fishbone diagram has multiple functions that can be applied in manufacturing, sales process, and marketing aspects. Each category has different characteristics. The fishbone diagram used in this research is manufacturing type while the most popular content in manufacturing is "5Ms"; methods, machines, materials, measurements and man. [4]

The necessity of accurate problem determination in construction projects comes from the importance of project management in construction projects.

Project success depends on project management success and the success of the end-product. This represents the micro and macro perspective of project success, the boundary of which inspires polarized reactions. Project success is influenced by many different factors, outside the control of project management.[3]

As given in (Al-Hajj, Zraunig 2018), project management practices in construction projects are unable to identify each of every factor affecting the projects' success or acceptability. The Fishbone Diagram designed for this study is an example for an ideal gap filler for the exigency in projects. Every given sub branch is relatable for non-theoretical real-life problem occurrences which is vital for problem identification and taking the necessary steps for solving the problems.

3. Results and discussion

During the research process of this study, in every main factor (M's) of the diagram, the "Delays" sub branch was observed due to deadline expectations of customers due to the nature of the construction industry. In the diagram made, even though the possible issues are designed as to be relevant with concerns of the customer, results of the research for subbranches shows us the company's concerns implicitly affects the final product and therefore the concerns of the customer.

Results from the M's Men and Machine shows us that these two different factors are connected to each other and deficiency in one of them significantly affects the other. This inference obtained from identification of possible issues proves that workforce and machine are key points in a construction and interdependent. Moreover, the inference proves us usage of Cause & Effect Analysis via Fishbone Diagram in construction projects can lead to determination of interrelations between different factors. Similar observations are also possible to notice between Method and Measurement, Measurement and Machine etc.

Usage of cause and effect analysis proved us that, with usage of cause and effect analysis by Fishbone Diagram it is possible to determine by-inferences as much as the possible causes to affect project acceptance. Presentation of such phenomenon to brainstorm purposes and problem-root determining will increase the problem-solving skills of the company and increase productivity.

By examining the example diagram Figure 1, it is possible to determine the key points with most effects to project's success by common branches in different M's.

Importance of the identification of the such possible failures comes up as this point. Impact of failures in construction industry is defined by (Kumara, 2015) as "As Construction project failures are increasingly reported around the globe and achieving success of construction projects is becoming extremely difficult in today's turbulent environment." [8]

By the examination of Figure 1, even though possible equipment issues are mostly a "Machine" related concern, conditions of equipment in construction sites have significant connection with other factors such as Men and Measurement. We can expect possible problems led by lack and failures in equipment due to its connection with other factors.

4. Summary and conclusions

In our study, an example Fishbone Diagram was examined for the purpose of validation of the cause and effect analysis for project managers in the construction industry. In our Fishbone Diagram, we identified the failure predecessors and their possible effects on construction project's acceptability.

During the creation process of the diagram, due to the research's nature, we identified around 80 causes and effects affects the acceptability of the project. As a side learning in this study, we discovered reasons of failure generalized for an overall construction project.

With the examination of the diagram, our study showed us that by the usage of the cause and effect analysis, it is possible to determine the problems as the main purpose and obtain indirect inferences.

Examinations made showed us that cause and effect analysis by Fishbone Diagram is possibly beneficial for companies' management related problem-solving processes.

By the results of this study, it can be deduced that solving some of the points which are connected by different factors identified with the Fishbone Diagram can make a significant contribution to the progress of the project. Vital aspects like delays in projects can be avoided with the cause and effect analysis and creating solutions for these causes.

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