

Quantify the Different Constraints for Delays in Infrastructure Construction Project Work and Recommending Corrective Measures for Same

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Abstract - *The aim and scope of this project is to identify the constraints in infrastructure construction project working environment. If constraints are better understood at the outset, it is believed that better performance can be assured. Identifying and removing constraints from bottleneck activities help to reduce uncertainties in infrastructure construction processes and increases the transparency of project management. This study was carried out based on literature review and a questionnaire survey. The data for this study will be gathering through a detailed questionnaire survey. The questionnaire form is forwarded to various construction industries through email and in personal. The objectives of the study is to successfully reduce the constraints which will help to decrease the unnecessary wastage and loss of both money and time because of inadequate planning.*

Key Words: Constraints, Bottleneck activities, Quantify, Workflow, Relative Important Index.

1. INTRODUCTION

Constraints becomes an important factors which focuses on the weakest rings in the chain. Constraints are defined as anything that limits a system from attaining higher performance towards its goal. Identifying and removing constraints from bottleneck activities help to reduce uncertainties in construction processes and increases the transparency of project management. Needs and constraints in a multi-party working situation bring complications in project management. Needs are diversified when the client is a large organization such as a public client or a corporate client. However, constraints in construction projects limit their achievement of high performance that we are unaware of the existence of the constraints, or, we tend to put more emphasis on the project goals. The construction working environment involves multi-party participation. Needs and constraints in a multi-party working situation bring complications in project management. These can further develop into conflicts and disputes, which bring cost consequences, direct and indirect, to clients and contractors. The project team members have to meet client's needs on one hand and to overcome constraints on the other hand. With the

limited literature for the constraints in the construction working environment, it is important to identify the potential constraints in the construction project, which will help to decrease the unnecessary wastage and loss of both money and time because of inadequate planning. Controlling the constraints is thus a pre-condition for high performance of the project. Constraints is based on the idea that every system has at least one bottleneck which can be defined as any kind of situation that impedes the system to reach high performance level in terms of its purposes. A constraint is defined as anything that limits an organization or entity from moving toward or achieving its goal. Constraints logic forms major portions of the organization's philosophy of continuous improvement. It is applied to identify what factors limit an organization from achieving its goals, developing a solution to the problem, and getting the individuals in the process to invent the requisite changes for themselves. It has been realized that reducing and eliminating critical constraints through better means of look ahead planning are the keys to achieving reliable workflow and, consequently, increased productivity. Constraint modeling is an indispensable step in construction planning. Reliable planning depends on effective identification, formulation, and satisfaction of key constraints in production processes. Constraint management helps to optimize production plans, resolve resource conflicts, and increase the availability of resource and information prerequisites. Reducing uncertainties in the workflow requires new methodologies and tools that can deal with other types of constraints rather than only the process constraints. Infrastructure Construction projects are facing a greater number of uncertainties and more severe risks, which could cause much bigger losses than in the past. Construction projects are subject to numerous constraints of various types, including contractual due dates, resource limitations, and safety, financial, and managerial constraints. Construction projects are characterized by their complexity, uniqueness, and the fact that there are various types of constraints imposed by stakeholders. If constraints are better understood at the outset, it is believed that better performance can be assured.

2. IDENTIFICATION OF CONSTRAINTS

2.1 INTRODUCTION

Collection of information through literature review and preliminary study of the factors are causing constraints in delay of construction work. The collected data will be the base for the further progress of the study. In our study, we firstly classified the constraints into five categories based on literature review they are as follows

2.2 ECONOMIC CONSTRAINTS

The economic constraints mainly happened with budget limit and allocation of the money. Due to the budget limit, the adopted construction system may not be the best option for achieving the project goal and quality. It will affect the proceeding of the project. As for the allocation of money to be used in the project, if the money is not effectively allocated, it will affect the progress of the project. The effect on the project is the product quality and performance of the project (Muhwezi, Acai and Otim, 2014).

2.3 LEGAL CONSTRAINTS

The legal constraints exist because there are many regulations that are ruling the construction project. The legal constraints are mainly related to work law, safety regulations, and supervision plan. For example, as prohibited by law, certain types of construction work could not be carried out during Sunday and public holidays. As for the impact of the legal constraints, from one side, it may affect the schedule and lead to project delay (Lau and Kong, 2006).

2.4 ENVIRONMENTAL CONSTRAINTS

The public concern and regulations require the environment to be protected such as air protection, tree preservation, traffic limit, noise control and so on. In the planning and design stage of the project, the responsible people need to go to the "Environmental Department" to apply for the approval justification for the project. This takes time and will affect the project progress. If the approval is not obtained on time, the whole project will be delayed, or could not be carried out. There are also other technical constraints arising from air protection, tree preservation, traffic limit, limit due to excavation permit for works, etc (Lau and Kong, 2006).

2.5 TECHNICAL CONSTRAINTS

There are quite a few technical constraints arising from restrictive site area and congested surroundings which are particularly applied to the site environment in India. On one hand, building projects in India are usually constrained with restrictive site area where storage space, transportation and temporary works require input of careful planning by design engineers, while the design and construction of the building works itself can be fairly certain

at the outset. On the other hand, coordination of services works also poses technical constraints in construction. While having electrical wiring, ventilation duct work, fire services and plumber works with further complication of broadband alignment, telephoning system and security system give rise to technical constraints that demand coordination and collaboration of multiparties in terms of design and construction. Technical constraints are more readily recognized at the outset and at the stage of design, but this does not mean that all constraints can be overcome (Lorterapong and Ussavadilokrit, 2013).

2.6 SOCIAL CONSTRAINTS

No construction work could proceed in rural area without people's involvement. The social factors constitute constraints in the construction working environment. It is not surprised to learn that undesirable effects come from a relative small number of key persons and the constraints are human constraints (Wang, Shou and Wang, 2015). These social constraints may appear minor and insignificant, but is very complicated to deal with. Sometimes it may arouse big problems for the project and will at the same time affect the progress of the project. Constraints related to people can appear in three different forms:

- a) Human resistance
- b) Emotional constraints
- c) Ownership of the problem

In implementing changes, there will be human resistance. So constraints have to be thought of during the planning stage before actual implementation so as to minimize the effect of human resistance. As for the emotional constraints, there is tendency for people to take defensive action rather than 'toleration' even the rational minds tell them not to. In this stance, people are emotional disturbed. In situations when constraints are concerning job security, the impact of the emotional constraints can be even greater and can cause devastating effects. As for the ownership of the problem, people may at times facing problems caused by others or by Act of God. It is easy to say that they do not cause the problem and thus are not responsible for it. Someone have to be held responsible for whatever causes there are. Moreover, providing an answer to a problem even if you are aware of it sometimes may not bring the expected results.

3. RESEARCH STRATEGY

Data collection is a vital part of research. In this project, data was collected from Sangli region through direct interview based on standard questions formulated. A questionnaire was designed to collect information from Contractors and Architects.

The questionnaire contains a set of simple and straight forward questions whose purpose is to collect particular data and information. This provides the basis to identify the constraints in delay of infrastructure construction project work. The collected data will be the base for the further progress of the study. On the basis of collection of data to identifying constraints in delay of infrastructure construction project work by Relative Importance index method.

4. PRIMARY DATA

The primary data was obtained using the survey method. These include the distribution of questionnaires and collection of data from key respondents and professionals pertaining to the infrastructure construction industry. In order to achieve the aim and objectives of the study, well-designed questionnaire were formulated to gather information from appropriate respondents. Data obtained was analyzed to get meaningful conclusions and recommendations.

The design of questionnaire was done based on the analysis made in various literature reviews. Various data's have been collected for designing the questionnaire. Total 26 questions related to different factors were designed but those questions having more impact on delay have selected. Questionnaire was generally designed in the rating of factors on five point scale was given in the questionnaire.

5. ACTIVITIES CONDUCTED

- 1) To ensure maximum participations, the questionnaires were sent to major projects, clients and their contractors and consultants.
- 2) The data collected were presented, tabulated and analyzed using suitable statistical techniques.
- 3) A discussion of the results is linked with the findings of the literature and delay causes were identified and ranked based on their severity.
- 4) A comprehensive review of the literature related to the topic of this study is performed.
- 5) To achieve the study objectives, several research techniques have been reviewed and the questionnaire technique has been selected due to the applicability to this research.
- 6) The questionnaire is developed based on the literature findings and preliminary discussions with some parties involved in public projects.

$$\text{Relative Important Index} = \sum W / (A \times N)$$

Where,

W is the weighting given to each factor by the respondents (ranging from 1 to 5),

A is the highest weight (i.e. 5 in this case), and

N is the total number of respondents (Gunduz, Nielsen and Ozdemir, 2013).

6. RANKING OF CATEGORIES

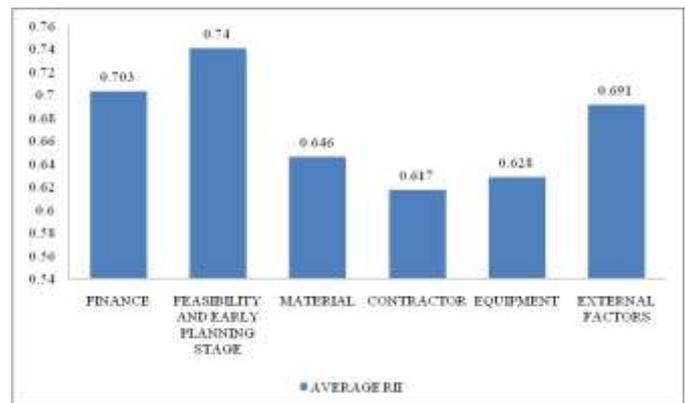


Fig 1. Graphical Representation of all Categories and their RII

All the six categories involved in the total survey are combined together in following Figure. The Figure 1 shows average of RII of each group in this stage to compare them together. From Figure 1, it is seen that causes of feasibility and early planning stage shows maximum RII 0.740. According to participant's response, causes related to are feasibility and early planning stage affecting the delay of any project in construction in large percentage, which is then followed by finance category as it shows second highest RII in this stage i.e. 0.703. The third delay factor is related to the External factors whose RII is 0.691. Material and Equipment Category are at fourth and fifth position in this ranking with RII 0.646 and 0.628. The Other (Contractor related causes) Category stands at bottom position in this ranking as it shows lowest RII 0.617, which shows this is not affecting the project delay too much as compared to other factors in this stage according to participant's response.

7. RECOMMENDATIONS TO REDUCE DELAY PROBLEMS

Delays can be avoided or minimized when their causes are clearly identified. According to the preceding findings, the following recommendations can be made as ways to minimize and control delays in construction projects:

1. Contractors should not be rewarded jobs for which they lack sufficient expertise. They should gain necessary experience before the bidding stage. Inadequate experience of contractors is the most important factor in causing delays. Contractors with inadequate experience

cannot plan and manage projects properly, and this may result in deleterious consequences.

2. Contractors should pay more attention to preparing effective planning and scheduling. During construction, planning and scheduling may be revised if necessary conditions occur. Only a project that is well planned and scheduled can be well executed.
3. All working drawings must be clearly drawn indicating all the dimensions and labels to scale so as to avoid confusion during construction.
4. Site management and supervision should be done correctly. Administrative staff should be assigned to make necessary arrangements to complete projects within the specified time while meeting quality and cost requirements.
5. Owners may demand design changes during construction, but only to the extent that no adverse effects occur with respect to mission critical activities.
6. Delivery of construction materials to a site should not be late so that work may be executed in the planned order.
7. Generally, large projects may entail having many subcontractors working under main contractors. If a subcontractor is capable and reliable, the project can be completed on time as planned. If the subcontractor underperforms because of inadequate experience or capability, the project may face delays. The use of many subcontractors may lead to a high risk of delays.
8. Inspection and testing by consultants is an important activity during construction since poor quality inspection may result in lower quality of work.
9. The quality and experience of the labour force can have a major impact on projects. Unqualified workers may lead to inefficient work and cause accidents during construction.
10. Clients should ensure that proper planning and costing of the works are made during the pre-contract period so as to avoid intermittent stoppage of works as a result of funding constraints since this not only increases the
11. construction period but also impacts on the contractors overhead costs and costs associated, with mobilization and demobilization during the period within which the works were suspended.
12. Delays in deliveries to construction sites, approval of design documents, and progress payments are delay factors caused by owners. Sites should receive deliveries as soon as possible. Design documents should be approved promptly; otherwise, work progress could be

delayed. Progress payments should be made on time to contractors to finance the work.

13. Owners should make decisions as quickly as possible so as to avoid delay.
14. Since many parties are involved in a project (client, consultant, contractor, and subcontractors), communication and coordination with other parties is a crucial factor in the timely completion of the project. Effective communication avoid most delays. Proper communication and coordination channels between the various parties should be established during each phase of construction. Problems with communication may result in misunderstandings and, therefore, delays in the execution of the project.

8. CONCLUSIONS

To have a good understanding of the identified constraints at the planning stages, we suggest the management to have the constraints documented and to consider these constraints in the relevant project planning agenda and schedule as well as the designing of the organizational structure. At the implementation stage, the management should keep track of the progress and be aware of the constraints they encounter. The management should ensure that enough resources, which include money, facilities, staffing and effort, are allocated to decrease the limitations from the constraints encountered. In view of the nature of the different types of constraints, we suggest that the middle managers are empowered to take up adaptive management in response to the prevailing conditions. Delay is a serious issue in construction industry as it impacts the time and cost of projects.

Delay in construction projects would cause for extra cost and loss in financial return or other benefits from project. Thus, delay is costly for both owner and contractor. The extent of delays should be reduced by identifying the root causes of financial related problems and find out the solutions that are able to reduce the extent of delays in construction project. The survey findings indicated that the root causes of financial related delays are because of poor cash flow management followed by late payment, insufficient financial resources and financial market instability. Contractor's instable financial background, client's poor financial and business management, difficulties in obtaining loan from financiers and inflation were identified as the most significant underlying causes. All parties involved in the construction project agreed on the fact that clients should bear the greatest responsibility and play the most important role in lessening the impact of financial problems and delays.

In this project work, we identifying the different constraints by RII method which are directly affected on the work delay in the infrastructure construction project. Mainly feasibility and early planning stage shows maximum RII

0.740 so out of 6 factor this is most effected delay in the infrastructure construction project work in this way So it is identifying and removing constraints from bottleneck activities, which helps to reduce uncertainties in construction process and increase the transparency of the project management.

The identification of the constraints helps project managers not only understand the characteristics of the constraints, but also predict the time and stage that the constraints may be encountered. The economic constraints, legal constraints and the environmental constraints are mainly appeared in the planning and definition stage. It affects the proposal and design of the project. The technical constraints and social constraints are expected to be encountered during the project implementation and maintenance period. A good prediction of the constraints helps make good project planning and resources allocation. Project managers can judge whether the constraint is maintained through the whole progress of the project.

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