MANAGING DESIGN PROCESS AND ITS EFFECT ON CONSTRUCTION PROJECTS

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Abstract - Development projects in middle east present special conditions in which the designers/ consultant of projects must focus on each design stage from conceptual design to tendering stage to deliver all design phases without any delay. International consultancy firms whose there staff are multinational and had the opportunity to work in the region, the advanced new architectural and structural software, the squeezed time of project completion by the client, and the fast growth of project development (new cities) and infrastructure development are some factors that contributed to the delay of project completion where designers of consultancy firms don't have the sufficient capability to manage and control the design process. This study determines the factors that contribute to project delays caused by consultancy firms who don't manage and control design process based on the clear understanding the project objectives.Findings and recommendations of this research is recorded based on specific questionnaires designed for design engineers, resident engineers and architects who works with consultancy firms and based on interviews with some of project managers from client and contractor side to find out the effect of consultant adoption to the implications of managing the design procedures for any project and actions should be considered and taken by design managers and the rest of his team to complete the design on time without any discrepancies in design drawings and tender documents of the construction project.

Keywords - Process of design, Engineers Obligations, Design Management, Project Objectives, Architect and Engineer

I. GENERAL INTRODUCTION

Involvement of designers from different countries during the construction booming in the Middle East caused a big impact in operational work of projects for all project participants either during design or construction. Consultancy firms have received many claims from the contractors due to the additional works and changes. Architects and resident engineers who communicate directly with clients was not aware of the impact of changes during design and construction based on client requirements.The problem of changing scope is expected and is a major issue, no matter how project is planned, it is almost certain to be changed before completion, no matter how carefully it is defined at the staring, most of projects are subjects to considerable uncertainty [1]. Pre-planning may mitigate some issues, in high risk projects, the better project planning improved success of four measures, schedule over run, cost overrun, technical performance and satisfaction [2]. There are multi causes of delays caused by projects participants where the designer and resident engineer should properly communicate with the client and contractor to control whatever changes may happen. Ignoring considerations of principles of controlling the project during design in term of time, cost and quality cause major delay during the design. Applying quality standards to the process of managing the projects as well as the project deliverables is necessary approach as confirmed by [3]. It is important to identify any factor that may affect the design process at very early stage of the project. According to the extensive checklist that has been prepared by [4] project team should go through plan, budget and schedules along with projects record and control that should be considered during design and construction. . Project delays has a big impact on project stakeholders who participate in the causes indirectly where most of them are follow a certain types of processes e.g. project management applications and techniques, primavera and other technological systems to deliver the design on time. Handing over dates of projects are not always accomplished on time due to many reasons like communication process within the design team and the client representative, lack of information of project objectives by the architect, and updating of design criteria and codes by designers. Common causes of delay caused by consultancy firms in projects are many where the highest ranking problem is the lack of experience of managing design process that should be planned at very early stage of the project. Project manager, design manager and resident engineer needs two kinds of credibility, technical credibility and administrative credibility where technical competence of project managers seems to be associated with project success that lead to a positive leadership characteristic [5]. This mitigates numbers of problems that might be associated during the design phases mainly communication problems and skills of management of design engineers. Accomplishment of project development team depends on the skills of with which they handled two way communication and problem solving, plus their willingness to deal with uncertain information [6].

At early stage of the project it is essential to determine in advance the expected factors that may delay the design progress that is the responsibility of senior management of consultancy firm.

II. OBJECTIVES OF RESEARCH

Research is concentrated on the obligations of project a participant mainly the team of consultancy firm managed by the architects who's their responsibilities is mitigating issues contributes to the design process delays. It is focused on the determinations of finding the factors attributes to the delay of projects caused by resident engineers and his team during the design and construction. Project is defined as a combination of human and non-human resources to build a certain project within agreed time, cost and quality. It has a starting and completion date for a series of activities prepared based on the clear objective that should be analyzed by the architect engineers who should translate these objectives into information, drawing and design data.

Any lack of understanding will lead to discrepancies in the design documents which affect the design process, so the information should be very clear

The recorded information are collected from different sources e.g. researches of similar topics, books, literature review, survey of questionnaire and interviews with experts who are involved in design and construction process.

Main reasons attributes to the lack of adopting design management to the maximum level of accuracy that cause discrepancies of design documents has been determined through the analysis of the feedback and respondents of the questionnaire. The results of survey questionnaire and findings of study findings has been interpreted and used as a indication and mark to measure the action of design team who should mitigate factors keep causing problems to design progress.

III. IMPACT OF CULTURAL FACTORS

Cultural background has always a major effect on work and human behavior along with project progress. The construction industry is still suffering from many problems caused by cultural factors. Culture reflects the human aspects of the engineering environment, it consists of beliefs, moral, habit and customs learned from others regardless what education individuals received Due to the cultural differences between foreign consultants and the clients of the projects a major common problem is always occurred because of the differences in religions, habits, and traditions.etc.There is a clear impact of cultural issues on the performance of multinational consultancy and contracting firm's projects in Dubai. The fast growth of projects development in the region has led to establish many international design offices. Some of these firms appoint local architects to manage the project for keeping the identity of the design and because they are familiar in the traditions and habits of the people (owners of projects) in the area. Some prefer to have their own architects and design managers who are familiar in the firm roles, policies and procedures. This means that engineers and managers increasingly have to deal and communicate with individuals from different cultures and should develop their interactive skills to tackle such problems. International Consultant and their design managers and local architect do not have same way of thinking but both have the same target (which is handing over the project on time). Sometimes they have difficulties in communications due to differences in traditions, language and habits. Also because of their different cultural backgrounds, they have different behavior, belief, attitude and values, which reflect how they run the project. Consultancy firms should know how to deal with individual's clients such as the Client representatives, the Consultant, the Contractor, local authorities and the other organizations who are from other different cultures. He must also understand and develop the communication skills, leadership skills, interpersonal skills, flexibility and the technological skills to overcome all the problems. Architects who are unable to deal effectively with the society or environment of work, due to multi-cultural factors or differences in legislation should be aware of the implications of the cultural differences and aware of essential aspects of management and execution skills to avoid project progress delay. Most suitable definition of culture could be introduced as the entire heritage of a society transmitted by word, literature. It includes all traditions, habits, religion and language [7]. The Foreign consultant design manager and resident engineers do not have same way of thinking but both have the same target which is completing and handing over the project on time. Due to the different cultural backgrounds, they have different behavior, belief, attitude and values, which reflect how they run the project either during design or construction.

IV. MIDDLE EAST WORK ENVIRONMENT

Traditional type of contract is the adopted and used type in most of the countries of Middle East where the main project participants, client, consultant and contractor are always involved during design and construction. Consultancy firm the firm who prepare the complete design from conceptual till detailing and then tendering department start floating the tenders for bidders. The contractor is fully responsible about implementing what has been designed within a specific cost and quality standards comply with the technical specifications.

The important characteristic of traditional type of contract Procurement is that the Contractor has to build according to drawing and specifications that is prepared by consultant. The client hire consultancy firm who represents him while preparing the contract documents mainly tender documents, BOQ, drawings and specification including conditions of contract. Contractor normally requested to enter his price in the schedule of rates as a part of tendering process.

Preparing all kind of drawings of project requires big efforts of consultant team starting from the architect to quantity surveyor where continues support and regular meeting are conducted with the client or his representative to produce the drawings and other contract documents. Responsibility of design is fully the consultant responsibility, so that's why the consultant should be fully aware about the contractual obligations with the client. The bill of quantity form is a compiled document describes the work activities that should be executed along with the rates including the unite rate of each activity. It is used as a document for the payment and considered as document to control the cost of the project under the supervision of the consultant. Sometimes design manager's fails to describe and specify main activities of the work in the bill of quantity of the project which cause a major delay in handing over the project on time. This kind of problem is very common due to the lack of experience in managing the design process which cause financial penalties that should be paid by the contractor..Design liability is always the consultant responsibility, so they have to control the design in a very professional method to avoid any pitfall with client .Project architectural features requested by the local clients contributes to the delay of design. Other factors contribute to the project delays are complexities of the design, details of specifications, type of consultant management, overall organizational structure of consultancy firm, communication process of design manager with his team, and with the client [8]. Due to any wrong behave from the consultant or design manager regardless if it is technical or management, it is going to affect the design process that's make the design management not effective.Project execution is monitored and supervised by the consultant representative who should have qualified experienced team who are familiar in the condition of the contract and technical work execution which sometimes not always available with all consultancy firms. Submittal and approval process of the project materials requires good internal communication experience between resident engineer and the project architects and

other material engineers who are authorized to check these submittals. Proper communication plan should be prepared in advance within the consultancy firm for every single project, which is a part of managing design process. Project resident engineer of the consultant firm is the engineer who is responsible about reviewing drawing, bill of quantities, conditions of contracts and the draft construction methodology of the project that should be prepared in advance by the office team to evaluate the constructability of overall project. Lack of experience of site supervision plan of the project might cause major contractual conflicts with the client or contractor that lead to a delay in the project. Supervision plan should be prepared in advance which is a part of design management. Within the approval of the architect, design manager comment on the submitted drawings/material if approved or rejected to contractor to proceed with the work based on the plan of managing design process.

V. FACTORS OF DELAYS ATTRIBUTED BY CONSULTANT OFFICE

The majority of delays can be traced to inconsistent or to incomplete detailing of drawings, incorrect dimensions of walls and openings, inadequate detailing of difficult locations and inconsistent detailing. This creates difficulties in getting the approval of the final detailed design and other tender documents from state authorities. Other common factors are causing the delay in projects e.g. discrepancies of contract documents and incomplete drawings. Many contracts were bid on the basis of incomplete information, require extensive changes during construction. The design responsibility is transferred from the owner organization to the Consultant who is responsible for the design management in the Project and to be delivered by the design procedure system [9]. Poor appreciation of the design management process is another factor that causes delay by the Consultant

VI. PHASES OF PROJECT DESIGN

Most of consultant and project designers in consultant firms dont not complete the design without completing precise documents developed by experts through the phases of procedures due to the size and complexity of the required information. Phases interact with each other in a way to guarantee that the design complies with the client's needs as well as being constructible. Architect and consultant engineer they both should be familiar with designs phases, so they can communicate with all project participants mainly the project contractor. The listed factors are some important factors that cause a major delay to the project if the consultancy firm don't adopt any effective design management methodology:

1. Incomplete design drawings
2. Lack of implications of design management
3. Slow response to the technical inquires
4. Process of approval of submitted drawings
5. Technical experience of architect
6. Technical experience of design manager
7. Applications of QA/QC on the design
8. Internal and external communications of consultant
9. Availability of design team all the time
10. Irregular changes in drawings and specifications
11. Lack of controlling changes

Due to some cultural reasons and based on the low performance of consultant office, architect of the project and the resident engineer, clients / owners of projects stop communicating with them where interaction and communication becomes very week during the critical phases of the design. Regular meeting will be reduced and information become not very clear to all parties where many inquire remains pending. This cause major delay to the design process and the commencement date of construction will also be delayed..

VII. DESIGN OF QUESTIONNAIRES SURVEY AND DATA COLLECTION

Questionnaire and survey was developed to assess and estimate the perceptions of the Architect to the relative importance of adoption of design management procedures. The objectives of survey of questionnaire are to find out how much consultant team of consultant office attributes in the factors of project delays if they don't apply implications of effective design management. The questionnaire and the survey are developed based on 11 common factors that participate to the delay that introduced in the general introduction and literature review of this research. Questionnaires were sent to senior architects, resident engineers, design manager and projects managers who have long enough experience in construction engineering projects. Respondents were requested to record what they think of each delay factor on a percentage wise where the maximum percentage represents the maximum severity of delay. The weighting scale classifications used in the research survey results are as shown in Table-1. Participants were requested to mark the level of importance of each factor.

	Scale description	Rank	Scale	Delay
1	Direct cause	5	100	Major
2	Always cause	4	80	Major
3	Normally cause	3	60	Minor
4	Often cause	2	40	Minor
5	Could be ignored	1	20	No delay

TABLE-1

The listed identified eleven factors that cause a major delay to the project contributed by the consultant has been identified and incorporated with formulas to come out for the ranking as interpolated in table 3. Based on the feedback of respondents and the analysis of the results of questionnaires it is noted that they share a common opinion where many comments are similar to each other's.

They have difficulties with the incomplete design because they all admit that they don't have enough time and resources to manage the design process based on the discrepancies of the design documents, many of them they are not authorized to response to the technical inquiries due to cost impacts and there is an issue of approval process that should be only by the architect who is not available all the times. Technical experience is sufficient but managerial experience is not because there is no budget for training. Applications of quality are applicable where all of the offices have the ISO quality certificates. Communication is very limited and most of them depend on the contractor to keep the record of changes. Table-2 shows the Rankings for delays caused by the consultant as per the result survey and analysis

Delay factor	Rating of respondents	Rating of severity	Highest & lowest rank
1	79%	2.5	8
2	63%	3.7	2
3	73%	3.4	6
4	62%	3.9	1
5	88%	2.2	10
6	85%	2.4	9
7	90%	2.0	11
8	68%	3.5	3
9	71%	3.0	5
10	70%	3.2	4
11	77%	2.8	7

TABLE 2

VIII. RESULTS ANALYSI OF MAJOR DELAYS CAUSED BY CONSULTANCY OFFICE

The researcher has identified in percentage wise the scale of severity as indicated in Table-1 where severity value is assumed based on the assumption of assigning the first highest percentage as the highest value, the second highest as to next highest and so on. Value of 5 is considered as 100% severity, value of 4 is considered as 80%, and so on.
The rate of respondent in second column of table 2 showing the average response rating record based on their experience on the severity of impact of each identified delay factor of Table 1. It is recorded as a percentage, e.g. a 63 % is the highest means this factor always causes delay which is the lack of implications of design management., process of approval the submittals and communication process. The rates of the second highest factors are 62 % which are the process of approval of submittals. Communication internal and external the average of 70-71% and the availability of the design team all the time. The average of the severity of factors caused by consultant firm team, architect and resident engineer is ranging between 63% to 71% percentage. In ranking order the percentage could be considered ranging from 5 to 0, where 5 is highest and 0 is the lowest. The highest ranking is of 3.9 and the lowest is of 2.0 as shown in Table 2. Factor no.7 is the lowest factor of cause of delay might be cause by the consultant that is the applications of quality assurance and quality control. The second lowest factor of cause of delay is the technical working experience of the architect. It is also observed that more than 59% of the interviewed engineers requested senior management to adopt design management implications in the firms they working with.

CONCLUSION

Project team of consultancy firms starting from the design manager to the quantity surveyor and the architect should be familiar with project objectives and client requirements. In addition the principles of preparing the drawing and specifications are essential to all the team that is a part of design management process. This helps them to come out with correct figures of the approximated cost that complies with the client needs. Understanding the conditions of the contract and contract requirement is a must mainly by the resident engineer to monitor the work progress in a very professional method. One of important tools that architect and design manager should practice professionally are the written and verbal communications which requires a very good experience. Many questions about technical issues related to work progress; contractual and financial issues could be raised and discussed by all project stakeholders and participants during the project progress meetings to avoid conflicts [10]. To eliminate and avoid factors attributes to project design delay, a proactive action should be considered and taken in advance by the design manager and his team. The action should be focused on prepared plan to manage and implement correct design method complies with the project objectives and client requirements. Senior management of any consultancy firm should make sure that team members are having the full experience about the process and implications of design management that should be developed through contiguous training. Contractual terms and conditions is also minimum essential required knowledge for the engineer who manage and control the design to minimize any contractual or financial impact that might occur due the design changes requested by the client during the phases of the design and tender. The design manager should be fully familiar with all types of communication e.g. verbal and written communication, emails, contractual and technical letters, meetings and memos writing. Senior management should not ignore the cultural issues of the country they are working on because people are affected by their cultures like traditions, habits, and religions and behaves which reflects their personalities and their insistence to the identity of their projects.
In case of any modifications or design changes, the design manager should advice the client about the contractual and financial implications of these changes to avoid any exceeders for the original project budget. The architect of the project should minimize the level of changes to the maximum and this might be achieved by understanding the project objectives directly from the client through proper direct communication with the client.
Apart of the design management procedures that architect and design manager should consider during the design phase is nomination of contractor for some special items and provisional items along with the prime cost of the elements. They must consider the contractual and financial part of this issue to avoid any conflict during the execution. Final review and auditing of design documents and drawing which are a part of the conditions of the contract should be checked and reviewed carefully by the design manager to make the effective design management implemented correctly for the project.

RECOMMENDATION

Managing and controlling design process through an effective design management to prepare and develop precise design drawings, documents and conditions of contact during the design phase requires enough time and continuous co-ordinations between the client, his representative, architect of the project and the design manager and his team.
Spreading the awareness of benefits of applying and adopting the effective design management is essential and necessary to accomplish an effective design plan that will guarantee the eliminations of any discrepancies and conflicts. Consultant offices can do that through continuous training and enhancement of current processes. Current of design management processes in consultancy firms should be revaluated and reviewed to identify the gaps and overcome tall challenges they are facing. Client should approve and sign each design phase before they start the

next phase to minimize the number of changes that help to complete the design on time without a delay. There should be enough time to spend with the project owner to understand his objective beyond the project where the architect has to translate the objective to clear ideas that can be translated smoothly in to conceptually architectural, design and detailed drawings. Design elements and criteria should comply with the project requirements and specifications based on the approved regulations and coded. These processes are a part of the effective design management of any consultancy firm. Understanding the project objectives also participate in controlling the project budget through understanding the required time to produce each type/set of drawing.

Draft of construction methodology of the project that covers health and safety plan, environmental plan, quality plan, and risk plan should be prepared and studied by the design team to ensure that project will be constructed without any potential claims or problems. Bill of Quantities should also be prepared to covers and describes all work items that will be executed including the unite item and rate price of each item for the project.

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