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DECISION MAKING IN CONSTRUCTION MANAGEMENT USING AHP AND EXPERT CHOICE APPROACH

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Abstract -*The term and content of construction decision management are outlined in this research work. The main issues of construction industry were identified and possibilities to solve them are discussed. The model for decision making in construction management by using multi-criteria methods with their application in case study are discussed. AHP method and "Expert Choice" computer program is to be employed for calculations. In this paper a systematic methodology is presented under the consideration of many factors. Which include building an analytic hierarchy structure with a tree of hierarchical criteria and alternatives to ease the decision making. The paper also presents a thorough sensitivity analysis to demonstrate the confidence in the drawn conclusions.*

Key Words:**Decision making, Decision management, Contractor selection Crane selection.**

1. INTRODUCTION

Construction industry plays an important role in the development of the nation. In modern management Decision-making is an integral part. Rational or sound decision making is taken as primary function of management. Every manager takes many multiple decisions subconsciously or consciously making it as the key component in the role of a manager. Decisions making has an important role as they determine both organizational and managerial activities. Mainly the decision can be defined as a course of action purposely chosen from a set of alternatives to achieve organizational or managerial objectives or goals. This process is continuous and indispensable component of managing any organization or business activities.

The selection of a capable contractor is essential to the good performance of any construction project since they are responsible by core activities in the process. Selecting the efficient contractor from numerous applicants that are available today in market is a complicated problem for clients. In addition, selecting suitable suppliers significantly reduces material purchasing cost, improves the competitiveness of businesses, increases flexibility and product quality and helps with speeding up the process of material purchasing. In this way, according with this process should detect a supplier to whom the customer can entrust the responsibility to perform the project adequately. In this way, the selection criteria are very important for the decision making, since which are strictly related with the objectives of the client in relation to the contractor. If the criteria wrong the contractor selected may not be according with the client needs, even if the role decision process is carried out in the right way. In the basis of long-term assets, it is crucial to select a proper contractor, which could ensure the quality of the constructed building. It is found that efficiency of project success largely depends on performance of contractor that is selected.

Various decision making software are used in the construction project and most commonly used are Analytical Hierarchy Process (AHP) and expert choice. AHP is used to assist in building the model and help draw decisions. Expert Choice™ software is used to conduct the experimental assessments and get good result.

2. LITERATURE REVIEW

Literature survey is an important part of any project. Literature survey has to be conducted to understand various aspects of the project and it helps in the successful completion of the project. A well planned literature review is characterized by a logical flow of Ideas, current and relevant references with consistent appropriate referencing style. It conveys an in depth information about the project.

Seyit Ali Erdogana et.al.,(2005) The term and content of construction project management are outlined in this article. The main problems of construction industry were identified and the solution to solve problems discussed. Multi-criteria methods was used for decision making purpose and applied to real case study. AHP and "Expert Choice" software was employed for calculations.

Ludovic-Alexandre Vidal et.al.,(2010) Project complexity is ever growing and needs to be understood, analyzed and measured better to assist modern project management. The overall ambition of this paper is therefore to define a measure of project complexity in order to assist decisionmaking, notably when analyzing several projects in a portfolio, or when studying different areas of a project. A synthesized literature review on existing complexity measures is firstly proposed in order to highlight their limitations. Then submit a multicriteria approach to project complexity evaluation, underlining the benefits of such an approach. In order to solve properly this multi-criteria problem, first conduct a critical state of the art on multicriteria methodologies.

At last, this tool permits to define a relative project complexity measure, which can notably assist decision-making. To define complexity scales and subscales are in

order to highlight the most complex alternatives and their principal sources of complexity within the set of criteria and sub-criteria which exist in the hierarchical structure.

E Szafranko et.al.,(2017) In a construction business, one must oftentimes make decisions during all stages of a building process, from planning a new construction project through its execution to the stage of using a ready structure. Decision making process is made very complicated due to certain conditions specific for civil engineering. For these diverse decision situations, it is recommended to apply various decision making support methods. Both, literature and hands-on experience suggest several methods based on analytical and computational procedures, some less and some more complexes. Mainly the article focused on the methods which can be helpful in supporting decision making processes in the management of civil engineering projects. MCE, AHP or indicator methods are used for the multi criteria methods. These methods have both advantages and disadvantages, whereas decision situations have their own specific nature, a brief summary of the methods alongside some recommendations regarding their practical applications has been given at the end of the paper. Aim of this article is mainly to review the methods of decision support and their analysis for possible use in the construction industry

P. Kousalya et.al.,(2012) This paper aims at giving an application of Analytical Hierarchy Process (AHP, a Multi Criteria Decision Making method) . In this paper AHP is applied for selection of a student from an Engineering college who is eligible for All Round Excellence Award for the year 2004-05 by taking subjective judgments of decision maker into consideration. More than two criteria were identified for getting this award and the alternatives are the different Branches of an Engineering college, in the state of Andhra Pradesh, INDIA

Thomas L. Saaty Katz et.al.,(2008) Decisions involve many intangibles that need to be traded off. For this, they have to be measured alongside tangibles whose measurements must also be evaluated as to, how well; they serve the objectives of the decision maker. An Analytic Hierarchy Process (AHP) is a theory of measurement through pair wise comparisons and relies on the judgments' of experts to derive priority scales. These scales that measure intangibles in relative terms. In this comparisons are made using a scale of absolute judgments that represents how much more; one element dominates another with respect to a given attribute. In this judgments may be inconsistent, and how to measure inconsistency and improve the judgments, when possible to obtain better consistency is a concern of the AHP. The priority scales are synthesized by multiplying them by the priority of their parent nodes and adding for all such nodes.

Thomas Saaty et.al.,(1993) Various methods of consensus of preference rankings of individuals are described in applying group decision making. In this article they discuss two different approaches, one deterministic and the other stochastic. The first one is applicable to situations where the group is small, and the stochastic method applies to opinions of the population at large where one cannot deal with people on an individual basis. Separating line between these two approaches is not made in stone and it is the choice of the decision maker to select one approach or the other. These two approaches they address the issues of obtaining priority weights for a group of individuals. In the deterministic method ranking of the judges is considered.

EdmundasKazimieras et.al.,(2015) Selecting the right contractor in construction industry is an important problem for an organization while the competition in global markets increases.

Performance of contractor evaluating by a multiple attribute decision making process. It consist of vagueness and imprecision. It is based on a set of hardly exact measurable attributes: capability and skills, occupational health and safety, technical capacity, managerial capability, bid amount, past performance and experience, financial soundness. The achievements and interests of the stakeholders should be taken into consideration when selecting the attributes and their importance for the evaluation of contractors. In this research, the paper presents a novel method based on multiple attribute Weighted Aggregated Sum Product Assessment with the grey attributes scores – WASPAS-G method. This method was applied in a case study of evaluation and selection of a right construction contractor, which has to be the most appropriate to stakeholders. In this technique, due to its capabilities of handling imprecise information because of applied grey relations and capabilities of providing decisions of enhanced accuracy when aggregating two methods, it is also used to sustain the ranking of development strategies, selecting the most effective investment or management decisions.

Thomas L. Saaty et.al.,(1994) People make three general types of judgments to express importance, preference, or likelihood and use them to choose the best among alternatives in the presence of environmental, social, political, and other influences. In the basis of these judgment on knowledge in memory or from analyzing benefits, costs, and risks. From past knowledge, we sometimes can develop standards of excellence and poorness and use them to rate the alter natives one at a time. This is useful in such repetitive situations as student admissions and salary raises that must conform to established norms, and without norms one compares alternatives instead of rating them. The observation must fall in an admissible range of consistency. AHP includes both the rating and comparison methods. The rationality requires developing a reliable hierarchic structure or feedback network that includes criteria of various types of influence, stakeholders, and decision alternatives to determine the best choice.

Prof. Rajiv B Bhatt et.al.,(2007) Describes an investigation of companies on the criteria for evaluation of contractors'qualification and the importance of criteria weight A bibliometric research by Dr. Alvaro Alvin found that the number of publications related to MCDM – Multi criteria Decision Making /MAUT – Multi attribute Utility Theory increased 4.2 times, from 1992 to 2006. This method can be

mostly attributed to a relevant growth of the publications focused on AHP and EMO –Evolutionary Multi-objective Optimization. PetarAdamovic, CaslavDunovic, Muja - MarijaNahod give a classification of trenchless methods applied in the model, assumptions, limiting conditions, input and output quantities by using Expert choice method which is based on AHP **Lee et.al.,(2007)** Stated AHP is the procedure occupied an assortment of options in the decision and capable to apply sensitivity analysis on the subsequent criteria and benchmarks. It makes judgments and calculations easy because of paired comparisons, and it demonstrates the compatibility and incompatibility decisions which is the recompense of multi criteria decision making **Taslicaliet.al.,(2006)**AHP is a multi-criteria decision making (MCDM) method that helps decision-maker to face a complex problem with multiple conflicting and subjective criteria (e.g. location or investment selection, projects ranking, selection of contractors etc).

JíriFraneket.al.,(2015) Reviews and discusses effects of utilization of various judgment scales on priority estimation in AHP. There have been studies that have been concerned with the comparison of judgment scales but there were no studies concerned with consistency measures that are needed.

K Nishijima et.al.,(2015) General aspects of sustainable decision making are investigated and a possible formulation of socioeconomic sustainable decision making is illustrated on the problem of lifecycle based design and maintenance of civil engineering facilities. First, an overview is given on the present understanding of sustainability indicators, and on available theoretical and methodical frameworks for including such indicators in sustainable decision making. Thereafter, basic principles of sustainable decision making are suggested by defining the "rules" for optimizing decisions that are made at present, but may have consequences in the future. A decision-theoretical framework is then formulated, which allows for modeling the interaction between intra-generational decision making and inter-generational decision making, utilizing the recently developed concept of agent based systems representation. The suggested framework is general, but is illustrated here on the specific c and simple decision problems related to life-cycle based design and maintenance of civil engineering facilities. For this problem, sustainable decisions are identified through minimization of the joint economic consequences for the present and future generations related to design and maintenance over the life cycle of such facilities. The suggested approach is demonstrated on a specific example considering the optimization of a concrete structure subject to chloride induced corrosion of the reinforcement.

Doraid Dalalah et.al.,(2010) Due to the central role of cranes in construction operations, specialists in the construction industries have cooperated in the development of structured methods and software to help select the best crane type in construction sites. Selection of crane is a time consuming process which needs extensive data exploitation and moderately few systems have been developed to aid in selecting cranes and in setting their lifts. These systems may have rich databases, they lack the support of knowledge based decision making. Crane selection is a multi-criteria decision-making problem with conflicting and diverse objectives. In this paper a systematic methodology is presented under the consideration of multiple factors and objectives that are witnessed to be crucial to the construction process. In this the model includes building an analytic hierarchy structure with a tree of hierarchical criteria and alternatives to ease the decision-making. Mainly three alternative crane types were considered, namely, Tower, Derrick and Mobile cranes. The Analytical Hierarchy Process (AHP) was used to assist in building the model and help draw decisions. The crane selection objectives into layered sub-goals, conclusions could be drawn on the type to be used in construction according to knowledge based evaluation and assessment. Expert Choice™ software is used to conduct the experimental assessments, and the judgments were found to be consistent, precise and justifiable with narrow marginal inconsistency values. This paper mainly presents a thorough sensitivity analysis to demonstrate the confidence in the drawn conclusions.

Sabah Alkass et.al., (1997) this paper describes a methodology for crane selection for construction projects. The methodology is incorporated into an integrated computer system capable of advising users on the selection of appropriate cranes for their construction projects. Expert's knowledge has been captured, classified and coded in the system's knowledge-base. The system integrates a knowledgebase with algorithmic programs, and commercially available tools such as: database management, spreadsheet applications, graphics and simulations. The system utilizes Object Oriented Programming characteristics of the abstraction, inheritance, modularity, and encapsulation of data. The system allows for the stored data and knowledge to be accessed by all parties involved in the crane selection process. It is also capable of facilitating user friendly interface. Description of the methods and current practices used for crane(s) selection for construction projects is also presented. A case example is presented, to demonstrate the effectiveness of the system

Salo et.al.,(1997) Point out that the integers from one to nine yield local weights, which are unequally dispersed, so that there is lack of sensitivity when comparing elements, which are preferentially close to each other.

J. Olearczykaet.al.,(2014) Heavy industrial construction project requires the installation of hundreds of large heavy modules. Effective utilization of lifting equipment is critical to ensuring economical project start-up. Capturing and evaluating global crane relocation, movement, and decommissioning, as well as object lift study and digital visualization, is essential in order to reduce costs and time. This paper presents a unique methodology that combines crane selection, optimum lift sequencing, and project global and individual lift visualizations in a single-sequenced algorithm. The state-of-the-art methodology incorporates all site constraints needed to ensure safe, the algorithm is

divided into several modules and sub-modules which focus on different aspects of the crane management process. The algorithm buildup structure is designed to employ specific volumes or even stage sections independently which allows the user to run either the entire program or just a specific portion. In this paper the authors also discuss modules of site preparation stages of the algorithm and the mechanism for lift object path development. The visualization algorithm presented in this paper is based on specific case studies, and synopsis for such case is provided for further evaluation. A student dormitory at Muhlenberg College in Allentown, Pennsylvania, is presented as a case study demonstrating efficient construction based on advanced equipment planning. In the case study, real time construction schedule updating in the weather changes allows the construction site manager to accurately modify crane lift sequence to ensure timely project delivery

Alvaro Alvimet.al.,(2010) found that the number of publications related to MCDM – Multi criteria Decision Making /MAUT – Multi attibute Utility Theory increased 4.2 times, from 1992 to 2006. This phenomenon can be mostly attributed to a relevant growth of the publications focused on AHP and EMO –Evolutionary Multi-objective Optimization. PetarAdamovic, CaslavDunovic, Maja - MarijaNahod give a classification of trenchless methods applied in the model, assumptions, limiting conditions, input and output quantities by using Expert choice method which is based on AHP

3. CONCLUSIONS

Several studies and discussion are done on decision making in construction management at various field. Decision making in construction is a challenging task in construction industry. The construction project management process begins with identification of the user requirement, project constraints, resource needs, and establishment of realistic objectives to meet the strategic goals. Selection of proper contractor from numerous applicants that are available today in market is a complicated problem for clients. The selection of equipment like crane by contractor is a time consuming process which needs extensive data exploitation.

The AHP assists with the decision making process by providing decision-makers with a structure to organize and evaluate the importance of various objectives and the preferences of alternative solutions to a decision. By using this model & with the help of AHP technique one can develop contractor selection approach which can be most useful for the stakeholders.

AHP and expert choice not only helps decision makers arrive at the best decision but also provides a clear rationale that it is the best by reducing complex decisions to a series of one-on-one comparisons, then synthesizing the results. Upon selection of these construction parameters using AHP software and expert choice software, helps in timely completion of work enabling good quality, durability and safety of the work.

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