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Decision Making in Crane Selection: AHP and Expert Choice Approach

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Abstract: ***Cranes are considered to be one of the most important equipment used in construction due to their key role in performing lifting tasks all over the construction site. An Analytical Hierarchy Process (AHP) used to select the best cranes among three.***

Keywords: Crane selection, criteria, Multi criteria decision making (MCDM) system, Analytical Hierarchy Process (AHP). Consistency

1. Introduction

The scale of investment in choosing a crane is the importance of the crane selection process. Thus, careful attention to such selection should be considered owing to the huge price that may be paid in case of mistake. Numerous factors may be considered when thinking about the best crane to use in a construction site such as the factors that affect stability, capacity and the proper setup. Not only , the weights, the dimensions, the lift radii, the type of lifting to be done, serviceability of the equipment but also the site conditions are considered to be important in the crane operation

2. Research Objectives

- To understand the nature of crane selection approaches practiced by construction companies
- To explore and define the potential criteria which affect the selection of crane.
- To develop theoretical model that represents the appropriate crane selection based on AHP process

3. Methodology

The process of crane selection is a multi-criteria decision-making problem with diverse objectives. In this work, a systematic methodology is presented under the consideration of multiple factors and objectives that are noted to be important in the construction process. The model includes building an analytic hierarchy structure with a tree of hierarchical criteria and alternatives to smooth the decision-making. A lot of crane models are available in different shapes and sizes, though, they usually fall into three categories,

1. Derrick Cranes.
2. Mobile Cranes.
3. Tower Cranes

While deploying 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.

The main goal of the presented hierarchical model is to select the best crane that will serve the construction process in a fairly optimized manner. The following criteria items are to be considered:

- Building Design
- Capability
- Economy
- Safety
- Site condition.

4. Analytical Hierarchy Process (AHP)

Analytic Hierarchy Process is an effective decision making technique based on multi-criteria decision making methodology (MCDM). It consider the human judgment, experience, perception and feelings in the decision making process. The Analytic Hierarchy Process was chosen for this study based on following reason:

a) The ability of AHP to incorporate tangible and intangible factors in a systematic way.
b) It able to solve constructed problems in a variety of decision making situation, ranging from the simple personal decisions to the complex decision.
c) The problem is broken down in a logical pattern from the large elements to smaller elements.
d) It works by examining judgments made by decision makers and measure the consistently of those judgments.
e) It does not required numerical judgment from the decision maker.

The important criteria and their sub criteria are given below

Table 1: The important criteria and sub criteria's

criteria	Sub criteria
1.Building design	Building height Project duration
2.capability	Power supply Load lifting frequency Operators visibility
3.economy	Cost of move Cost of rent Productivity
4..Safety	Initial planning Safety
5. Site conditions	Soil stability Access road requirements Operating clearance

4.1 Assessments / pair wise comparisons

One of the major strengths of the AHP and Expert Choice is the use of pair wise comparisons to derive ratio scale priorities, as opposed to using traditional approaches of assigning weights.

Figure 1: Pairwise comparison of main goal

After the judgments have been entered, it is possible to request suggestions for reducing the inconsistency. This can be done from any comparison model. The priority values of each criterion are shown in figure 2

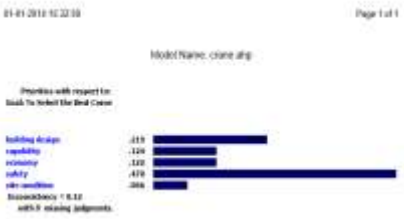

Figure 2: The priority values of each criteria

In the 'Data Grid' it is possible to use the 'Ratings' function which specifies intensities, that can be assigned to the alternatives under the criteria. Use numbers 1 to 5 to give ratings for each alternative

Figure 3: Rating of each alternatives

Sensitivity analyses from the 'Goal' node will show the sensitivity of the alternatives with respect to all the objectives below the goal. It can also be performed from the nodes under the goal if the model has more than three levels to show the sensitivity of the alternatives with respect to an objective or sub objective

The final obtained 4 types graphs are shown in figure 3

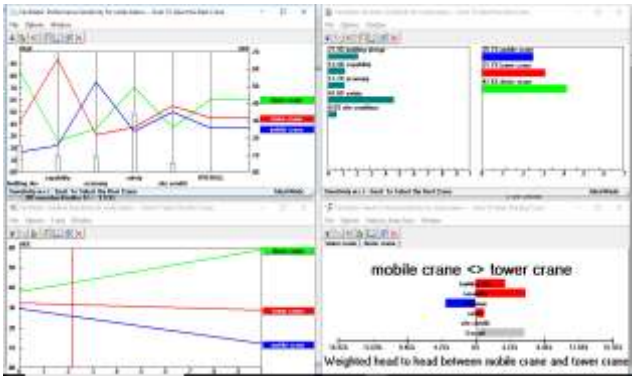

Figure 4: Final graphs of selection

5. Conclusion

The proposed model was used to choose crane for construction of apartment. After analyzing all alternatives, the best crane been chosen. The AHP process is simplifies using a decision support system.

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