

Abstract

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MANAGEMENT OF DYNAMIC CONSTRUCTION SITE LAYOUT PLANNING

The effective and efficient management of construction resources is the core of success for any construction project. Traditionally, researchers and industry professionals identify the five main construction resources to include, time, capital, labor, equipment and material. Although, one of the important project resources that have been overlooked during the planning phases of most construction projects is site space. Due to the complexity of the site layout planning problem, construction managers often perform this task using previous experience, ad-hoc rules, and first-come-first-serve basis which leads to uncertainty and even to inefficiency. In a broad sense, layout planning is concerned with the placement of temporary facilities (e.g. Storage areas, fabrication yards, caravans, etc....) within the boundaries of the construction site with the goal of attaining one several layout objectives. Two layout planning approaches are commonly found in the literature namely static layout planning and dynamic layout planning. Over the past four decades a number of site layout planning models have been developed to support this important planning task worldwide. However, in Egypt the construction sector – companies - still have lack of awareness of the importance of applying site layout planning due to the unawareness of its benefits and the dependency on previous experience while performing this task. The research needs in this study are therefore designed to focus on three main thrusts: (1) supporting global optimization of dynamic site layout planning (2) integrating material procurement and site layout planning in a construction logistics planning model (3) adaptation of the model to be applicable to the construction environment in Egypt and to integrate the previous experience used within the model. The efforts put into this research aim to develop an adapted optimization model that enable the optimization of dynamic site layout and material logistics planning during construction. This primary goal is broken down into the following objectives: 1. To formulate a dynamic site layout planning model in order to overcome the inefficiency of existing models and be able to generate a global optimal solution by considering the effects of first stage layout decisions on the layouts of subsequent stages, to reduce the project cost by the minimization of travel times, and the cost from and to site facilities. The removal of unnecessary movement of resources and handling of materials, and the minimization of orientation and relocation costs of site facilities which will be done by identifying different facilities needed to support construction operations, determining their size and shape, and positioning them within the boundaries of the available on-site areas using a suitable optimization technique. Dynamic layout planning approach is to be applied to create several layouts spanning the project duration so that each unique layout will strive to achieve the site requirements set forth during the layout's life span. 2. To develop an optimization model of construction logistics planning that is capable of integrating and optimizing the previously formulated dynamic model, critical planning decisions of material procurement and material storage on construction sites. 3. To develop an adapted optimization model of above-mentioned construction logistics planning model to be applicable to the Egyptian environment. In order to achieve the afore-mentioned objectives, the research work in this study is organized into six major research tasks, which are: (1) perform a comprehensive literature review (2) develop a construction logistics planning model (3) develop expert interviews and a revised construction logistics planning model (4) Implement and verify an automated construction logistics planning model (5) Apply and validate a case study to the automated construction logistics planning model and (6) Conclusions and recommendations. Finally, expert interviews were conducted that reflect the nature and conditions of the construction environment in Egypt. An adapted construction logistics planning model was developed that creates new knowledge on the integration and simultaneous optimization of the critical planning decisions of material procurement and site layout planning in order to minimize ordering, financing, stock-out, and site layout costs in Egypt.