

Abstract

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AN AUTOMATED DYNAMIC SITE LAYOUT PLANNING SYSTEM - A CASE STUDY OF EGYPT

One of the serious tasks in the construction planning was the site layout planning as it had a considerable effect on construction sites. However, in practice site layout planning was often ignored overlooked due to its complexity. Project Managers often performed a site layout planning based on experience, ad-hoc rules and first-come-first-serve approach which may lead to inefficient site layouts that had a negative effect on construction projects. Therefore, the automated systems can be considered as the most effective methods to develop an efficient site layout as they fully covered all concerns that cannot be taken into account by manual methods. Although, a lot of automated site layout planning systems had been developed to support this serious planning task. However, they remained having serious limitations and drawbacks such as a single objective, integrating with regular facilities and site areas only, 2D site layouts representation, inefficient approaches to reflect the dynamic nature of construction sites, ignoring space reuse and facilities relocation, equal area space search, generating static layout, did not cover end users' requirements, highly complex for users, ignoring the user interaction and lacking of flexibility in the system design. This revealed the need to develop new automated systems to cover the limitations and drawbacks of the existing automated systems and offer the end users' requirements. Furtherer more, the quantitative study of survey returned by twelve participations from the Egyptian sites guided this research to list the end users' requirements. These results led to identifying MATrix LABoratory (MATLAB) and Genetic Algorithm (GA) as the suitable tool and technique to overcome the site layout planning limitations and shortcomings as well as offer the end users' requirements. Therefore, this research had developed an automated dynamic site layout planning system (ASLS) which had positive impacts on the construction industry in terms of: (1) improving the site layout and space planning (2) maintaining the construction projects cost and time (3) improving the overall safety of construction sites and (4) protecting the surrounding environment. The automated system subjected to a validation process through two construction projects based in Egypt to examine its accuracy and effectiveness. The validation process results proved its accuracy and effectiveness in developing optimal site layouts for construction projects. In addition, an evaluation process was used to examine its functionality, completeness, performance, usability and user acceptance through functional (black-box) test, structural (white-box) test and users' trial. The functional (black-box) and structural (white-box) tests results verified its completeness and performance. The users' trial results indicated its usability in terms of effectiveness, efficiency and satisfaction and revealed that it was acceptable to use and efficient as it saved time. This research concluded that the developed automated system (ASLS) was effective and outperformed existing automated systems in generating global site layouts while satisfying the layout constraints by offering a number of new capabilities. Furthermore, this research contributed to knowledge by creating an innovative dynamic space search method and formulation of a novel objective function that minimized the harmful effect of construction activity on the surrounding neighboring. Recommendation emerged from the research findings were used to suggest the integrating of the automated system with the Computer Aided Drafting (CAD) and Building Information Modelling (BIM) to facilitate the data exchange and provide the project stakeholder with different scenarios of site layout.