



Design of a construction management data visualization environment: A top–down approach

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ABSTRACT

Explored in this paper is the topic of designing a construction management (CM) data visualization environment with emphasis on its use for supporting the time management function during the planning and execution phases of construction projects which are characterized by sizeable volumes of data of different types. A brief overview of recent construction data visualization work is first provided. Then, as part of a top–down design approach, we introduce concepts and useful terminology related to a structured way of thinking about analytical reasoning and visual analytics, and their relationship with construction management functions. The focus of the latter then shifts to how a construction data visualization environment can support project participant analytical reasoning needs for the management of time, specifically planning/predicting and monitoring/diagnosing/controlling construction conditions and time performance. A case study of aspects of an actual project examined using the construction data visualization environment developed to date is then presented. Purposes served include demonstrating the breadth of support that can be offered for reasoning by such an environment, and providing a test case for demonstrating the kind of evaluation process one should engage in to assess how well an environment conforms to the requirements set out for it. Time management functions treated for this case study include assessing quality of a baseline schedule, assessing actual vs. planned construction conditions and time performance, and assessing reasons for deviations. An evaluation of the current environment is then made to assess conformance/non-conformance with the requirements established for it and to identify worthwhile extensions to it. The paper concludes with a discussion of lessons learned from work performed to date, and their application to create a more comprehensive visualization environment that supports multiple CM functions.

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1. Introduction

The primary focus of this paper is on the use of a top–down approach coupled with the extension of thought processes, principles and guidelines previously described [1] for the design and development of a data visualization environment for construction management. For most projects, the large volume of data generated while executing a diverse set of CM functions poses significant challenges to their constructors, particularly in regard to generating insights and deducing cause–effect relations in a timely manner in support of decision making. Data visualization can play a pivotal role in addressing these challenges and improving project performance in terms of “cost and profit, time, scope, quality, safety and regulatory

compliance” [2]. It deals with the effective portrayal of construction data to generate insights about the data and to unveil the undiscovered useful information embedded in it [3].

Visualization of construction data offers several benefits. These include:

- identifying and communicating interdependent relationships across various data items thus enhancing the ability of the construction team to interpret data and improve decision making [4];
- amplifying cognition of quantitative data;
- improving and verifying the completeness and accuracy of data;
- reducing the time spent in comprehending and explaining information;
- providing managers with information rich overviews about the status of various project components;
- avoiding misconceptions due to inadequacies in data sets;
- explaining the divergence and disparity between the planned and as-built stories [5–7]; and,
- assessing the quality of a construction schedule [8].

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