Building Information Modeling for Managing Design and Construction: Assessing Design Information Quality

Contractors planning and executing construction work encounter many kinds of problems with design information, such as uncoordinated drawings and specification, missing relevant information, and late delivery of design information. Research has shown that missing design information and unintended outcomes, such as building defects, schedule delays, and budget overruns are related. Research in other fields indicates a relationship between information management and the performance and efficiency of organizations. This has led to the assumption that better information will eventually lead to a better outcome of construction work. Even though contractors regularly encounter design information problems, these issues are accepted as a condition of doing business and better design information has yet to be defined. Building information modeling has the inherent promise of improving the quality of design information by suggesting technologies and methods that are supposed to improve design information. However, building information modeling provides no means to assess these improvements of design information.

This research introduces design information quality as an equivalent to information quality in the field of information systems. Design information quality is defined as conformance of the design information supplied by the design team to a contractor’s specifications for the planning and execution of a construction project.

The following eight criteria have been identified in order to describe design information quality:

* Relevance – scope, sequence, and time-frame of the information delivery
* Consistency – the coordination of design information, with respect to geometry, functional requirements, and compliance with standards and regulations.
* Correctness – extent of missing, incorrect, or outdated design information.
* Precision – accurate geometry and unambiguous requirements for the scope.
* Availability – effort to securely access current design information.
* Distribution – effort to manage, share, and route design information.
* Flexibility – effort to transform, extract, or update information for work tasks.
* Amount of Information – the number of documents and files, and other media, should be appropriate for the scope.

The criteria were identified by empirical studies and theory on information quality in the architectural, engineering and construction (AEC) industry and other fields. Empirical research was conducted to understand the design information problems that contractors (information consumers) encounter. The problems were identified by observations and interviews made in 12 organizations.

One prerequisite for improving design information quality is the ability to identify and specify information requirements for the task at hand. Requirements can only be fulfilled if they are explicit. Information requirements are task-dependent, and because AEC projects are perceived as unique, they often also depend on the project, person, and time in the project. Hence, the work flow and, consequently, the information flow are unique. Therefore, the present study suggests a method for identifying information requirements collaboratively between the design and the construction team. The method is based on pull scheduling for design from lean construction. Furthermore, the study suggests the adoption of information delivery manuals for documentation of the information requirements.

Apart from identifying the criteria, the research also describes observable phenomena in order to assess each criterion. A scale is suggested to score each criterion based on the current practice. The scale consists of five points, ranging from traditional to most innovative practice. However, since technology and practice changes rapidly, the definition of each score has to be adjusted regularly.

Finally, the framework is applied to a construction project in order to evaluate its practical application. The framework provides meaningful measures on the improvement of the design information quality during the project and identifies areas with low design information quality for further improvement and investigation. Naturally, the framework must mature through its application in research and practice. Nonetheless, it does provide the means for practice to articulate problems in design information quality in order to eventually make design information quality an area of competition. It also allows practice to assess the effect technology and process improvements that are supposed to affect design information quality. Practice can also use the framework to evaluate the risk of low information quality. Research can use the framework to identify the relation of design information quality and positive or negative outcomes; for example, with respect to building defects, schedule, and cost conformance.

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