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Improving the design process with information management

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Abstract

This paper presents a method to quantify the time and cost impacts on Engineer, Procure, and Construct (EPC) projects resulting from information management driven process changes to the design process. Many engineering and construction companies have implemented information technologies and other changes, fully expecting to save time and cost, gain competitive advantage, improve productivity, better align project objectives, and improve product quality. Previous efforts to quantify benefits have been function or technology specific. The method described herein illustrates the value of evaluating process improvement strategies at the project level to avoid misleading conclusions regarding the actual benefit of investments. The research results strongly suggest that information management strategies applied to the design process may substantially improve total project performance.

Keywords: Information management; Process modeling; Process improvement strategies; Simulation; Information technology

1. Introduction

In large part, success in engineering and construction is measured by how firms effectively manage change. New systems, often created in response to competitive pressures in the marketplace, create change, often with unpredictable, or even undesirable results. Managing change, and predicting the ultimate impacts on work processes, is as important as managing any other aspect of the business enterprise. Today's leading edge organizations will only remain leaders in the future if they proactively, and continuously, improve their work processes to meet the advancing capabilities of competitors, and the changing expectations of their customers. It is therefore critical for the engineering industry to have the ability to evaluate potential work process changes to ensure that they produce desired results, improving the effectiveness and/or efficiency of corporate operations.

Companies within the engineering and construction industry have begun efforts to implement many forms of strategic change, including strategies for partnering, standardization, and electronic exchange of information. Unfortunately, justification for making these changes has primarily been qualitative. As a result, the likely impact to such quantitative measures as project cost and schedule is frequently unknown until after the process changes are already in place. In some cases, the resulting project impacts may not be known until after projects are fully

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executed. It is undesirable for the implementation of a work process modification, or any form of strategic change, to result in surprise consequences to the organization. Process changes are intended to improve, not hinder, the organization's ability to perform.

To date, a satisfactory method to quantify, and predict, the project level impacts of proposed process change has not been developed. This is undoubtedly due, at least in part, to the difficulty in capturing the performance variability inherent in executing construction engineering projects. By their nature, engineering, procurement, and construction (EPC) projects are typically complex, multidisciplinary and costly, constituting a major capital investment by owner companies. Such projects vary in scope, design, and execution strategy. As a result, the individual activities that comprise the design and construction work processes are themselves highly variable from project to project. The ability to predict, and quantify, the time and cost impact of any proposed work process change improves the likelihood of meeting, or exceeding, project performance criteria. Without such an ability, work process modifications may have unknown, or possibly even adverse, project impacts.

To correctly evaluate the time and cost impacts of proposed work process changes, the EPC process must be examined holistically. Failure to look at the entire EPC process, despite the multiorganizational complexity, can only result in suboptimization, as firms institute a piecemeal, discipline specific, approach to process improvement. Organizations must be alert to the potential for reaching misleading conclusions regarding time and cost savings that accrue from process improvement strategies when the analysis has failed to extend beyond a subprocess level of the project.

In response to these needs, this paper presents a method to quantify the time and cost impacts that are likely to result from proposed work process modifications. Such modifications may be driven by technological or organizational change. As a case study example, this paper summarizes a research project that evaluated the potential time and cost impacts that may result from strategically implementing information management strategies in the design phase of an EPC project.

2. Design background

The life cycle of an EPC project includes pre-project planning, design, materials management and procurement, construction, and start-up. Clearly, engineering design is only one phase in a much larger process. It is, however, a very important piece of the whole. Based on a recent study of 20 EPC projects, the engineering design process consumes approximately 28% of project labor costs and 22% of project activity time [1]. In addition to the time and cost resources consumed during the design process, the quality of the design product can also influence the project schedule and cost. The quality and accuracy of the design can influence the number of field interferences, the amount of rework required, the optimization of material resources, and the ease and efficiency of construction. The design product may even influence an owner's future operations and maintenance by providing an accurate history of design development decisions.

Despite the significance of the design process to the delivery of the constructed facility, the design process is still riddled with inefficiencies. While many engineering and construction companies have invested heavily in computing technology, the ability to integrate information across functional and organizational boundaries is generally limited. Research indicates that projects are still fragmented and highly dependent on information exchange in paper form [15]. Workman [16] cites works by Cooper and Kleinschmidt (1986), Dougherty (1992), and Workman (1993), who have all conducted field research to specifically review the interactions in engineering-driven organizations. Their studies indicate conclusively that personnel within engineering organizations frequently have communication difficulties. From field interviews with 80 individuals on 18 new product teams in five engineering-driven firms, Workman [16] found that people in various functional groups possess different information, tend to focus on their own part of a project, and define the entire process from their own perspective.

Parfitt et al. [12] identifies a significant contributor to poor communication in the engineering and construction industry to be the lack of an efficient means of disseminating information from one department to another. For example, plotted drawings are