

A Design Management Model: Processes, Operations, and Projects

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Abstract

An agenda for the study of design management is presented here. This agenda is predicated on an innovative conceptual underpinning for the management of operations. There are at least three distinct ways in which design processes may be conceived: (1) as a capable of transitioning inputs to outputs; (2) as a flow of materials and information over time and place; and (3) as a process of providing value for consumers. Each of these three perspectives has merit and should be considered. On the other hand, until very recently, the conversion model was the standard practice in the AEC (architectural, engineering, and construction) business. The existing thought and experience of design management is reviewed, basic hypotheses are suggested, and then a research program for design management based on those assumptions is proposed.

Keywords: Design management, Management model, project management

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1. Introduction

The architecture of AEC (architectural, engineering, and construction) buildings presents challenging management challenges. While quality in site construction can be defined as conformance to specifications, design must yield those requirements through careful identification of client needs and thorough translation of those necessities into engineering specifications. While quality in site construction can be defined as fitness for purpose, design must generate those requirements. Multiple clients of the design have a right to have their opinions represented, and their requirements are often in direct opposition to one another. All across the design process, trade-offs between many, conflicting design requirements must be made, and this must be done often with little knowledge and under great pressure from both the budget and the timeline. As a result of the fact that many design choices are independent of one another, the management of the flow of work among the numerous experts is both particularly crucial and challenging. The early phases of design are notoriously difficult to analyze and regulate in relation to certain milestones of development. It is impossible to quantify the amount of work that has been performed and that still needs to be done on any specific assignment and, as a result, in the project as a whole since there are no tangible deliverables such as drawings. To make things even more difficult, projects are becoming more susceptible to uncertainty as a result of the quick speed of technical development, the swift changing of market possibilities, and the failure to maintain pace with the unrelenting demand to lower both time and cost.

In AEC projects, it is generally accepted that the administration of design and engineering presents a number of challenges. The most major factors that lead to design flaws include ineffective briefing and communication, deficiencies in the technical expertise of designers, and a lack of faith in the process of preplanning design work (van den Berg, 2019). Consequences such as tardy approvals from customers, delayed appointments of experts, and insufficient time to thoroughly finish design documentation were commonplace. The most common reasons for severe deviations during the design process were insufficient scheduling and/or resource allocation, inadequate or absent input information, and changes (Ma et al.,

2020). These factors were found to account for the majority of severe deviations (Wawak et al., 2020). The most significant type of faults is the one that is induced by the design of the building (Almashkor et al., 2021). The greatest group of design-related flaws is comprised of those that are brought on by a lack of cooperation across different professions.

This paper is organized as follows: Section 2 is dedicated for literature review. Section 3 focuses on the value-driven design conception. Section 4 will be assigned for the innovative structural assemblies as a potential solution. Section 5 is specified to the topic of IT-supported design management. Section 6 represents conclusion which includes important concluded remarks for research directions.

2. Literature review

The traditional perspective on design management has, for the most part, been the same as the perspective on project management. Accordingly, the issues with the design would be attributed to a lack of implementation of management methodologies, which, in view of the empirical study conducted, is at least partly correct. This viewpoint is advocated by those in the field of project management (Armenia et al., 2019), and it is also supported, in large part, by "best practice" guidebooks for the administration of construction design projects (Gray et al., 1994).

On the other hand, the ideas and procedures of project management have been shown to be incapable of resolving the complex issues that arise with design management. The primary reason for this is due to the fact that the principles of project management are based on the helps to calculate (Lecler et al., 2018). The assumption at the center of the conversion model is that the work that needs to be done can be broken down into its component components and then handled as though those parts were entirely autonomous from one another. This conversion model incorporates management strategies including work breakdown patterns and earned value analysis as part of its framework. Budget and scope considerations drive work breakdown structures, which ensure that all of the project's scope is contained in one of the sections and allocate expenses to the various components in such a way that the entire cost is rolled up. This separation into pieces is important in order to transfer accountability to internal or external jobs, which may then be regulated against commitments made to the project's scope, budget, and schedule. This is basically a contractual mindset, which makes it easier to handle contracts as opposed to the management of production (of designs). A vision of the development process that may be found in the realm of manufacturing is referred to as concurrent engineering (CE) (Salomone, 2019). Despite the fact that the term may have a number of different interpretations, in most contexts, it refers to the contemporaneous or integrated evaluation of various design criteria that convey the requirements or wishes of many stakeholders. Instead of using a concurrent style of design, the conventional approach uses a sequential one. An idea is conceived by the architect, who then passes it on to the professional engineer for implementation (Othman et al., 2021). There is a good chance that she won't be able to design the building in the way that the architect had envisioned it, which is why rehoops and modifications are so prevalent.

The AEC community has just recently started to get familiar with concurrent engineering ideas. The use of information technology instead of rethinking the design process was an early focus of attention for the industry. In the construction industry, the formation of cross-functional teams is another trend that is becoming more common. Initiatives of this kind are sometimes referred to as partnering, teaming, and other similar terms (Kalabina & Belyak, 2021). Partnerships, for instance, have shown to be inadequate on their own for bringing about more fundamental shifts in mental models or in the administration of production. Cycle patterns are high-level flow patterns that provide the foundation for controlling the movement of

unfinished work through the many design specialties. These models are used in the process of designing computer programs. For example, there is an architectural model that classifies programming as a kind of business administration or predesign activity rather than design proper, as well as phase models for schematic design, project development, and construction documentation (Suryani & Riantini, 2019). The phases are differentiated from one another according to the papers that are created. The goal of each document is to secure commitments to an ever-more-detailed design in the interest of avoiding unnecessary backtracking. This dependence on drawings is a direct result of the architect's primary concentration, which is the manipulation of space (Kim et al., 2018). A succession of creative activities serves as a conceptual framework for the core design process that takes place inside each phase.

When there is no substantial architectural component involved in the design process, engineering-driven design methodologies diverge. The importance that is placed on aesthetics in AEC structures other than buildings is far lower, with the only exception being bridges. Bridges have the potential to be among the most beautiful objects that have been constructed by humanity. However, the procedure for building things like motorways, tunnels, sewage treatment facilities, and refineries is also thought of in terms of a phase model quite similar to the one used for architecture. However, the basic design cycle is envisioned more in terms of issue solving than in terms of creativity, even if creativity is frequently engaged in the production of various potential solutions. This is because the fundamental design cycle focuses on the generation of possible solutions.

Curiously, none of these AEC models clearly presents the procedure for developing and using design criteria for either the product or the process. Constructability criteria are often used after viable designs have been generated rather than being incorporated into the design process itself, which has been vigorously supported by the process industries. In addition, buildability is only one of several important process requirements that must be considered.

3. Value-driven design

Predesign steps that determine design requirements and value engineering include value principles. Architectural programming defines client demands and other design criteria. The level to which inquiry creates value for the consumer is often overlooked or underplayed. This may be due to the designer's focus on perfect design and eagerness to get to work. Reflection shows that value is created via a learning process that involves a debate between aims and methods. A client may desire a building to generate rental money from commercial office space users and feel it should have a particular look, number of stores, and location. The customer's preferences may alter when prices and requirements disclose their repercussions. Alternate design alternatives or a fault in the business opportunity evaluation may trigger changes. Traditional design phasing uses check valves to prevent backflow from continuing this "dialogue." This strategy works only when the debate has reached the choice stage. AEC needs to conceptualize value as a process and build process tools. Value engineering varies. First, in design-bid-build, the builder may only offer design ideas once the bid papers are prepared. Value engineering is a kind of peer assessment wherein the concept is criticized at different stages by some outside group. Both types of value management criticize an existing design. Why do it again?

It is promoted that putting value development at the core of the design process. This aggressive method avoids the criticisms of value engineering and helps rethink the design process. Recent value management guidelines don't identify value engineering, a cornerstone in manufacturing-oriented product development.

4. Innovative structural assemblies as a potential solution

It has been widely held that the primary issue with the construction industry is that design and building are seen as two distinct processes. As a result, it should come as no surprise that significant hopes have been placed in the design-build method of procuring building projects. In this method, the design and construction phases of a project are organizationally linked from the very beginning. However, it is indicated that the layout procurement approach on its own does not yield outcomes that are noticeably superior to those produced by traditional procurement methods. It is somewhat superior in a few different ways, but contrary to the opinions expressed in these two studies, we do not believe the differences between the two to be very significant. According to our findings, the difficulty with design-build appears to be that the ability of organization commitment is not fully exploited. Control and development of the design phase remain inadequate, even though the approved change is better, and in the end, there is really not much of a difference in process capacity in comparison to the traditional organization.

5. IT-Supported design management

Both in practical application and in academic study, there has been a significant amount of interest in the use of information technology to help design and its administration. One significant area of growth is the creation of information models for products as well as processes. The increased use of digital technologies has unquestionably resulted in the delivery of advantages. In spite of this, the implementation of information technology in reality has generated a qualitatively novel design process only very infrequently. Some intriguing direction in regard to this surprisingly limited influence of information technology can be provided. The establishment of a scientific foundation for the use of information technology in structural and civil engineering. Understanding the planning, design, management, and other related topics would be one of the aspects of this scientific basis that would be covered. This may be understood in the following way: The problem with construction computers is neither a lack of capabilities in modern technologies in terms or in the uses of that technology specifically; rather, the problem lies in a lack of knowledge of engineering and building. In addition, scholars working in the field of information technology actively contribute in the development of robust theories of design.

6. Conclusion

As a step toward a sound conceptual basis of design and innovation, experts advise considering engineering as conversion, flow, and value creation. Engineering is often seen as a conversion. The conversion perspective is engineering-focused. WBS and CPM are utilized for this. This conception abstracts away time and customer. Flow and value creation are ignored. Conventional engineering has two problems: poor process and weak cooperation. Conventional engineering management is inefficient and ineffectual. In the flow perspective, waste elimination is key. Thus, methods including reducing rework, teamwork, and releasing information in small lots are emphasized. Design Structure Matrix represents and manages flows. From the customer's perspective, the value creation view aims to decrease value loss. Requirement analysis, requirements management throughout design, and interactive cycles are recommended. Quality Management is a promising technique.

Concluded is a graphical representation of the comprehension of the fundamental concepts associated with design-making direction, as shown in Figure 1.

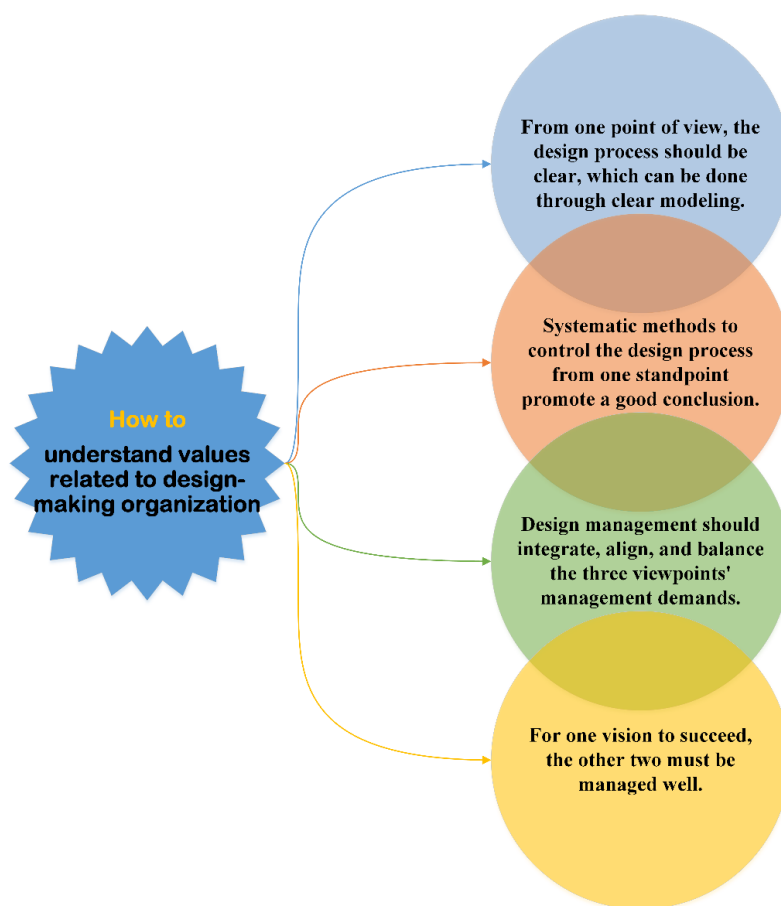


Figure 1: A comprehension of the fundamental concepts associated with design-making direction

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