Organizational Culture for Construction Enterprises in the Fourth Industrial Revolution

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Abstract. Construction industry is slow to innovate and adopt new technology. Construction innovation can be disruptive or enabling, depending on the organizational culture of construction enterprises. Since organizational culture shapes business practices, there is the need to understand the implications of organizational culture on innovation adoption. The aim of this conceptual study is to recommend the organizational culture type for construction innovation adoption in the Fourth Industrial Revolution (Industry 4.0). The methodology includes the interpretivism research philosophy, inductive research approach, and qualitative research methodological choice. Using the integrative literature review, qualitative/textual data were gathered on the dimensions of Industry 4.0, organizational culture types, and the dominant organizational culture types among construction enterprises in eleven countries. The findings include the need to manage change in the digitalization of processes and products involved in construction activities' value co-creation. The adhocracy culture is recommended as best supporting innovation adoption in the rapidly diffusing era of Industry 4.0. This could be subjective; hence, a limitation and theoretical implication for a future empirical study to validate.

Keywords: Construction enterprises · Industry 4.0 · Innovation ·
Interpretivism · Organizational culture

1   Introduction

Organizational culture and organizational climate are, often, confused. However, organizational culture adopts qualitative research methods and is contextualized while organizational climate uses quantitative methods and is generalized [1]. Organizational culture is about shared basic assumptions, values, and beliefs while organizational climate is about shared perceptions of policies, practices, and procedures [2]. Organizational culture is characterized by a nuanced view to truly understand and change organizations [3]. Resistance to change is rooted in the anxiety of uncertainty and stimulus overload surrounding a paradigm shift from the familiar to the unfamiliar practices [4]. This conundrum characterizes most construction enterprises to the extent that innovation is seen as a threat to their stability. However, innovation is inevitable

because, by nature, it is any idea, conduct, or mechanism that is novel. It is, often, uniquely different from the existing practices and, as a result, influences cultural change in people, processes, and products through diffusion [5].

This means diffusion and adoption of innovation can either disrupt an organizational culture or enables it to flourish. The Fourth Industry Revolution (Industry 4.0) is a smart factory characterized by decentralized decision making or social innovations for new practices to tackle social challenges [6]. Industry 4.0 is characterized by smart work geared at transforming the labor market through digitalization [7]. Industry 4.0 allows for sustainable manufacturing because it supports decentralization, virtualization, and interoperability [8]. Industry 4.0 allows for open innovation by facilitating combinations of technology, market and society [9]. With the unique nature of the construction industry, unlike the manufacturing industry, the primary research question is what are the implications of Industry 4.0 for construction enterprises in terms of organizational culture for innovation? Following, this study aims to investigate the organizational culture type for construction innovation adoption in Industry 4.0. Its three objectives include to: (1) establish the different dimensions of Industry 4.0 that can affect construction innovation; (2) describe the characteristics of the different organizational culture types and; and (3) propose the organizational culture type that best supports construction innovation adoption for Industry 4.0.

1.1   Research Question Mode

The mode of this study's research question (see the previous section) is gap-spotting; particularly, under-researched area [10]. This is because Industry 4 is yet to be fully-understood and fully-explored. It is an emerging concept that is yet to be investigated in relation to the other existing concepts. This leaves other areas such as implications for organizational culture under-researched.

1.2   Conceptual Paper Justification

A conceptual paper does not have numerical data due to its focus on integrating the existing relationships among concepts to advance alternative relationships [11]. As such, this study uses the integrative literature review to collect qualitative data to achieve its three objectives. The integrative literature distils representative literature on a topic to generate new perspectives [12].

1.3   Conceptual Framework

A conceptual framework situates a new study in the pertinent existing body of knowledge and is made up of the relevant theoretical and empirical works aimed at developing new knowledge about the existing associated concepts [13]. This study adopts the conceptual framework of the system view of construction innovation, which argues for rigorous interactions and partnerships [14]. Organizational culture affects innovation [15], which, in turn, influences adopter categories [16].

2   Methodology

Research methodology encompasses methods and techniques to systematically answer research question [17]. The research onion model offers an operative sequence to systematically design a research methodology [18]. This study is based on the interpretive phenomenology research philosophy. Phenomenology allows for subjective interpretations as a starting point in understanding a social phenomenon [19]. The research approach is inductive, which is often operationalized by collecting data to study a phenomenon under consideration to develop a theory [18]. This separates it from the deductive approach that is about testing a hypothesis.

Stemming from the research philosophy and approach, the methodological choice is qualitative, which centers around texts and observations to depict reality by studying and describing people in their actual contexts [20]. Integrative literature review was used following the checklist provided by [21].

The literature reviewed and discussed subsequently were selected via the Google Scholar search engine for a wider spread across the main and the alternative publication routes. The following five keywords that are central to this study were used: (i) Construction Enterprises, (ii) Fourth Industrial Revolution, (iii) Innovation, (iv) Interpretivism, and (v) Organizational Culture. Peer-reviewed authoritative/seminal conceptual and empirical journal articles and conference proceedings were retained for further analyses. The abstract, methodology, and conclusion sections of the papers retained were critically analyzed to judge significance using the seven criteria provided by [22]. More importantly, judging the validity and reliability of the papers retained the nine using the nine strategies recommended by [23].

2.1   Dimensions of Industry 4.0

The first objective was about the dimensions of Industry 4.0. The study by [24] was based on a brainstorming research method technique among eleven experts drawn from across the world. [24] analyzed Industry 4.0 in terms of institutions, technology as well as firm innovation and start-up strategy. Subject expertise boosts creativity [25] and, increasingly, experts' brainstorming session is being digitalized for ease of data management during the ideation process [26]. The strengths of subject expert brainstorming technique makes the analysis provided by [24], arguably, more authoritative and reliable in understanding the different dimensions of Industry 4.0. The four main dimensions of Industry 4.0 are discussed, in brief, subsequently.

The emerging *definitions*, in the forms of common phrases/terminologies used to refer to Industry 4.0, underscore that continuous and future transformational change in all industries is premised on digitalization of processes and products.

The transformational change necessitates *institutional response* at the macro and micro levels to nurture and boost creativity of the different organizations and departments that are involved in the co-creation of processes and products.

Consequently, since "smart work" characterizes Industry 4.0, *technological response* is inevitable. The design and fabrication of the different technologies must allow for flexibility in the forms of inter-connectedness and -operability.

Similarly, digitalization of processes and products does not have to negatively impact on the organizations. Equal attention should be paid to *organizational start-up strategy and innovation* to sustain value co-creation in the supply chain.

From the preceding discussions, it can be reasoned that there are benefits and, admittedly, challenges associated with Industry 4.0 Revolution. As a result, smart organizations are being strategically-positioned through digitalized and transformational changes for the people, processes and products involved in their value co-creation activities. Industry 4.0 is about integration, which could be disruptive to some construction organizations depending on their organizational culture types.

2.2   Organizational Culture Types

The Competing Values Framework (CVF) is an influential and extensively used model in the study of organizational culture [27]. CVF was initially used to define predictors of organizational effectiveness [28]. CVF is based on two dimensions of: (i) flexibility and discretion versus stability and control, and (ii) external focus and differentiation versus internal focus and integration [29]. The two dimensions describe four models of CVF including: (i) human relations model, (ii) open system model, (iii) rational goal model, and (iv) internal process model [29]. These four CVF models morphed into the four organizational culture types including: (i) Clan, (ii) Adhocracy, (iii) Market, and (iv) Hierarchy [30] as shown in Fig. 1 and discussed subsequently.
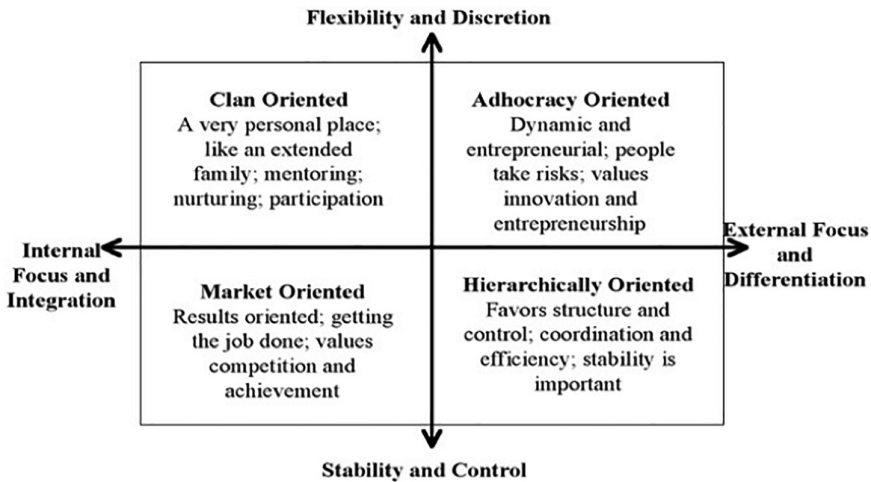

Fig. 1.   The four culture-archetypes of CVF, Source [31]

Clan culture stresses flexibility plus discretion/change and concentrates on the internal organization. Clan-type organizations are characterized by teamwork, employee involvement, and corporate commitment. Clan-type organizations have shared values and common goals developed over a long period of time, steady association, non-existence of rigid options, and closely-guarded member interaction.

Adhocracy culture accentuates flexibility and change but it is externally oriented. Adhocracy-type organizations are characterized by creativity, entrepreneurship and risk taking. Consequently, adhocracy culture typifies a temporary institution that is inevitably terminated once the demand-driven organizational tasks have been completed and, later, reconstituted as soon as new tasks arise.

Market culture is externally focused and control oriented. Market culture-type organizations are characterized by productivity and competitiveness. The term market has been used figuratively to depict the organizational management's focus on the fundamental principle of maximizing profit and optimizing cost of production. The organizational goal is profit maximization through market competitiveness.

Hierarchy culture also favors control but focuses on the internal organization. Hierarchy-type organizations are characterized by productivity, synchronization, and close observance of rules and regulations. Rooted in the management concept of "bureaucracy", the hierarchy culture has a distinct organizational structure, uniform rules and procedures, stringent control, and clearly-defined responsibilities.

By and large, [32] distilled that while there are these four distinctive cultural categories, organizations are, in reality, unlikely to reflect only one cultural type because, to be effective, the adoption of some elements of each of the four organizational culture types is necessary. The common organizational culture types among construction enterprises are discussed in the subsequent section.

2.3   Organizational Culture Types Among Construction Enterprises

In relation to the second objective of this study, some empirical studies have established common organizational culture types among construction enterprises in different parts of the world using the organizational culture assessment instrument (OCAI). The OCAI diagnoses six aspects or dimensions of organizational cultures or "cultural subsystems" for organizations to assess their current and preferred culture types [31]. The six dimensions include: (i) dominant organizational characteristics, (ii) leadership style, (iii) employee management, (iv) organizational glue, (v) strategic emphasis, and (vi) success criteria. The subsequent OCAI-based empirical studies can, as a result, serve as a basis to identify the most prevalent organizational culture type among construction enterprises for suitability or otherwise for innovation adoption.

[33] conducted a time-constrained online survey to gain overall picture of the values in international and sub-units of international construction companies in Finland. 200 "white-collar workers" (33.3% response rate) were selected from construction sub-services and company size of less than 100 to 500 employees. Market culture was dominant with a preference for clan culture.

[34] steered a preliminary study on culture profiles of 159 senior managers (34.3% response rate) in five construction enterprises. The selection was based on (i) enrollment in the Chinese first-class construction enterprises, (ii) involvement in building construction and similar organization size, and (iii) regional diversity. Hierarchy culture was dominant with a growing preference for market culture.

[35] undertook an empirical study involving 826 managerial and non-managerial professionals from 134 contracting and architectural firms (38.2% response rate) in Turkey. The selection for participation was based on (i) origin of the firms as being

local, (ii) medium- and large employee-sized firms, and (iii) industry position measured by market share. Hierarchy and clan cultures were dominant.

[32] conducted an exploratory study among 56 managers of different levels across 56 contracting firms (38.6% response rate) in Singapore. The selection for participation was based on (i) local origin of the firms for cultural uniformity, and (ii) medium- to large-sized contractors measured by tendering limit and minimum paid-up capital and net worth. Hierarchy and clan cultures were found to be dominant.

[36] interviewed 139 local and expatriate project managers (71.6% response rate) in Hong Kong contracting firms. The selection was from a self-generated list of project managers. Clan culture was dominant at both project and organization levels while hierarchy culture was the least favored at both levels. The result for the hierarchy culture could be due to the expatriate project managers.

[37] conducted a pilot study among 15 high-, middle-, and low-managers across five private construction firms in Indonesia. Purposive selection criterion based on market position as leading contracting firms was used. The results showed an incongruent organizational culture profiles within the five Indonesian construction firms with the hierarchy culture still being be the most dominant.

[38] examined 71 small, medium, and large quantity surveying (QS) and building construction firms (19.3% response rate) in South Africa. Systematic sampling method based on company registrations with the relevant national bodies was used. Market culture was the dominant with a growing preference for clan culture, both among the QS and building construction firms.

[39] studied 59 project managers across four large project-based organizations in Australia, selected based on employee size, operating in heavy engineering, and a strong matrix structure of management. Hierarchy structure was dominant for knowledge sharing, combined with market culture or clan culture, depending on preference for competition or collaboration, respectively.

[40] assessed 61 senior managers (42% response rate) across three contracting firms in Botswana. Stratified sampling method based on registration with the Public Procurement and Asset Disposal Board was used. The market culture was found to be dominant across the three firms. The medium large firms preferred the clan culture while the small firms preferred the hierarchy culture.

[41] undertook a questionnaire-based descriptive study. It involved 74 construction companies (55.2% response rate) in Gaza Strip, selected based on classification by the Palestinian Contractors Union. The clan culture was the dominant current and desired organizational culture type. Small and medium organizations were predominantly market culture and clan culture, respectively.

Lastly, [42] investigated the links between organizational culture, innovation and performance. It involved 446 CEOs of Spanish organizations (27.9% response rate). Selection was based on having more than 15 employees and being located in southeast Spain. The results include: (i) adhocracy culture has a positive effect on innovation and performance, (ii) clan culture has no significant result on innovation but a positive effect on performance, (iii) hierarchy culture has a negative impact on innovation and performance, and (iv) market culture has no significant result on innovation and, paradoxically, has a negative effect on performance.

Most notably for construction innovation, [14] concluded that the configurations of innovation in the construction industry differ in diverse ways because the construction industry is project-oriented and, as a result, disjointed. This set-up makes construction innovation to remain unseen as it is jointly-developed at the project level.

2.4 Innovation Diffusion and Adopter Categories

As opposed to merely re-inventing the wheel, it is possible to plan innovation because it is "a process" whereby a novel idea, conduct, or mechanism is conceived of and brought into reality. This delineation of what truly qualifies as an innovation has influenced conceptualizing the innovation diffusion process as a normal curve of distribution as shown in Fig. 2. What this means is that innovation as a "finite product" cannot be planned or programmed. If the process or product of innovation is finite, it becomes what [43] has construed as "preventive innovations". Figure 2 should, as a result, be viewed as a way of classifying the active players in the social system based on their innovativeness [44], which also applies to construction enterprises.
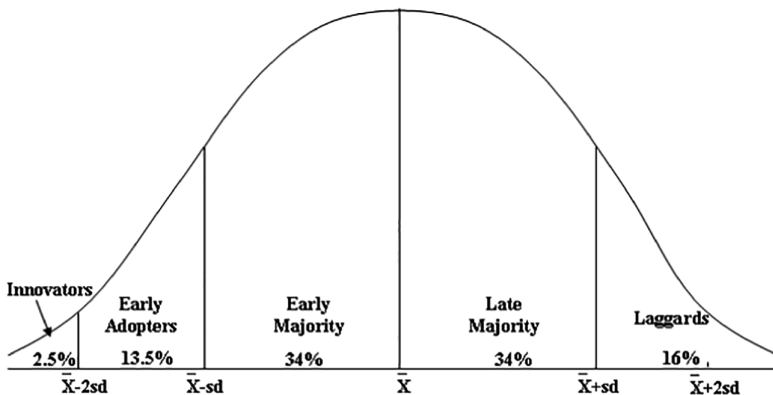

Fig. 2. Adopter categorization, Source [44]

Innovators embrace new ideas and are able to manage uncertain or unsuccessful innovations. They are trail blazers importing innovation from other allied systems. As such, innovators are frowned upon by the their own members because of their adventurousness and valuable external networks. Innovators should possess intricate technical know-how to be able to sustain their creativity and invention.

Early Adopters occupy leadership roles in the social system to distill an innovation for other members. Early adopters carry innovations forward. Their opinion leadership in adopting the innovation decreases other members' uncertainty about the innovation and this helps the innovation process to diffuse appreciably. They are, desirably, more discrete about their adoption choices than the innovators.

Early Majority also possess wholesome communication with external members; however, the absence of opinion leadership like the early adopters means that they are not as quick in adopting innovation. They adopt the innovation just before the other

half because of their above average social status and contact with the early adopters. They are influenced by the competitive pressures from a "bandwagon" effect.

Late Majority are different from the early majority because they wait until most of their peers adopt the innovation. They are considered late because they adopt an innovation after the average member of the society. They adopt an innovation only after it "snowballs" from the early majority. This is due to their skepticism, below average social status, little to no financial lucidity, and opinion leadership.

Laggards are the most localized group of the social system. Their long decision-making process, due to their need for practical and safe innovation, means they are pathologically late to adopt. This is also due to their weak networks that mainly consists other members from the same category, absence of opinion leadership, limited resources and, lastly, the lack of awareness-knowledge innovations.

3   Results and Discussion

Related to the research question, this study aimed to ascertain the most appropriate organizational culture type for construction innovation adoption in Industry 4.0. Following from the integrative review of the literature as a methodological choice, for Objective 1, the multifaceted dimensions of Industry 4.0 necessitate diverse institutional and technological responses for the necessary innovation and start-up strategy by construction enterprises. This calls for a paradigm shift towards an open innovation culture to maximize the gains from Industry 4.0's collaboration, integration, and interoperability. For Objective 2, the hierarchy culture is the most dominant organizational culture type among construction enterprises, which can be attributed to the need to maintain control and focus on the internal organization. Moreover, since most construction enterprises have more than one organizational culture type [32], it was unsurprising to also find that the clan culture type and the market culture type were common among construction enterprises. The clan culture type emphasizes flexibility while the market culture is externally focused. For Objective 3, since the adhocracy organizational culture has been found to have a positive effect on innovation and performance [42], it is, therefore, proposed as the organizational culture type that best supports construction innovation adoption for Industry 4.0. This is a deviant proposition and a foundation for a future empirical study. More so, since the dominant culture type among construction enterprises is the hierarchy culture, combined with either clan culture, where collaboration is favored at project and organization levels or market culture, where competition is favored at project and organization levels.

4   Conclusion

Industry 4.0 is an emerging concept with opportunities and challenges. Construction enterprises should ensure that the people, processes and products involved in their value co-creation activities are open to the accompanying changes. As a managerial implication, the adhocracy culture best supports change and should be adopted by construction enterprises. It should be noted that this recommendation has stemmed

from a conceptual study. A theoretical implication is the need for a future empirical study to test if this claim in favor of the adhocracy culture is valid or otherwise.

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