

Importance of Digitalization in the Construction Industry

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The construction industry is among the least digitized industries, and the lack of innovation in construction project management practices has led to decreases in productivity. The European Directives for Public Procurement are pushing the entire construction supply chain towards more radical digital transformations over the next years, and project managers are left with the difficult task to harness ICT for the involvement and management of project stakeholders. This entry is based on the article "Realizing the Need for Digital Transformation of Stakeholder Management: A Systematic Review in the Construction Industry" recently published in the Sustainability journal.

Keywords: digitalization ; digital transformation ; construction industry

1. Importance of Digitalization in the Construction Industry

The construction industry is characterized by highly interdisciplinary, fragmented, and temporary project organizations, process discontinuities, and unique projects ^[1], and this fragmentation is making it very difficult to meet construction project requirements in terms of cost, time, and productivity ^[2]. Complexity is added by the reciprocal interdependencies between different stakeholders, such as financing bodies, authorities, architects, engineers, and many others, which makes it necessary for construction projects to improve integration, cooperation, communication, and coordination ^[3]. Important elements of stakeholder interaction are information management and communication processes, which are considered to be main constituents of efficient human cooperation ^[4]. Documents serve as a key information carrier, and in today's business world, they are mainly handled as individual computer files, which requires ICT for their creation and storage ^[5]. The construction project aspects mentioned illuminate the fact that they are very dependent on reliable and updated information and thus require a number of ICT-based business systems, communication tools, and shared storage servers ^[6].

The construction sector has been slow to adopt innovations in processes and organization, and in general, it has not yet embraced new digital technologies, which is corroborated by the fact that the construction industry is among the least digitized industries ^[7]. The lack of innovation in construction project management practices has been described as having led to lost productivity ^[2]. Additionally, there is a growing demand for making the construction industry more sustainable, which also requires changes in traditional practices ^[7]. The McKinsey Global Institute estimates that the world will need to spend USD 57 trillion on infrastructure by 2030, which is a massive opportunity for the digital transformation of the construction industry ^[7]. Digitalization is a hot topic in the construction industry today, which is corroborated by a great number of developed ICT tools ^[8]. Web-based project platforms, digital meetings, and BIM have all existed for quite a while ^[8], although they are mostly not used to their full potential ^[1]. It is apparent that ICT is essential in daily work for most professionals in the construction industry ^[9], and Jahanger et al. ^[2] showed that proper digitalization of construction and project management practices can help in reversing the decline in productivity. The European Directives for Public Procurement are pushing the entire construction supply chain towards more radical transformations over the next years by supporting research, development, and training for digitalization ^[10].

2. Digitalizing Construction Stakeholder Management Practices to Enhance Performance in Construction Projects

Large construction projects are mostly focused on overcoming current infrastructure capacity problems or opening new business opportunities ^[11], and they bear great importance for the promotion of the economic and social wellbeing of the wider stakeholder community. These projects include numerous contracting parties and a vast range of potentially conflicting interests, which requires highly complex problem-solving activities such as stakeholder management ^[12]. Stakeholder management comprises two major processes (e.g., stakeholder analysis and engagement) ^[13], and it is increasingly becoming a part of construction project practice ^[14]. Inadequate stakeholder management has led to process disruptions and adverse outcomes in many large construction projects ^{[11][12]} and it is considered as a fundamental instrument for setting the direction of projects ^[15]. Additionally, there is a great need to manage stakeholders through various engagement strategies (i.e., communication, partnership, and capacity building strategy) to increase the sustainability of construction projects ^[16]. Significant empirical research conducted in recent years further divides stakeholder analysis processes (i.e., stakeholder identification, classification, assessment of stakeholder influence, etc.) ^{[17][18][19][20]} and stakeholder engagement processes (i.e., stakeholder communication, involvement, collaboration, etc.) ^[13]

[21][22] which is consistent with stakeholder management becoming a formal project management knowledge area [23]. The project management body of knowledge (PMBOK) standard [24] for project management formalizes stakeholder management through four processes (identification of project stakeholders, planning of stakeholder engagement, management of stakeholder engagement and monitoring, and control of stakeholder engagement), which comprise several underlying practices.

Through rapid advancements in ICT, opportunities arise in enhancing communication between participants of different organizations (i.e., internal stakeholders) in construction projects [24]. Furthermore, obtaining external stakeholder support necessitates strategic engagement, often using information and communications technology (ICT) [25]. Building information modelling (BIM) promotes the collaborative working of different stakeholders, enabling them to support and reflect their respective responsibilities by inserting, extracting, updating, and sharing information through the BIM model [26]. Computer-mediated collaboration has been the main focus of Computer Supported Collaborative Working (CSCW) studies, which deal with ICT-supported information sharing, information exchange, collaborative decision making, and control protocols [27]. Web (cloud) applications exploit Internet and web technologies to enhance information sharing between various project stakeholders throughout the project lifecycle [28]. In large construction projects, ICT supported visualization and simulation are considered very important for coordination of both internal and external stakeholders [29]. Additionally, software packages supporting a social network analysis method (i.e., UCINET, NetMiner, etc.) can be used to analyze and visualize stakeholder relationship networks and their influence. Ninan et al. [25] provides evidence that ICT was used strategically to hegemonize stakeholder support and persuade stakeholders to support project decisions. They emphasized social media as a key type of ICT system which can assist in conducting stakeholder engagement strategies.

Using digital technology for communication and collaboration is often seen as an important managerial tool, and project managers are left with the increasingly important task of finding proper ways to harness ICT collaboration tools for the involvement of project stakeholders [30][31]. The digitalization of various construction project management practices is relatively well researched, considering the number of various ICT tools and articles dealing directly or indirectly with this broad research field. Nevertheless, the adoption of the digital way of performing project and stakeholder management practices in construction projects is still very low compared to some other industries [25], and part of this problem lies in the weak systematization of ICT systems which support these practices. There is not enough information on what a particular ICT tool serves for, which stakeholder should use it, and for what purposes; in other words, research streams related to the digitalization of various management processes and activities (i.e., stakeholder engagement, collaboration, analysis, etc.) are vague. There are numerous papers dealing with the collaboration and cooperation of specific internal construction project stakeholders through various ICT tools (i.e., contractor with subcontractors, project manager with other stakeholders), and on the other hand, ICT usage for external stakeholder involvement and analysis (i.e., project end users) is becoming an increasingly important topic. Therefore, this study analyzes a body of literature and answers the following questions:

- “What are the general ways of using ICT systems and tools to manage construction project stakeholders?”
- “Which processes and underlying practices of construction stakeholder management are digitalized and to what extent?”
- “What are the circumstances in which digital stakeholder management is needed in future research?”

3. Conclusions

Our insights shows that organizational factors are those which prevent construction stakeholders from discovering the true potential of digital collaboration. For example, contractor firms need to first raise their organizational competencies for planning and scheduling in digital form to be able to engage in digitalized cooperative planning in projects. The same is true for collaborative designing in BIM, where each architectural and engineering firm should have considerable experience and competence in BIM 3D modelling to engage in this type of collaboration. Even for the narrower use of digital collaboration on 3D models (i.e., view 3D visualization and input textual comments), organizations such as public owners (e.g., transportation agencies) must restructure some internal processes and train their employees to be able to digitally collaborate with other project stakeholders.

Furthermore, organizational factors affecting poor digitalization are tied to obsolete business processes of firms working in construction projects, which hinders the ability of each stakeholder (e.g., individual or organization) to properly share information and communicate with other stakeholders. For example, BIM and virtual reality can indeed help in engaging end users early (i.e., design development), but owners and designers must explore and develop new processes and abilities to really be able to engage other stakeholders properly. Additionally, social media is a very present means of the everyday interactions of most individuals, and it is used in some projects as part of a digital client relationship management process (so-called CRM 2.0) [83]. However, again, results show [25,83] that the benefits of social media are not so high in construction projects because digital business processes such as CRM 2.0 are not very common in construction industry organizations.

The importance of digitalization (especially in the field of collaboration and management of construction project stakeholders) is paramount, and this was especially seen in the last couple of years when digital collaboration was unavoidable (i.e., the COVID-19 crisis). It is important to investigate how to make ICT more user-friendly and how to devise organizational and project processes which are more prone to digital collaboration between construction stakeholders.

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