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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/19877

DOI URL: <http://dx.doi.org/10.21474/IJAR01/19877>



RESEARCH ARTICLE

CONTRACTORS PERSPECTIVES ON THE BENEFITS OF DIGITAL DATA MANAGEMENT TOOLS: A QUALITATIVE ANALYSIS

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Manuscript Info

Manuscript History

Received: 08 September 2024

Final Accepted: 17 October 2024

Published: November 2024

Abstract

This study articulates the perspectives of ten major construction contractors regarding two categories of challenges pertaining to the influence of digital innovation on the construction industry. Major contractors assert that web-based software enabling electronic collaboration among project stakeholders would significantly influence the sector, yet necessitates surmounting considerable obstacles related to clients, subcontractors, and architects. Major contractors anticipate that mobile computing devices capable of capturing and transmitting digital files and job costing data will significantly influence the sector in the future.

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Introduction:-

A longstanding debate in the literature about the adoption of technical breakthroughs is whether diffusion is primarily influenced by technology-push or demand-pull forces. While it may be an oversimplification, academics are sometimes criticized for believing that technology-push is the primary driver, whereas industry experts are perceived to focus on the practical challenges associated with the adoption of advances. An examination of the abstracts indicates that the present research substantiate this generalization. This study aims to expand the perspective on digital innovation in the construction sector by synthesizing the opinions of a sample of significant construction contractors.

The present research will initially provide a concise overview of the current literature about the fundamental challenges related to the adoption and effects of digital innovations in the construction industry. The present research will thereafter examine the consolidated results from structured interviews with IT and operations managers at ten of the twenty largest contractors. The research is based on two themes:

One, which innovations are poised to significantly influence the sector in the next five years, and how are major contractors leveraging these technologies for their advantage?

Two, in what ways have the business environment and organizational challenges influenced the adoption of digital technologies, and conversely, how have these innovations impacted the business environment and organizational issues?

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Literature Review:-

Classical economics demonstrates that market forces compel rational enterprises to explore process innovation to minimize the costs of delivering their products or services (Abanda, F. H., Mzyece, D., Oti, A. H., &Manjia, M. B. 2018). Economists and computer scientists have demonstrated that information technology—the hardware and software systems facilitating the swift transmission, storage, and analysis of information—is a potent process innovation for enhancing operational efficiency (Jahanger, Q. K. 2024). Business strategists have demonstrated that in numerous industries, digital innovation has not only led to significant decreases in operational costs but has also generated new ancillary markets and altered the competitive landscape in current businesses (Subramanya, K., Kermanshachi, S., &Pamidimukkala, A. 2023).

The architecture, engineering, and construction (AEC) sector is perhaps one of the most information-intensive businesses. Every construction project encompasses a distinct structure or constructed system, a specific location, and a unique amalgamation of designers and builders. Moreover, attaining the project objectives concerning prices, time, and quality necessitates stringent coordination among numerous specialized yet interdependent companies and personnel (Stefanakis, P. (2019). The design and construction process necessitates the rapid transmission of substantial technical data across the various organizations participating in a project for successful completion. Contemporary information technologies possess the capacity to revolutionize all functional departments and operational procedures inside construction companies (Hasan, A., Ahn, S., Baroudi, B., &Rameezdeen, R. 2021).

Given the high information intensity of construction and the swift advancements in information technology in recent decades, one may anticipate that the construction industry would be at the forefront of IT innovation adoption (Chowdhury et al. 2021). Nevertheless, the literature addresses numerous industry obstacles as noted below that impede the implementation of construction technologies (Vaughan, J. L., Leming, M. L., Liu, M., &Jaselskis, E. 2013).

1. Cyclical sales elevate the risk associated with high fixed costs.
2. Vertical and horizontal fragmentation complicates the integration of the value chain.
3. The limited scale of enterprises hinders their ability to bear substantial capitalization expenses.
4. The artisanal character of construction labor, which frequently opposes alterations
5. Minimal profit margins on overall contract value elevate the danger of substantial capitalization expenses.
6. Elevated management intensity, which obstructs the pursuit of strategic yet non-urgent initiatives
7. Task attributes that induce ambiguity regarding the anticipated functionality of innovations.

The above paragraph suggests that there are strong theoretical motivations for contractors to enthusiastically adopt digital innovations, alongside significant practical reasons for them to exercise caution as consumers of technology. This paper aims to transcend theoretical discourse and provide the perspective of large contractors on digital innovation. The particular matters examined encompassed:

Which specific technology do contractors anticipate will significantly influence the AEC business in the next five years?

What actions are contractors undertaking to use these technologies?

Has information technology innovation generated substantial transformations within organizations?

What organizational challenges impede the deployment of promising digital innovations?

What alterations in the corporate landscape are facilitating or obstructing digital innovation among contractors?

Research Methodology:-

The methodology employed was well-researched inquiry. The research included a modest qualitative study utilizing a small yet significant sample. Eleven organizations from the top 10 overall contractors or top 15 building contractors were initially contacted via telephone or email and invited totake in a brief telephone interview regarding the influence of digital innovation in construction. The sample can be classified as a convenience sample, as the author initially reached out to personal contacts within these organizations to obtain the name of a senior IT manager.

Upon identifying the relevant individual(s) within the firm, the cover paragraph and survey questions presented and dispatched to them. Participants were informed of the confidentiality of their interviews, meaning their responses would not be associated with their company identity. Two individuals opted to engage by email; the other participants were questioned via telephone. Ten out of the eleven firms approached engaged in the research. One firm contacted failed to react to multiple emails and telephone messages. Alongside interviewing senior IT managers, project managers from three companies were also consulted to confirm that operations staff held comparable views to IT staff.

Findings

This section of the study succinctly examines the respondents' replies to the five previously enumerated issues.

Question 1

Which information technologies will significantly influence the sector in the next five years, and how are contractors leveraging these technologies for their advantage?

All interviewees asserted that web-based technologies facilitating inter-company integration will significantly impact the sector by enhancing project efficiency and improving managerial and client monitoring. The capability to convey and document RFI, submission data, and installation progress is paramount. Almost all interviewed organizations have invested in project collaboration software, such as BIM, Primavera; however, none are now requiring the usage of this system for all projects. The utilization of such software for a certain project appears contingent upon the client's preferences, the nature of the project, and the geographical location. Numerous contractors mandate that essential subcontractors on certain projects utilize the system for submitting RFIs and payment requests. All organizations responded that software solutions, often linked to centralized company-wide databases, which integrate project, geographical, and functional units, will remain essential to their project management, estimating, and marketing operations. Numerous firms indicated the necessity for improved integration of project collaboration software with work costing and accounts payable systems.

The majority of interviewees indicated that mobile computing devices linked by high-speed wireless networks will significantly enhance on-site coordination, surpassing the improvements made by Nextel-type radios. Numerous respondents indicated that the capacity to input payroll and task costing data while traversing the site is their foremost priority for such systems, whereas others prioritized the capability to capture, transmit, and retrieve drawings, papers, and digital photos. The majority of respondents indicated or suggested that the true usefulness of PDAs and pocket PCs will only be actualized when connected over high-speed wireless networks. A company has imposed a freeze on additional acquisitions of PDAs, citing inadequate value at present.

Numerous companies indicated that simulation and visualization tools will gain significance. The conventional application of this program presently entails architectural rendering for company development objectives. Subsequent technical enhancements to the program will enable it to serve as a robust instrument for coordinating design and installation, especially for mechanical systems.

The majority of interviewees indicated that multimedia training solutions, mostly web-based, will remain significant. In contrast to previous decades, when staff training emphasized enhancing management and production competencies, the paramount training today centers on the utilization of corporate IT systems.

Contractors perceive web-based software that enhances collaboration among essential project stakeholders as the technology poised to significantly influence the industry, and they believe they have achieved substantial advancements in this domain. They anticipate that considerable disparities in client requirements and the reluctance of architects and subcontractors to adopt digital innovations will persist as major difficulties for many years.

Mobile computing devices capable of capturing, storing, and transmitting digital files and job costing data via high-speed wireless networks are anticipated to significantly influence the industry; nevertheless, contractors' strategies for adopting these technologies are progressing at a slower and more uncertain pace.

Web-based staff training systems and data mining of historical company databases for enhancing estimating, marketing, and project management capabilities are anticipated to remain significant digital applications. Information technology innovation has not generated significant organizational alterations within organizations, including structural modifications, recruitment practices, or evaluation systems. Corporate objectives for efficiency

are increasingly propelling IT innovation, rather than customer needs for novel services or the skills of competitors. In contrast to other sectors, contractors in the IT industry are not leveraging innovation to establish new markets, launch markedly novel services, or transform conventional procedures and communication methods.

Question 2

Has information technology innovation generated substantial transformations within organizations?

Almost all participants reported that project managers (PMs) and operational managers are executing fundamentally the same activities as before, albeit now utilizing a computer. Numerous companies said that the availability of real-time project status data enables operations managers to engage more actively in project oversight than previously. Numerous managers stated that IT has enabled the company's geographic operating units to become more interconnected and has significantly enhanced the consistency of processes and documents across the firm, ranging from operational data reporting to marketing proposals. Numerous interviewees reported that IT has significantly augmented the training requirements for employees. No participants reported that IT had significantly altered their company's organizational structure, recruitment methods, or performance evaluation system.

Question 3.

What organizational challenges have hindered the implementation of promising IT innovations?

The identified obstacles to IT innovation were largely anticipated. Almost all interviewees report experiencing persistent pressure to rationalize the expenses associated with new technologies and capabilities. The dilemma is exacerbated by the predictability of expenses, which can be estimated with acceptable accuracy, yet the tangible benefits remain uncertain, mostly due to the difficulty in forecasting the level of prospective user engagement with the system. Almost all participants indicated that numerous older personnel in their organization shown a diminished willingness and ability to master IT systems compared to their younger counterparts.

Question 4

What alterations in the corporate landscape are facilitating or obstructing digital innovation among contractors?

The majority of respondents responded that their organization's objectives are influencing the speed and trajectory of IT innovation within their company. The management and the corporation saw IT as a potent instrument for enhancing operational efficiency, enabling cost reduction, profit margin augmentation, and market share expansion.

Despite the above paragraph, clients and rivals are pertinent to IT investment decisions. The majority of interviewees reported that certain clients exhibit enthusiasm for the concept of real-time project data. The difficulty in providing these clients stem from the significant variability in the quantity and type of data they want. Other clients are proficient consumers of such data and may clearly express their information requirements. The difficulty in supplying these clients lies in the significant disparity of their IT systems, necessitating costly bespoke integration. About fifty percent of the interviewees indicated the necessity to match competitors' IT capabilities, but this concern was limited to competitors offering potential clients real-time project data, rather than a fear of competitors surpassing their own firms in efficiency.

It is unsurprising that none of the enterprises indicated that subcontractors, material suppliers, or designers were urging them to adopt IT advancements. All three were predominantly reported as obstacles. Subcontractors genuinely perceiving that they lack the time or financial resources necessary for procuring IT hardware and expertise. Architects often recognize the advantages of employing an electronic project management system for handling RFIs and submittals; yet, they often hesitate to use these systems due to concerns over liability and ownership. Numerous companies disclosed initiatives undertaken to access material providers' databases for real-time price and inventory information. Numerous additional companies indicated that vendor systems exhibit significant variability, necessitating costly bespoke integration.

Conclusion:-

Interviews with IT and project managers from 10 major contractors offer insights into their utilization of digital technology and their perspectives on the future of IT in the AEC industry. The results largely corroborate prior research and suggest significant difficulties warranting more examination. The opening of this paper highlighted that numerous authors have identified various obstacles to technical advancement in AEC. An encouraging insight from the interviews was that all managers emphasized digital technologies potential instead of challenges. Industry-wide concerns were addressed solely after the author raised them. The study identified four catalysts for the adoption of

new information technology among contractors: competitive advantage, process challenges, technological opportunities, and institutional mandates. The limited study presented in this publication unequivocally substantiates two of these factors—competitive advantage and technical potential. The interviews revealed that major contractors perceive themselves as leaders in establishing the speed and trajectory of their IT innovation, while simultaneously monitoring clients and competitors as they advance.

It is discovered that construction businesses demonstrated effective strategic management in two domains: enhancing knowledge transfer among employees and recognizing chances for market expansion. This paper's analysis suggests that, unlike most other sectors, construction contractors have not amalgamated the two domains. The interviews indicate that large contractors utilize digital technology for strategic information and knowledge transfer, but do not employ the same for market and service expansion. Assessing whether this conduct signifies that the AEC business is technologically backward or reflects a natural reaction to a difficult organizational context necessitates a more thorough analysis.

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