A Human-Centric Evaluation of BIM's Impact on Job Satisfaction in the AEC Industry Through Transformed Collaboration.

Research Problem Statement or Purpose

Although the Architecture, Engineering, and Construction (AEC) industry plays a significant role in the United States economy—contributing $1.2 trillion to the U.S. GDP in the last quarter of 2023 (Geospatialmedia, 2023)—mental health challenges within the sector remain a serious concern. This challenge is critical because more than 9 million people are employed in the industry (Trade.gov, 2021), yet well-being and job satisfaction of its workforce have received less attention. AEC occupations consistently report higher-than-average suicide rates in the U.S. (CDC, 2021; Holistic-Healthcare-Group, 2020), highlighting the urgent need for attention to mental health and workplace satisfaction in this vital economic sector.

Compounding the human challenges is a two-decade stagnation in AEC productivity, frequently linked to slow uptake of digital technologies due to human resistance (RibeirinhoMaria, 2020). Although technologies such as Building Information Modeling (BIM) are designed to improve productivity by enhancing collaboration, communication, and workflows, their adoption is often met with hesitation. This reluctance stems from a preference for conventional methods, resistance to change, and the stressors that new technology can introduce, all of which impede implementation (Elhendawi et al., 2020). In addition, job satisfaction can be obscured by technology. Research into job satisfaction has used various factors to capture employee fulfillment but often misses variables that are highly dependent on technology and rarely considers characteristics unique to AEC job sites.

While extensive research has been conducted on the technological and organizational aspects of BIM, its impact on job satisfaction remains underexplored—an oversight with potential implications for workforce resilience in the AEC industry. This study investigates the relationship between BIM usage for collaboration and job satisfaction, emphasizing how the frequency of BIM use influences employee satisfaction levels by incorporating job-satisfaction indicators (Fig. 1). Furthermore, the research aims to identify user subgroups—categorized by age, professional role, and years of experience—whose job satisfaction is more significantly influenced by the use of BIM technologies.
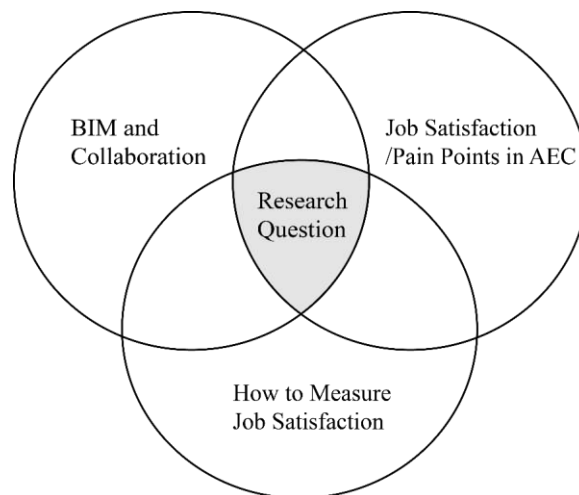

Figure 1: *The research question is developed from overlapping gaps in three areas of research*

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Research Methodology and Approach

This work is part of a larger body of research. A robust literature review has considered what is already known about the use of BIM, methods for assessing job satisfaction, and characteristics of the construction industry that make workplace fulfillment difficult to assess. This paper started by identifying and categorizing relevant literature for the review, beginning by defining clear objectives that focus on the relationship between BIM, job satisfaction, and its impact on the AEC industry. The search was conducted across academic databases such as Web of Science and Google Scholar, using targeted keywords (e.g., "BIM AND job satisfaction") while applying inclusion criteria, including relevance to human factors studies. After screening titles and abstracts for alignment with the research objectives, the selected papers were systematically organized into three main categories: BIM (definitions, benefits, and challenges), job satisfaction elements (e.g., frameworks like JCM), and job satisfaction within the AEC industry (industry-specific studies). This process provided updated information on BIM's benefits and challenges, approaches to measuring job satisfaction, and pain points related to job satisfaction in the AEC industry. These insights serve as valuable tools and targets for designing an effective survey.

The next steps in this research will include conducting surveys with construction professionals and follow-up interviews. Through surveys, this research considers a broad perspective of BIM on construction sites while case studies allow for more detailed accounts of job satisfaction. From the literature review, a framework for asking about job satisfaction pertaining to BIM will be developed. The goal of the questions is to capture the influences of BIM on a user-to-user basis, accounting for the individuals' experiences that may vary from project to project.

Key Findings

From the literature review, key findings influence future work on the subject of BIM use and job satisfaction in AEC:

- **Job satisfaction has been measured through many factors but struggles to capture all possible characteristics of job activities.** One of the leading methods of assessment is Hackman and Oldham's Job Characteristics Model (JCM) (Hackman, 1980). It has been particularly influential in the study of career fulfillment, offering a structured way to measure and enhance job satisfaction. Characteristics such as skill variety, task identity, task significance, autonomy, and feedback are key features in shaping an individual's commitment to the organization and their level of engagement or involvement in their job (Hackman, 1980). However, the JCM has been criticized for not fully capturing the impact of technology on job satisfaction (Liere-Netheler et al., 2017). The Work Design Questionnaire (WDQ) includes motivational, social, and contextual characteristics in its assessment (Dunham, 1976), which can capture the cultural impact on satisfaction, but still lacks aspects of job fit (Ling & Loo, 2015), co-worker support (Leung et al., 2016), and job complexity (Bayo-Moriones et al., 2010). Furthermore, not all technologies contributes contribute equally to workplace value, making measuring the influence of technology on job satisfaction more obscure.

- **While numerous studies have examined job satisfaction across various industries, focusing specifically on the AEC sector is vital due to its distinct characteristics.** The AEC industry is marked by a fragmented structure, unique and often non-repetitive projects, difficulties in automation, labor-intensive processes, a high-risk business environment, and inherently stressful and hazardous working conditions (Hu & Panthi, 2018). Understanding the specific job stressors and key factors that influence satisfaction in this sector is imperative for

crafting effective strategies to enhance job satisfaction, especially through the integration of advanced technology frameworks like BIM.

- **BIM offers significant advantages, but it also introduces workplace challenges and stressors that merit further investigation**. While streamlined communication (Ghaffarianhoseini et al., 2017; Wang et al., 2022) and real-time collaboration (Villena Manzanares et al., 2024) of BIM improve the efficacy of overall project management and stakeholder participation, incorporating BIM is limited by human, organizational, and technological barriers (Xu et al., 2022). Human cultural tendencies resist change (Alankarage et al., 2023), including the adoption of BIM (Morlhon et al., 2014), which can be attributed to a lack of awareness (Arayici et al., 2011). Interpolating BIM is challenging as data management can be confusing (Dena, 2024) with insufficient collaboration among stakeholders (Villena-Manzanares et al., 2020) and some companies may lack the necessary resources, including adequate training (Arayici et al., 2011), and incompatible software and hardware (Tchouanguem Djuedja et al., 2019). Understanding how AEC employees weigh the disadvantages of BIM on a daily or use-to-use basis would aid in re-evaluating BIM's usefulness. To gain a clearer understanding of how BIM influences job satisfaction, it is essential to examine how AEC professionals experience and assess its benefits and challenges in their everyday tasks. An in-depth evaluation of these aspects will not only shed light on the practical value of BIM but also help in formulating targeted strategies to overcome its limitations.

This work emphasizes the need for human-centric considerations in BIM implementation. Although financial benefits, quality control, and design outcomes are all considerations in assessing the effectiveness of BIM technologies, the impact on individuals working in the industry is critical as well. Figure 2 summarizes that while BIM can enhance communication and

collaboration, it also creates new challenges which can negatively impact job satisfaction. These consequences will be further explored through this research.
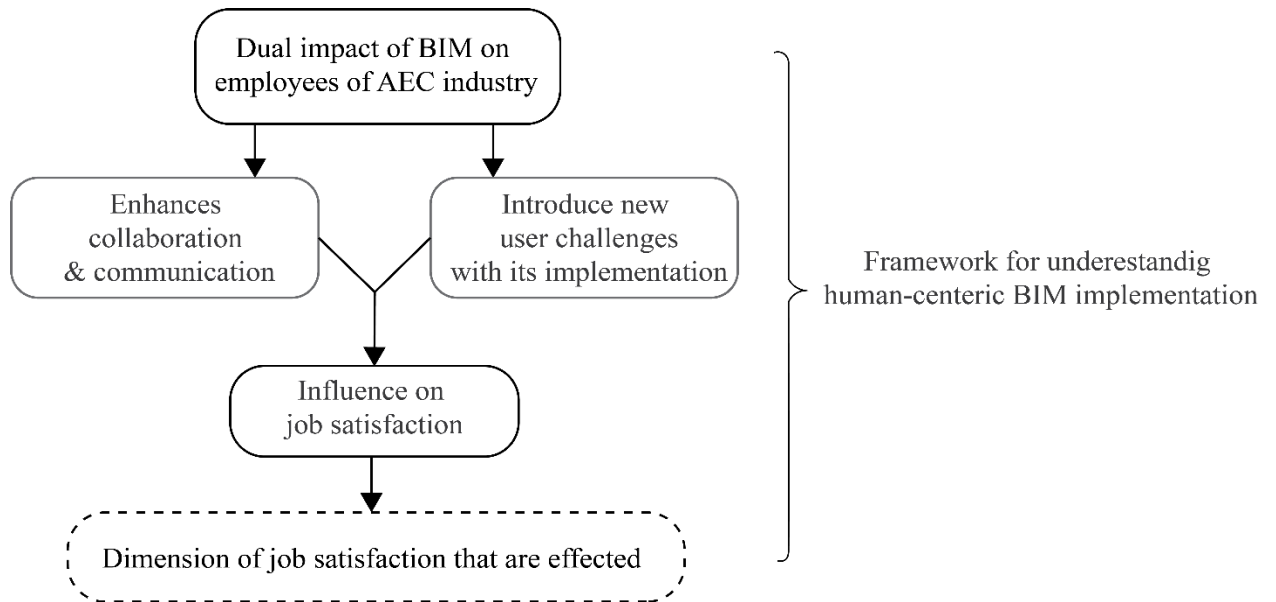

Figure 2: *Emphasis on human-centric considerations when assessing BIM Use in AEC.*

Implications

This work is valuable in improving the overall well-being of employees in the construction industry, which can improve overall performance, increase profits, extend resiliency, and, more importantly, improve mental health. Although many variables have been shown to influence job satisfaction on a job site, it is important to be critical of the use of technology as technological advancements rapidly evolve, requiring a resilient workforce. The incorporation of Artificial Intelligence and the Internet of Things may unlock new opportunities for enhancing job design and optimizing employee experience. Therefore, capturing job

satisfaction with existing technologies is important before new ones emerge. Moreover, organizations must leverage BIM to solve core industry pain points. This entails using the technology to increase project flexibility, reduce hazardous working conditions, and improve communication and collaboration within teams. By taking a human-first approach, the AEC industry can better navigate the challenges of technological integration, paving the way for a more motivated, satisfied, and resilient workforce.

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