Enhancing Project Manager-GenAI Interaction: A Bidirectional Analysis for Construction Project Management

Shi Maruoyan[a], **Zhu Hanjing**[a], **Liang Mingxuan**[a], **Hwang Bon-Gang**[a]

[a] *Department of the Built Environment, National University of Singapore, Singapore* e1168824@u.nus.edu, hanjingz@nus.edu.sg, Mingxuanliang@u.nus.edu, *bdghbg*@nus.edu.sg

1. Introduction

Project management is essential in the construction industry, ensuring structure and guidance for successful outcomes. With digital transformation accelerating, the industry increasingly integrates Generative Artificial Intelligence (GenAI) into project management. While GenAI offers significant potential, existing research often treats it solely as a technical tool, overlooking its dynamic interaction with project managers across lifecycle phases. Additionally, studies rarely examine feedback mechanisms between GenAI and project managers, which are critical for optimizing effectiveness. This research aims to address these challenges by conducting a comprehensive lifecycle analysis of the interaction and feedback processes between GenAI and project managers, with a focus on enhancing collaboration and contributing to project outcomes. Specifically, this study will be guided by the following research objectives:

(1) To identify current and potential applications of Generative AI across the construction project lifecycle;

(2) To identify key factors in the interaction between project managers and GenAI tools among different lifecycle phases;

(3) To propose a Generative AI-Project Manager Interaction Evaluation Framework (GAI-PMIEF) to guide the interaction between project managers and GenAI; and

(4) To develop a Project Manager-Based Bidirectional Feedback System (PM-BFS).

2. Methodology

To identify critical evaluation factors in the interactions between project managers and GenAI throughout the construction project lifecycle, this study proposes the Generative AI-Project Manager Interaction Evaluation Framework (GAI-PMIEF) and Project Manager-Based Bidirectional Feedback System (PM-BFS), aiming to contribute to decision-making, project efficiency, and human-AI collaboration.

2.1 Proposed Conceptual Framework: GenAI-Project Manager Interaction Evaluation Framework (GAI-PMIEF)

This study introduces the GAI-PMIEF to systematically analyze and improve the bidirectional interactions between project managers and GenAI tools in construction project management. Unlike existing frameworks that focus solely on AI performance or the unidirectional application of AI tools, the GAI-PMIEF is designed to evaluate both sides of the interaction. It emphasizes the mutual assessment between project managers and GenAI systems, aiming to optimize their collaborative effectiveness across all phases of the project lifecycle.

Based on the bidirectional interaction emphasized in this study, this evaluation is divided into two aspects: Project managers' Evaluation Metrics for Generative AI Tools and GenAI's Evaluation Metrics for Project managers.

Table 1: Project Managers' Evaluation Factors for GenAI Tools

Primary Factor	Subfactor	Aspect	Metrics for Evaluation
Goal	Individual Goals	Skill Enhancement, Achieve Task Objectives	System development; Overall System Accuracy ;
	Collective Goals	Successful Project Delivery, Effective Collaboration	Objective Fulfillment Rate; Knowledge Transfer
Performance	Usefulness	Problem Solving Ability Relevance to need Ability to handle errors and provide guidance	Solution Accuracy; Problem Resolution Rate; Learning Adaptability
	Accessibility	Clarity of Instructions User-friendliness Simplicity of the Interface	Instructions Clarity Rate; Ease of Navigation; User Effort Score
	Efficiency	Promptness of Responses Time savings when using the tools Reduction in Effort for Completing Tasks	Resource Utilization Completion Time; Workload Reduction;
	Trust and Safety	Trust in GenAI tools Privacy Concerns Reliability of Responses	Trust Score; Safety Incidents; Confidence
	Quality	Accuracy and Correctness of Chatbot Responses Relevance of Information Credibility and Trustworthiness of Source Depth and Comprehensiveness	Accuracy Rate; Relevance Score; Feedback Quality
	Personalized Experience	Tailored Content Customized Recommendations Feedback and Progress Tracking	Alignment with Priorities; Accuracy of Customization; User Satisfaction Ratings
Mutual Learning and Improvement	Adaptability	Frequency of Output Adjustments Time required for adapting to inputs Interactivity Positively	Learning Curve; Model Improvement Rate; Strategy Knowledge Retention; Adaptability Score
	Iterative Refinement	Number of Iterations required to achieve optimal results Improvement in Output Quality	Iteration Count; Convergence Speed
	Collaboration	Frequency of Interactions Collaborative Decision Making	Output Consistency; Impact of Corrections; Decision Effectiveness

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Reference: (Brosque et al., 2020; De Visser et al., 2018; Dellermann et al., 2019, 2019, 2021; Fragiadakis et al., 2024, 2024; Gînguță et al., 2023; Kapočiūtė-Dzikienė, 2020; Mason, 2007; Nielsen, 1994; Norman, 2013; Regona et al., 2022; Robertson et al., 2024; Saihi et al., 2024; Seeber et al., 2020; Shneiderman, 1983; Tankelevitch et al., 2024; Zhang et al., 2023 among others).

Table 2: GenAI' Evaluation Factors for Project Managers

Primary Factor	Subfactor	Aspect	Metrics for Evaluation
Goal	Individual Goals	Skill Enhancement, Achieve Task Objectives	Skill development; Adaptability to AI Tools
	Collective Goals	Successful Project Delivery, Effective Collaboration	Objective Fulfillment Rate
Performance	Decision-making	Decision Accuracy Ability to Recognize Key Issues Time Management Safety Management Budget Management Risk Management Resource Utilization	Decision Accuracy; Prioritization accuracy; Task completion time; Incident Prevention; Budget Adherence; Frequency of proactive risk identification; Resource utilization rate
	Leadership and Communication	Effective leadership Clarity of Communication Team Collaboration Stakeholder Management Conflict Resolution	Leadership; Prompt Clarity; Interaction Frequency; Resolution Speed
	Technical Expertise	Domain-Specific Knowledge Analytical Competence Problem-Solving Skills Strategic Thinking	Knowledge Depth; Plan Quality; Data Accuracy; Strategy Alignment
	Innovation Consciousness	Flexibility and Creativity Awareness of Innovative Solutions Adoption of Emerging Technologies	Flexibility; Creativity; Technology Awareness; Implementation Rate
Mutual Learning and Improvement	Workflow Integration	Seamless Adoption of GenAI Outputs Efficiency in Task Execution	Automation Effectiveness; Workload Reduction
	Learning and Adaptation	Adaptability of GenAI Outputs Skill Improvement	Knowledge Transfer; Learning Speed
	Feedback Mechanisms	Clarity of Feedback Timeliness of Feedback Loops	Feedback Clarity rate; Input Relevance
	Collaborative Refinement	Effectiveness of Feedback to refine GenAI outputs Enhancement of Results	Feedback Utilization; Iteration Frequency; Improvement Rate

Reference: (Alam et al., 2010; Apel et al., 2004; Chipulu et al., 2013; Clarke, 2010; Dainty et al., 2003; Fragiadakis et al., 2024; Hanna et al., 2016; Hwang et al., 2024; Hyväri, 2006; Maedche et al., 2019; Muzio et al., 2007; Pant & Baroudi, 2008; Peng et al., 2024; Pereira & de Carvalho, 2009; Simard et al., 2017; Wang et al., 2022; Wu et al., 2023 among others).

This framework provides a structured foundation to analyze and enhance the collaborative potential of GenAI and project managers.

2.2 Development of the Bidirectional Feedback Mechanism

The Project Manager-Based Bidirectional Feedback System (PM-BFS) is designed to address the critical need for dynamic, two-way feedback mechanisms between project managers and GenAI tools. This system ensures that both parties—human and AI—actively contribute to iterative improvements, enabling enhanced decision-making and adaptive project management processes throughout the lifecycle of construction projects.

Unlike traditional feedback systems that emphasize one-way communication, the PM-BFS adopts a bidirectional approach, incorporating insights from both project managers and GenAI tools. The system enables project managers to provide qualitative and quantitative feedback on GenAI outputs while allowing GenAI tools to analyze and adapt to project managers' responses, decision-making patterns, and strategic adjustments to refine their recommendations and align with lifecycle-specific challenges. This bidirectional approach ensures iterative improvement in GenAI recommendations and enhances project managers' ability to leverage AI effectively. The PM-BFS not only addresses current gaps in human-AI collaboration but also ensures alignment with evolving project demands and industry standards.

3. Significance and Potential Contributions

This study advances construction project management by introducing a novel interaction framework and feedback system to enhance the integration of GenAI across project lifecycle phases. The GAI-PMIEF establishes structured evaluation criteria to facilitate effective human-AI collaboration, while the PM-BFS enables bidirectional feedback, driving continuous improvement in both AI models and project management strategies. Furthermore, longitudinal studies will assess the long-term impact of GenAI integration on project management outcomes, ensuring its scalability and adaptability for broader applications. This research not only provides practical tools to address key challenges in integrating GenAI into construction project management but also advances academic understanding of Human-GenAI interaction, laying a strong foundation for further exploration of GenAI's role in lifecycle-oriented industries.

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