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Control or Collaboration? A Literature Review Reflection on the Challenges of AI Integration

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ABSTRACT

Artificial Intelligence (AI) is increasingly redefining the landscape of creative and professional disciplines, particularly within architecture and design. Transitioning from a passive tool to a potential active digital collaborator, AI presents new challenges and opportunities in creativity, operational efficiency, and human–machine collaboration. This literature review examines the implications of AI integration, particularly in the context of the Architecture, Engineering, and Construction (AEC) sector, where maintaining high standards of adaptability, professionalism, and accountability is paramount. Generative AI tools enable rapid exploration of design alternatives and offer real-time feedback, improving workflow efficiency and supporting iterative ideation. However, the increased reliance on AI poses risks, including design homogenization, excessive automation, and potential misalignment between AI-generated outputs and human creative ideation. Addressing these challenges requires structured methodologies that support AI augmentation while preserving the uniqueness of human-driven design processes. The review highlights hybrid collaborative environments where human designers and AI systems interact through dynamic, iterative workflows. These models encourage shared control and adaptability, allowing AI to enhance rather than obstruct creative development. Ethical considerations—including authorship, bias, and decision accountability—are also central to ensuring responsible AI integration. To fully realize AI's potential in design, educational systems must evolve to include AI literacy, algorithmic ethics, and collaborative design strategies. This will prepare future professionals to critically engage with evolving digital tools and the changes of next societies. Future research should focus on scaling these frameworks across the entire design lifecycle and assessing AI's long-term effects on professional practices. By fostering balanced collaboration, AI can address pressing global challenges while amplifying creativity, diversity, and inclusivity in the design process.

Keywords: AI in Architecture, Human–AI Collaboration, Workflow Adaptation, Creative Control, Digital Design, Design process, Design Ethics.

INTRODUCTION

The rapid integration of Artificial Intelligence (AI) into architectural practice and education presents both opportunities and critical challenges. As AI progresses from being a supplementary tool to acting as an active agent in the creative process, architecture faces the imperative to redefine roles, authorship, and design methodology (Andrés and Zhang, 2023; Del Campo, 2023). This literature review explores how AI is reshaping the design profession and architectural thinking,

particularly focusing on issues of control, creativity, collaboration, and ethical responsibility (Eltaweel and Su, 2021; Mehrpouya and Ghasemi, 2023).

The shift towards human–AI collaboration in architectural workflows raises essential questions: To what extent can AI co-create meaningfully with humans? How should the profession and education systems adapt to foster hybrid creativity? This paper interrogates these questions through a structured literature review, proposing a framework of analysis that emphasizes balanced collaboration and intentional integration strategies (Maher and Fisher, 2023; Sevaldson, 2018).

LITERATURE REVIEW AND METHODOLOGY

This literature review synthesizes findings from twenty-five peer-reviewed sources published between 2020 and 2025, drawn from journals and conferences such as Design Studies, Automation in Construction, ACM Transactions on Computer-Human Interaction, and Architectural Research Quarterly. These works were selected for their relevance to AI integration in architectural and design practice, focusing specifically on the human-centered aspects of creativity, collaboration, adaptation, and ethics.

To frame the central tension between control and collaboration, the study builds on conceptual frameworks developed in human–AI interaction research. Kim and Maher (2021) propose typologies of co-creativity based on initiative and autonomy, while Cimolino and Graham (2022) present a shared control model that maps degrees of human and AI participation. In architectural contexts, AI tools such as text-to-image generators, generative adversarial networks (GANs), and reinforcement learning systems have enabled novel applications in form-finding, layout optimization, and performance simulation. However, such tools are often criticized for reducing the richness of design iteration, for encouraging stylistic convergence and for not achieving professional outcomes consistently.

Methodologically, this study adopts a qualitative approach through a structured literature review. Peer-reviewed journal articles, conference proceedings, doctoral theses, and seminal texts were selected based on their relevance to AI integration in architecture and design. Selection criteria included empirical studies on generative design, frameworks for human–AI interaction, and theoretical discussions on creativity, authorship, and ethics in digital design.

The review includes both historical perspectives (Cross, 2006; Lawson, 2006; Nasar, 1992;) and contemporary AI scholarship (Del Campo, 2023; Yu et al., 2024; Rezwana and Maher, 2023), aiming to capture the evolution and present state of discourse in the field. Special attention was given to sources that focused on collaborative design processes, shared control, and educational implications, including literature from the domains of human–computer interaction (HCI), computational creativity, and systems design (Liu and Lim, 2020; McCormack, Gifford and Hutchings, 2019; Stolterman and Wiberg, 2010). The reviewed sources reflect a spectrum of perspectives on AI integration, from theoretical frameworks to practical implementation. Table 1 summarizes key contributions and the themes they address within the broader discourse of human–AI collaboration in architecture.

Table 1. Summary of Key Literature Themes

Theme	Key Authors	Core Insights
AI as Creative Partner	Rezwana & Maher (2023); Kim & Maher (2021)	AI supports ideation but requires human strategic direction
Hybrid Workflows	Liu & Lim (2020); Del Campo (2023)	Blending manual and AI processes enhances adaptability
Shared Control	Cimolino & Graham (2022); Cai et al. (2019)	Collaborative frameworks mediate control and authorship
Ethical Challenges	Mehrpouya & Ghasemi (2023); McCormack et al. (2019)	Bias, responsibility, and authorship are critical concerns
Educational Implications	Sun & Ye (2024); Duarte (2001); Maher & Fisher (2023)	Curriculum must adapt to include AI literacy and ethics

FINDING

3.1 From Tool to Partner: AI and Creative Agency

AI is redefining its role in design, increasingly participating in early conceptual phases and generating options that overcome conventional design limitations (Rezwana and Maher, 2023). Human designers benefit from enhanced ideation capabilities, real-time simulations, and rapid iteration cycles together with immediate real-time feedback. However, this evolution challenges traditional notions of authorship and originality (McCormack, Gifford and Hutchings, 2019).

Studies show that AI's potential as a digital partner becomes worthwhile when humans maintain strategic control while leveraging computational strength (Kim and Maher, 2021; Jiang and Hendriks, 2020). However, insufficient human direction and supervision risks fostering over-reliance on automation, which can produce homogenized outputs and undermine the uniqueness of individual design identities (Zhang et al., 2021). This dynamic not only compromises output quality but may also devalue the perception of professional expertise in the field.

Structured interaction frameworks like COFI facilitate co-creative interaction, encouraging designers to reflect on inputs and outputs critically (Rezwana and Maher, 2023). They enable users to interact with AI systems while preserving agency, allowing generative design to become a support mechanism rather than a replacement.

3.2 Hybrid Workflows and Shared Control

Contemporary workflows blend manual and automated processes, creating hybrid models that demand new understandings of shared authorship and control (Cimolino and Graham, 2022; Liu and Lim, 2020). These workflows extend beyond form generation into decision-making, scenario evaluation, and environmental simulation (Li, Wu and Xu, 2025).

Interfaces that promote human oversight while enabling dynamic AI contributions are essential (Cai et al., 2019). Human–AI teaming models provide examples where tasks are divided based on strengths—computational precision and human intuition—leading to iterative, multidimensional exploration (Del Campo, 2023; Goldschmidt, 2014). Projects involving parametric design and

generative algorithms demonstrate successful application of hybrid logics (Sevaldson, 2018; Duarte, 2001).

3.3 Ethical and Educational Implications

AI in design raises pressing ethical concerns: Who is responsible for AI-assisted decisions? How do we attribute authorship in co-generated works? What biases exist in training data that influence outcomes? (Mehrpouya and Ghasemi, 2023). Scholars argue for transparency protocols and ethical guidelines to ensure responsibility remains with human actors, even when AI is involved.

Educational institutions play a pivotal role in preparing the next generation of designers to engage with AI critically (Sun and Ye, 2024). Pedagogical strategies must shift toward integrating algorithmic literacy, ethical design, and collaborative methodologies into the curriculum (Picon, 2019; Duarte, 2001). Frameworks such as human-centered design (Maher and Fisher, 2023) support the cultivation of reflective and thorough practitioners.

DISCUSSION

AI's role in architecture is no longer a technical augmentation but a creative partner. The challenge lies in integrating AI into collaborative environments that respect and amplify human creativity (Andrés and Zhang, 2023). This is not a matter of replacing the designer but aligning computational processes with human intentions (Maher and Fisher, 2023).

The fear of homogenization can be addressed by designing feedback mechanisms and critique systems within AI interfaces (Zhang, Raina and McComb, 2021). By treating design as a dynamic, open-ended system rather than a linear and mono-dimensional process, AI can foster diversity rather than suppress it (Sevaldson, 2018).

Designers must evolve from tool users to collaborators in a system where responsibility, ethics, and creativity are shared. A number of conceptual and operational frameworks support the collaborative integration of AI in design practice. Table 2 outlines key models and their relevance, offering structured pathways for aligning computational processes with human-centric design objectives.

Table 2. AI Integration Models in Architecture

Model/Framework	Contribution	Reference
COFI	Facilitates co-creative interaction with AI	Rezwana & Maher (2023)
Human-AI Teaming	Division of tasks based on strengths (human vs AI)	Jiang & Hendriks (2020)
Shared Control Model	Maps levels of control between humans and AI	Cimolino & Graham (2022)
GAN-based Generative Design	Supports form-finding and iteration processes	Liu & Lim (2020)
Systems Oriented Design	Addresses complexity in hybrid systems	Sevaldson (2018)

The discourse shifts from efficiency to meaning—how to make architecture more responsive, inclusive, and innovative through hybrid intelligence.

CONCLUSION

The integration of Artificial Intelligence in architecture and design is no longer speculative—it is rapidly reshaping how professionals approach creativity, collaboration, and decision-making. This literature review reveals that while AI tools offer powerful opportunities to expand ideation, automate repetitive tasks, and simulate design scenarios at unprecedented speed, their true value lies in how designers strategically and critically engage with them. AI's evolution from passive instrument to active co-creator challenges conventional notions of authorship and originality (Rezwana and Maher, 2023; Kim and Maher, 2021). However, this shift need not compromise creative autonomy. On the contrary, when embedded within well-defined collaborative frameworks—such as COFI or hybrid control models—AI can act as an enabler of diverse, contextually rich solutions (Cimolino and Graham, 2022; Liu and Lim, 2020).

At the same time, ethical and educational responsibilities must not be suspended. The risks of bias, loss of authorship clarity, or overdependence on algorithmic outputs are real and must be addressed through ethical guidelines and curriculum reform (Mehrpouya and Ghasemi, 2023; Sun and Ye, 2024) in the professional practice and education context. Developing a design culture that emphasizes transparency, critical feedback, and adaptive learning is essential for AI's responsible use (Sevaldson, 2018; Stolterman and Wiberg, 2010).

Crucially, this review underscores that human-centered design thinking remains indispensable. AI cannot replace the nuanced judgment, empathy, professionalism and contextual awareness of the human designer—it can only augment these traits when used with purpose. As argued by Maher and Fisher (2023), the goal is not to replicate human creativity but to support it in navigating complexity, embracing uncertainty, and achieving sustainability and inclusivity exactly as in a company office/team.

Looking ahead, future research should focus on structuring these frameworks across varied design scales and phases, testing them in different projects, integrating real-time feedback mechanisms, and observing long-term professional adaptation. This would enable a more granular understanding of AI's role in shaping architectural education, practice, and culture.

By fostering balanced, ethically grounded collaborations between human designers and AI systems, the field can move toward a more inclusive, creative, and responsive design paradigm—one where technology amplifies rather than defines the architectural imagination.

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