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건축 설계에서 고객 요구 대응을 위한  
AI와 BIM의 융합적 시너지  
- TheBIM -

2024. 11.

과 제 명	인공지능 기반의 건축설계 자동화 기술개발		
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연 구 기 관	경희대학교 산학협력단	연구책임자	김인한

# 「홍보」 성과 확인서

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홍보성과

구분	간행물발간		
홍보명	건축 설계에서 고객 요구 대응을 위한 AI와 BIM의 융합적 시너지		
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위 연구과제를 통해 발생된 성과와 증빙이 상기와 같음을 확인합니다.

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# The BIM

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BIM : Central to the digitalization of the construction industry

건설 산업 디지털화의 핵심 동력

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# 건축 설계에서 고객 요구 대응을 위한 AI와 BIM의 융합적 시너지

Synergy of AI and BIM in addressing client needs for building design

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건축 설계의 주요 과제 중 하나는 다양한 고객 요구를 효과적으로 이해하고 반영하는 것입니다. 전통적인 방법은 고객의 기대를 구체적인 설계 요소로 전환하는 데 종종 어려움을 겪어 오해, 지연, 비용 증가를 초래합니다. Artificial Intelligence (AI)과 Building Information Modeling (BIM)의 통합은 이러한 문제를 해결하기 위한 혁신적인 방법을 제공합니다. AI 도구는 고객의 선호도와 실시간 피드백을 기반으로 설계 옵션을 자동으로 생성하여, 고객 기대와 결과물 간의 일치도를 크게 높입니다. 또한, 예측 분석을 통해 자원 사용, 에너지 효율성 및 장비 성능을 최적화하여 중요한 고객 문제를 해결합니다. 이 글에서는 AI와 BIM의 시너지 효과를 탐구하고, 초기 설계 단계에서 시가 이해관계자 참여를 어떻게 개선할 수 있는지 사례를 통해 설명합니다. 향후에는 실시간 데이터 분석 및 복잡한 구조물에 대한 생성 모델이 중심이 되어, 건축 설계 전반에 걸쳐 최적화된 지능형 건물이 등장할 것입니다. AI-BIM 통합은 건축 설계를 더욱 유연하고 효율적이며 고객 중심으로 변화시킬 것입니다.

## Introduction

BIM has revolutionized the AEC industries by enhancing collaboration, visualization, and project management throughout the project duration. The integration of AI with BIM holds the potential to further advance the capabilities of building design and construction, particularly in addressing complex client needs during design phase. This synergy facilitates automated design processes, predictive analytics, and optimized decision-making, making it possible to meet client expectations with higher accuracy and efficiency. With the rise in data-driven approaches and smart technologies, the collaboration between AI and BIM offers a new paradigm for client-centric building design and management [1]. Traditionally, designing building floor plans has been a labor-intensive process requiring multiple iterations to align with client needs. Architects and designers spend a significant amount of time interpreting vague requirements, adjusting layouts, and proposing solutions. AI, however, brings automation and real-time customization to this process, reducing the gap between initial concept and final design.

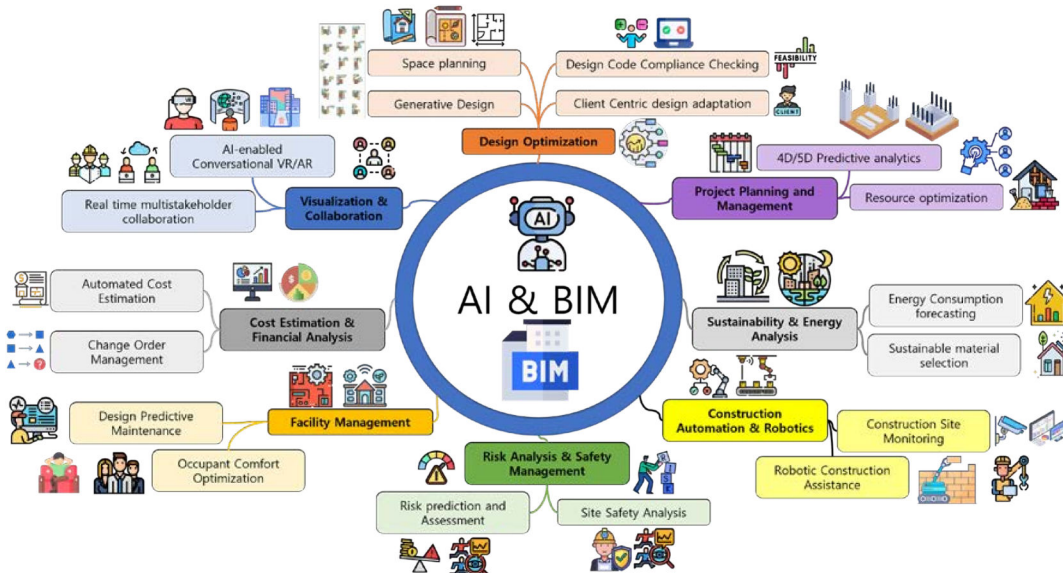


Figure 1 Applications of AI and BIM synergy

Figure 1 illustrates the benefits of integrating AI with BIM in enhancing various aspects of building design and construction. This synergy improves multiple dimensions of the process, revolutionizing the industry. The article explores how AI-BIM integration can enhance building design, supported by case studies showing improved stakeholder engagement in early design stages. It also discusses AI applications, highlighting a new AI-BIM platform that exemplifies this integration. The focus is on real-time data analytics and advanced generative models for complex building designs, leading to intelligent, self-managing buildings optimized throughout their lifecycle. The ongoing evolution of AI-BIM integration promises to transform building design into a more dynamic, adaptive, and client-centric field.

**Enhancing Building Design through AI and BIM Integration**

AI improves the building design process by automating repetitive tasks, exploring design variations quickly, and providing real-time interactive visualizations for client engagement. Generative design tools use AI to create multiple design options based on predefined constraints, allowing designers to explore innovative solutions rapidly. This accelerates decision-making and ensures client preferences are incorporated from the start. AI-driven data analysis also optimizes designs for performance and sustainability, evaluating factors like energy efficiency and material usage. Predictive capabilities help identify potential project challenges early, enhancing efficiency and reducing costs.

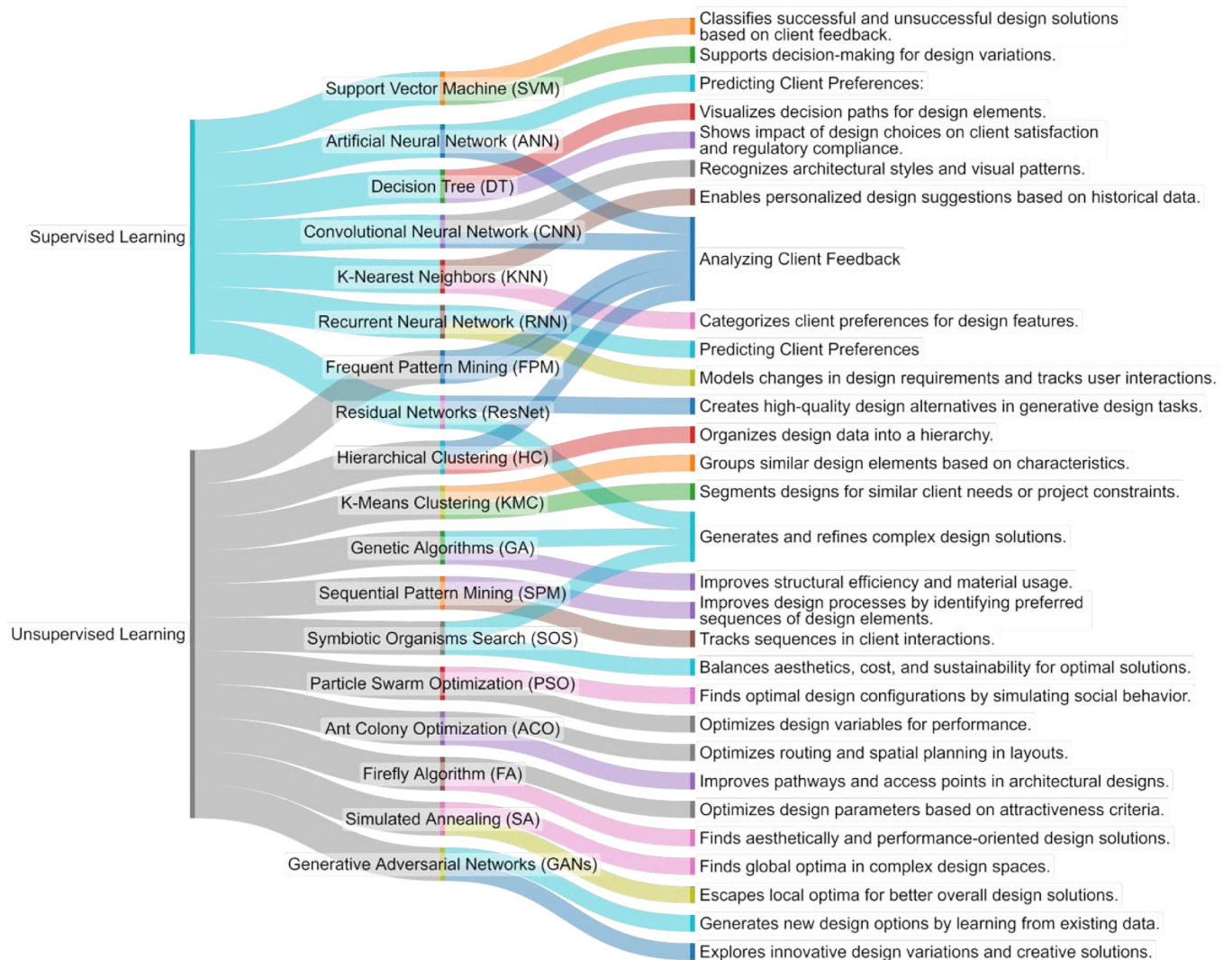


Figure 2 AI algorithms and its uses in addressing client needs for building design

To effectively address client needs, various AI algorithms can be utilized. Generative algorithms like Genetic Algorithms and GANs generate and refine complex designs, while Reinforcement Learning improves designs iteratively based on client feedback. Natural Language Processing (NLP) tailors designs by interpreting client inputs, and supervised and unsupervised learning algorithms predict preferences by identifying user behavior patterns. Decision trees and Random Forests evaluate multiple design options against client criteria, ensuring optimal alignment with priorities [2]. These algorithms streamline decision-making and foster a more collaborative design process, as shown in Figure 2.

**AI in Action: Use cases**

So, how can AI revolutionize architectural design? In recent years, AI has increasingly been integrated into architectural design processes, offering innovative solutions to longstanding challenges. Below, we present two specific use cases from recent research to demonstrate the transformative potential of AI in architectural design.

**1) Generative AI for Design Intent Synthesis**

AI can effectively incorporate complex design requirements in architectural exterior design. Imagine architects conveying detailed client needs and artistic sketches to an AI model, which then generates design concepts that align perfectly with these inputs. Recent research has achieved this using generative AI-powered design tools. Researchers have developed a system that combines advanced AI techniques with domain-specific knowledge, revolutionizing how architectural designs are created. The AI model, trained on a dataset of famous architectural works and equipped with tools like ControlNet, understands both textual and visual inputs, as shown in Figure 3. This enables the AI to transform simple sketches into fully-realized designs that meet specific requirements, such as style and functionality. This approach significantly accelerates the conceptual design process, allowing architects to quickly explore various options that satisfy client expectations. The

result is a powerful tool that enhances creativity and efficiency, paving the way for a new era of AI-driven architectural design.

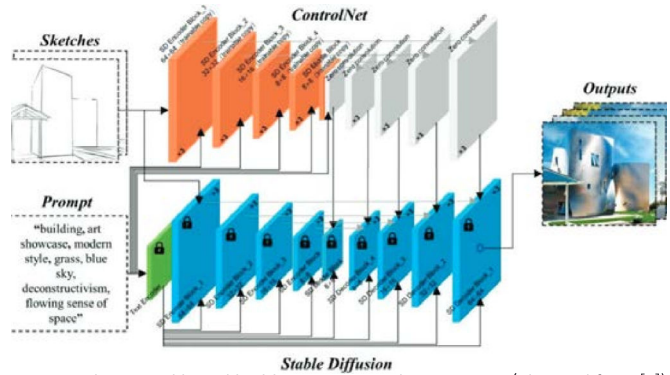


Figure 3 Client need based building exterior style generation (obtained from [3])

**2) AI-BIM Design recommendation System**

Can AI design modular homes that meet unique client needs? To answer this, a recent study developed an AI-BIM system that uses NLP to turn client input into tailored modular housing designs. By analyzing client preferences, the system recommends three design options from a BIM database, ensuring they align closely with specified requirements as shown in figure 4. This approach speeds up the design process and enhances client satisfaction by offering personalized, accurate design solutions.

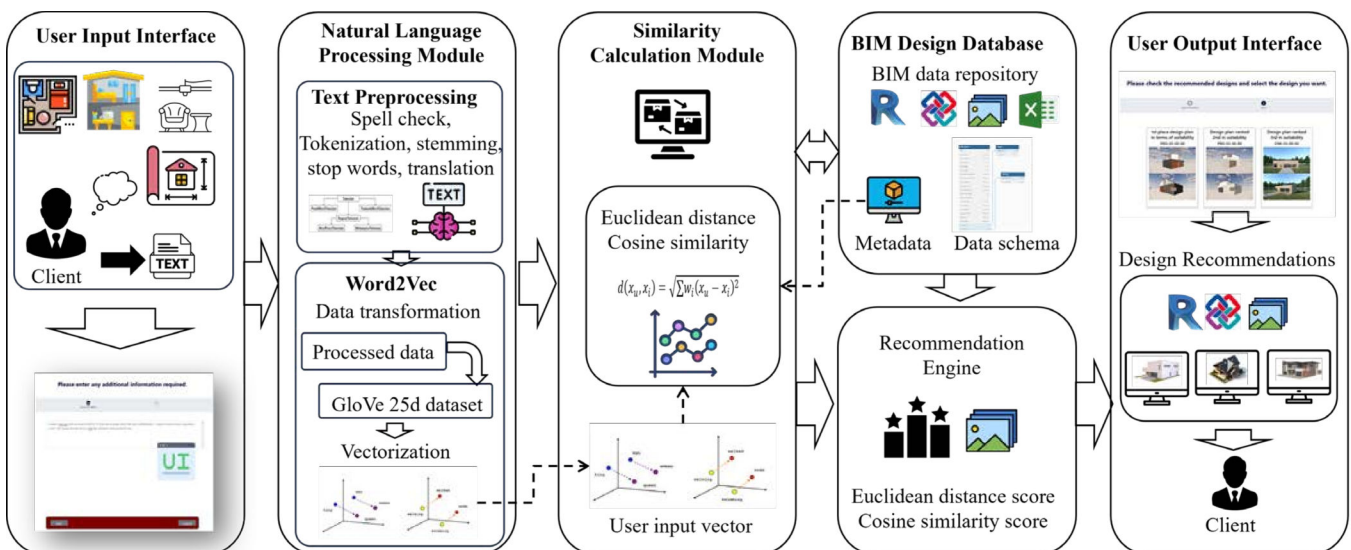


Figure 4 AI-BIM design recommendation system architecture (obtained from [1])

**Conclusion**

The synergy of AI and BIM is transforming the AEC industry by streamlining building design and enhancing client satisfaction. AI automates complex design processes, enabling real-time customization and accurate interpretation of client needs. This synergy reduces the need for iterative revisions, accelerates decision-making, and optimizes project outcomes. Case studies demonstrate that AI-BIM integration improves stakeholder collaboration and design precision, paving the way for intelligent, data-driven buildings that are optimized throughout their lifecycle. As technology advances, AI-BIM will redefine client-centric design and collaboration, making the entire building design and construction process more efficient, adaptive, and responsive to complex requirements.

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경희대학교 건축학과 황정은 교수는 지속 가능한 도시 환경 조성 및 미래 지향적 건축 설계를 목표로, 모듈러 건축, 스마트 빌딩, 서클러 스마트 도시를 연구하고 있으며, BIM과 AI 기술을 융합한 접근을 통해 이러한 분야를 발전시키는 연구를 진행하고 있습니다.

Professor Kyung Eun Hwang from the Department of Architecture at Kyung Hee University conducts research on modular construction, smart buildings, and circular smart cities, with the goal of advancing sustainable urban environments and innovative architectural design. Her work emphasizes the integration of BIM and AI technologies to develop innovative solutions for design and management in the built environment.



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