Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

STAGES OF INTERIOR DESIGN SKETCH PROJECT AND THE CAPABILITIES OF ARTIFICIAL INTELLIGENCE

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Abstract

The interior design process is divided into several stages, and at each stage, the design solution must meet technical, functional, ergonomic, aesthetic, and regulatory requirements. Traditionally, achieving these requirements relied on the knowledge and experience of designers and was a labor-intensive, manual process. This article analyzes in detail the main stages of interior design—preparatory, conceptual, sketching, visualization, and working project stages. For each stage, the technical, functional, ergonomic, aesthetic, and regulatory demands are outlined, and how artificial intelligence (AI) can support them is illustrated with real-world examples. Modern tools such as Midjourney, ChatGPT, Planner 5D, ReRoom AI, Autodesk Forma, Coohom, and Twinmotion are examined through the lens of each design stage. The analysis results are summarized in a comparative table, and the ethical and safety aspects of using AI are also discussed. The article concludes with key findings and practical recommendations for professional practice.

Keywords: Interior Design; Design Stages; Artificial Intelligence; Functional Requirements; Ergonomics; Aesthetic Solutions; Regulatory Requirements; Ethics and Safety.

1. INTRODUCTION

Interior design is a multi-stage creative and technical process aimed at organizing interior spaces in a functional, aesthetic, and safe manner to support human life and activity. At each stage, several important requirements define the quality of the design: functionality, ergonomics, aesthetics, technical adequacy, and compliance with regulatory norms. These requirements ensure that design solutions are aligned with user needs, architecturally sound, and socially safe. In traditional approaches, these stages are completed manually by the designer, which results in high labor intensity, vulnerability to human error, and reduced time efficiency. In this context, the rapid integration of artificial intelligence (AI) technologies into the interior design process not only increases productivity but also enables new creative approaches and accelerates experimentation. The aim of this article is to analyze the requirements for each stage of the interior design process, evaluate the roles AI technologies can play, compare them to traditional methods in terms of time, quality, and labor efficiency, and explore potential limitations, as well as ethical and safety concerns.

2. THEORETICAL FOUNDATIONS AND LITERATURE REVIEW

2.1 Stages of Interior Design Sketch Project and Their Methodological Basis

Numerous textbooks and academic sources emphasize that the interior design process is carried out through a systematic sequence of stages. For example, *The Interior Design Institute* (2021) outlines the process in 13 steps; however, in practice, models with 5 to 7 stages are more commonly used. These typically include: initial analysis (programming), concept development, design development (sketching), construction documentation, visualization, and implementation.

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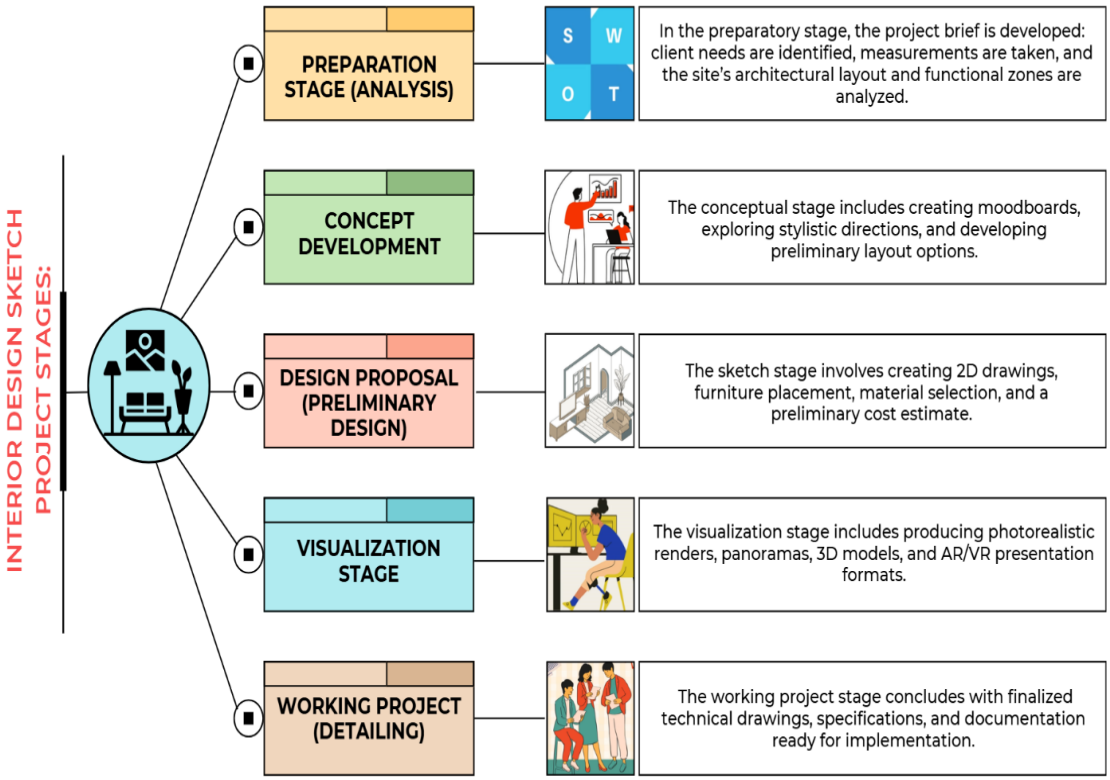

2.2 Application of Artificial Intelligence: Literature Analysis

In recent years, AI technologies have increasingly been used as support tools at each of these stages. Research shows that:

- AI tools such as ChatGPT are effective in the early stages for analyzing client needs and gathering preliminary information.
- Midjourney, Planner 5D, and ReRoom AI are used for generative design, style selection, furniture arrangement, and material compatibility.
- Twinmotion and Coohom offer high-speed, high-accuracy 3D visualization and rendering.
- Platforms like Autodesk Forma and Spacemaker AI allow for automated evaluation of plans in accordance with building codes and regulations.

According to *Nature* (2023), diffusion-model-based AI tools can generate nearly 30 interior variants in under 2 seconds. At the same time, research by *Mason & Hanger* (2022) highlights ethical and safety concerns among designers when using AI, such as incorrect spatial arrangement, copyright infringement, and cultural bias.

3. METHODOLOGY

This study uses a qualitative analysis approach to examine each stage of the interior design process and assess the potential for integration with artificial intelligence technologies. Initially, data on design stages and their associated requirements were gathered from authoritative sources, including scholarly articles, academic manuals,

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and professional practice reports. Based on this information, the requirements for each stage were categorized into five key indicators: technical, functional, ergonomic, aesthetic, and regulatory. Next, academic literature, industry reports, and practical examples of AI applications in design were analyzed. For each design stage, tasks that AI could support or automate were identified, along with specific tools and platforms that could be used.

A case study approach was also employed. Platforms such as Midjourney, Planner 5D, and Coohom were examined to understand their functions, identifying which stages and requirements they are best suited to support. Additionally, experimental AI systems referenced in academic literature (e.g., interior generation via diffusion models (Chen et al., 2024), or regulatory validation tools (Mason & Hanger, 2024)) were analyzed for their relevance to different design stages.

Based on the findings, the advantages and limitations of using AI at each stage were identified. Specific attention was paid to time and resource efficiency (productivity), the impact on design quality, potential risks (AI errors, inconsistencies), and safety considerations (e.g., data privacy, responsible use).

The results were then organized into a comparative summary table, listing for each design stage: the applicable requirements, AI support options, compatible platforms, approximate time/cost benefits, expected deliverables, potential risks, productivity gains, and safety remarks. The table was designed in a concise, bullet-point format for clarity and ease of comparison.

The final section of the article presents conclusions based on this analysis and provides recommendations for professional practice. These include general prospects and limitations for AI integration in interior design workflows, ethical and safety considerations, and suggested directions for future research in the field.

4. RESULTS AND DISCUSSION

Based on the theoretical framework and methodology described earlier, this section presents a step-by-step analysis of the tasks that artificial intelligence can perform at each stage of interior design and how these affect core design requirements. For each stage, the conventional manual procedures and required criteria are first recalled, followed by an evaluation of AI implementation opportunities, example tools, and expected outcomes.

Table 1 later summarizes this analysis, showing, for each stage and design requirement, what can be achieved with AI, which platforms are suitable, potential savings in time and cost, documentation produced, possible challenges, efficiency impact, and safety-related considerations.

Preparatory Stage (Initial Analysis)

The primary goal of the preparatory stage is to establish communication between the designer and the client, clarify project goals, and collect initial data. At this stage, the designer organizes verbal and written information received from the client and formulates a technical brief for the project.

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The design requirements at this stage can be categorized as follows:

- Functional requirement – accurately capture all of the client's needs and expectations.
- Technical requirement – precisely measure and document the object's dimensions and infrastructure (floor plans, utility layouts).
- Ergonomic requirement – identify special needs of end users (e.g., elderly, disabled) at the earliest phase.
- Aesthetic requirement – correctly interpret the client's tastes and desired style.
- Regulatory requirement – identify building code limitations (e.g., building category, capacity) early on and reflect them in documentation.

AI Applications at This Stage:

1. Client communication and needs analysis:

AI tools such as ChatGPT can serve as conversational assistants. The designer may use AI to automatically generate a structured list of client questions or extract core preferences from a free-form description. For instance, if a client writes a long paragraph about their intended use of a space, ChatGPT can summarize the key functional needs and generate a convenient briefing outline.

This reduces time and minimizes the risk of overlooking important details due to human error. However, the designer should always review the AI-generated summary and confirm it with the client, as AI may sometimes generalize or misinterpret information.

2. Measurement and site analysis:

Modern computer vision and augmented reality (AR) technologies greatly aid spatial measurement. With devices equipped with LiDAR (e.g., smartphones, tablets), apps like Canvas or RoomScan Pro can scan the interior, calculate dimensions automatically, and generate a 3D model or floor plan in minutes. These AI-based tools detect inconsistencies in measurements and notify the user.

This not only improves efficiency (eliminating the need for hand-drawn sketches) but also enhances accuracy—AI-measured deviations are typically within a few millimeters, unlike manual measurements which can vary by 1–2 cm. Nonetheless, key dimensions should still be double-checked manually for compliance purposes.

3. Floor plan generation and early zoning:

Tools like Planner 5D offer AI-driven features for quick spatial organization. After scanning the space, the model can be uploaded to Planner 5D, where the AI Floor Plan Generator suggests room divisions and basic furniture layouts based on input data (room shape, size) and planning norms (Architecture, 2024).

While detailed layout isn't required at this early phase, reviewing preliminary zoning options helps clarify the client's functional needs. AI accelerates this process and makes early-stage decision-making more visual and interactive.

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4. Ergonomic considerations:

If the space will be used by elderly or disabled individuals, the designer needs to account for this from the beginning. Standard dimensions for door widths, ramps, and furniture heights should be considered. Here, AI can act as a knowledge assistant. For example, asking ChatGPT “What are the minimum bathroom dimensions for a wheelchair user?” may yield relevant building code information or at least suggest the appropriate regulatory documents (e.g., DSN, SanPiN). This shortens the research time for the designer. However, designers must verify such information against official codes, especially when health and safety are involved.

5. Aesthetic preferences:

Understanding the client's stylistic preferences is a key challenge in early design stages. Designers typically present visual references to the client or ask the client to provide images of liked interiors. In this process, generative AI can serve as a powerful intermediary. Tools like Midjourney or Stable Diffusion can transform a client’s verbal description into conceptual visualizations. For example, describing “a modern minimalist interior with warm colors and soft lighting” to the AI can result in multiple high-quality images. These visuals help bridge the gap between abstract ideas and concrete expectations, enhancing communication and reducing misinterpretation.

onceptual Stage (Creative Concept Development)

The conceptual design stage is one of the most creative and significant phases in the interior design process. At this point, the designer develops one or more conceptual solutions for the client and presents them visually. From a functional perspective, the proposed concept must demonstrate how the space will serve its intended purpose—i.e., how the space will be zoned, the function of each zone, and how people will circulate through the space. Ergonomic requirements must be considered to ensure that the proposed layout does not result in discomfort (e.g., furniture should not obstruct key pathways, windows and doors should open freely, etc.). Aesthetic requirements are central to this stage: the concept should reflect a particular style aligned with the client's preferences, and the harmony of color and material combinations should be present. Technical constraints should also be preliminarily taken into account, including fixed wall placements, sources of natural light, and the positioning of systems such as radiators and ventilation. Regulatory compliance must be at least preliminarily verified to ensure the concept does not fundamentally violate

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legal norms—for example, proposing an open kitchen should take into account whether gas regulations permit such arrangements, or whether the number of restrooms planned for a café matches code requirements.

Artificial intelligence can play a significant role at this stage as a creative collaborator. One of its primary contributions is generative design—the ability to rapidly create creative alternatives using computational tools. Models such as Midjourney and DALL·E 2 can produce realistic interior visuals based on descriptive text prompts. For instance, a designer can request “a cozy boho-style living room with large windows and lots of plants” and receive multiple unique compositions in seconds. While these outputs may not be immediately buildable due to missing spatial data or fuzzy details, they serve as a powerful source of inspiration. Studies have shown that generative AI tools provide designers with highly diverse solution sets in a short time, enabling collaborative selection or rejection of elements together with clients (Chen et al., 2024).

As illustrated in Figure 1, although current generative models such as DALL·E 2, Midjourney, and Stable Diffusion have some technical limitations—such as incorrect proportions or implausible furniture—they are extremely effective for quickly visualizing initial ideas. Moreover, recent developments like AIDDM (Aesthetic Interior Design Diffusion Model) demonstrate that AI can handle complex interior design tasks, including 2D planning, 3D modeling, material application, and rendering—all in a few seconds (Chen et al., 2024). This enables the designer to evaluate multiple stylistic variations instantly, saving days of work and freeing up time for deeper creative focus.

In addition to image generation, designers can use AI tools for automatic layout planning. Platforms such as Planner 5D allow users to input area dimensions and room lists, then generate a customized floor plan using the AI Plan Generator. Similarly, tools like Maket.ai (similar to Autodesk Forma) can generate plan options based on spatial constraints.

These tools function as “assistive planners,” producing alternatives for the designer to compare, combine, or refine. Although these systems currently perform best on simple apartment or office layouts, research indicates that energy-aware planning (e.g., daylight optimization) is becoming feasible through AI within minutes—a process that would otherwise require multiple manual iterations (Meselhy & Almalkawi, 2025).

Although ergonomics and anthropometry are always part of concept planning, they are often handled implicitly through experience. AI can make these evaluations more precise and immediate. For example, a designer can run a quick ergonomic audit on a draft plan using AI tool—possibly integrated into BIM software—which can flag layout issues such as “distance between sofa and TV is less than 2.5 m” or “no sufficient circulation space around dining table.” Although such tools are still limited, especially in commercial software, prototypes exist. In some offices, AI agents are used to simulate human movement across open-plan offices, identifying bottlenecks in circulation (StyleNations, 2024). With machine learning and computer vision, AI can analyze spatial layouts for compliance with standard clearances—even in small apartments.

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Designers with computational skills can experiment further using environments such as Grasshopper or Rhino Inside, where simple Python scripts or AI libraries can be deployed to optimize circulation paths or accessibility layouts. While still experimental, this area is growing among designer-programmers.

In terms of aesthetics, this stage demands the most time and creativity.

AI becomes a true co-creator in this realm. Designers can:

- Use generative imagery through tools like Midjourney and Stable Diffusion to visualize their ideas, sometimes revealing unexpected details that enrich their creative thinking.
- Create moodboards and style transfers through AI integrations in tools like Canva, where a reference image can generate matching color palettes or textures (Canva, 2024).
- In the future, use text-to-3D AI to instantly generate walkable virtual models from text input. These technologies, while still evolving, promise revolutionary changes to how concepts are presented and experienced.

Despite these advantages, AI-generated visuals must be handled responsibly. First, as shown in Figure 1, generative outputs can contain unrealistic elements or stylistic mismatches. Designers must evaluate every component critically: e.g., “This shelf is too small to be functional” or “This wall pattern contradicts my intended minimalist concept.” Thus, AI suggestions should be treated as inspirational prompts, not finalized decisions. Second, authorship issues may arise since generative models are trained on internet data, which could include traces of other artists’ styles. Designers must strive to reinterpret AI outputs into original work, not directly copy visual elements. Third, managing client expectations is crucial—clients should be informed that AI visuals are concept references, not final blueprints, to avoid disappointment in later stages.

Technically, AI can also serve as an analyst and optimizer. For instance, it can quickly evaluate natural light distribution based on conceptual floor plans. Previously, such analysis required manual estimates or software-based simulations. Today, trained AI models can approximate daylighting maps, highlighting dark zones and prompting design changes. Similarly, AI can assess compatibility with infrastructure. If a concept includes a large ceiling chandelier, AI might warn, “Ceiling height is too low,” or “Gypsum board ceiling cannot support this weight.” These assessments can be generated based on prior project data and help the designer iterate smarter.

AI also supports sustainable design recommendations. It can analyze local climate data and suggest improvements: “Install sunshades on west-facing windows,” or “Use stone flooring to moderate indoor temperatures.” While designers may already know such rules, AI helps recall and quantify them quickly.

Finally, AI can assist with preliminary code compliance. For example, if the concept includes a small bathroom, AI can verify whether its proposed size (e.g., 2 m²) violates the 3 m² minimum requirement. Tools like UpCodes integrate AI to automatically scan draft plans and report issues related to exits, fire codes, or accessibility (Mason & Hanger, 2024). While AI may apply regulations rigidly, and sometimes flag acceptable

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deviations as errors, it helps avoid costly missteps by serving as an early filter. Designers should still verify results against national building codes and consult professionals.

In summary, AI at the conceptual stage transforms the designer's role from a technician to a creative director. The designer evaluates multiple options, selects the most suitable ones, and customizes them to meet project needs. As research shows, AI does not replace designers—it amplifies their creativity, enabling them to explore more in less time (Meselhy & Almalkawi, 2025). This leads to better project outcomes and greater client satisfaction.

Sketch Design Stage (Design Development and Technical Refinement)

The sketch design stage—also referred to as the design development phase—is where the selected concept is refined and developed into a more precise, buildable proposal. At this point, the designer makes numerous technical decisions concerning dimensions, materials, and infrastructure integration. The deliverables of this stage typically include 2D drawings, selected 3D views, updated material samples, and a preliminary cost estimate (bill of quantities), which are submitted for client approval before moving to the working documentation phase.

Key Requirements at This Stage:

- Technical requirements – All drawings and proposed solutions must be structurally and infrastructurally feasible within the existing building. For example, if a partition wall is added, the load-bearing capacity of the floor must be considered. If a chandelier is added, ceiling construction must support its weight. Electrical loads must match the network's capacity.
- Functional requirements – The final plan must comprehensively address the client's needs. All zones and user functions should be clearly defined and spatially accommodated.
- Ergonomic requirements – Since precise measurements are used, all dimensions and layouts must conform to ergonomic standards (distances, heights, and clearance widths must ensure comfort and accessibility).
- Aesthetic requirements – The proposed materials and colors must be confirmed through physical or digital samples. The style must be consistent in every detail (e.g., ceiling decorations must harmonize with wall finishes).
- Regulatory requirements – The sketch design should be close to the level of documentation that could be submitted for code review. Compliance with all applicable standards—fire safety, health and sanitation, construction, energy, and environmental codes—must be verified.

The Role of AI in the Sketch Design Stage

While the conceptual stage emphasizes creativity, AI's role in the sketch stage shifts toward technical automation, error checking, and optimization.

1. Automated Drawing and Modeling AI significantly enhances the drafting process. For example, Autodesk is actively developing systems based on GAN (Generative Adversarial Networks) that can transform a hand-drawn floor sketch into a clean,

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editable CAD drawing. Similarly, computer vision tools can extract 2D plans and 3D models from photographs, PDFs, or point clouds (e.g., using tools like Matterport). This allows designers to work directly from earlier scans or AI-generated models without having to redraw them manually. A scanned model from the preparatory stage can be imported into Autodesk Revit for refinement—this is part of what is now called BIM 2.0, where real-world conditions are digitized and used for direct design.

2. Generative Design for Optimization While generative design supported conceptual exploration earlier, in the sketch phase it focuses on detail-level optimization. For example, if a furniture layout has been approved, AI can help optimize lighting systems. Software like Relux or DIALux already includes AI functions that analyze room geometry and automatically recommend the number and placement of light fixtures for optimal illumination. AI bases its recommendations on vast lighting datasets, ensuring efficiency and accuracy. This allows designers to generate scientifically validated lighting schemes without manual calculations. Designers retain creative control and can override AI decisions for aesthetic reasons, but AI saves time and enhances technical precision.

3. Material Selection and Compatibility At this stage, designers choose real-world materials and products. Many large material catalogs now incorporate AI-powered recommendation systems. For example, if a designer selects a specific chair or table, AI may suggest complementary items or similar alternatives. Platforms such as Coohom and Homestyler offer AI tools that automatically populate a room with stylistically and dimensionally appropriate furnishings. While not final, these AI-based layouts serve as a strong foundation that the designer can refine.

   Similarly, AI tools can now perform automatic material switching. If a client asks to see the same room with laminate instead of ceramic flooring, AI can instantly replace textures and update the visual. This allows real-time comparison without manually recreating materials or models. Such style-transfer functions are particularly valuable for presenting multiple alternatives to clients quickly.

4. Ergonomic and Regulatory Compliance Checking At this stage, ensuring full compliance with ergonomic standards and building codes is critical. AI can function as a quality control auditor. Software like Solibri and Navisworks can already detect basic conflicts (e.g., doors clashing with windows or insufficient ceiling heights). Future versions will integrate advanced AI to detect more complex rule violations. For instance, AI can determine whether the distance between a cooktop and a dining table is less than the required 1.2 meters. AI may also flag subtle risks—e.g., placing a work zone too close to a window, which might pose a safety hazard when the window is open.

   Some prototypes have even been tested to verify universal design compliance for accessibility. In one trial, an AI tool reviewed a bathroom model and identified whether a wheelchair user could maneuver inside, highlighting problematic zones (HolonIQ, 2024). Such tools, once adopted in practice, could automatically audit a model before it is submitted for regulatory review.

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While AI does not replace human code inspectors, it significantly enhances drawing quality and completeness. According to Mason & Hanger (2024), AI can review architectural codes with up to 95% accuracy, helping prevent design errors or legal violations early on.

5. Preliminary Cost Estimation AI can also support cost estimation during the sketch phase. Manual bill-of-quantities preparation is labor-intensive, requiring designers to research market prices and calculate quantities. Tools like CostX and PlanSwift automate some of this, but AI can go further. If a designer uploads an interior model, AI can extract wall area, suggest paint types, estimate labor costs, and output a rough cost summary. It may even check online catalogs for up-to-date product prices and compile a preliminary budget.

   These cost estimates are approximate, but they provide clients with early financial orientation. Final costs will depend on bids and procurement, but AI's real-time estimates are already being tested in construction tech, where early warnings about cost overruns are seen as vital (Meselhy & Almalkawi, 2025).

Summary

In the sketch design phase, artificial intelligence serves as both a creative assistant and a technical verifier. It accelerates drawing production, offers data-driven optimization, and enables rapid variant testing.

It also helps detect design flaws and regulatory conflicts. As designers transition from concept to technical development, AI ensures precision, consistency, and efficiency—without removing the human designer from the decision-making process.

As always, the final responsibility rests with the designer. AI recommendations—no matter how advanced—must be reviewed critically, tested against standards, and interpreted creatively. When used responsibly and reflectively, AI becomes a powerful ally, not a substitute.

Visualization Stage (3D Modeling and Rendering)

The visualization stage is the final phase in the interior design process where the design solution is represented in its most realistic visual form. Its primary purpose is to present the final outcome of the project through photorealistic visuals.

At this stage, the designer (or 3D visualizer) develops a complete 3D model based on the sketch designs, applies selected materials and colors, adjusts lighting, and generates high-resolution renders. Additionally, if requested by the client or required by the project, panoramas, VR tours, and animation videos may also be produced.

The goal is to bring the design concept as close to reality as possible for checking all details and delivering a compelling presentation.

The requirements at this stage include:

- Technical: The 3D model and renders must fully correspond to the sketches and design drawings (objects must appear in their correct dimensions and positions).
- Functional: Visualization must demonstrate that the space is fully functional (e.g., if chairs are too close to walk between them, the issue must be resolved).

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- Ergonomic: The visual should allow ergonomic issues to be noticed (e.g., incorrect sink height visible in a render or uncomfortable proportions in a VR tour).
- Aesthetic: The render must be artistically impressive and clearly express the design's aesthetic intentions—color harmony, lighting, texture, and composition.
- Regulatory: As visualizations are part of project documentation, they must not contain violations of regulations (e.g., missing window guards visible in the render must be corrected).

Artificial intelligence has shown impressive advancements in this stage in recent years.

The concept of AI-generated renders has emerged, allowing designers to obtain quality interior visuals without traditional ray-tracing rendering (Chen et al., 2024). Key AI applications include:

1. Initial 3D model generation:

   Tools like Planner 5D use AI to generate 3D scenes from 2D plans, including walls and furniture layouts (Architecture, 2024). Technologies like NVIDIA's NeRF convert photos into 3D environments—especially useful for redesigning existing spaces or modeling surroundings outside the window.

2. Accelerating rendering:

   Traditional ray-tracing requires powerful hardware and hours of processing. AI-based denoisers (like those in Nvidia Iray) significantly reduce rendering time by filling in image details using trained models. This enables near real-time rendering adjustments, allowing designers to see changes instantly.

3. Text-based scene editing:

   Generative AI models (e.g., Stable Diffusion) allow textual prompts like "change wall color to green," directly modifying the render. Models like OpenAI's Point-E aim to enable full 3D space control through text or voice commands.

4. Real-time visualization:

   Tools like Twinmotion and Lumion use AI to optimize lighting and materials instantly. Unreal Engine technologies now achieve ray-tracing quality in real time using AI for global illumination (e.g., RTX DI).

5. Interactive and VR/AR experiences:

   AI improves immersive presentations through behavioral modeling, eye-tracking analysis, and real-time object interaction. For example, in AR apps like IKEA Place or Planner 5D AR, AI places 3D furniture in real-world contexts using computer vision.

6. Presentation enhancement:

   AI assists in creating beautiful portfolio layouts, writing impactful presentation texts, and generating conceptual artwork (e.g., Midjourney visuals, ChatGPT speeches), supporting designers in communication.

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Despite these advances, AI cannot replace design thinking. A well-rendered but poorly conceptualized design remains flawed.

Designers must balance realism and expectation, sometimes choosing stylized or sketch-like renders to avoid misleading clients with overly idealized visuals. AI should be an assistant, not the author of the design's essence.

In conclusion, AI is transforming the visualization phase into one of the most dynamic and expressive parts of interior design, expanding human capabilities while requiring designers to maintain critical oversight of both technical and emotional accuracy in their work.

Working Design Stage (Final Documentation Phase)

The working design stage is the final phase of the entire design process, in which the project is fully documented, and construction-ready working drawings, material specifications, estimates, and other supporting documents are prepared.

In this phase, the designer (or a team of engineer-designers) translates the agreed design solution into reality by preparing all instructions in written and graphic forms.

Working design documentation usually includes the following: full layouts (furniture and equipment placement plan, finish floor plan, electrical and lighting layouts, ceiling plans and sections, plumbing layouts, etc.); detailed enlarged component drawings (e.g., production drawings of furniture, shelf sections, cornice profiles, etc.); and all dimensions and notations.

It also includes lists and tables: wall finish schedules, door and window schedules, furniture and fixture schedules, lighting schedules, and other specification formats.

The final budget estimate is also developed at this stage, now more precise and based on actual construction prices and selected equipment quotations.

The requirements of this stage are strict and mandatory:

- Technical requirements – all drawings must correspond to existing structures and be coordinated with engineering systems (so that the project does not cause issues during construction).
- Functional requirements – the final design must fully meet the client's initial needs (everything necessary must be present and correctly represented).
- Ergonomic requirements – all specified elements must meet usability standards (e.g., furniture heights, handle positions, lighting levels must comply with norms).
- Aesthetic requirements – the final documents must fully reflect the design concept (materials, colors, and approved styles must be consistent and accurate).
- Regulatory requirements – all local building codes and standards must be strictly followed (the project must pass state or internal expert reviews without issues).

Any error at this stage can lead to construction problems, misexecution, or even legal consequences.

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Role of Artificial Intelligence at the Working Design Stage While the role of AI in this final phase may seem more limited compared to earlier stages, it still serves as a powerful tool for automation and quality control. Below are several key areas where AI can be effectively applied:

1. Automation of Document Preparation

Working documentation can span dozens of pages and drawings, both on paper and digitally, which requires significant labor. With BIM (Building Information Modeling) technologies, much of this process is already automated—drawings can be generated directly from a 3D model. AI can further enhance this by integrating into BIM platforms like Revit or ArchiCAD, using plugins to:

- Automatically add dimension lines and code labels
- Organize layers and titles
- Pull standard details from a library and adapt them
  For example, an AI can automatically generate a lighting fixture detail drawing or identify and adapt a matching component from a database using machine learning. It can also number and index items, create furniture schedules from the model, and display images and dimensions.

Microsoft's "Copilot for Autodesk" concept illustrates how a designer could simply ask, "List all doors in the project," and the AI would extract that data from Revit, generate a table, and place it in the correct layout sheet.

This greatly improves productivity. AI can even help generate alternate design variants, e.g., suggesting two material options for a ceiling finish and preparing separate drawing sets for each.

2. Normative and Quality Control

This stage demands error-free output. AI can act as an automated checker:

- It can scan all door widths to ensure compliance with a 0.8 m minimum clearance.
- It can check ceiling heights, corridor widths, and toilet clearances.
- It can even assess compound rules, e.g., "The lowest point of a chandelier must be at least 2 m above the floor" to avoid head injuries.

  AI-based tools like *UpCodes* provide such regulatory checks (Mason & Hanger, 2024), helping designers catch overlooked mistakes. They also compare drawings for internal consistency: for example, AI might detect that the ceiling height in a plan is 3.0 m while the section shows 3.2 m and flag the inconsistency.

It can also compare drawing tags to schedules—e.g., if a furniture item is labeled in the plan but not listed in the specs, AI will identify the mismatch. These checks are time-consuming for humans but effortless for AI.

3. Construction Planning Support

At this stage, the designer may also be involved in construction scheduling and cost estimation.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

AI-powered tools in project management can:

- Generate Gantt charts based on project quantities
- Estimate build time based on historical data
- Predict cost fluctuations or supply delays

If a designer uploads scope quantities and asks, “How long will this take to build?”, AI may respond with an estimate like “6 weeks” and break down the phases.

Some PropTech startups also use AI to predict delivery risks or pricing volatility.

During construction, AI can assist with author supervision. For example, AI could analyze site photos and compare them to the 3D model, spotting errors like electrical outlets installed in the wrong position.

4. User Manuals and Operation Guides

For large projects, designers may prepare operation guides for users. AI can help generate these texts.

If the designer provides project data (e.g., rooms, systems, user types), AI can use prebuilt templates to create user-friendly manuals, saving time and adding client value.

Ethical and Security Considerations

Despite its advantages, using AI in the working design stage requires caution:

- Do not rely blindly on AI. Designers must verify all outputs.
- Avoid sacrificing creativity for rule compliance. AI should support—not limit—design ideas.
- Data confidentiality must be ensured. Design documents may include proprietary or copyrighted information, and uploading them to open AI platforms (like ChatGPT) risks data leakage. Therefore, companies often deploy internal AI systems disconnected from public servers.

In conclusion, while creativity is less involved in this stage, AI's ability to handle repetitive, detail-heavy tasks makes it invaluable.

It helps ensure error-free, highly detailed project documentation, improves construction efficiency, and enhances the designer’s competitiveness by delivering fast, accurate results.

As Meselhy & Almalkawi (2025) noted, the core goal of AI in design is to optimize workflows and free humans to focus on value-added creative tasks. For interior designers, this means spending less time on paperwork and more on client collaboration and innovation.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Preparatory Stage (Initial Analysis)

Table 1: Opportunities of Artificial Intelligence Assistance

Pes of Requirements	Description of Requirements	Tasks Performable by AI	AI Platform	AI Processing Time	Time Required by Traditional Method	Free / Paid	Generated Document / Visual Output
Technical Requirements	Determining the condition of the building and rooms, communications, load-bearing walls, and energy supply.	Analyzing technical documentation, digitizing existing drawings, and creating a 3D layout.	ChatGPT, Planner5D → *ChatGPT-based chatbot; Planner 5D AI planning tool*	1 h	2-3 days	Planner5D – free (premium features are paid)	Digital plan, 3D model
Functional Requirements	Defining the number, function, and layout of rooms based on the client's needs.	Developing room programs and proposing layouts adapted to user needs.	ChatGPT, Coohom, Planner5D LiDAR scanner apps (Canvas); Matterport AI → *ChatGPT, Coohom, Planner5D LiDAR scanner applications (e.g., Canvas); Matterport AI*	1-2 h	1-2 days	Coohom – free (pro mode is paid)	Functional zoning map
Ergonomic Requirements	Ensuring necessary dimensions and distances for furniture and equipment, as well as comfortable movement paths.	Applying anthropometric standards and testing ergonomics in virtual spaces with human figures.	ChatGPT, Coohom, ChatGPT or custom design FAQ bot; anthropometry AI dataset → *ChatGPT, Coohom, ChatGPT or a dedicated design FAQ bot; anthropometric AI datasets*	0.30- 1 h	1 day	Coohom – free (pro mode is paid)	Ergonomic drawings, 3D model with human figures
Aesthetic Requirements	Selecting the initial design direction based on style, color, materials, and decorative elements.	Creating aesthetic visuals and moodboards using Midjourney, and generating design suggestions with Coohom.	Midjourney, Coohom, Midjourney, DALL·E 2; ReRoom AI; Pinterest AI → *Midjourney, Coohom, Midjourney, DALL·E 2; ReRoom AI; Pinterest AI*	1-2 h	1-2 days	Midjourney – paid, Coohom – free	Moodboard, generative images

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Regulatory Requirements	Aligning the project with construction codes, fire safety regulations, sanitation standards, and evacuation norms.	Commentary on regulatory documents, consultations based on general requirements	ChatGPT, TheArchitectsDiary, UpCodes AI (code Q&A); Mason & Hanger CodeGPT	1 hour	2 days	ChatGPT – free (GPT-4 is paid)	Regulatory compliance document

Table 2: Analysis of AI Integration and Efficiency

Types of Requirements	AI-Enabled Capabilities	Effectiveness of AI Assistance	Potential Issues	Need for Human Involvement	Time Saved with AI (%)	Platform Link |	Ethical and Safety Notes
Technical Requirements	Automatic Drawing Recognition	Rapid Assessment of Technical Condition	AI may misinterpret input	Technical specialist review required	70%	https://planner5d.com	Confidential technical data security is essential
Functional Requirements	Optimal Space Allocation	Functionality through optimized layout	Personal needs may not be fully captured	Designer refines functional program	60%	https://coohom.com	Privacy of personal data
Ergonomic Requirements	Visual Ergonomic Analysis	Identifying comfort and safety	May not always fully align with real space	Furniture layout compared with actual space	50%	https://coohom.com	Special caution for children and people with disabilities
Aesthetic Requirements	Conceptual Inspiration and Design Variants	Accelerates style selection	AI-generated images may be overly stylized	Collaboration between designer and client is essential	60%	https://midjourney.com	Avoidance of stereotypes is necessary
Regulatory Requirements	Speed of Regulatory Review and Search	Early detection of errors | Local building codes (SHNQ) may not be fully covered	Final analysis conducted by a qualified specialist	Cross-check AI output with national standards and legal frameworks	40%	https://openai.com/chatgpt	Risk of misinterpretation of regulations

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Conceptual Stage (Creative Idea Development)

Table 3: Opportunities of Artificial Intelligence Assistance

Pes of Requirements	Description of Requirements	Tasks Performable by AI	AI Platform	AI Processing Time	Time Required by Traditional Method	Free / Paid	Generated Document / Visual Output
Technical Requirements	Assessing the compatibility of the building's structural and technical condition with the concept	Receiving AI-based suggestions about the building's structure and existing utilities	ChatGPT, FloorPlanner AI Autodesk Forma (Spacemaker); ClimateStudio AI.	30 minutes	2 days	**ChatGPT – Free / Plus version available, FloorPlanner – Paid**	Technical specifications, drawings
Functional Requirements	Rational distribution of room layouts and their functional relationships	Generating functional zoning options with the help of AI	Planner 5D, Coohom Maket.ai Plan Generator; Planner 5D auto-furnish.	1 h	2-3 days	**Planner 5D** – Free / Paid version available, **Coohom** – Free / Paid version available	2D/3D plans, zoning scheme
Ergonomic Requirements	Evaluating usability: circulation paths, equipment sizes, and spatial fit	Obtaining AI recommendations and visual evaluations based on specified criteria	Coohom, ChatGPT Pathfinder AI (evakuatsiya sim); Space Syntax AI tools.	30 minutes	1-2 days	**Coohom** – Free / Paid version available, **ChatGPT** – Free	Ergonomic diagrams, list of dimensions
Aesthetic Requirements	Developing initial ideas and concepts for style, colors, and materials	Producing concept visuals via Midjourney and stylistic explanations via ChatGPT	Midjourney, ChatGPT Midjourney, Stable Diffusion (text-to-image); Adobe Firefly.	15–30 minutes	1–2 days	**Midjourney** – Paid, **ChatGPT** – Free	Moodboard, collage, style description
Regulatory Requirements	Ensuring compliance with building codes and sanitary stan	Interpreting SHNQ and SNIP codes using ChatGPT and conducting regulatory searches	ChatGPT UpCodes Sketch Check; архитектура Norm AI.	10–20 minutes	1–2 days	Free / Plus	List of regulatory requirements
Conceptual Requirements	forming the overall stylistic direction of the project concept and establishing visual identity foundations	Using AI to propose conceptual design directions and generate iterative design variations	Midjourney, DALL·E 3, ReRoom AI, Maket AI, InteriorAI	1–2 minutes	2–3 days	**Midjourney** – Paid, **ReRoom AI** – Free / Paid, **Maket AI** – Free	Conceptual collage, design direction, concept sketches

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Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Table 4: Analysis of AI Integration and Efficiency

Types of Requirements	AI-Enabled Capabilities	Effectiveness of AI Assistance	Potential Issues	Need for Human Involvement	Time Saved with AI (%)	Platform Link |	Ethical and Safety Notes
Technical Requirements	Automatic floor plan recognition, analysis of technical drawings	Faster preparation of drawings, visual representation of existing utilities	Risk of incorrect recognition of drawings	Yes, for final review and correction.	40%	"https://planner5d.com/ "https://planner5d.com	AI decisions must be verified; incorrect plans can be dangerous.
Functional Requirements	Automatic suggestions for room functions and preliminary plannin	Proper zoning and optimal planning, solutions tailored to client needs	May not fully understand the client's needs with sufficient accuracy	Yes, for adapting to user needs.	50%	"https://coohom.com/ "https://coohom.com	User privacy must be protected.
Ergonomic Requirements	Automatic calculation of ergonomic standards and recommendations based on anthropometry	Creating user-friendly spaces, ensuring ergonomic accuracy	Anthropometric data may be generalized	Yes, for on-site evaluation of ergonomic conditions.	30%	"https://planner5d.com/ "https://planner5d.com	Standards must always align with national regulations.
Aesthetic Requirements	AI-generated moodboards and conceptual collages	Rapid identification of creative ideas, comparison of visual options	Aesthetic decisions may appear artificial or not match the designer's style	Yes, stylistic decisions must be approved by the designer.	60%	"https://midjourney.com/ "https://midjourney.com	Visualizations should not promote inaccurate stereotypes.
Regulatory Requirements	AI-assisted recommendations and automated	Consideration of fire safety, sanitation,	AI may not understand local regulations or be	Yes, verification must be done by a	35%	"https://thearchitectsdiary.com/	Caution is needed when applying

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

	checks for compliance with regulations	and evacuation routes	unaware of recent updates	specialist based on regulations.		"https://thearchitectsdiary.com	regulations automatically via AI.
Conceptual Requirements	Generation of conceptual ideas based on text, including moodboards and compositional visual concepts	Accelerated development of creative concepts, clearly defined stylistic direction	Originality issues: suggestions may be generic or resemble previous works; AI-generated visuals may look overly idealized	Yes, the final proposals must be selected and justified by the designer.	60%	"https://maket.ai", "https://midjourney.com"	Visualizations may be unrealistic and lead to false perceptions. Designer review is always necessary.

Conceptual design stage (design proposal and development)

Table 5: Opportunities of Artificial Intelligence Assistance

Pes of Requirements	Description of Requirements	Tasks Performable by AI	AI Platform	AI Processing Time	Time Required by Traditional Method	Free / Paid	Generated Document / Visual Output
Technical Requirements	Bosh reja va qavat rejalari ishlab chiqish	AI yordamida avtomatik chizmalar generatsiyasi (plan, layout)	Planner 5D, RoomGPT ML CAD Converter (eskizdan AutoCAD); Revit Copilot.	5-10 daqiqa Planner5D: https://planner5d.com/	1-2 kun	To‘lovsiz (chegaralangan funksiyalar), Premium mavjud	PDF yoki PNG ko‘rinishidagi plan chizmalar
Functional Requirements	Funksional zonalarni joylashtirish	Zonalarni optimal tarzda joylashtirish uchun tavsiyalar	Coohom, ReRoom AI Unity + ML Agents; Anylogic Space Sim.	10-15 daqiqa Coohom: https://www.coohom.com/	1 kun	To‘lovsiz versiyasi mavjud, Premium imkoniyatlar pullik	Funksional zonalangan 2D va 3D maketlar
Ergonomic Requirements	Ergonomik yechimlar (mebel	AI orqali mebel o‘lchamlari va joylashuvini hisoblash	Planner 5D, Coohom Solibri + Rule-based AI; Navisworks plugin.	10 daqiqa Ergonomic AI Plugin (forum tavsiyasi)	0.5 kun	Asosiy funktsiyalar tekin, lekin eksport pullik	Ergonomik joylashuv bilan 3D

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

	joylashuvi va o‘lchamlar)						interyer modeli
Aesthetic Requirements	Fasad dizayni va 3D vizualizatsiyalar	Midjourney va Coohom orqali realistik vizualizatsiya	Midjourney, Coohom Coohom AI furnish; Amazon StyleSnap; Adobe Color AI.	5-20 daqiqa Midjourney: https://www.midjourney.com/	1-2 kun	Pullik (Midjourney), Coohomda freemium	Fasad va ichki makonning render tasvirlari
Regulatory Requirements	Normativlarga muvofiqlik tekshiruvi	ChatGPT orqali normativlar sharhi va tavsiya	ChatGPT, UpCodes (AQSh) (detailed check); Intl. Building Code AI.	3-5 daqiqa UpCodes: https://up.codes/	1 kun	ChatGPT tekin, professional huquqiy xizmat pullik	Normativ sharhlar, jadval va tavsiyalar matni

Table 6: Analysis of AI Integration and Efficiency

Types of Requirements	**AI-Enabled Capabilities**	**Effectiveness of AI Assistance**	**Potential Issues**	**Need for Human Involvement**	**Time Saved with AI (%)**	**Platform Link |**	**Ethical and Safety Notes**
Technical Requirements	Automatic generation of master plans and floor layouts based on 3D models	Planning speed and accuracy are improved, with more precise visual representations	Errors may occur due to reliance on uncertain or incomplete input data	Yes, final design decisions require human review and oversight	45	"https://planner5d.com/ "https://planner5d.com	It is essential to verify the accuracy of AI-generated design solutions
Functional Requirements	Optimization of functional zones and proposal of alternative layout options	Room layouts become more optimal, ensuring comfortable user movement	AI systems may lack sufficient understanding of human behavior and intent	Yes, customization must align with specific user needs and preferences	50	"https://coohom.com/ "https://coohom.com	Individual needs and contextual factors may be overlooked
Ergonomic Requirements	AI-based ergonomic adaptation for furniture and	Convenient circulation paths and efficient furniture	Physical comfort may not be fully accounted for	Yes, on-site ergonomic evaluation is necessary to ensure physical comfort	30	"https://planner5d.com/ "https://planner5d.com	Full reliance on AI should be avoided in critical decision-making

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

	equipment placement	placement are achieved	in real spatial environments				
Aesthetic Requirements	3D visualization, facade design alternatives, and color scheme suggestions	The project's external appearance can be evaluated more easily through visualization	Aesthetic approaches are often subjective and require individual judgment	Yes, designer validation is essential to maintain conceptual integrity	60	"https://midjourney.com/ "https://midjourney.com	Incorrect visuals or stylistic outputs may reinforce cultural or design stereotypes
Regulatory Requirements	Automated compliance checking of sketch drawings against normative standards	The likelihood of project approval increases as potential issues are identified early	Local building codes and regulations may not be integrated into the database	Yes, collaboration with technical specialists is required for feasibility and compliance	35	"https://thearchitectsdiary.com/ "https://thearchitectsdiary.com	Automatically generated code or regulation suggestions must be carefully reviewed

Visualization stage (3D modeling and rendering)

Table 7: Opportunities of Artificial Intelligence Assistance

Pes of Requirements	Description of Requirements	Tasks Performable by AI	AI Platform	AI Processing Time	Time Required by Traditional Method	Free / Paid	Generated Document / Visual Output
Technical Requirements	Development of master plan and floor plans	Automatic drawing generation using AI (plan, layout)	Planner 5D, RoomGPT NVIDIA AI Denoiser (OptiX); Stable Diffusion (image2image).	5-10 m	1-2 days	Free (with limited features), Premium available	Plans in PDF or PNG format
Functional Requirements	Placement of functional zones	Recommendations for optimal placement of zones	Coohom, ReRoom AI Unity + AI user testing; BIM Collison AI check.	10-15 m	1 day	Free version available, Premium	2D and 3D models with functional zoning

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

						features are paid	
Ergonomic Requirements	Ergonomic solutions (furniture layout and dimensions)	Calculation of furniture dimensions and layout via AI	Unreal Engine VR + AI avatars; Ergonomic VR evaluator.	10 m	0.5 day	Core functions are free, but export is paid	3D interior model with ergonomic layout
Aesthetic Requirements	Façade design and 3D visualizations	Realistic visualization through Midjourney and Coohom	Midjourney, Coohom Stable Diffusion (inpainting); Adobe Firefly (context replace).	5-20 m	1-2 days	Paid (Midjourney), Coohom offers freemium access	Rendered images of façade and interior space
Regulatory Requirements	Compliance check with regulations	Regulation commentary and recommendations via ChatGPT	ChatGPT, UpCodes (AQSh) Render AI check (Image-based code check).	3-5 m	1 day	ChatGPT is free, professional legal services are paid	Fire Safety Visualization

Table 8: Analysis of AI Integration and Efficiency

Types of Requirements	AI-Enabled Capabilities	Effectiveness of AI Assistance	Potential Issues	Need for Human Involvement	Time Saved with AI (%)	Platform Link |	Ethical and Safety Notes
Technical Requirements	Rapid 3D model creation	The spatial configuration of the project can be quickly identified	AI models may sometimes inaccurately estimate spatial dimensions	The model requires verification and correction	70–80%	"https://planner5d.com/	It is important to pay attention to engineering errors within the model
Functional Requirements	Generation of high-quality renders	Clear and precise visualizations are generated for the client	Rendered images often idealize details beyond practical realism	Certain details may need to be manually edited	60–75%	"https://www.midjourney.com/ va https:/www.d5render.com/ "https://www.midjourney.com/	Visual manipulation may occur, potentially misrepresenting actual costs

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Ergonomic Requirements	Automatic simulation of lighting and shadow conditions	Design alternatives can be explored based on day and night lighting conditions	Lighting simulations may not fully correspond to real-world conditions	Lighting parameters must be adjusted appropriately	60–70%	"https://twinmotion.com/ vahttps:/enscape3d.com/ "https://twinmotion.com/ va https://enscape3d.com/	Artificial lighting in visualizations may not reflect real-world conditions
Aesthetic Requirements	AI-based suggestions for color and material options	Aesthetic solutions can be selected with greater confidence	AI-generated design suggestions may not reflect the client's personal taste	Selected materials should be coordinated with the client	50–60%	"https://www.coohom.com/ "https://www.coohom.com/	AI may overlook differences in taste, culture, and user background
Regulatory Requirements	Creation of realistic animation	Impactful content is produced for effective project presentation	Animations and dynamic elements may lack realistic physical behavior	Editing and refinement tasks are carried out by the designer	50–65%	"https://lumion.com/ "https://lumion.com/	Renders must be protected under intellectual property and copyright laws

Detailed design stage (final documentation)

Table 9: Opportunities of Artificial Intelligence Assistance

Pes of Requirements	Description of Requirements	Tasks Performable by AI	AI Platform	AI Processing Time	Time Required by Traditional Method	Free / Paid	Generated Document / Visual Output
Technical Requirements	Develop floor, wall, ceiling, and flooring	Automatically generate 2D drawings and	ReRoom, Planner 5D, Homestyler Revit Autograph (AI	1–2 h	2–3 days	Most features available in the free version;	Floor and ceiling drawings, 3D view

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

	plans and drawings	connect them to the 3D model	dimensioning); CAD Assistant AI.			premium features are paid	
Functional Requirements	Create layouts for lighting and socket placement	Provide recommendations for optimal lighting placement	Dialux Evo, ReRoom AI BIM 360 + AI audit; Speckle AI.	30 m – 1 h	1–2 days	Core functions are free; rendering features are paid	Lighting and electrical layout
Ergonomic Requirements	Prepare plumbing and utility system diagrams	Model the layout of systems and generate drawings automatically	Autodesk Forma, MEP modeler Solibri ADA checker ruleset; HFES AI check.	1–2 h	2 days	Mostly paid on professional platforms	Utility network and wiring diagrams
Aesthetic Requirements	Illustrate occupational safety and fire prevention measures	Suggest safety signage based on regulatory documents	UpCodes AI, FireAI StyleGPT (design style check AI); Autodesk ML style analyzer.	30 m	1 day	Mostly paid under commercial licenses	Safety signage layout
Regulatory Requirements	Prepare drawings in DXF/DWG format	Export drawings and save them in standard formats	AutoCAD AI, Planner5D Export UpCodes Complete; ICC SMARTreview AI.	1 m	1–2 h	Basic export is free; DWG export may be paid in some cases	DXF/DWG files

Table 10: Analysis of AI Integration and Efficiency

Types of Requirements	AI-Enabled Capabilities	Effectiveness of AI Assistance	Potential Issues	Need for Human Involvement	Time Saved with AI (%)	Platform Link |	Ethical and Safety Notes
Technical Requirements	Automatic generation of complex floor and ceiling plans	Fast and accurate drawing preparation reduces human error.	AI-generated plans may not always comply with all regulations.	Final verification and approval by the architect.	80%	"https://planner5d.com/ "https://planner5d.com/	AI errors must be considered; human verification is always necessary.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.16750461

Functional Requirements	Simulation of lighting efficiency	Energy savings achieved through optimal lighting placement.	Lighting models may not accurately reflect real-world results.	Lighting level assessment by the engineer.	70%	https://www.dialux.com/en-GB/dialux-evo	Simulation is an approximate model; final testing is required.
Ergonomic Requirements	Optimizatio n of utility networks	Construction errors are prevented; system integration is clarified.	Network layouts may not align properly with the physical site.	On-site inspection of utility systems.	75%	"https://www.autodesk.com/solutions/bim	
Aesthetic Requirements	Interior style generation based on text prompts, automatic color palette suggestions , and moodboard generation	Style-matching options are quickly visualized, client preferences identified, and visual analysis automated.	Stereotypical images may overlook diverse cultural aesthetics and rely only on mainstream styles.	Final selection made by the designer based on client feedback and personal taste.	60%	https://up.codes/ai https://up.codes/ai	Compliance with national standards must be assessed by a human.
Regulatory Requirements	Export capability in DXF/DWG format	Export in compatible formats is fast and lossless.	Exported formats may be incompatible or have visual issues.	Final review of formats and drawings.	90%	"https://www.autodesk.com/products/autocad/overview "https://www.autodesk.com/products/autocad/overview	

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.0000000

CONCLUSION AND RECOMMENDATIONS

Conclusion. The conducted analysis shows that artificial intelligence (AI) technologies can significantly impact all stages of the interior design process. In the preparatory stage, AI helps in better understanding client needs and organizing data. In the conceptual stage, AI becomes a creative partner, assisting in generating, evaluating, and refining design ideas (Chen et al., 2024). Based on theoretically established requirements, AI tools contribute to optimizing initial solutions, identifying potential errors, and forming documentation in the sketch development stage. In the visualization stage, AI demonstrates its most powerful potential, facilitating instant generation of photorealistic images, creation of virtual environments, and testing user experience (Chen et al., 2024). In the final working design stage, AI contributes by automating quality control and documentation preparation, ensuring the design output is complete and reliable.

It must be emphasized that AI technologies only bring these benefits when used appropriately. As the analysis highlighted, AI tools still have limitations: they cannot make intuitive, context-aware decisions like designers and may sometimes provide incorrect or irrelevant suggestions (Mason & Hanger, 2024). Therefore, AI should not be viewed as a replacement for designers but rather as a tool to enhance their capabilities (Meselhy & Almalkawi, 2025). Designers must integrate AI-generated information with their own knowledge and experience, maintaining critical thinking and creative control. Especially in regulatory, legal, and safety-related decisions, final responsibility must remain with the human professional. AI can advise, but the expert must decide.

Regarding ethics and safety, several important principles must be followed when applying AI in interior design. First, **privacy**: clients' personal data (e.g., home plans, usage habits) uploaded into AI systems must be protected, ensuring it is not shared with third parties (Mason & Hanger, 2024). Second, **intellectual property rights**: since the origins of images and ideas generated through AI may be unclear, designers must ensure that final designs do not infringe on copyright or intellectual property. Third, **transparency**: if a designer adopts a solution proposed by AI, the rationale should be made clear to the client and team—for example, "we selected this solution because AI showed it had the best lighting distribution among 20 options." This builds client trust and demonstrates that AI decisions are being used responsibly (Future, 2024). Fourth, **human factor and employment**: the introduction of AI should not displace professionals like designers or visualizers but rather ease their workload. Therefore, design industry professionals must enhance their qualifications and learn to work collaboratively with AI, seeing it as a helper rather than a competitor.

Based on these points, the following recommendations are proposed:

1. **Integrate AI into design workflows**: Design studios and individual designers should gradually adopt AI tools into their processes. Start by identifying time-consuming, repetitive tasks and apply suitable AI tools. For example, automate floor plan drawing using LiDAR + Planner 5D, or speed up rendering using AI denoisers. Begin with small tasks and develop internal protocols and best practices for AI use.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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ISSN (Online):0493-2137
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Vol: 58 Issue: 08:2025
DOI: 10.5281/zenodo.0000000

2. **Enhance staff qualifications**: Designers and architects need to improve their AI literacy. This includes prompt engineering, analyzing AI-generated outputs, and comparing AI suggestions with regulations. Professional associations and training programs should include topics like "AI in Design" and organize regular workshops and seminars.
3. **Develop dedicated AI platforms**: Large interior design firms may develop internal AI assistants trained on their proprietary data instead of relying on public models like ChatGPT. These systems can provide fast recommendations and document templates tailored to the firm's design philosophy, offering a competitive advantage.
4. **Maintain balance and oversight**: Each project should have a responsible designer overseeing the integration of AI. This person should validate each AI-generated output and ensure compliance with creative and regulatory requirements. For example, if AI conducts a code compliance audit, the responsible architect must review and approve each item.
5. **Establish ethical codes and standards**: The design industry should develop professional ethical guidelines for using AI. These codes should include principles like transparency of authorship, protection of client confidentiality, and critical assessment of AI outputs. Eventually, official regulations may follow (e.g., procedures for expert review of AI-generated projects).
6. **Participate in AI development**: Designers and researchers should collaborate to develop AI tools tailored for interior design with attention to local building codes and cultural contexts. Most current AI tools are based on foreign data, so adapting them to national contexts requires designer feedback and involvement.

In conclusion, the integration of artificial intelligence in interior design processes is an innovative approach aligned with current global trends. When used responsibly and effectively, AI enhances designers' productivity, improves project quality, and offers clients new possibilities (Architecture, 2024). At the same time, designers and architects must maintain human creativity, judgment, and ethical integrity. Like any technology, AI is a means to an end—its true value lies in the human intellect and taste that guide it. Efficient and safe use of AI in interior design marks an essential step toward the future of the field, empowering professionals to perform at higher levels and achieve new creative heights.

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Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 58 Issue: 08:2025
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