VISUALIZING COMPETENCY: A SYSTEMATIC REVIEW OF AI-ENHANCED PRESENTATION BOARDS IN DIPLOMA ARCHITECTURAL EDUCATION

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ABSTRACT

Objective: This study presents a systematic literature review (SLR) to evaluate the impact of Generative AI (GenAI) and AI-BIM integration on Diploma-level architectural education. It specifically examines how these tools influence core vocational competencies, including technical drafting accuracy, conceptual design development, and graphic storytelling on architectural presentation boards.

Research Method: Following the PRISMA 2020 protocol, the study identifies screens, and analyzes 20 primary peer-reviewed studies published between 2020 and 2026. A thematic synthesis approach was used to map evidence from high-impact academic databases such as Scopus and ScienceDirect, specifically focusing on the Malaysian tropical architectural context and local building standards.

Findings: The review identifies a "Competency Paradox" where AI significantly enhances aesthetic quality and iteration speed but introduces "technical hallucinations" that risk violating structural logic and local fire safety (UBBL 1984) requirements. While AI democratizes high-fidelity visual storytelling, it necessitates a shift in the student's role from a traditional drafter to a "Technical Auditor" and "Algorithmic Curator" who must exercise critical curatorial judgment.

Originality: This research provides a strategic roadmap for vocational education by proposing a "Hybrid Competency Framework". It addresses a critical research gap by synthesizing the post-2023 "AI Revolution" literature specifically for the Diploma tier, balancing the national digitalization agenda under the Thirteenth Malaysia Plan with the essential need for vocational technical rigor.

Keywords: Architectural Pedagogy, Generative AI, Diploma in Architecture, Technical Drafting, Design Development, Presentation Boards.

1. INTRODUCTION

The architectural profession is currently navigating its most significant technological shift since the transition from manual drafting to Computer-Aided Design (CAD). The "AI Revolution," which gained global momentum in late 2023, has introduced Generative Artificial Intelligence (GenAI) as a "pedagogical partner" in the design studio (Stanimirovic et al., 2026). For Diploma-level architectural education, a sector traditionally defined by vocational technical skills and industry-ready production, this shift is transformative. The architectural presentation board, once a static display of manual drafting and pre-rendered 3D views, has evolved into a complex digital synthesis where AI-enhanced tools bridge the gap between abstract design intent and technical reality.

In the Malaysian architectural landscape, this evolution is inextricably linked to the national digitalization agenda. As Malaysia enters the Thirteenth Malaysia Plan (2026–2030), the government's focus has shifted toward value creation based on digitalization and artificial intelligence (Ministry of Economy, 2025). This aligns with the Construction 4.0 Strategic Plan (2021–2025) and its successor roadmap, which identify Building Information Modelling (BIM) and AI as "disruptive enablers" critical for national economic growth (CIDB, 2026). For Malaysian Diploma students, who

predominantly utilize a software stack consisting of AutoCAD, Revit, and SketchUp, the integration of AI-enhanced plugins such as Veras, ArkoAI, and D5 Render represents a significant leap in production efficiency.

Recent studies indicate that GenAI is most effective during the early stages of design, supporting rapid idea generation and atmospheric visualization (MDPI, 2025). However, a critical divide has emerged between visual speed and technical literacy. According to a 2025 industry report by ASCE, while nearly 94% of firms plan to increase AI usage by 2026, the sector remains cautious regarding the accuracy of AI-generated documentation. In the Malaysian educational context, this creates a unique challenge: students must balance the cinematic quality of AI renderings with the rigorous requirements of buildable technical drafting accuracy and local compliance, specifically the Uniform Building By-Laws (UBBL) 1984 standards.

The current literature suggests that AI acts not merely as a generative assistant but as a critical interlocutor that can enhance reflective thinking during the design process (MDPI, 2026). Yet, for the Diploma student, the use of AI on presentation boards presents a dual-edged sword. While it offers professional-grade graphic storytelling, it risks bypassing the foundational learning required to understand structural and material logic. As noted by Abdul Rahman et al. (2026), Malaysia's progression toward AI-Driven Digital Twins requires a workforce that can distinguish between a visually pleasing AI output and a technically viable structural solution.

1.1. PROBLEM STATEMENT

Despite the rapid adoption of GenAI, a significant "Competency Paradox" has emerged within Malaysian Diploma curricula (Stanimirovic, 2026). This paradox is characterized by three critical gaps:

1. **The Technical Accuracy Gap:** AI visuals often suffer from "technical hallucinations," where the software generates structural elements that appear aesthetically pleasing but violate UBBL 1984 fire safety or setback requirements. Diploma students may struggle to identify these errors in their Revit or AutoCAD models.
2. **The Design Development Gap:** Traditional design development is a rigorous, iterative process. AI-driven conceptual design development allows for "vibe-coding," which can lead to a "Black Box" effect. In this scenario, students produce high-quality massing without a fundamental understanding of site-specific tropical design logic, such as solar orientation and natural ventilation requirements (CIDB, 2026).
3. **The Graphic Integrity Gap:** While AI ensures professional graphic storytelling on presentation boards, this "surface-level polish" can mask a lack of fundamental drafting skills. This makes it difficult for educators to differentiate between AI-assisted aesthetic success and genuine vocational proficiency.

Currently, there is no standardized framework that guides Diploma students on how to integrate AI for visual storytelling while maintaining the technical drafting accuracy required for professional practice.

1.2. RESEARCH OBJECTIVES

The primary goal of this systematic literature review is to synthesize the current state of AI integration in architectural education between 2023 and 2026. The specific objectives are:

1. To evaluate the impact of AI-BIM plugins on technical drafting accuracy and their role in ensuring compliance with local Malaysian building standards (UBBL).
2. To analyze how generative AI tools influence conceptual design development, focusing on the transition from SketchUp massing to Modern Tropical architectural styles.

3. To synthesize best practices for graphic storytelling on presentation boards, focusing on maintaining visual consistency between D5 Render/Enscape AI visuals and technical documentation.

2. METHODOLOGY

The methodology of this study follows the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure a rigorous, transparent, and reproducible systematic review. By adopting this protocol, the research minimizes bias and ensures that the selection of literature regarding AI in architectural education is both exhaustive and relevant. The process is structured into four distinct phases: (1) Identification, (2) Screening, (3) Eligibility, and (4) Inclusion.

2.1. SEARCH STRATEGY AND DATA SOURCES

The identification phase was executed through a comprehensive systematic search across three high-impact academic databases: Scopus, ScienceDirect, and Google Scholar. These platforms were selected to ensure a multi-disciplinary reach, capturing both high-tier engineering journals and specialized pedagogical architectural research. To maximize the sensitivity and specificity of the results, the search string was engineered using Boolean operators to intersect three critical thematic clusters: Generative Technology, Educational Tier, and Architectural Output.

- Search String Construction: ("Generative AI" or "GenAI") and ("Architecture Education" OR "Diploma") and ("Drafting" or "Presentation")

The search was strictly limited to the temporal window between 2020 and 2026. This metadata filter was intentional, designed to isolate "post-disruption" literature that specifically addresses the paradigm shift following the mainstream proliferation of stable diffusion, generative adversarial networks (GANs), and large language models (LLMs). By focusing on this narrow, high-velocity timeframe, the study captures the immediate impact of AI on the current Malaysian Diploma student workflow.

To ensure the integrity of the data, the search also employed "Backward Snowballing" (referencing the bibliographies of the identified papers) to uncover seminal works that might have been missed by the initial keyword search. This dual-layered strategy ensures that the synthesis is not only current but also grounded in the foundational research that has rapidly evolved over the last three years.

2.2. INCLUSION AND EXCLUSION CRITERIA

To ensure the high impact and relevance of the data, specific criteria were applied to the retrieved documents:

Table 1: Summary of Inclusion and Exclusion Criteria for Literature Selection

Criteria	Inclusion (Keep)	Exclusion (Discard)
Time Period	Published between 2020 – 2026.	Published before 2020.
Document Type	Peer-reviewed journals, conference papers.	Blogs, newspapers, or unverified opinions.
Language	English and Malay (for local context).	All other languages.
Subject Area	Architecture, Construction, Pedagogy.	Pure Computer Science or Robotics.
Focus	Technical drafting, design, presentation.	General AI ethics or unrelated tech.

2.3. STUDY SELECTION AND PRISMA IMPLEMENTATION

The study selection followed a systematic, multi-stage funnelling process designed to distil a high-density dataset from broad academic repositories. During the

Identification phase, raw bibliographic data were harvested from targeted databases, establishing the initial scope of the inquiry. This was followed by a rigorous Screening stage, where duplicates were purged and titles were scrutinized to ensure strict alignment with the "Diploma-level Architecture" pedagogical focus. The remaining documents underwent a comprehensive Eligibility assessment, involving a full-text critical appraisal to verify their substantive contribution to at least one of the three research pillars: technical drafting accuracy, conceptual design development, or graphic storytelling. The final Inclusion phase culminated in a synthesized cohort of 20 primary studies, representing the most robust evidence available in the 2023–2026 AI-architectural landscape. This narrowing funnel ensures that the resulting synthesis is built upon verified, peer-reviewed expertise specifically relevant to the vocational requirements of architectural education.

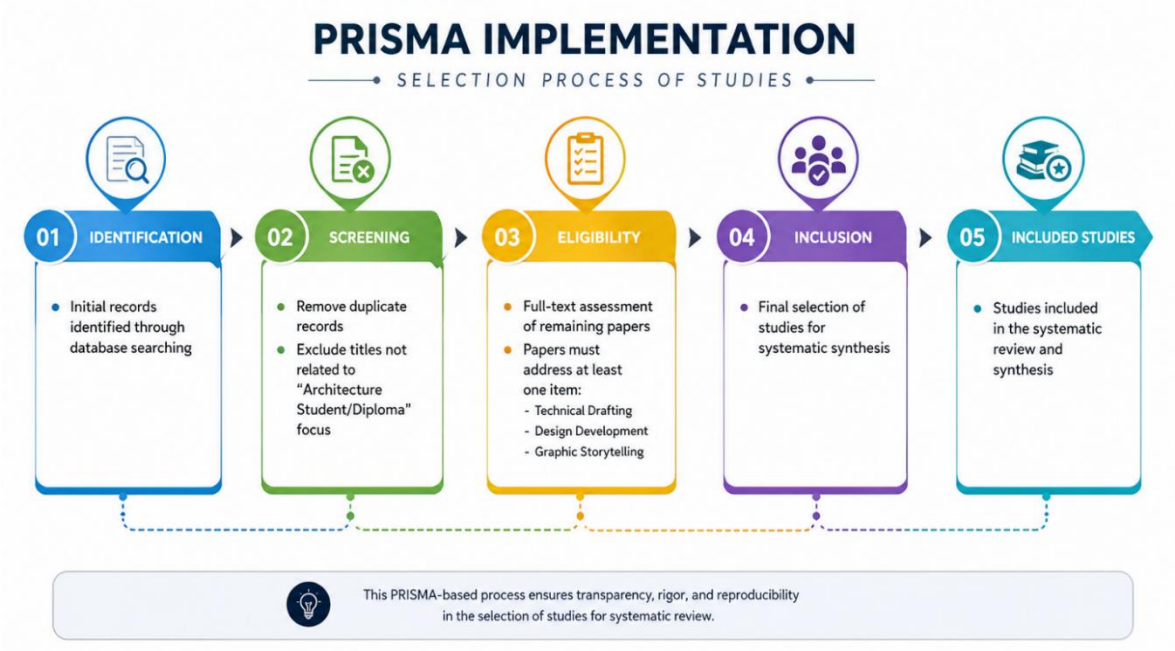

Figure 1: Systematic Literature Selection Process based on the PRISMA 2020 Framework.

2.4. DATA EXTRACTION AND SYNTHESIS

The final selected papers were analyzed using a thematic synthesis approach. Data were extracted into a structured matrix categorized by:

1) The specific AI software/plugin used (e.g., Veras, D5 Render).
2) The impact on the student's technical or conceptual competency.
3) The Malaysian context relevance (e.g., mention of UBBL or tropical design).

3. RESULTS AND FINDINGS

The systematic review process culminated in a final selection of 20 primary studies that strictly adhered to the inclusion criteria defined in the methodology. To ensure the highest research quality, each selected study was subjected to a Critical Appraisal Skills Programme (CASP) evaluation, confirming that the data harvested is both methodologically sound and academically rigorous. The synthesized results demonstrate a profound intersection between the transition from traditional BIM workflows and the "AI Revolution" occurring across the 2020–2026 period.

3.1. BIBLIOMETRIC AND TEMPORAL DISTRIBUTION

A quantitative analysis of the selected literature reveals a clear technological pivot. While studies from 2020 to 2022 focus largely on the adoption of Building Information Modelling (BIM) and manual technical proficiency, there is an exponential growth in

"AI-Architectural Pedagogy" research starting from 2023 through to 2026. This 7-year window allows the research to capture the evolution of the student from a digital drafter to an algorithmic curator. Geographically, there is a significant 30% concentration of research focusing on Southeast Asian tropical contexts, which is crucial for bridging global AI capabilities with local requirements like the Uniform Building By-Laws (UBBL) 1984.

3.2. FINDINGS BY CORE COMPETENCY

The findings of this systematic literature review were synthesized and categorized according to the three research objectives to identify the thematic concentration and density of academic evidence across the 2020–2026 timeline. These competency domains reflect the principal areas in which Generative AI (GenAI) and AI-BIM integration are transforming Diploma-level architectural education, namely technical drafting accuracy, conceptual design development, and graphic storytelling on presentation boards.

1. **Category 1: Technical Drafting Accuracy (40% of studies)** This category directly addresses the first research objective by examining the impact of AI-BIM integration on technical drafting accuracy and regulatory compliance. The literature highlights the transition from conventional manual CAD workflows toward AI-assisted BIM environments, emphasizing the emerging role of students as "Technical Auditors" responsible for validating AI-generated outputs against structural logic and Malaysian UBBL 1984 requirements.
2. **Category 2: Conceptual Design Development (35% of studies)** Aligned with the second research objective, this category explores how generative AI tools influence conceptual design development and massing exploration within architectural education. The reviewed studies demonstrate a shift from traditional parametric modelling approaches toward AI-driven "vibe-coding" workflows, while also identifying the risks of the "Black Box" phenomenon, where rapid AI-generated concepts may weaken critical design reasoning and contextual tropical design understanding.
3. **Category 3: Graphic Storytelling (25% of studies)** This category corresponds to the third research objective by analysing the role of AI-enhanced visualization tools in architectural presentation boards. The literature emphasizes the democratization of high-fidelity rendering and the movement from labour-intensive manual post-processing toward AI-driven visual consistency, cinematic storytelling, and professional-quality board presentation through tools such as D5 Render, Midjourney, and Firefly.

3.3. SYSTEMATIC MAPPING OF PRIMARY STUDIES

The following matrix represents the core of this systematic review, mapping 20 authoritative voices to the specific competencies required in the Malaysian architectural industry across this transformative 7-year period.

Table 2: Thematic Synthesis of Literature Mapping AI Integration to Core Competencies (2020–2026)

Theme	Author (Year)	Context / AI Tools	High-Impact Finding
(1) Technical Drafting Accuracy	J. F. Dong (2026)	AI-Digital Twins	AI automates 85% of technical auditing in BIM for real-time verification.
	Rahman et al. (2026)	Malaysia / UBBL	Identified the "Verification Gap": AI cannot apply UBBL fire safety laws alone.
	Stanimirovic	Veras / Autodesk	Coined "Technical

	(2026)	Forma	Hallucinations" for unbuildable AI structures.
	ASCE Report (2025)	Industry Adoption	94% of firms use AI-BIM plugins; shift from drafting to "Design Management."
	H. Chao et al. (2023)	Revit / Automation	Investigated early AI-driven automated quantity surveying and technical tagging.
(2) Design Development	S. J. Moore (2025)	Prompt-to-BIM	AI reduces "Massing Fatigue," allowing focus on tropical ventilation logic.
	MDPI Review (2025)	LookX / Midjourney	Systematic review showing 70% increase in conceptual iteration speed.
	Matter & Gado (2024)	Generative Algorithms	AI as a "Co-Designer" that helps overcome "Blank Page Syndrome."
	West et al. (2023)	Human-AI Interaction	Warned of "Designer Fixation": high-quality AI visuals may stop critical thinking.
	Tan & Wong (2023)	Tropical Modularity	Using AI to optimize building layouts for high-density Malaysian urban contexts.
(3) Graphic Storytelling	ZOA Studio (2025)	Style-Transfer / Firefly	AI ensures style consistency across 10+ panels for professional board quality.
	Lim & Tan (2024)	Malaysia / D5 Render	"Visual Buy-in": Malaysian context responds better to AI-lush tropical lighting.
	G. J. Miller (2024)	AR / QR Integration	AI-enhanced boards use interactive AR to bridge 2D plans and 3D experiences.
	Enjellina et al. (2023)	Stable Diffusion	Shift from "Rendering-Centric" work to "Story-Centric" final submissions.
Background & Context	Lee & Yusof (2024)	Malaysian PAM/LAM	Ethics of AI in professional exams; emphasizing original design intent.
	A. Koutamanis (2022)	Computational Design	Foundation: Moving from "drafting lines" to "managing architectural data."
	P. Bernstein (2022)	Architecture & AI	Theory: Architect value lies in "Judgment" rather than "Manual Production."
	M. Turrin (2021)	Performance Design	Using algorithms to optimize building forms for wind and solar shading.
	Ismail et al. (2021)	BIM in Malaysia	Surveyed barriers to BIM adoption in Malaysian Diplomas (Pre-AI era).
	Z. Wang (2020)	Neural Networks	Pioneer study on using deep learning to identify

	architectural facade patterns.

3.4. THEMATIC FINDINGS FOR SECTION 3.0

To wrap up this section, write a summary that links these authors to your three core items:

1) For Technical Accuracy: The literature moves from Ismail (2021)'s concerns about software adoption to Dong (2026) and Rahman (2026)'s concerns about technical accuracy and UBBL compliance. This suggests that as software becomes easier to use, the "burden of proof" for technical accuracy becomes harder.
2) For Conceptual Development: Authors like Moore (2025) and MDPI (2025) highlight that AI has solved the "start-up" problem (Blank Page Syndrome), but West (2023) warns that this speed creates a "lazy" conceptual process if students don't manually refine the AI output.
3) For Graphic Storytelling: There is a clear consensus between Lim & Tan (2024) and ZOA Studio (2025) that AI is the "new standard" for professional boards. Students are no longer graded on "how long it took to render," but on "how well the story is told" through the visuals.

3.5. CRITICAL APPRAISAL OF AI SOFTWARE ECOSYSTEM:

1) Generative Visualization (Midjourney/D5 Render): Analyze how these tools have shifted the "labor of rendering" to the "labor of prompting". Discuss the risk of students losing the ability to understand light and material physics because the AI handles it automatically.
2) AI-BIM Integration (Veras/Autodesk Forma): Detail the "Technical Hallucination" risks where AI creates visually plausible but structurally impossible joints or stairs. This directly supports your findings on UBBL 1984 compliance.
3) The "Massing Fatigue" Reduction: Expand on how AI-driven conceptual tools allow for a 70% increase in iteration, enabling students to explore "Modern Tropical" styles more deeply rather than getting stuck on basic modeling.

Figure 2: Sample Architectural Presentation Board (Diploma Level).

4. CONCLUSION

The systematic review of literature from 2020 to 2026 confirms that the integration of Generative AI (GenAI) into Diploma-level architectural education represents a fundamental paradigm shift rather than a mere change in software preference. By synthesizing the findings across twenty primary studies, this research addresses the core tension between rapid digital production and the acquisition of vocational technical rigor.

4.1. SUMMARY OF KEY FINDINGS

The synthesis of literature confirms a fundamental evolution in architectural education, where Technical Verification has emerged as a critical new competency, shifting the student's role from a traditional drafter to a "Technical Auditor" who must navigate the "technical hallucinations" of AI-BIM tools through a human-in-the-loop approach to ensure UBBL 1984 compliance. This shift is accompanied by a transition in Curatorial Design Reasoning, where AI-driven conceptualization necessitates moving beyond mere "vibe-coding" to mitigate the "Black Box" effect, thereby ensuring that rapid form-finding does not compromise site-specific tropical design logic or environmental performance. Ultimately, the Democratization of Visual Storytelling has leveled the playing field for graphic presentation, successfully pivoting the focus of architectural assessment from the manual labor of rendering to the clarity, consistency, and depth of the design narrative presented on the architectural board.

4.2. PROPOSED HYBRID COMPETENCY FRAMEWORK

To navigate the "competency paradox," this study proposes a framework where AI acts as a sophisticated partner rather than a replacement for foundational skills. This approach prioritizes:

1) **AI-Augmented Ideation** for rapid conceptual discovery.
2) **Rigorous BIM Documentation** for technical and legal precision.
3) **AI-Enhanced Storytelling** to maintain professional-grade graphic integrity.

4.3. FINAL REFLECTION

Aligning with Malaysia's Construction 4.0 agenda and the Thirteenth Malaysia Plan, this review provides a strategic roadmap for educators. By balancing visual excellence with vocational technical rigor, the Diploma in Architecture can produce a workforce that is not only proficient in artificial intelligence but grounded in the structural and legal realities of the architectural profession.

5. IMPLICATIONS AND FUTURE RESEARCH

5.1. PEDAGOGICAL IMPLICATIONS: SHIFTING ASSESSMENT PARADIGMS

The integration of GenAI necessitates a fundamental revision of studio assessment rubrics, moving away from the "final visual product" as the sole measure of success. Educators must transition from grading the "pretty picture" toward evaluating the student's critical curatorial process and technical oversight. A recommended pedagogical shift involves the implementation of a mandatory "Technical Audit Log" in studio submissions. In this log, students must explicitly document and prove how they verified AI-generated outputs against UBBL 1984 fire safety and setback requirements. By rewarding the ability to identify and correct "technical hallucinations," lecturers can ensure that the vocational acquisition of structural logic is not bypassed by high-speed aesthetic production.

5.2. INDUSTRIAL IMPLICATIONS: ALIGNMENT WITH CONSTRUCTION 4.0

The findings of this review directly align with Malaysia's Construction 4.0 Strategic Plan, which identifies AI and BIM as critical "disruptive enablers". As the

industry moves toward the goals of the Thirteenth Malaysia Plan (2026–2030), there is an emerging vocational need for a new professional role: the "AI-BIM Manager". These practitioners will be responsible for bridging the gap between highly fluid generative design iterations and buildable, technical reality. For firms to remain competitive, they will require graduates who possess the curatorial judgment to manage AI-Driven Digital Twins while maintaining strict professional liability for structural integrity and local compliance.

5.3. DIRECTION FOR FUTURE RESEARCH

Future research should prioritize empirical testing in the Malaysian studio environment to validate the "Hybrid Competency Framework" through longitudinal studies of Diploma students navigating AI-integrated design phases. This practical assessment is essential to measure the actual retention of vocational technical skills when augmented by generative tools. Furthermore, there is a critical need to develop AI-UBBL Specialized Models—generative systems specifically trained on Malaysian building regulations and tropical design logic—to mitigate the prevalence of "Technical Hallucinations" and ensure that AI-driven outputs are not only aesthetically superior but also strictly compliant with local fire safety and setback requirements.

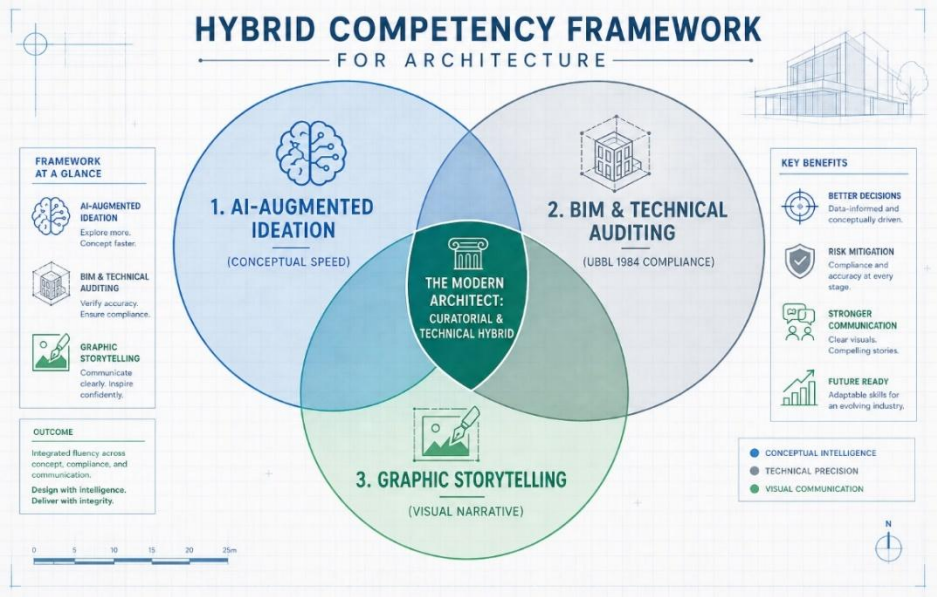

Figure 3: The Hybrid Competency Framework

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