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A Strategic Framework for Transforming the Construction Industry via Large Language Models

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Abstract

Although the broader construction sector is experiencing rapid digital growth, specific domains, such as construction's organizational operations, still rely on manual workflows, leading to operational inefficiencies, communication gaps, and delayed project timelines. To address these challenges, this study develops an applied strategic framework for integrating Large Language Models (LLMs), such as ChatGPT, Google's Gemini, and DeepSeek AI, to revolutionize core organizational operations. Using McKinsey's 7S framework for organizational diagnosis, the research identified critical performance gaps in document management, interdepartmental communication and on-site decision-making. To bridge these gaps, the proposed framework established five key LLM-driven initiatives. Key findings

indicate that the strategic implementation of these AI tools can reduce document preparation time by up to 50% and lower operational rework costs by at least 25%. Furthermore, the study formulated targeted Key Performance Indicators (KPIs) and a comprehensive risk mitigation strategy. The risk assessment highlights that strict data encryption protocols and mandatory human-in-the-loop validation are essential to counteract potential AI inaccuracies and successfully overcome employee resistance to change. Ultimately, this evidence-based framework equips infrastructure providers with the strategies needed to successfully transition from traditional, manual workflows to smart, AI-driven, highly productive operations.

Keywords: Large Language Models, Construction industry, Strategic transformation

1. Introduction

The modern era's quickly changing digital economy is putting more pressure on companies in every industry to restructure, enhance operations and efficiency and meet the demands of their growing client base. Digital transformation has become a necessity, not an option, in the current era. New technologies like artificial intelligence (AI) are gaining importance, driving corporate structures to evolve in ways never imagined before. The most innovative AI technologies are Large Language Models (LLMs) such as the ChatGPT OpenAI, Google's Gemini and DeepSeek AI, which are well known for their high accuracy in natural language processing, creation and comprehension. According to a study by Hadi et al. (2024), one type of artificial intelligence (AI) that has become a potent tool for a variety of applications, such as question answering, machine translation, and natural language processing (NLP), is large language models (LLMs). These approaches are currently transforming data management, decision-making, and communication with employees and clients in companies today. However, the construction industry has not yet fully adopted these technologies, which has delayed their widespread adoption (Kampelopoulos et al., 2025). At this point, the construction industry is at a crucial growth stage, with the 5G rollout and digital connectivity driving demand for professional, high-speed wireless networks. For this seamless growth to take place, the construction sector must maintain the pace of providing adequate infrastructure for network transmission. However, some infrastructure providers still depend on and run their businesses through manual processes, isolated departments and systems, and old-school reporting methods. Most of these inefficiencies contribute to poor communication among employees, resource waste, underutilization of human capabilities, and delays in project completion. The standard requirements of the construction industry are directly proportional to the capabilities that LLMs offer (Kampelopoulos et al., 2025). From preparing daily site reports to conducting safety audits, answering technical questions from engineers and site technical officers, and assisting in preparing safety documents such as the risk assessment, LLMs could assist with completing these tasks. This allows employees to work more efficiently and make better decisions with fewer complications. To automate repetitive procedures, boost employee morale, and improve the organization's business performance, this paper presents a comprehensive business plan for integrating LLM technologies into the organization's core operations. Assessing the organization's present performance gaps and readiness will be the first step in the transformation process described

above. Next, a clear vision and strategic goals will be established. After that, it will offer specific LLM-based solutions, followed by an implementation strategy, success metrics, and a risk mitigation plan to overcome the digital challenges faced by the construction industry. This paper aims to:

a) Assess the industry readiness and identify gaps in its current performance and the latest developments in LLMs.

b) Propose key initiatives and create success metrics for LLMs transformation.

c) Design a risk and mitigation plan to address various implementation challenges.

1.1 Background and Knowledge Gap

In the construction industry, some operational activities are done manually. The employees utilize the department's server, which serves as a repository for various documents, including technical survey reports, as-built documents, construction and as-built drawings, and all site handover documents. All employees can access this to find the designated file location, which is sorted by project. Hence, searching for past documents or construction drawings on the server is a manual process, time-consuming, and reduces work efficiency, as it requires proper searching to locate the desired files. Besides, the construction industry has a couple of working structures: a project and administration team based at the headquarters, and an implementation team, including site engineers, technical officers, and safety officers, located at their respective project sites. With two different cultures within the organization, it is crucial to maintain communication within the project. As of now, the site team updates HQ on any site-related issues or progress via phone calls, emails, and weekly meetings. This can cause certain delays in delivering the right information at the soonest time.

As for site activities, various petty works need to be done, such as creating daily site reports for all activities, requesting inspection forms (RFIs), and preparing daily safety reports to ensure that the safety and well-being of workers receive consistent priority. It is petty when it must be done daily. Daily efficiency could be hindered by the need to handle these workloads, which can be simplified. Other than that, for projects such as in-building system installations and rooftop and outdoor base station installations, there are several requirements from the building management before granting site access. Hence, documents such as method of statement, risk assessment, and loading calculations forms need to be designed and prepared according to site conditions, which also takes time. In addition to site activities, the contracts department prepares the bill of quantities (BOQ) manually for every installation work awarded to a subcontractor. The in-depth knowledge and awareness of the availability and use of AI are considered below average within the construction industry. This is due to a higher percentage of elderly employees still serving for the construction companies. As AI is increasingly introduced to younger generations, they are said to be more tech-savvy. Another issue is the lack of digital-related training, which provides wider exposure to all generations working in construction companies. Therefore, a gap analysis is needed.

To accurately identify these operational inefficiencies, the gap analysis was conducted through a comprehensive review of the organization's existing workflows. This involved

direct observation of inter-departmental communication channels between the headquarters and on-site teams, as well as an audit of the current manual document management procedures and server structures. Furthermore, an informal assessment of workforce digital literacy and demographic readiness was performed to pinpoint specific barriers to technology adoption. The findings from this observational analysis are summarized in Table 1.

Table 1. Gap Analysis of the Current Operation in Construction Industries

Performance Area	**Identified Gaps**
Document storage and management	Project related document is stored in the department server. There are plenty of folders and no proper management on which document is essential and supplementary making it difficult to find past documents.
Communication and coordination	Project progress and site activities updates are being delivered via phone calls and weekly meetings causing information miss out and delays in delivering important issues and updates hence creates dissatisfaction among stakeholders.
Document preparation	Plenty of repetitive documentations are being prepared on daily basis which might cause other works to be slowed down and affect daily efficiencies.
AI knowledge awareness	Bigger portion of employees are not aware of the existence of AI and its usage due to coming from the older generation who is less bothered on the latest technology.
Decision-making support	Some engineers and technical officers were hesitant to make decisions at sites due to lack of solution that is to be obtained from the corporate office despite receiving the approved design and technical proposal.

1.2 Vision and Research Objectives

A vision statement is an organization's plan for its future and aims to achieve the desired state in the long term. This vision will guide an organization in ensuring that the actions taken to achieve the dream are in the right direction. Therefore, the vision statement is crucial for digital transformation. The proposed vision for the construction industry would be *"To transform the construction company into a smart infrastructure provider by leveraging Large Language Models (LLMs) to automate operations, empower employees and provide faster and smarter solutions".* The word "smart" refers to the fact that the company has brought in digitalization to their business and become AI-driven in completing the daily tasks and making decisions. "Infrastructure provider" refers to the construction company's main business. Automating operations means avoiding repetitive documentation tasks; empowering employees means providing support for engineers and technical officers through LLMs; and delivering faster, smarter solutions means enhancing project deployment speed and intelligence.

Based on the identified industry gaps, the authors of this study have drafted several key objectives to execute the digital transformation plan and achieve the overarching vision. The proposed research objectives are:

1. To automate documentation processes and storage management using LLMs.

With involvement in daily document storage and preparation, the company plans to reduce employee burdens by automating repetitive documentation and enabling easy identification of required files.

2. To enhance decision-making from the office to the site in project deployment

Introduce AI chatbots to help engineers, technical officers, and even management with access to technical queries, method of statement, and safety regulations, ensuring better decisions are taken to increase work productivity.

3. To improve communication between employees and stakeholders

Fill the communication gap even faster and more systematically than before to avoid misunderstandings and dissatisfaction among stakeholders and increase workflow efficiency.

4. To improve regulatory compliance and the quality of the produced documents

Generate, review, and verify compliance documents, such as local council approvals, safety audits, and contractor work orders, using LLMs to reduce human error and associated risks.

5. To create an innovative culture within the workplace through the adoption of AI

Creating an internal cloud or server for employees to practice operational activities and integrating LLMs in an isolated, safe environment can encourage digitalization among employees.

2. Literature Review

The large language model (LLM) is a relatively new subfield of artificial intelligence that aligns with the Industrial Revolution 4.0. Advanced artificial intelligence systems, known as Large Language Models (LLMs), can comprehend and produce text that communicates coherently and generalize across a variety of activities (Naveed et al., 2023). This LLM has been integrated across manufacturing, human resources, e-commerce, education, and healthcare. However, the construction industry largely failed to follow the revolution. In actuality, the construction industry is among the least digitalized in the world, and most stakeholders recognize the long-standing culture of resistance to change (Young et al., 2021). ChatGPT, Google's Gemini, and China-owned DeepSeek AI are examples of AI models currently in the market and in use by millions of users. These three main models can assist in several domains in the construction industry, as shown in Table 2.

Table 2. LLM Models and Their Key Strengths for the Construction Industry

LLM model	Strengths	Potential usage in the Construction Industry
ChatGPT	• Generates good technical documents • Good in providing answers for technical queries • Provides justification and good summaries for understanding	• Able to generate technical proposals and summary of project progress • Provide instant answers to engineers and technical officer's queries at site
Gemini	• Understands in multi modes (text, image and voice) • Integrated with other Google tools and information • Good in providing proper reasoning on long documents	• Can provide project planning and project schedules • Can analyze documents like method of statement • Can integrate with Google Workspace for better productivity
DeepSeek	• High transparency and customizable • Good in reporting and provide comprehensive long context document • Have vision-language model	• Can generate site inspection reports with images of site

Construction companies can gain several advantages by integrating LLMs into their daily operations. This could include daily document preparation and creating a better communication bridge between management and the project team to update all necessary project-related information and to address all queries raised by the site team during the deployment period. As evidence, a study by Zhang et al. (2025) reports that LLM-powered solutions for supply-chain insights, contract review, risk assessment, and project scheduling accelerate decision-making and reduce manual review time.

3. Methodology

3.1 Organizational Diagnostic Model and McKinsey's 7S Framework

An organizational diagnostic model is a framework designed to assess and understand a company's ongoing problem or situation, identify the main causes and propose solutions. In this business transformation plan, McKinsey's 7S framework is used to diagnose a construction company. McKinsey's 7S model, a method for examining an organization's internal components holistically, enables diagnosing internal organizational issues and developing a solution strategy (Suwanda & Nugroho, 2022). The seven components that make up this model are divided into two categories: soft components, which include management styles, shared values, staff, and skills, and hard components, which include strategy, structures, and systems (Demir & Kocaoglu, 2019). Table 3 presents the 7S elements used to analyze the company, based on current observations or situations within the organization, and the possible solutions that can be implemented through digital transformation using LLMs.

Table 3. McKinsey's 7S Framework Analysis

Elements	Current situation	Possible solutions
Strategy	The operations of the company are still done in the conventional method where they put their focus on saving costs, chasing timelines and prioritize project deployment efficiency. As of now, integration of AI is not included as part of its business plan.	➢ Introduce and implement a detailed digital transformation plan that involves the usage of LLMs to better optimize their operational activities such as documentation, communication within teams and employee's assistance. ➢ Ensure LLM initiatives and project deliverables do not intersect and cause disruption.
Structure	The company has an organized hierarchical structure where the management team, contracts team, HR and the admins are based in HQ while the implementation team which consists of engineers, safety team and technical officers are based at site according to projects. Hence the communication and delivery of information is slow and based on weekly meetings.	➢ Introduce LLM integrated platforms such as AI chatbots to allow simplified and smart Q&A processes to take place during crucial situations. ➢ Introduce AI integrated document sharing assistant which can fill up communication gaps within project team and increases frequency and accuracy of delivering updates and progress daily.
Systems	Most of the company operating systems are manual. Documentation such as daily site reports, RFIs, safety related documents and access permit letters and contracts' BOQ documents are prepared from scratch. As for the document searching, it is also done manually in main servers which causes time wastage.	➢ Create automation for all repetitive tasks such as generate and draft documentations and fill up BOQs to save time. ➢ Introduce LLM integrated servers to perform document searching and retrieval to reduce time spent on looking for one.
Skills	Employees are rich in technical knowledge let it be theoretical or on-site hands-on works. However, the interest and competency on AI related tools are average. Young engineers are open to try and adapt to the technology but lack of exposure and training to upskill themselves.	➢ Integration of LLMs can act as a smart assistant by providing real-time solutions, summarizing long-text documents and generating installation and testing checklists to align with engineering competency. Expose employees to digital awareness training where LLMs are exposed and taught to improve employees' digital literacy.
Staff	As for the generations of employees, the company is well known for its high retention rate. This means there are number long serving employees who are considered from the older generation who may be resistant in transforming from the traditional system. Junior employees depend highly on their seniors for decisions and guidance being at site despite having approved designs and proposals due to lack of self-confidence.	➢ Introduce an internal cloud for the older generation to practice integrating LLM with their daily working activities to establish the digital mindset. Introduce LLMs as virtual mentor to support junior engineers in providing reference and guidance to be more independent at work.
Style	The company possess good leadership skills among the seniors of the company in terms of passing of knowledge and managing projects from design till handover. However, they prefer not to take risk in operations when it comes to digitalization.	Nurture a leadership culture that encourages operational experiments which involve the integration of AI by applying LLM in mini tasks or projects as a pioneer to plant a winning mindset even in digital transformation.
Share Values	The company brings good values to the table such as quality and quantity in terms of project completion but not much from the innovation as it is quite lacking as part of the values.	Improve existing core values with better development in terms of efficient project delivery time, document automation and adding smart minds as a new value to the organization.

Source: Waterman, R. H., Peters, T. J., & Phillips, J. R. (1980) and Demir, E., & Kocaoglu, B. (2019).

4. Results

4.1 Key Focus Areas

The in-depth analysis of the diagnostic model identifies five key focus areas where Large Language Models (LLMs) can be implemented to benefit the company's growth. These areas are selected not only because they exhibit operational inefficiencies, but also because LLM capabilities can be demonstrated and serve as an eye-opener for other businesses in the construction industry. Table 4 displays the key focus areas for LLM-integrated transformation.

Table 4. Key Focus Areas for LLM-Integrated Transformation

Key Focus Area	Transformation Objectives	LLM-Based Solution	Expected Impacts
On-site decision making within project teams	To strengthen the confidence in junior engineers and technical officers to quickly act with proper guidance.	LLM virtual assistants or mentor to give instant solutions related to technical queries and design clarifications	Dependency on senior engineers can be reduced, and work efficiency can be increased.
Automation and management of document	To reduce delays in preparation of document, to ease searching of document.	LLM-based tools to auto generate documents using accurate prompts by text or voice and LLM-integrated tool to easily locate documents with providing key words or the content of the file.	Administration time can be reduced and work reporting made easier.
Communication between site, HQ and clients	To improve visibility of project progress and site activity updates and information delivery between parties.	LLM-based platforms like dashboard to summarize daily progress and generate site activity descriptions	To increase the engagement within teams, increase trust of customers and reduced miscommunications between teams.
Compliance based documents	Produce quality document with integrity for safety, regulatory and clients	LLM based tools to review and verify documents to ensure documents prepared with compliance	Resubmissions of documents can be reduced, can be better ready for safety audits and fasten any permit or handover processes.
Development in digitalization within employees	To establish an innovative mindset, ready to take risks and adaptation of AI technology	Form an internal AI server for employee training and non-failure AI trials and exposure to the success of LLM integration to gain employee trust	Improved involvement in AI tools, employee confidence can be increased and ability to break through the traditional culture.

Source: Kampelopoulos, D., Tsanousa, A., Vrochidis, S., & Kompatsiaris, I. (2025)

4.2 Key Initiatives of LLM Integration in Operations

After identifying the key focus areas that need extra attention, several key initiatives are designed to integrate LLM solutions within the organization. These initiatives align directly with the transformation objectives listed in Table 4, and the goal is to achieve them to continue building a successful transformational plan for the company.

4.2.1 LLM-Integrated Virtual Site Assistant

This AI-based site assistant is a mobile-friendly chatbot with LLMs pre-trained and integrated into the system. Large datasets of technical details, such as material specifications, technical proposals, and as-built documents from past projects, are being trained and integrated into the application. Site engineers and technical officers, who are mostly site-bound, will heavily use this app to clarify queries such as installation methods, design concerns, and rectification ideas on their mobile phones. The chatbot receives queries and can provide detailed responses based on the training data. The impact of this AI chatbot is that the solution reduces the delay caused by the uncertainty of the decision to be made while waiting for upper management to deliver. Moreover, it builds confidence among newcomers and junior employees to take on decision-making responsibilities. As for the evidence, a study by Handler et al. (2024) reports that LLMs assist with various tasks, such as gathering information, exploring options, and making decisions, thereby enabling more brainstorming and improved information interpretation.

4.2.2 AI-Integrated Document Generating & Locating Engine

This document-generation engine is an LLM-integrated engine that automatically generates daily-use documentation at both the office and site levels. These documents are daily site reports, technical proposals, request for inspection (RFI) forms, permit letters and contractual documents such as tender documents and BOQs. These documents can be automated by using a human's voice or text as prompts to tune the engine. As a result, the engine automatically generates structured, organized Word documents that can be further amended, or the engine can be requested to regenerate them accordingly. By using this document engine, the operations team can aim to reduce the time spent preparing this document by at least 50% compared to its usual time. Moreover, it might reduce any human errors previously made by employees. Indirectly, it tends to free up engineers' time and allow them to focus more on design.

On the other hand, the locating engine finds and locates documents stored on the server. It just needs prompts such as keywords or content from a document being searched, and this engine will locate the file in the shortest time, directly saving employees' time. Feng et al. (2024) reported that integrating LLMs enhances document retrieval effectiveness in businesses. However, it is crucial to note that the effectiveness of these generated documents relies heavily on the quality of user prompting. Because any AI application is only as good as its prompting, employees will be trained to use specific, context-rich prompts to ensure the LLM generates accurate and relevant construction documents.

4.2.3 AI-based Smart Dashboard

As site progress is updated once per week, and miscommunication occurs between the site team and the management team that is not on-site, this causes real chaos among stakeholders. Therefore, an AI-based smart dashboard is planned to be introduced to address several communication issues. This AI-based solution has been experimented with and proven successful in a study made by Safejack (2024) when Safejack, a real-time AI dashboard, was

introduced for construction management, where it provides the stakeholders with daily updates on information like site progress, safety matters and workforce used, and this eventually led to better communication and decision making. This dashboard can be used by all parties involved in the projects by simply uploading brief progress updates for any deliverables. The LLMs integrated into the dashboard will analyze the input and send daily updates and information for all stakeholders' notification. Integration of this dashboard will eventually bring transparency among stakeholders about the current situation for each project and increase reporting efficiency, so clients do not have to wait days or weeks to know what is happening at base station deployments.

4.2.4 AI-Integrated Document Validating Engine

While creating a document via AI implementation is beneficial and important for operational efficiency, ensuring the resulting document is valid and complies with all required regulations is equally important. Since the company is an organization that puts 100% effort into ensuring all construction projects are completed with proper legal documents and in compliance with all construction standards, enhancing this process with an LLM will bring significant benefits. This LLM-based validation tool automatically reviews documents and verifies their validity and compliance with third-party requirements, including external auditors, Occupational Safety and Health (OSH), local councils, infrastructure owners, and building management. For example, the input data is the completed contractor work order, and the output data is a marked-up document highlighting missing compliance parameters. Document controllers must upload a completed form or document to this engine, and the engine can mark errors, highlight any important information, and note any missing portions. With this validation, the submission and approval rates of a particular document can be accelerated, directly improving the quality of the submission. There will be fewer rooms for resubmitting documents due to incomplete information or amendments resulting from human error.

4.2.5 LLM-based Training Hub and Development

Any introduction or implementation of a foreign item requires sufficient awareness and adequate training to allow someone to become familiar with it. As mentioned throughout the transformational plan, the company has an average level of knowledge regarding AI and its digitalization. Therefore, introducing an LLM-based training hub and development is the right move to overcome this challenge. Apart from theoretical training that employees may attend to achieve their annual KPIs or for self-learning, the construction industry always teaches the hard way through hands-on applications. This training hub is an internal platform designed to be staff-friendly, allowing employees to practice various LLM tools available on the market. This can be done by uploading inputs such as sample reports or site photos, along with appropriate prompts, to show them that the desired output is just a keyboard away. In fact, younger generations can assist older generations who are hesitant to try these tools, as they fear that failures can cost the company. Fortunately, this internal server is purely for trial-and-error, allowing employees to try and see success in achieving the desired outcome. This platform accelerates exposure among employees with low digital literacy and helps

build confidence in applying AI-integrated solutions in their daily work. Indirectly, this initiative will also break the chain of the conventional operating method and give it a new face via LLM-based solutions.

5. Discussion

5.1 Formation of Success Metrics

The implementation of LLM tools will be tracked and measured according to key performance indicators (KPIs). These success metrics will ensure that the implemented LLM tools deliver value to the business transformation. Each metric will be aligned with the business transformational goals. The KPIs were structured into five categories and developed by the current authors: operational efficiency, customer satisfaction, employee productivity, AI innovation and learning, and financial performance.

5.1.1 Operational Efficiency

The impact and effectiveness of LLM integration into operations are evaluated through KPIs, as LLM tools automate document preparation and reduce time spent on preparation and submission. Table 5 displays the KPIs for operational efficiency.

Table 5. KPIs for Operational Efficiency

Metrics	Method of measurement	Target to achieve KPIs
Average time taken to generate documents	Track the time taken to generate documents by observing timestamps at the history logs	Reduce at least 30-40 minutes per report generation from manual process
Number of documents generated	Track the number of documents generated by observing the engine's usage logs	At least 70% of documents are auto generated through LLM tool
Time taken to approve submitted documents	Compare time taken to approve documents now and during manual preparation	At least 30% of waiting time for approval status is reduced

Source: Feng, J., Tao, C., Geng, X., Shen, T., Xu, C., Long, G., Zhao, D., & Jiang, D. (2024).

5.1.2 Customer Satisfaction

Customer satisfaction is a key factor in establishing a strong company image, even during tough times during project deployment. With the integration of LLM tools, this category is evaluated based on the performance of the LLM integration in the business, which will affect customer perception and satisfaction. Table 6 exhibits the KPIs for customer satisfaction.

Table 6. KPIs for Customer Satisfaction

Metrics	Method of measurement	Target to achieve KPIs
Client's level of satisfaction towards project progress	Conduct customer feedback surveys once every 3 months and once every completion of project	At least 70-80% of satisfaction score to be received
Number of missed out and delayed project progress updates	Observe the notifications received from the AI dashboard and track late-report submissions through submission portal	Zero updates to be missed and no reports to be submitted late
Accuracy of site activities progress reports	Compare actual site data received with the quality audit of site activity summaries made by LLM tool	At least 90% of similarity between actual site data and LLM generated summary

Source: Kampelopoulos, D., Tsanousa, A., Vrochidis, S., & Kompatsiaris, I. (2025).

5.1.3 Employee Productivity

Next, employee productivity will be measured as a success metric based on changes or increases observed after the implementation of LLM tools. Employee productivity is highly important, as employees are seen as the company's assets and represent its quality in the industry. Table 7 indicates the KPIs for employee productivity.

Table 7. KPIs for Employee Productivity

Metrics	Method of measurement	Target to achieve KPIs
Time saved per engineer on performing administration tasks	Compare time taken for an engineer to do administration works now and during the manual processes.	At least 3-4 hours of time saving per week for an engineer.
Rate of technical queries raised	Observe the number of emails or WhatsApp chats on technical concerns raised to the seniors.	At least 30% of repeating technical queries are reduced
Satisfaction of employees with LLM tool usage	Conduct a LLM tool performance and feedback survey every month	At least 70-80% of satisfaction score to be received

Source: Kampelopoulos, D., Tsanousa, A., Vrochidis, S., & Kompatsiaris, I. (2025).

5.1.4 Innovation and AI learning

In this metrics evaluation, the development of employees' awareness of digitalization and the effort they put into learning and adapting to the newly implemented LLM system are emphasized. The most important thing is that they must start taking risks by changing their work style from the conventional method to going full swing in the digital mode. Table 8 shows the KPIs for innovation and AI learning.

Table 8. KPIs for Innovation and AI Learning

Metrics	Method of measurement	Target to achieve KPIs
Number of employees trained to use LLM tools	Track the record for training attendance and obtain data from list of certificates provided	At least 80% of the involved employees have been LLM tool trained.
Frequency of internal server usage for training	Observe the number of users logging in to the built internal server and track them	At least 50-60 users logging in per week
Proposal of use-case ideas and prompts	Track the number of new use-case ideas and prompts submitted by employees through the feedback and suggestion form	At least 8-10 feasible ideas to improvise are being shared in a month

Source: Sufian, M., & Khan, R. N. (2025).

5.1.5 Financial Performance

Financial performance is considered one of the most crucial KPIs to monitor and evaluate closely. These metrics are used to observe cost savings and, at the same time, to increase the company's profitability, as the LLM integration is designed to improve return on investment (ROI). Table 9 displays the KPIs for finance performance.

Table 9. KPIs for Financial Performance

Metrics	Method of measurement	Target to achieve KPIs
Cost savings from reducing the administration workload	Calculate multiplication of amount paid for an employee per hour with the hours saved from work extension	At least 15% of costs being saved from previous record in labour.
Return on investment from faster project completion	Perform a cost-benefit analysis by using reduced holding time and the amount of money invested for the LLM integration	A break-even in ROI to be observed within one year
Reduced in costs for any rework related activities	Perform a quality audit on rework situations that occurred and calculate the difference in cost between now and during manual processes	At least 25% of cost and frequency of reworks to be reduced

Source: Kampelopoulos, D., Tsanousa, A., Vrochidis, S., & Kompatsiaris, I. (2025).

5.2 Risk Assessment and Mitigation Plan

It is a known fact that the modern era of digitalization brings multiple opportunities knocking at the doors of various businesses. As much as digitalization brings positive impacts and benefits to people and businesses, it also carries potential risks that could affect a company’s overall productivity, profitability, and reputation. To mitigate the risks posed by the newly implemented LLM, several mitigation plans can be implemented. Table 10 summarizes the risk assessment and mitigation plan.

Table 10. Risk Assessment and Mitigation Plan

Potential risks	Impact of the risk	Likelihood	Mitigation plans
Some highly sensitive project related data might be leaked if the built LLM is connected to an unprotected server	This event may cause breach of data privacy and security of information like the contracts of the project and legal issues	Medium	➢ Connect the built LLM to a secured LLM platform or server which has high security like encryption, control of access and comply to certifications like ISO 27001 ISMS ➢ Conduct regular cybersecurity related audits (internal and external) to ensure a responsible usage of LLM tool ➢ Allow access to certain highly restricted sensitive inputs or prompts certain roles of that department to avoid misuse
LLM tool may respond to certain queries or information incorrectly if the prompt provided is too general or not appropriate	Inaccurate technical specifications or safety related documents can cause issues in terms of operations, safety and compliance from local council	Medium	➢ Practice to allow senior engineer, senior technical officer or safety officer to review and acknowledge the LLM generated document before proceeding for site deployments or submissions ➢ Provide training to involved employees on identifying possible incorrect responses and ways to verify an AI-generated content ➢ Request AI transformation team to form libraries of verified prompts that can be used for employee usage to avoid future misuse of prompts
Employees may have high dependency on LLM tools and eventually the problem-solving skills on their own starts to fade	This over reliance may disrupt employees' critical thinking and use LLM tool to provide answers and not verifying or understanding the information by themselves	Low	➢ Ensure enough awareness on the real role of these LLM tools, as they are considered as supporting tools only and not decision maker ➢ Ensure to use the prompts with more practical mindset by asking to follow up questions to keep verifying the correct information ➢ Provide clear guidelines for the usage of AI on when can rely on LLM tool and when to consult certified personnel
Senior employees may avoid themselves from using the integrated LLM tools	Employees might avoid using the tools due to the fear of the growth of AI that they feel threatened of their placement in the company and feels they are undervalued for what they are capable of and what they been doing all this while	Medium	➢ Conduct AI usage awareness campaign and mention the relevance of the LLM based tools is not to replace human at all ➢ Use success trials that had been created during second phase of implementation to show the expected benefits to those resisting employees ➢ Give good appraisal and recognition in public to those employees have adopted using LLM tools in their daily work life to develop the new normal in the company.

Senior and older employees may find it difficult to learn the new age technology and may lack inconsistency in using the LLM tools	Lack of digital knowledge and readiness within employees might reduce the adaptation rate of AI in the department and they might start depending on the younger employees to help them solve tasks which uses LLM tools	High	➢ Assign AI Cloud team to provide LLM training in levels like beginner, intermediate and pro to allocate focus levels on those need more attention in learning the tools ➢ Introduce an AI helpdesk with the help of IT department to allow employees to seek for any help or guidance related to LLM tools usage

Source: Sufian, M., & Khan, R. N. (2025).

6. Conclusion

The strategic integration of Large Language Models (LLMs), such as ChatGPT, Google's Gemini, and DeepSeek AI, offers a viable pathway for the construction industry to transition from deeply rooted manual workflows to optimized, AI-assisted operations. Implementing targeted AI initiatives, particularly automated document generation and virtual site assistants, fundamentally enhances inter-departmental communication, resource allocation, and on-site decision-making. However, the successful adoption of these generative technologies necessitates rigorous risk mitigation strategies, including strict data security protocols, human-in-the-loop validation of technical outputs, and ongoing digital literacy training to prevent over-reliance. While this study establishes a foundational operational framework constrained primarily to specific infrastructure contexts, future empirical research should quantify the actualized return on investment and broader productivity gains across diverse construction disciplines. Ultimately, prioritizing robust governance alongside technological integration equips construction firms with the critical agility required to remain competitive and productive in an increasingly digitalized economy.

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Author contributions

Vikneswaran Ramasubramaniam was responsible for conducting the study and collecting information. Ong Choon Hee drafted the manuscript, Tan Owee Kowang checked it, and Lim Kim Yew revised it. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Obtained.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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