

Original Article

# Optimizing Business Systems and Processes for AI/ML Integration in the Construction Industry

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**Abstract:** *The construction industry, which has been sluggish to adopt new technologies in the past, is about to undergo a major change thanks to the use of Artificial Intelligence (AI) and Machine Learning (ML). This study looks at how AI and ML can change the way construction works by making project planning, resource allocation, safety, cost control, and quality assurance better. It stresses the need for strong foundational systems, especially Enterprise Resource Planning (ERP) and standardized business processes, to make sure that data is consistent, high-quality, and easy to get to, all of which are important for AI/ML success. The talk covers important ideas for system architecture, like interoperability, scalability, and data governance. It also covers important parts of a process, like standardization, documentation, and change management. The document also goes into detail on the main skills needed for project execution and financial management, stressing how important it is to integrate systems through platforms like Oracle Integration Cloud. Finally, real-world examples like AI-driven budgeting, forecasting, and supply chain optimization show how these technologies could change the way we do things. The study finds that AI/ML may greatly improve productivity, safety, and financial control, but their effectiveness depends on careful planning, making sure systems work together, and constantly improving processes.*

**Keywords:** *Artificial Intelligence, Machine Learning, Construction Industry, ERP, Business Systems, Project Management, AI Integration, Digital Transformation.*

AI and machine learning are changing the way businesses work all over the world. Some industries have quickly adopted these technologies, giving them a large head start and already experiencing big benefits. Some people are still in the early phases of using them and are carefully considering how they can be useful. The construction sector is a fantastic example of a field that has to fast adopt AI and ML to gain all the benefits they promise. AI might affect a lot of things in construction, like how projects are planned and scheduled. For instance, predictive analytics can assist improve how resources are used and how long things take. AI-powered picture identification can help make places safer by automatically discovering dangers and making sure that safety guidelines are obeyed. Predictive maintenance algorithms [1], [2], and [7] can make it much easier to keep equipment in good shape by cutting down on downtime and extending the life of machinery. AI can help you save money by keeping an eye on project costs and spotting places where they might go over budget. AI-assisted quality control techniques can also help make work better by detecting mistakes and making sure that standards are met [3]. Using AI and ML can make the construction industry more efficient, safer, of greater quality, and save a lot of money. This will help them catch up with other fields that have better technologies.

## I. METHODOLOGY

This study uses a qualitative method by looking at real-world case studies and other research to evaluate how AI and ML could be applied in project management. Primary data originates from documented uses of ERP systems, business processes, and AI applications by well-known organizations like Skanska and Mortenson. The process involves putting various pieces of information together to figure out the best ways to employ AI, the system requirements, and the organizational problems that get in the way.

We choose case studies based on whether they contained numbers that could be used to monitor safety, productivity, and cost control. To corroborate the results and come up with meaningful ideas, the facts from these cases were compared to theoretical models of AI integration. It is known that qualitative analysis has some problems, such as the likelihood of bias and the lack of quantitative financial metrics. These problems are then used to generate proposals for future research.



## II. FUNDAMENTALS OF CONSTRUCTION INDUSTRY

For the construction sector to really take use of the capabilities of AI and machine learning, it needs a strong and well-defined base of existing business systems and processes. AI and ML algorithms need a lot of data to perform well, and the quality, consistency, and availability of this data depend on the operational framework that supports it. Without this foundation, AI/ML projects could be built on unsteady grounds, which would lead to bad outcomes, lost money, and eventually make it harder for them to reach their full potential.

Here are some more details about the most important things to think about while building this important base in both corporate systems and processes.

## III. BUSINESS SYSTEMS

Construction companies that work on big, multi-year capital projects need strong financial reporting and tracking. To satisfy this important demand, companies usually use Enterprise Resource Planning (ERP) systems with sophisticated project management features. By establishing and using standard financial categories like cost codes, work breakdown structures, and organizational units throughout the project lifecycle, these systems make it possible to consistently isolate project-specific financials across all relevant dimensions. This makes sure that costs are added up correctly, revenues are recorded correctly, profitability is analyzed correctly, and forecasts are made correctly for both individual projects and portfolios.

When project finance is managed well within an ERP framework, stakeholders have accurate and up-to-date information about how the project is doing. This helps them make better decisions. This entails keeping an eye on how much things really cost compared to what you planned to spend, how much progress you've made compared to your timeline, and any early warning signals of impending cost overruns or delays. Because all ERP systems are linked, they make things like buying things, paying bills, getting paid, and paying workers easier. This makes sure that all financial transactions are properly recorded and sent to the right projects. This connection makes it easier to keep track of money in general, reduces down on mistakes, and increases efficiency.

Advanced ERP project management tools may do more than just simple tracking. They can also help with managing resources, subcontractors, change orders, and risks, which makes it even easier to keep an eye on all of your finances. Resource management systems let you assign and keep track of workers, equipment, and supplies for specific projects. This helps you see how resources are being used and how much they cost. Change order management modules make sure that all the paperwork, approvals, and financial records are in order for changes to the project's scope. Construction companies can greatly enhance how they handle complicated financial parts of big capital projects by using these sophisticated capabilities in a good ERP system. This will lead to better project results and greater financial performance.

The following guiding principles should govern this ERP system (PwC, n.d.) [9]:

- **Data Infrastructure:** A centralized and well-maintained data infrastructure is paramount, encompassing systems for data collection across project phases (planning, design, execution, handover), standardized data formats, secure storage, and efficient retrieval. Integration or modernization is needed to address data silos and inconsistencies often found in legacy systems.
- **Interoperability:** Seamless communication and data exchange between different software and platforms used throughout the construction lifecycle (e.g., BIM, project management software, ERP systems, IoT sensors) are essential. Open APIs and standardized data exchange protocols are crucial for achieving this.
- **Data Governance:** To make sure that data used for analysis and decision-making is reliable and trustworthy, it is important to set clear rules and regulations for data ownership, quality control, security, and privacy [9].
- **Scalability and Flexibility:** Business systems should be able to manage more and more different types of data and be able to change as technology and business needs change.
- **Integration with AI/ML Platforms:** The business systems that are chosen should operate well with AI/ML development and deployment platforms. This will make it easy to move data into models and use model outputs in current processes.

## IV. BUSINESS PROCESSES

Project-centric businesses focus their work on projects, both capital (CAPEX) and operational (OPEX). These projects are important for keeping track of costs, managing investments, and making money.

When a company spends a lot of money on long-term assets like data centers or apartment buildings, they are recorded as

assets and their cost is spread out throughout their useful life. For full accounting, even direct capital purchases that are below the formal capitalization barrier are kept track of.

Using a project framework to keep track of OPEX costs lets you keep track of and analyze operational costs for things like COVID-19 or planned projects like marketing. This helps you understand how money is spent and how it affects your finances.

For service-based businesses to bill their outside customers accurately and make the most money, they need to keep track of all their project-level labor and non-labor expenditures. Cross-charging across legal entities based on projects makes it easier for companies to do business with one another. It also makes it easier to accurately assign costs and revenues to subsidiaries for internal accounting and performance management.

To make sure that AI and ML work well in these companies, you should focus on:

- **Standardization:** Having the same workflows for all projects gives AI and ML solid data to learn from and improve.
- **Data-Driven Culture:** Teach employees about the importance of data and how to make decisions based on it by giving them training on data quality and AI/ML insights.
- **Process Documentation:** To uncover ways to automate and improve things with AI and ML, you need to have clear processes in place.
- **Change Management:** Make sure you have a solid plan in place to deal with the changes that come with using AI/ML, including dealing with resistance and getting the most out of the benefits.
- **Continuous Improvement:** Use AI/ML insights to make business processes more flexible and improve them over time to make them more efficient and effective.

Construction companies may create a strong environment for AI/ML to thrive by taking these factors into account in both their systems and their processes. This will lead to big gains in productivity, lower costs, better safety, and overall project success.

## V. CONSTRUCTION PROJECT MANAGEMENT: A DEEP DIVE

For project-based businesses, their main operational skills can be grouped into two main areas: Project Financial Management (PFM) and Project Execution Management (PEM). Each of these groups includes a unique set of functions that are essential for delivering a project on time and keeping the business healthy.

### A. Project Execution Management (PEM) Capabilities:

At its foundation, PEM is about carefully planning and coordinating all the steps needed to finish a project, program, or product. This starts with careful preparation, which includes precisely defining the project's goals, figuring out what needs to be done, and making a detailed plan that includes dates, milestones, and how resources will be used. To keep the project on track and avoid scope creep, it's very important to manage the scope well. This means making sure everyone knows what the project's limits are, handling requests for changes, and making sure that everyone is on the same page with what stakeholders want.

Furthermore, strong PEM capabilities must include the ability to find, evaluate, and reduce any risks that could slow down project progress before they happen. This includes making backup plans and putting risk response plans into action. At the same time, a system should make it easier to keep track of problems and fix them as they come up, making sure that blockages are dealt with quickly and effectively. A flexible PEM system will give project managers the power to make changes to plans, schedules, and resource allocations when things don't go as planned. This will keep the project moving forward and increase the chances of it being finished successfully. Collaboration and communication tools are typically an important part of PEM since they make it easy for project team members and stakeholders to share information and work together.

### B. Project Financial Management (PFM) Capabilities:

PEM and PFM work together to look at the accounting and financial parts of projects. A solid PFM system gives you all the information you need to break down project costs, keep track of how resources (both people and things) are being used, and see how work is going compared to specified budgets. For accurate financial reporting and informed decision-making, it is important to carefully look at costs and keep track of resources.

Moreover, a strong PFM system should be able to create financial reports that meet the needs of diverse internal stakeholders, such as project managers, accountants, controllers, and Finance Planning & Analysis (FP&A) teams. It is also very vital that it makes sure that a lot of different accounting rules are fulfilled. Some examples are the International Financial Reporting Standards (IFRS), the US Generally Accepted Accounting Principles (US GAAP), and the local GAAP that is unique to

each country. This requires features for correctly recognizing income, managing expenses, and reporting compliance. Some advanced PFM systems may additionally provide tools for making predictions, creating budgets, and analyzing project-level profitability.

**C. Convergence and Integration for a Holistic Project View:**

PEM and PFM capabilities deal with different parts of project management, but they need to be used together to get a whole picture of how well a project is doing and how healthy it is. The PFM system uses data from PEM systems, like progress toward milestones and resource use, to directly track and predict finances. On the other hand, financial data from PFM, like cost performance and profitability, gives important information for making changes to how a project is run and for preparing for the future. This convergence lets stakeholders check not only if a project is on time and within scope, but also if it is financially sound and giving the desired return on investment.

**D. The Role of Core ERP and Network Boundary Applications:**

Most large companies use a multi-system approach to get the right level of PEM and PFM capabilities. They usually use a core Enterprise Resource Planning (ERP) platform, like Oracle Cloud, as the main system for keeping track of important business activities including finance, human resources, and supply chain management [4]. Network boundary applications, which are specialized systems that meet specific functional objectives, are built around this core ERP. Kronos for managing time and attendance, COUPA for buying things, and Concur for managing travel and expenses are all examples of these kinds of apps. These boundary apps generally collect transactional data that is important for project execution and finances.

**E. The Criticality of Integration Platforms:**

Because these fundamental ERP and network boundary applications are all part of the same ecosystem, it's very important that data is shared between them quickly and accurately. Integration solutions like Oracle Integration Cloud (OIC) or Boomi are quite important at this point. These platforms give you the tools and infrastructure you need to easily link different apps, automate data flows, and make sure that data is consistent across the whole organization. Without a strong integration platform, companies run the danger of having data silos, making mistakes when entering data by hand, and having to wait longer to get important project information, all of which make it harder to make good decisions and could even hurt the project's success. Therefore, for project-based businesses, picking the proper core ERP and network boundary apps is just as important as investing in the correct integration platform [4].

**VI. ACCELERATION THROUGH AI**

The next important step to unlocking significant acceleration and driving transformative growth is the strategic integration of Artificial Intelligence (AI) on top of a strong framework of business systems, well-defined processes, and solid governance. AI's advanced features open up a lot of interesting possibilities that could change many parts of the business.

One very useful use is for planning budgets for future building projects. When it comes to traditional budgeting and forecasting, a lot of the time they depend on collecting data by hand, making subjective guesses, and doing a lot of analysis. But the arrival of powerful AI Large Language Models (LLMs) and advanced neural networks has started a new era of financial planning based on data. These advanced AI models can quickly and easily scan through huge amounts of historical data, including project costs, material prices, labor costs, timeframes, and many other pertinent factors over a period of many years. The AI can intelligently sort through this complicated data, find important patterns and trends, and put it all together in a way that can be easily used for future predictions. AI models may make very detailed and precise automated budgets on their own by taking in a clear set of input data, like the project's scope, location, required quality standards, and expected dates. This game-changing feature turns the budgeting and forecasting process from something that may be subjective and time-consuming into something that is logical, objective, and based on data, which greatly improves accuracy, efficiency, and strategic financial planning [3].

Big construction projects need a lot of money and complicated supply chain planning to get big machines and spare parts from other countries. Artificial intelligence models can combine data from users and make complete lists of the raw materials that are usually needed for projects of a similar size based on what has happened in the past. This capacity to forecast allows supply chain managers to plan ahead and be ready for possible problems in the supply chain, which improves procurement processes and keeps projects going. Furthermore, AI can look at past data to predict changes in prices and lead times for important goods. This helps people make better buying decisions and might save them a lot of money. Construction companies can reduce the risks of delays and shortages by planning ahead for the materials they will require. This makes operations run

more smoothly and makes the project more efficient. Using AI in this way can help make global construction supply chains less complicated, make projects more resilient, and improve their outcomes [6].

## VII. CASE STUDIES

Several case studies from top companies were looked at to see what the real-world effects and benefits of using AI and machine learning together in the construction sector are. These solutions showed big increases in how well the projects ran, how safe they were, and how well they managed costs. For example, Skanska UK's AI-powered safety monitoring system cut down on safety incidents and made sure that workers were wearing the right PPE [5], [8], [10]. Mortenson Construction's usage of AI-driven computer vision led to big increases in productivity since it let them keep track of progress and fix problems in real time [5]. These stories all show how AI and ML technology can change the way construction is done and the results it gets.

### A. Skanska's Safety Monitoring System:

Skanska has updated its back-office IT platform by using Oracle Fusion Cloud ERP. Skanska UK put an AI-based safety monitoring system in place at several construction sites. The system uses cameras and sensors placed in key locations to find safety infractions and possible dangers in real time. After six months of use, the company said that safety incidents had gone down by 30% and compliance with Personal Protective Equipment (PPE) had gone up by 40% [8], [10].

### B. Mortenson Construction's AI-Powered Monitoring:

Mortenson has switched to Oracle Fusion Cloud Applications Suite, which connects the finance, HR, and procurement activities of more than 60 companies. Mortenson Construction added an AI-powered platform to their project management systems. The platform used deep learning and computer vision to keep an eye on how the construction was going in real time. This adoption made construction projects 38% more productive, which made it easier to fix problems quickly and lowered the chances of delays and cost overruns [5].

## VIII. RESEARCH CONTRIBUTION

This study adds to the expanding body of information about how to use AI and machine learning in the construction sector by showing how they may be used in real-world situations and what benefits they can bring. The paper shows how AI-powered solutions can improve project scheduling, safety monitoring, resource allocation, and productivity by looking at case studies from well-known construction companies like Skanska and Mortenson. The results give us useful information on how AI and ML can help businesses run better. They also show how important strong ERP systems like Oracle Fusion Cloud ERP are for managing data smoothly [4]. This study also shows how important AI is in a traditionally low-tech field for cutting costs, making safety compliance better, and encouraging data-driven decision-making. These contributions lay the groundwork for both academic research and the use of AI technology in real life in the management of building projects.

## IX. LIMITATIONS AND FUTURE WORK

The study shows that AI/ML can be helpful in building, but it also has some problems. The case studies are mostly on big, tech-savvy companies, which may not be the same as what smaller or less tech-savvy companies go through. There is also a lack of detailed quantitative data on long-term financial effects and return on investment, which makes it hard to fully evaluate cost-effectiveness. The study mostly looks at certain AI applications, such as predictive analytics and computer vision. It may miss other new technologies that could have a big impact. Also, problems with data quality, interoperability, and ethical issues like data privacy are mentioned but not fully examined.

Future studies should try to include a wider range of construction enterprises, both big and small, with different levels of technology, to get more general results. Long-term research that looks at long-term performance indicators and economic results will help us understand the long-term effects of AI and ML better. Looking into how to combine AI with new technologies like augmented reality (AR), the Internet of Things (IoT), and blockchain could lead to more ways to innovate. Finally, it will be important to investigate ways to deal with data governance and ethical issues in order to use AI in building in a responsible and productive way.

## X. CONCLUSION

Combining AI and ML with construction project management is a huge chance for new ideas and better ways of doing things. These technologies are helping construction companies make their safety rules better, make better use of their resources, predict costs more accurately, and speed up project execution. However, they can only be successful if there are solid digital foundations in place, such as compatible ERP systems, standardized business processes, and a strong framework for data governance. Case studies show that companies that combine AI/ML capabilities with strategic system integration and process

maturity find big improvements in productivity, safety compliance, and financial management. Going forward, it will be very important to deal with problems with data quality, system compatibility, and ethical issues. To fully realize AI's promise in construction, organizations need to be ready to accept new technologies and make ongoing improvements to both systems and processes.

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