

# Revolutionizing Mega Energy Projects with AI Artificial Intelligence

Hassan Alanzi

Program & Projects Professional Unconventional Resources Development

**Abstract-** Artificial Intelligence (AI) is reshaping how projects are planned and delivered. Across industries, and especially in Energy mega projects, AI augments human judgment with predictive analytics, natural language processing, and optimization. In oil and gas, projects often span multiple years, involve global supply chains, and face volatile market conditions. AI enables earlier risk detection, improved cost control, and more accurate forecasting, all critical for large scale capital projects.

**Keywords:** Artificial Intelligence (AI), Energy mega projects, Predictive analytics, Natural language processing, Optimization.

## I. INTRODUCTION

Energy projects operate under extreme complexity, interfaces & overlap: tight deadlines, safety-critical operations, and exposure to geopolitical and commodity market volatility. Traditional project management tools struggle to process the volume of data generated from sensors, contractors, and financial systems. AI systems can learn from historical project performance, monitor real-time execution data, and surface recommendations that help projects sail with known problems and other issues arise during execution and closure (Chen et al., 2019).

## II. AI by the Triple Constraint

Constraint	Representative AI Capabilities	Outcomes
Scope	NLP for requirements quality; automated change impact analysis; duplicate/ambiguity detection.	Automated review of engineering drawings and contracts; early detection of scope creep in EPC phases
Schedule	Predictive task slippage; Monte Carlo schedule risk; dynamic resource leveling.	Forecasting drilling delays; pipeline installation sequencing; optimizing offshore rig schedules.

Cost	Cost anomaly detection; demand forecasting; procurement price intelligence.	AI-driven cost forecasting for materials (steel, pipes, compressors); vendor invoice anomaly detection.
------	---	---

## III. EXAMPLES OF AI UTILIZATION

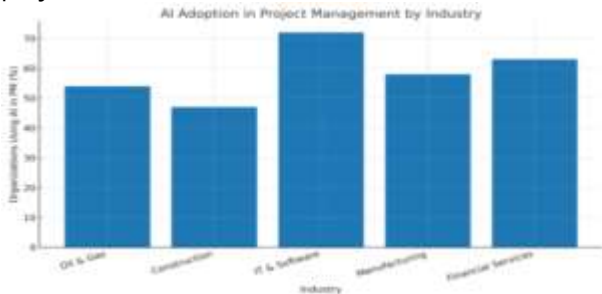
An Energy company implemented an AI-powered project management system to manage mega projects covering several systems and disciplines in electrical, mechanical, IT, digital, fire systems and many other types of projects with tangible and nontangible value. Such projects used machine learning algorithms to analyze project data, predict potential risks, and provide recommendations for mitigation. This is in part of having established documents of lessons learned from previous projects and organized depository system under projects controls.

### Results:

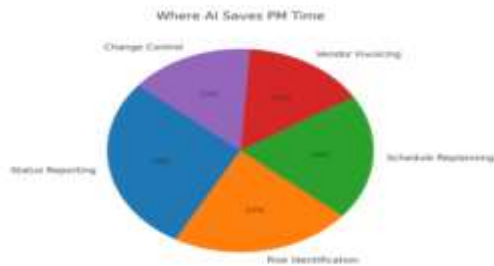
- **Scope Management:** AI helped reduce scope creep by 10%, resulting in a minimum 15% cost savings and in addition to cost avoidance of continuous technology update and attempts to add to the projects frozen scope.
- **Schedule Management:** AI-powered schedule optimization reduced project duration by 12%, resulting in a 10-12 % cost savings from budgeted projects reserved funds.

- **Cost Management:** AI-powered cost monitoring and prediction reduced cost overruns by 10%, resulting in overall schedule index and project optimization of 10-12%

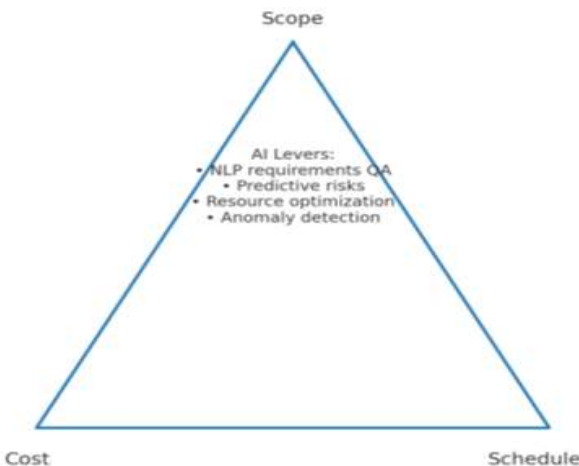
The following figures use illustrative, summarized average data to demonstrate typical effect sizes observed by early AI adopters in project management. Actual outcomes will vary by organization, data maturity, and change management in addition to the value scales of the projects.



AI Adoption in Different Sectors Project Management



Time Saved Distribution in Energy Projects Management



**Implementation Roadmap Sample (12–18 weeks)**

- **Phase 1 — Discover (Weeks 1–3):** Identify high-friction PM use examples in energy, manufacturing and oil/gas sectors such as cost reporting, field schedule planning, and contractors management.
- **Phase 2 — Pilot (Weeks 4–10):** Configure models, integrate with PM tools (Primavera, ERP, asset tracking systems), and validate results.
- **Phase 3 — Scale (Weeks 11–18):** Harden pipelines, set up governance, and train project managers and engineers on human-in-the-loop decision support.

**IV. RISKS AND CONTROLS**

- Data quality issues from diverse engineering, procurement and other types of executing projects contractors.
- Resistance from field engineers to adopt AI-driven scheduling.
- Ethical use: ensuring fairness in vendor selection and resource allocation.
- Cybersecurity: protecting sensitive geological and operational data.
- Cybersecurity: implementing AI regulations in information disclosure

**KPIs and Expected Benefits**

Common KPI targets in energy projects include: 15–25% reduction in cost reporting cycle time; 5–10% improvement in cost forecast accuracy; earlier detection of high-impact risks (e.g., rig downtime, vendor insolvency); and measurable schedule adherence improvements in critical path activities.

**Other Examples:**

The below are few cases studies extracted from public journal and research articles.

**Top 8 AI in Project Management Case Studies:**

The Neuroject article [3] provided an overview of AI in project management case studies, including one from the Energy industry. The article above highlighted how an Energy company used AI to:

- Reduce project costs by 10%
- Improve project delivery times by 12%

**AI-Driven Strategy in Oil and Gas:** Although not directly related to project management, the Flevy

article [4] discussed the application of AI-driven strategy in the manufacturing, oil, gas, energy & other operating industries. The article highlighted the potential of AI to:

- Improve operational efficiency by 10-15%
- Reduce costs by 5-10%

**AI use cases in Construction:** The SmartDev article [5] highlighted an overview of AI use cases in construction, including some relevant to the Energy industry. The article highlighted how AI can be used to:

- Improve project scheduling and resource allocation
- Reduce construction costs by 5-10%
- Improve safety and reduce accidents by 10-15%

**Case Studies of AI Implementation:** The Medium article [6] provided an overview of 14 case studies of unique AI implementation, including one from the Energy industry. The article above is an example also were highlighted how an energy and manufacturing sectors used AI to:

- Reduce costs by 12%
- Improve production by 10%



Average Quarter Baseline Cost MAPE (%) With AI Cost MAPE (%)

Layer	Examples in Delivering Energy Projects Management
Data Sources	Cost systems, Primavera schedules, logs, IoT sensors, vendor performance data
Processing	ETL pipelines, feature stores, digital twin platforms, cloud data lakes
AI/ML	Forecasting models, anomaly detection for cost & schedule, NLP for contracts, LLM

	copilots
Apps	Project dashboards, AI copilots in scheduling tools, risk consoles, cost control platforms

## V. CONCLUSION

AI is not a replacement for project managers but a force multiplier. AI has the potential to revolutionize project management in energy & infrastructure mega projects by combining predictive, prescriptive, and generative capabilities with expert oversight, energy organizations can materially improve scope clarity, schedule resilience, and cost discipline. Start small with pilots, validate results, and scale solutions that deliver measurable impact.

Reference to the research gate and several sources, the implementation of AI in mega project management can result in significant cost savings, including:

- 10-15% reduction in costs through predictive maintenance and equipment optimization
- 8-12% reduction in costs through supply chain optimization and logistics management
- 5-10% reduction in costs through project scheduling & resource allocation optimization
- 10-12% reduction in project costs
- 5-10% reduction in construction costs
- 10-15% improvement in operational efficiency

These cost savings can be achieved through the application of AI technologies such as predictive analytics, machine learning, and natural language processing. The use of AI in manufacturing, technology or any type of energy projects management can also lead to improved project delivery times, increased production, and reduced equipment failures. By providing predictive insights, automating routine tasks, and enhancing decision-making.

The case studies referenced to this article demonstrated the significant benefits of AI in scope, schedule, and cost management, resulting in substantial cost savings and improved project outcomes. As the Energy industry continues to

evolve, the adoption of AI in project management will become increasingly important for organizations seeking to stay competitive and deliver projects efficiently.

## REFERENCES

1. Accenture. (2020). Artificial intelligence: Realizing the true potential of AI in oil and gas. Retrieved from <https://www.accenture.com>
2. Chen, J., Xu, Y., & Xie, M. (2019). Application of machine learning in project management: A systematic review. *Journal of Industrial Information Integration*, 16, 100107. <https://doi.org/10.1016/j.jii.2019.100107>
3. Deloitte. (2022). AI and analytics in energy: Unlocking the digital advantage in oil and gas. Retrieved from <https://www2.deloitte.com>
4. McKinsey & Company. (2021). Artificial intelligence in the energy sector: Transforming operations and project delivery. Retrieved from <https://www.mckinsey.com>
5. Project Management Institute. (2021). AI in project management: The next frontier. Newtown Square, PA: PMI.
6. Shokri, A., & Li, X. (2020). Enhancing project performance with artificial intelligence: Insights from the energy sector. *International Journal of Project Management*, 38(8), 450–463. <https://doi.org/10.1016/j.ijproman.2020.04.005>
7. SmartDev. (2022). AI use cases in construction. Retrieved from <https://smartdev.com/ai-use-cases-in-construction/>