Through the Looking Glass of AI – Project Management in Wonderland [1, 2]

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1. Introduction

Artificial intelligence (AI) is becoming the center piece of products and services in today's business environment. After the introduction of Generative AI tools like Chat GPT over the past year this technology is beginning to play a key role in the commercialization and growing popularity of AI. With advances in machine learning (ML) as well as large language models (LLMs) such as ChatGPT, AI can help to improve business processes and team efficiency and enhance business and project decision-making. According to a 2023 annual global survey on project management, 82% of senior leaders indicated that AI will impact projects while 91% believe that AI will impact the project management profession (PMI, 2023b).

Technology has been an essential component of business innovation - be it the utilization of technology as part of the innovation process, or as a component of the final product or service itself. The advances in digital technology over the past decade with powerful digital platforms have been disruptive and transformational for innovation and entrepreneurship, leading to the formation of new types of business models, and new types of products/services and customer experiences (Nambisan et al., 2019). The types of functionalities that are provided by emerging technologies and particularly those offered through AI can be a source of great discovery and amazement. It has given rise to various types of applications that were previously unheard of or even imaginable, giving the impression of being magical and somewhat mysterious in its behavior and capabilities.

The next sections of this paper cover the topics of the strategic and business implications of AI followed by an analysis of the use of AI for project management practices, and a set of metrics to measure successful AI implementation. The final sections of the paper include a description of the barriers to successful implementation and required approaches to increase the likelihood of project success with an understanding and knowledge of AI and its capabilities.

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[1] *Editor's note: Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally presented at the 16th UT Dallas PM Symposium in May 2024. It is republished here with the permission of the author and conference organizers.*

[2] How to cite this paper: Veera, S. (2024). Through the looking glass of AI - Project Management in Wonderland; presented at the 16th University of Texas at Dallas Project Management Symposium in Richardson, TX, USA in May 2024; republished in the *PM World Journal*, Vol. XIII, Issue VII, July.

2. The Emergence of AI

A one-hundred-year study of AI which was launched in 2014 described AI as "Technology capable of actions and behaviors requiring intelligence when done by humans" (PANEL, 2016). More recently, a report published by the Project Management Institute (PMI) described AI as "the theory and development of computers that can approximate the functions and capabilities of human intelligence" (PMI, 2023a). ML is a subfield of AI, which involves the use of algorithms that enable machines to "learn and adapt without following instructions" (PMI, 2023a). Information is extracted from raw data and represented in a model, which is then used to make inferences about new data that is fed into the model. ML systems built in this manner can apply the knowledge and patterns learned from processing large volumes of data sets which are used to train these models. Based on such training, the functionality of facial recognition, speech recognition, object recognition, language translation and many others can be used to build a wide range of products and services serving many industries and customer segments.

"The digital wave, including the Internet of things, big data, cloud computing platforms, and other cyber-physical systems, has fundamentally altered how equipment is built and maintained and, consequently, how organizations are structured, and how they collaborate and think"(Tronvoll, et al., 2020). With improved wireless networks, the popularity of smartphones and tablets, and the widespread use of social media, today, many business-to-business (B2B) and business-to-consumer (B2C) products and services are tightly integrated with technology. This is evident in clothes that have wearables embedded in them, services that depend on real-time streaming data, home equipment that have smart speakers and temperature gauges, medical devices, and many other examples that generate tremendous volumes of data in a business as well as personal context. It is possible to combine such newly available data obtained from a wide variety of sources including customer relationship management (CRM) systems, manufacturing systems, and internet-of-things (IoT) devices. When ML algorithms are applied to such data integrated from multiple sources, it can provide many opportunities to predict and potentially explain consumer behavior as well as industrial systems processes. ML can be used as a key tool for decision making by businesses focused on marketing, social media, customer service, driverless cars, and many more.

A feature of digital technologies that has come into focus of late is their generativeness, which can influence organizational creativity and innovation in new ways (Nambisan et al., 2019). The generative AI system LLM released by OpenAI is designed to produce new content based on content that humans have already created by detecting patterns in them. The model was trained on enormous volumes of internet-based text and scripts of dialog. This training enabled the model to imitate human conversations, one of the end results of which is that it has found its way into the creation of numerous online chatbot types of products. Besides leading to new types of products and services, these models and tools can be of great benefit in managing portfolios of projects and programs in organizations, and project managers can leverage their capabilities in many ways.

3. Strategic and Business Implications

According to the State of AI Report "AI will be a force multiplier on technological progress in our increasingly digital, data-driven world. This is because everything around us today, ranging from culture to consumer products, is a product of intelligence" (PANEL, 2016). Therefore, AI will play a key role in all aspects of business and digital transformation. For example, application releases will increasingly include embedded AI functionality. Organizations' attitude towards AI as well as the manner in which they approach the transformation where AI plays a central role in business will be a differentiating factor (PMI, 2023a).

With the move towards use of AI for many different types of tasks in the workplace it is increasingly playing a bigger role in enterprises. Strategy execution should be driven from the middle, while it needs to be guided from the top; "companies must foster coordination across units and build the agility to adapt to changing market conditions" (Sull et al., 2015). Therefore, the implications of AI on business strategy and in turn on the portfolio of projects and programs that are funded for bringing the organizational strategies to fruition are critical for project managers.

Rapid development of ML and AI in the recent years provides new tools to solve business challenges in many areas (Gan et al., 2020). With the increase in automation using tools such as robotics process automation (RPA), many of the repeatable processes done by humans can now be done by machines, and humans can then focus on activities that can allow them to use their skills better. Besides investing in such automation which can improve accuracy and speed, there is also a need to invest in training and change management. AI capabilities can play a crucial role here, as data collected on the product, customers, as well as previously implemented projects for scaling new products can all be the source of valuable inputs into generating valuable insights. With the help of such data, going a step further, ML algorithms can be developed and incorporated into project management tools help to make quick and more accurate decisions for the business with respect to the product or service and for project managers with regards to the implementation of such projects.

4. AI and Project Management Practices

Organizations will be required to develop a clear vision for AI transformation and then translate this vision into a portfolio of programs and projects (PMI, 2023a). Such a portfolio of programs and projects may utilize AI capabilities for managing the organization's projects on the one hand, while on the other they may consist of projects that are geared towards delivering AI-based products to the business and its customers. Project leaders should leverage Gen AI and ML tools to align project objectives with the organizational strategies to deliver value (PMI, 2023b). PMOs have already begun incorporating AI-based initiatives into various projects and programs for the organization. In addition, companies providing project management tools have also incorporated AI into the traditional tools to make them more intelligent and insightful. As more and more businesses and tools providers make AI the norm in their processes and offerings, project managers encounter many more projects and tools that leverage this technology.

Therefore, project managers who stay ahead of the curve and at "the forefront of the progression of emerging technologies and help drive AI adoption within their organizations, will position themselves for career success" (PMI, 2023b). The use of AI in delivering projects can be broadly categorized according to the various aspects involved in delivery of a project (independent of the methodology i.e. agile, waterfall, etc.). While the term 'project' is used here, it implies the practice of project management and may apply to projects, programs or portfolios of projects. Table 1 provides a set of AI use cases for the various project management process groups and knowledge areas. The details are provided in the sections below.

4.1. Project Planning AI tools

AI-based tools can be applied in managing the triple constraints of project management, all the way from Portfolio management down to Programs and Projects. Use of historical data can play an important role for organizations, as it can provide a realistic picture of how estimates and actual values of cost were incurred for projects delivered in the past. The Planning phase in project management is a very important one and the amount of time and effort spent on this phase can impact the successful execution of the project. This is especially true in certain types of industries that extensively use Project Management, and research has indicated that for some industries there is a significant relationship between planning and the success of the project. For instance, "the level of planning completeness is positively correlated with project success in the construction industry" (Serrador, 2012). Similarly for all projects involving software and digitalization, one of the most critical activities involves estimating the effort and time involved in the development of the software product under consideration (Angelis & Stamelos, 2000).

This information can be helpful in making projections and estimations, which can be valuable for a PMO in funding projects as well as for project and program managers in tracking and controlling the budget for the specific project or set of projects being implemented. Cost estimates are critical for the project manager to be able to control the project as they serve as the standard for comparison of actual versus planned cost throughout the life of the project. As shown in Table 1 there are a variety of AI-based use cases for initiating and planning of projects.

4.2. Project Execution/Implementation and Control AI tools

"Control systems track actual performance, and the deviations from the planned performance levels are used to inform corrective action. The process of tracking actual performance and utilizing deviations to inform corrective action ensures that strategies are implemented as planned" (Muralidharan, 1997). The lessons learned register can capture important knowledge gained during project delivery. Similarly, other project artifacts that are used by the project manager such as the risk register would have clear documentation of the risks and the required information for managing them on an ongoing basis as the project is implemented. The process of monitoring and control of projects is "based on observation, systematic measurement of performance, identifying variances, and adoption of corrective / preventive actions as well as changes management" (Montes-Guerra et al., 2014),

Therefore, identifying which of the triple constraints deviated from the original plan, the reasons for the same and what actions were taken to course-correct would all be useful information for project managers that would implement similar projects in the organization at a future time. This data can be a rich source of training data for algorithms that may be developed for future projects of a similar nature. Tracking and reporting such information during project closure can help understand how well the process and tools that were utilized worked, and what improvements could be made in the future. Such systematically measured, monitored and documented data can be used by organizations to automate the work of delivering future projects and making more knowledge-based decisions regarding risk management including the probability and impact analysis of specific types of risks.

As organizations are increasingly encountering a fast-moving, technology-driven and business environment, risk management is increasingly required to focus on the 'unknown-unknown' types of risks, to be proactive and for the business to remain competitive (Marshall et al., 2019). These types of risks are the more difficult to predict and anticipate. Therefore, if AI can be utilized to plan and respond to the more predictable risks, the organizational resources can focus on managing the unknown unknown types of risks which are of a more complex nature. The use of archived historical project data and ML algorithms can be leveraged to manage the more predictable and known risks in an automated manner.

AI and Industry 4.0-related technologies are disrupting several sectors including healthcare. Through the use of AI to create blended or hybrid medical curricula**,** it is possible to support clinical and shared decision-making, tele-health applications, and to scout social media networks and use them to share meaningful medical news and advice. A teaching factory paradigm supported by Industry 4.0 technology involves practitioners in task-specific industrial problems in groups with the help of AI in the context of VR, Robotics, and 3D imaging (Mourtzis et al., 2018).

Besides the use of AI for more objective and measured data of a controlled nature, generative AI can also be a source of efficiency in managing projects. For instance, the project risks are first identified through the structured brainstorming exercises conducted during workshops with stakeholders. The risks are documented in the form of risk statements in the Risk Register. As shown in Table 1 under the Risk Management use cases, by training AI models that use prior data on the types of risks and the associated risk statements, it would be possible to generate a risk register. Such a risk register would contain the appropriate risk statements reflecting the types of risks that are fed into the model with the required cause and effect details.

Table 1: AI Use Cases for Project Management

PM Process / Knowledge Area	AI Use Cases in Project Management
Initiation	Environmental scanning Initiatives identification Business Case and Project Charter
Planning	Time and cost estimation Cost benefit analysis Schedule development Generate WBS
Control	Earned Value analysis Cost control/risk mitigation Predict schedule, cost variances
Risk Management	Risk identification, analysis Risk planning - probabilities, impact, risk responses Risk response thresholds Triggering risk responses when risk thresholds are reached
Communication	Documents, emails, workflows Summarize meeting notes Risk reporting, communication Summarize lessons learned Create visualizations, reports, charts, dashboards Chatbots

Source: Author

4.3. Project Communication and Collaboration AI tools

Project managers do not have formal authority when leading projects. Instead, they have to rely on their professional credibility and expertise, and their leadership, communication and interpersonal skills to influence team members and other stakeholders to get the project work done. Leaders and Project Managers who accomplish the business objectives through use of "work challenge and expertise as influence methods" were observed to have a higher effectiveness on overall project performance, and also encouraged a climate of involvement and debate among team members (Thamhain & Gemmill, 1974).

Over the project implementation lifecycle, as the external conditions change and during the process of balancing the triple constraints of cost, schedule and scope, the project manager is required to collaborate with multiple groups of people, trying to influence them without having the authority to control their actions. Obstacles may arise due to resistance from various stakeholder groups with conflicting priorities and interests during the project lifecycle, and a project manager skilled in the art of negotiation can effectively accomplish many of the project activities successfully through stakeholder communication and negotiation.

Therefore, project managers need to use persuasion and influence for getting project deliverables done and for make key decisions throughout the project. This includes communicating with the project team at all times, and research has shown that "team facilitation, group cohesion and internal processes have a strong impact on team performance" (Engelhard & Holtbrügge, 2017). Traditional AI and Gen AI capabilities can be of benefit to project managers in making sure they have the required real-time information at their fingertips to make the well-informed decisions, as well as in developing presentations and reports to present to stakeholders for getting their buy-in. This is reflected in Table 1 with the set of use cases under the Communication knowledge area of project management.

5. AI-related Metrics and Product or Service Metrics for AI-based Projects

Analytical insights and metrics about the AI-based product or service being delivered can be valuable in understanding how successful the product is in meeting customer needs, what improvements can be made and how the business can get a better return on its investment in the product. The metrics can be associated with the product or service itself, the ML algorithms and their success or failure, and finally when applied to managing projects, project management metrics can incorporate AI and ML aspects within them. Table 2 provides a set of metrics that can be used for evaluating AI-based model performance, accuracy & quality; data quality and business value derived from the data underlying the AI; as well as the products and services built using AI, such as feature adoption, customer acquisition and retention metrics. There are many other metrics that can be used in each of these areas for all AI-based models and products including those used for AI-based project management applications.

Feature adoption metrics can be used to track number or percentages of monthly average users who engage with a specific AI-based feature. This may include monthly active users (MAU), daily active user (DAU) metrics. Based on these and feature-specific findings it would be possible to redirect efforts to enhance high-performing features and eliminate those that are unpopular. Similarly, churn metrics can inform the product team whether the product's customer acquisition cost is too high companies can grow even without acquiring new customers. An example of this is seat-based products where happy customers continue to expand their licenses as they onboard new employees.

AI model performance metrics can be used to measure the performance and accuracy of the ML model. For example, a confusion matrix and measures of Precision, Recall, and Sensitivity can be used on the one hand while mean absolute percentage error, bias and variance, gain and lift measures can be used on the other. As AI algorithms are dependent on being trained on large volumes of data and the effectiveness of their results is strongly dependent on the data quality, metrics to measure the quality of data are also important. Finally, when AI is used in the context of project management for automation, optimization and prediction, a combination of the traditional project management measures and metrics and ML metrics can be used. For example, measures for the triple constraints of cost, schedule and scope management can be utilized, while

the application of historical data and algorithms trained on the historical data can then help to predict and also control the project during execution.

Table 2 - AI Model, Data and Product Metrics

Metric Type	Name
AI/ML Modelling Performance & Accuracy	Model precision, recall and sensitivity metrics using confusion matrix, ROC Curves
AI/ML Modelling Performance & Accuracy	Accuracy of model - Mean Absolute % Error (MAPE)
Model Quality	Model Bias and Variance measurement
Model Performance	Gain and Lift charts - effectiveness of model prediction and resulting benefit to business
Business Value from data	ROI from data quality improvement
Data Quality	Accuracy, completeness, consistency of data
Data Quality	Velocity, frequency, timeliness of data
Data Quality	Data issues management metrics
AI Product Feature adoption metrics	Daily Active Users, Monthly Active Users
AI Product Customer acquisition Metrics	Customer Churn metrics
AI Product Customer retention Metrics	Customer Retention rate

Source: Author

6. Implementing AI in Organizations

Operationalizing the new products and services for customers often requires scaling a product that was developed a minimum viable product (MVP) in an experimental manner for deploying widely to a large customer base. Such an approach enables "accelerated learning to help reduce the uncertainty that accompanies commercialization projects, thereby bringing the resulting new technology to market faster" (Moogk, 2012).

When an enterprise starts to scale their AI programs from dozens to hundreds of models in production, rigorous processes are needed to manage and govern full model life cycles to maintain control on their quality, accuracy and currency. Similar to DevOps 'ModelOps' is the term that refers to the enterprise capability focused on governance and lifecycle management of all types of decision models including AI models (Hummer et al., 2019). While ModelOps refers in general to all types of models including statistical models, rule-based models, etc., ML Ops specifically refers to ML models.

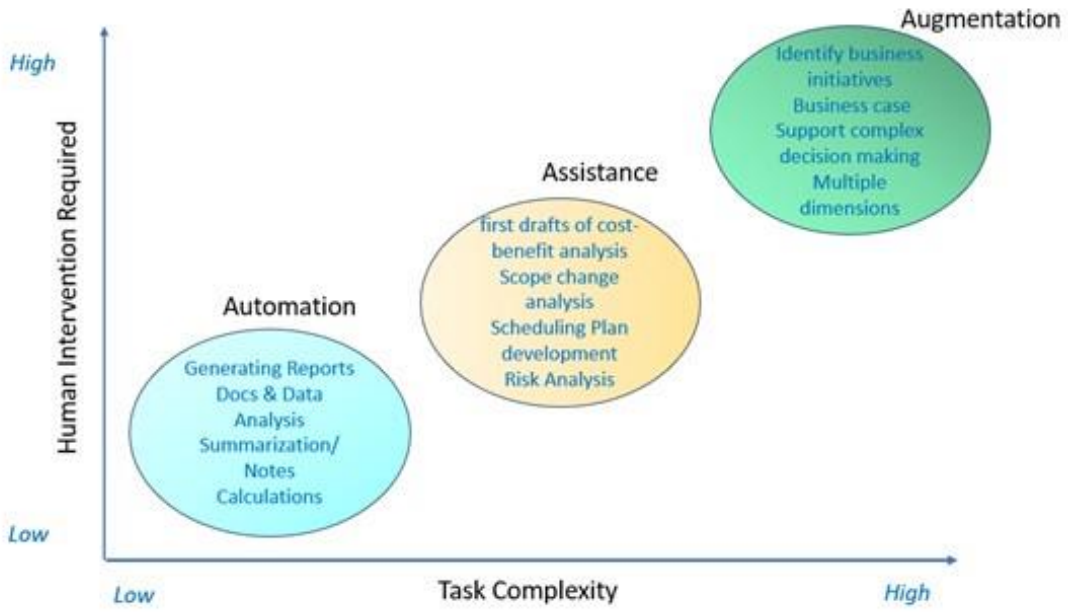
6.1. Factors contributing to successful AI Implementation

With digital technology playing a central role in all aspects of organizational processes, employee-driven digital innovation is beginning to take root in organizations (Opland et al., 2022). Providing the right tools, training and processes to further build on this capability would help companies to further improve their competitiveness in the marketplace. A large part of this change required

companies and employees to embrace digital technology and learn to work collaboratively in a remote setup. A company culture that fosters learning through small, incremental and iterative changes can experiment with digital technologies on a small scale and then scale the successful experiments to the rest of the organization, and ultimately is able to adapt the long-term plans (Vial, 2021).

Understanding its own value chain can enable firms to increase the value that initiatives (that are based on a set of resources, capabilities and competencies) can give to the organization. "Attack from a position of strength" applies to new product management, because when there is a strong fit between the needs of the new product project and the resources, competencies, and experience of the firm, products become successful (Cooper, 2019). Practitioners who can use their domain expertise to bring about seamless collaboration across different organizational functions can help drive success in implementing AI.

Figure 1- GenAI Application for Automation, Assistance, or Augmentation



Source: Adapted by Author from (PMI, 2023b)

As shown in Figure 1, the use of GenAI in project management and for improving organizational productivity should be customized by evaluating tasks and deliverables according to the level of complexity involved as well as the degree of human intervention required (PMI, 2023b). By following this framework, GenAI functionality can be utilized to provide support for automation, assistance or augmentation types of tasks within the organization to make optimal use of the

technology. Innovation can be successful and beneficial for the business when employees are empowered to build new competences and contribute to value creation, and companies combine their resources to provide new products to customers (Trabert et al., 2022). Providing the right tools, training and processes to further build on this capability would help companies to further improve their competitiveness the marketplace.

6.2. Barriers and Challenges to successful AI Implementation

Enterprises are facing a range of operational challenges as they put AI models into production. Some of the barriers include difficulties in integration with existing systems, lack of data of good quality to train models on, insufficient infrastructure to handle large volumes of data, lack of standardization in data and processes, and last but not the least, negative perceptions from customers due to lack of understanding and/or insufficient transparency of algorithms and their functioning. The availability of talent can also be a challenge and often companies rely on third party partners to ramp up their efforts to implement AI and then to train their workforce in adopting the tools and technologies. Finally, there are security and privacy issues due to the fact that AI technology relies on a great deal of organizational and business data. Besides addressing some of the traditional threats to the communication network such as single point of failure (SPoF), denial of service (DDoS), and stolen identities, local and global situational awareness would also be required to monitor large-scale complex systems (Wang et al., 2022).

7. Conclusion

AI will complement rather than replace humans, by creating human/machine collaborations. The focus of work will shift from working on repetitive tasks to managing robots and AI technology that carries out such tasks. Therefore, an investigation into how AI can transform project management is timely and critical (Müller et al., 2024) and in this paper the author has provided an analysis of some of these topics. As AI applications continue to increase in popularity and become ubiquitous in business and personal lives, the role of project managers can be expected to change in the future (Holzmann et al., 2022). Further in-depth research as well as an understanding of the approaches adopted by project managers in implementing AI and the lessons learned from the same will be valuable in further advancing such knowledge and understanding.

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