Artificial Intelligence Augmented Project Management

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Abstract. Project Management (PM) is a critical function for organizations and businesses. Whilst projects are important and continue to be important, the failure rate is still alarmingly high. The emerging technologies in this Fourth Industrial Revolution (IR 4.0) era, particularly Artificial Intelligence (AI) continues to grow rapidly around the globe. This trend is fueled by technological advancements such as decreasing computational cost, increasing communication speed, inexpensive sensors, and advanced materials. The importance of AI-based project management is acknowledged by practitioners and there is a recognition of how these technology evolutions can enhance project management functions. However, little is known about AI requirements and implementation in project management. The most important question is how to implement AI in project management as the domain knowledge itself is difficult & highly complex. At present, there is no widely recognized model or framework for coming up with AI applications in Project Management. This research intends to address this research gap by proposing possible use cases for AI-augmented PM (AI-PM). It is envisioned that this research will pave the way toward the development of a suitable framework and generate findings that will benefit developers as well as users.

Keywords: Augmented Project Management · Artificial Intelligence · Use Cases · Framework · Model

1 Introduction

In today's world and global economy perspective, Artificial Intelligence (AI) is a new tool to predict the future of organizations and businesses outcome. Like many other professions, project management will not be immune to the impacts of AI. From the context of project management, AI is seen as a capable tool to assist Project Managers and organizations to monitor budgets, monitoring schedules, AND assessing potential risks and impacts to make predictions based on the pattern its sees.

Little research has been done on AI in project management. Most of the research works have focused on analyzing the features of the data based on intelligent behavior to provide better decision-making for scientific and business applications. However, in

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domains with a highly complex process and multi-discipline domain, such as project management, organizations require a framework and guidance for the successful implementation of AI in project management. An appropriate framework is needed to develop purposeful artificial intelligence (AI) applications [1].

A simple search on Lens.org, the online patent and scholarly literature search platform, the publication trend related to Artificial Intelligence, Use Cases, Models, Framework & Guidelines is increasing over the past 10 years (https://link.lens.org/ImsOq5ML66k). This signals the importance of the research area.

Next, we also found an increasing research trend in AI application in project management when we searched for the combination of Artificial Intelligence and Project Management. However, the numbers were smaller but the trend was increasing (https://link.lens.org/wKhhtQeVnUd).

When we further searched for the combination of Artificial Intelligence, Project Management, Use Cases, and Framework, the returned results were even lower (https://link.lens.org/3uJFG0pyjyd). This indicated clear evidence of a research gap when we narrow down the research. Furthermore, there is also a lack of works originating from Malaysia which suggests the need for works that also include local context.

Inspired by previous research and motivated by the gaps identified, this paper intends to address this research opportunity by proposing possible use cases for AI-augmented PM (AI-PM). The goal is that it can be a reference for future product development, strategically implemented, and adopted in the organizations.

2 Literature Review

Projects are important and continue to be important. Global investment in project management is significantly high and is expected to grow in the coming years. Over the past decade, organizations make a lot of investments in the project. All of the transformation and change need to be delivered by a project. According to Bain & Company[1], most of the work will be project-based in 2027. As the world becomes more projectized, the opportunity for project management is tremendous.

Astonishing as stated by PwC[2], 97% of organizations believe project management is crucial to a business goal, performance, and success therefore, ensuring success is important to the organization.

However, according to statistics, the project failure rate is alarming. As stated by [2], 41% of projects fail due to inadequate sponsor support, and 44% of projects fail to deliver due to a gap between the organization's business and project objectives. Meanwhile, as reported by Wellingtone[3], 27% of projects go over budget.

With the IR 4.0 and the digital age, there are several recognitions on how technology evolution can enhance PM function. One of the emerging technologies in IR 4.0 is AI.

[1] https://www.bain.com/insights/firm-of-the-future.

[2] https://www.pwc.com.tr/en/publications/arastirmalar/pages/pwc-global-project-management-report-small.pdf.

[3] https://financesonline.com/35-essential-project-management-statistics-analysis-of-trends-data-and-market-share/.

Many studies highlighted the AI's potential to enhance PM function and propel our global society into a fourth industrial revolution.

According to research by IDC[4], 40% of Digital Transformation will be related to AI, while Accenture[5] predicts that 80% of finance accounting tasks will be automated in the upcoming years.

As stated by [1], organizations require methodological guidance to develop purposeful artificial intelligence applications in complex and multi-discipline domains such as project management. Realizing the great potential of these emerging technology, it is important to understand and identify the concept and capabilities of how AI can enhance PM function and organization enhancement.

According to [3], organizations need the necessary assessment, prerequisites, and framework to successfully enable AI initiatives. For that reason, use cases have been recognized as an effective planning tool to describe the possible scenario of what AI can do to enhance PM function, understand the value, and where the AI solution fits.

The importance of AI-based project management is acknowledged by practitioners, but the most important question is how to implement this AI in project management as the domain knowledge itself is difficult & highly complex.

At the present moment, there is no widely recognized model, structure, or standard for coming up with AI applications in Project Management. A researcher has developed a new method to identify use cases given the technology and business problem [4] but not specifically for the Project Management domain. As of today, AI application in Project Management can be seen as still in the infancy stages. A key takeaway based on recommendations by [1, 5], use cases are recognized as a good technique for user-driven solutions in deploying successful technology. It is a key tool for achieving human-centered design in innovations.

According to [5] to achieve project delivery success and company growth organizations rely on human experiences and expert judgment, but the desired result is inconsistent. Technological advancements in AI pave the way for more rapid technology-driven change in organizations and reinventing we work. According to [6], AI is able to provide project managers and team members with an intelligent assistant by driving the innovation and business value through automation, analytics, estimation prediction, actionable recommendations, and guidance for decisions making. For example, according to [7], chatbots for virtual customer assistants can provide service more safely to customers. In object detecting technology, according to [8], the Machine Learning algorithm can provide a high level of confidence as the technology has reached high-level accuracy. While in the latest research on demand forecasting, according to [9], a more accurate forecast can be achieved with the advantage of AI-based demand forecasting. In the speech recognition solution, according to [10], Machine Learning needs to be trained and enabled to understand emotions transmit by speech. With this technology capability, meaningful translating can be achieved.

Therefore, from a technological perspective, Artificial Intelligence (AI) is one of the most powerful and important technological innovations of our times. It will completely transform how the way we think, work and live and therefore will transform our lives

[4] https://www.idc.com/research/viewtoc.jsp?containerId=US43154617.

[5] https://www.accenture.com/us-en#zoom=50.

and organizations. To make the most use of AI and prepare our organization's project management for AI, it is vital that we approach this strategically.

2.1 Malaysian Perspective

In the Malaysian context, technology innovation plays a key role in national & economic development to achieve national aspirations. AI is one of the foundation technologies to achieve IR 4.0 and move toward IR 5.0.

The National AI Framework[6] is in the proposal stages. The proposed roadmap aims to make Malaysia a high-income nation where AI augments job, drive national competitiveness, encourage innovation and brings economic prosperity, social goods, and improve people's wellbeing.

A study has been conducted in 2018 involving 100 organization leaders and 100 employees in Malaysia on the adoption of AI. The study by Microsoft-IDC[7] on the adoption is based on 6 dimensions which are (1) strategy – the extent to which an organization considers AI as a core strategy, (2) investment – investment in AI digital platform, (3) culture – the extent to which employees are empowered to take a risk, participating in organization's AI journey, (4) capabilities – organization's capability to develop deploy and monitor AI models, (5) infrastructure – availability of data and tools to support AI, and (6) data – availability of data including quality, timeliness, and governance of data.

The top 3 challenges organizations in Malaysia face in the adoption of AI are (1) lack of investment commitment from organization leadership to invest in AI, 28%, (2) lack of competent resources in AI, 18%, and (3) lack of advanced technology infrastructure and tools to promote insights from AI, 17%.

Clearly, business leaders require a mindset change to embrace AI where these technological advancements, skills resources, and infrastructure are the core components of the new organization's innovation culture. This study showed that implemented digital transformation leveraging AI saw tangible business benefits, improve efficiency, accelerated innovation, and gained competitive advantages. According to PMI Malaysia[8] statistics, there are 1,214 project managers certified as Project Management Professionals (PMP) in Malaysia. Suggesting a sufficient critical mass of expert users that can benefit from AI-PM solutions.

3 Towards AI-PM Use Cases

This section presents the discussions on the proposed AI-PM use cases. Firstly, common use cases in AI projects are presented. Then, use cases for AI in PM are proposed.

[6] https://airmap.my/.

[7] https://news.microsoft.com/en-my/2018/02/06/digital-transformation-contribute-us10-billion-malaysia-gdp-2021/.

[8] https://pmi.org.my/.

3.1 Use Cases for Common Use in AI Projects

3.1.1 Demand Forecasting

Demand forecasting is the process of estimations of probable future demand over a determined period. Estimations are based on a set of historical data and other information.

With AI, key functions that can support this use case (but are not limited to) are (1) Financial forecasting, (2) Supply chain waste reduction, and (3) Resource optimizations.

As AI is able to effectively process a huge number of data, respond to changes in the data sets, discover complex relationships and analyze it within a very short time, these are among the key use cases in Demand Forecasting that AI can be implemented.

3.1.2 Fraud Detection

Fraud detection can leverage machine learning, statistical analysis, and behavior monitoring to identify the patterns and strategies used by criminals to commit fraud.

With AI, the solution can stop damage before it occurs. As AI is able to analyse data, respond to transactions, detect potentially fraudulent activities, and calculate risk scores, among key use cases that can be supported in Fraud Detection (but are not limited to) are (1) Analyzing clients' behavior, (2) Tracking clients' location and determining clients' habits, and (3) Detecting any unusual client activities.

Nowadays, Machine Learning continuously gets better at discovering pattern anomalies and the ability to flag issues much faster than human detection.

3.1.3 Object Detection

Object Detection is one of the technologies related to computer vision that allows computer systems to identify and position objects in the type of an image or video.

With AI, Key functions that can be supported (but not limited to) are (1) Face recognition, (2) Self-driving, (3) (3) Surveillance i.e., detecting any unusual activities, and (4) Traffic tracking & monitoring.

Object detection is one of the great computer vision technologies and deep learning. It helps to identify, detect, classify or track objects in images or videos. The visual can be either humans, animals, cars, or other objects. The processes started with information gathering through data collections through computer visuals, key in into models, and analysis using machine learning algorithms or deep learning algorithms. The camera is used as a device to capture the image and sends it for processing. As deep learning is able to effectively process a huge number of data, this model was trained until accurate results are achieved. Based on the training, the trained model is expected to discover and identify and classify the objects or other instructions likes: What is the object? Is the object moving or not moving?

3.1.4 Speech Emotion Recognition

Speech Emotion Recognition is a process to detect human emotion through their voice during conversation or speaking and interpret it. Detecting emotion is important to business strategy especially in managing stakeholder expectations through understanding their emotion.

With AI, key functions that can support this use case (but are not limited to) are (1) Feedback capture i.e., after a talk, a big presentation. (2) Health education i.e., talking to people about their health, and (3) Entertainment festivals i.e., award ceremonies, and celebrations.

Speech Emotion Recognition has been an active research field for the last decade. These use cases become more obvious in marketing as an organization needs to understand their client's emotions to able to provide good engagement and understand feedback and improve their way of marketing strategy. However, the challenge in Speech Emotion Recognition is more label data with appropriate emotion is required to train machine learning.

3.1.5 Customer Service Communication

Customer services are important to the organization. It helps to retain customers, improve services opportunity, and increase customer satisfaction which directly will increase future retention and new revenue.

With AI, key functions that can support customer services use cases (but are not limited to) are (1) Live chat in the contact center i.e., via AI Chatbot, (2) Virtual assistants i.e., guide the user to perform technical troubleshooting, and (3) Analyzing customer support requests or route to respective agent.

With these use cases, a live chat and virtual assistant could provide an assistant to the user for any inquiry, information, or supports needs. An AI-powered chatbot is expected to deliver an intelligent and meaningful conversation to solve customer inquiries by providing users with good information, guidance, and tips or referring them to other organization persons or representatives if required.

3.1.6 Diagnostic and Imaging Assistance

AI provides a clear picture of different anomalies that once remain unclear. The anomalies are so small that humans could not detect them.

With AI, key functions that can support this use case (but are not limited to) are (1) Analyzing patient reports, and (2) Assisting doctors in providing the patient diagnosis.

AI tools scanned the image thoroughly and provide a better view of identifying issues. It can help provide a diagnosis by detecting problems that went unnoticed by humans. ML algorithms are used for diagnostic development and support humans by recognizing the right pattern so valuable insight can be derived from the analysis.

3.2 Use Cases for AI in Project Management

Project management is one highly complex management field with many knowledge areas. It involves many management, technical and human skills and aspects. Knowledge, proper skills, and vast experience are needed to succeed in this domain knowledge.

In order to suggest use cases for project management domains, PMBOK 6th Edition is referred to as a primary guide to better align and suit project practitioners, organizational project management, and technological needs.

The PMBOK had been widely recognized globally as a framework that provides standards and best practices, for delivering projects successfully through its complete framework standards.

3.2.1 Integration Management - Project Prediction & Forecast

AI can help the team to monitor and coordinate project activities by connecting the interdependencies of process/workflow, administration of repetitive tasks, tracking data, and monitoring performance. One of the key functions of AI is its ability to provide real-time status updates through dashboard visualization.

With AI, key functions that can be supported in this use case (but are not limited to) are (1) Forecast project scenario & outcome, (2) Provide insight on the possible outcome, and (3) Facilitating project planning.

With AI-empowered project management, project managers will gain valuable information and insights which help them to direct and manage the project, make an informed decision and take necessary action to meet or avoid the prediction or forecast. This will result in smooth project delivery and meet the project objective and desired results.

3.2.2 Scope Management – Control Scope

AI can assist in baselines the scope and serves as a guideline to keep the project within specific limits. Project managers can utilize this AI to build and map a project scope based on a defined scope baseline for better validation, control, and monitoring of project works.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Define scope, (2) Create a task, (3) Create Work Breakdown Structure, (4) Prioritize work, and (5) Validate scope.

Scope requirements on similar project types based on historical information from the previous project can be provided to machine learning algorithms for training and more accurate scope control.

3.2.3 Schedule Management – Work Estimation

Schedule management is one of the important aspects of a project. The schedule needs to be created, agreed upon with all stakeholders, and monitored. Work estimation is building an estimation & realistic project schedule in order to meet deadlines. Project managers can utilize AI to assist the team to understand what the critical path, activities, and priorities is.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Forecast project plan, (2) Estimate work and effort, (3) Provide warning signal on schedule slippage, (4) Forecast of issues that potentially will occur, and (5) Forecast potential bottleneck.

Machine learning algorithms can be input by project data from the previous similar types of projects based on historical information for better and more robust project planning. In addition, work estimation status on actual work progress can be tracked and monitored for current and future schedule estimation control.

3.2.4 Cost Management – Cost Forecasting

Cost forecasting is built on estimation & realistic financial analysis to estimate and control project costs.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Budget forecast i.e., over budget, within budget, and (2) Budget implication due to increasing scope & slippage timeline.

Machine Learning has capabilities to process large amounts of data quickly, find patterns in data, learn from it, and make predictions. Machine learning algorithms can be used to provide project costs on similar project types based on historical information from previous projects.

3.2.5 Risk Management – Risk Prediction

Risk prediction is a process to predict the potential risk that will happen. Among the task in risk prediction is performing risk modeling, identifying risk, analyzing & calculated risk.

With AI, key functions that can be supported in this use case (but are not limited to) are (1) Risk identification, (2) Risk tracking, and (3) Risk prediction.

The existing Monte Carlo simulation combined with machine learning can help project managers to analyze the prospective financial performance for better cost forecasting from inside or outside projects and improve the simulation of financial risks and opportunities for better project financial monitoring and control.

3.2.6 Resource Management - Resource Optimization

Resource management is ensuring adequate resources are available throughout the project life cycle until completion. Resource optimization is one of the techniques to control resources. It will identify the resources needed and map the resources needed with the scope or task to be delivered i.e.: manpower or tools – are they available, when should they be ready, and how long they're needed.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Assessing the type of resources needed, (2) Resource Scheduling, (3) Resource Allocation, and (4) Resource Optimization.

In today's global scenario, managing resources becoming more important as project managers are required to do more with fewer resources. These resources will significantly impact project delivery and productivity. Therefore, resource optimization is required to ensure resources are readily available when needed.

3.2.7 Communication Management – Stakeholder Feedback Analysis

Communication management is ensuring the effectiveness of information exchange throughout the project until completion. Stakeholder feedback analysis is a strategy to get feedback from stakeholders during formal or informal communication using AI.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Stakeholder Feedback Analysis, (2) Communication Channel, and (3) Issue/Log Analysis.

Despite AI will enhance communication, these possible use cases are still lacking in the investigation of how to implement it in a project environment and require insight into how technological advancement in AI could maximize the potential of these use cases.

3.2.8 Procurement Management – Partner Evaluation

Partner evaluation is important in the procurement planning aspect. Partner evaluation will start with identifying the partner needed, assessing the partner's background & project experience, assessing the partner's resources readiness, and mapping the partner with the scope of work and task to be delivered. These partner evaluations required AI to be input with historical data and key criteria including the partner's previous performance, issues, support services quality, commitment, manpower, and financial & operation stability.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Partner Evaluation, (2) Partner Selection, and (3) Contract Review.

Partner evaluation is extremely important before the procurement decision to select any partner/vendor to work with. In today's global supply chain challenges & resources shortages, partner selection will impact the overall project completion, success, or failure.

3.2.9 Quality Management – Quality Control

Quality is one of the project management processes. Quality control focuses on fulfilling quality requirements. Project and product requirements should be captured to meet customer expectations.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Quality Control, and (2) Compliance Check.

An integrated information system will allow the project manager to monitor all related processes. As AI could help the team to monitor and notify the changes through dashboard visualization, it will be a good technology to connect the interdependencies of process/workflow. Administration of repetitive tasks, tracking data, and monitoring performance.

3.2.10 Stakeholder Management – Stakeholder Analysis

To increase the chances of success, project managers need to identify and engage all stakeholders in an appropriate way. AI could assist in stakeholder analysis by providing valuable information about stakeholders based on the analysis of stakeholders as projects move from different phases over time. The analysis can include stakeholder power, interests, involvement, influences, and the potential impact on the project.

With AI, key functions that can be supported in this use cases (but are not limited to) are (1) Identify Stakeholder, (2) Stakeholder Analysis, (3) Assess Stakeholder Expression, and (4) Meaning Interpretation.

The process of identifying and analyzing stakeholders is iterative. With the assistance of AI, the project manager could foster appropriate engagement to ensure stakeholders are managed and satisfied.

4 Conclusions

As AI is gaining attention, enhancing project management by leveraging this technological advancement will allow organizations to realize the true value of project management and enhance the success to meet the project objectives.

Organizations must create a strategic advantage and take this opportunity to leverage AI in organizational project management to give organizations competitive advantages. As this technology evolves rapidly, possible business use cases as proposed and suggested could potentially be leveraged and applied for development and leading to organizational success and growth.

The undeniable capabilities of AI such as the ability to process a large amount of data in the shortest time, find a pattern, learn, and make future predictions are the important technological aspect in proposing AI use cases in project management [11]. The outlook of AI is bright, the unique capabilities in project forecasting based on multiple project scenarios will continue to be a key aspect of the future trend in the project management area [12].

The most important issue is how to implement AI-PM in the organization as it is challenging and very complicated? To answer the question, if companies would like to wish to institutionalize their practices and recognized their value from it, then there is a need to establish processes, methodologies, or frameworks for successful implementation, embrace and catalyze the true value of AI-PM. Thus, the use cases would be a good reference towards achieving this goal.

In conclusion, AI-PM is seen as having the potential to address vital organizational needs by providing specifically designed solutions to empower the organization and more specifically assist project managers in successfully delivering projects that create value for the stakeholders.

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