

How to apply AI technology in Project Management^{1, 2}

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ABSTRACT

In this decade, AI has undoubtedly been one of the most influential technologies. AI has changed the way people live and work, and project management isn't an exception. There is always controversy about the use of AI technology. This article first explains the need for the company to use AI technology and studies why AI is full of controversy. After considering the advantages and risks of AI, this paper proposes several AI technologies that project management can adopt. Also, quantitative analysis was performed using the Multiple Attribute Decision Model method. In the end, we concluded that using Machine learning-based project management is the optimal option.

Keywords: Artificial Intelligence, Project Management, Machine Learning, Multiple Attribute Decision Model

INTRODUCTION

In every era, the emergence of new technologies will have a huge impact on people's lives and working methods. Application of these technologies will greatly improve work efficiency and create huge economic benefits, also bring opportunities and challenges. Therefore, actively understanding and applying new technologies is essential to improve the company's competitiveness. The United States Patent and Trademark Office (USPTO) has issued an increasing number of patents for inventions developed by AI, which proof that AI's innovative capabilities will revolutionize our industries and affect the world economy.

AI was described as "*The designing and building of intelligent agents that receive percepts from the environment and take actions that maximize its chance of successfully achieving its goals*"³ by Stuart J. Russell and Peter Norvig who are computer scientists known for their contributions

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³ Russell, S. J., & Norvig, P. (2010), *Artificial intelligence: A modern approach* (3rd ed.). New Jersey: Pearson Education

to AI. It was born at a workshop in 1956. After more than 60 years of development, AI has achieved breakthrough development. Especially in the 21st century, high-performance hardware and massive amounts of data generated by the Internet have paved the way for it. Various complex algorithms are also implemented, such as convolutional neural networks (CNN), support vector machines (SVM), decision trees and so on. These technologies have been researched by scientists and have produced many new applications such as face recognition, image recognition, and natural language processing, which have brought changes to various industries.

Briefly summarize the process of machine learning. The user provides a large amount of data to the computer and selects the appropriate model and algorithm. The program utilizes the data to adjust the parameters and refine the model. This model will become a black box that predicts the corresponding result based on the input. For example, by entering a large number of pictures with cats, the program learns the characteristics of the cat and can identify whether there are cats in the picture. Complex algorithms allow programs to automatically discover the implicit information in the data, which may be easily overlooked by humans. Therefore, AI is often used to analyze data that people already have and predict possible outcomes which can be useful when people are trying to do risk management. By using visualization methods, AI is also skilled at discovering slowly changing trends of data. One of the applications based on AI is Natural Language Processing (NLP). By utilizing this technology, the computer can finish some simple but repetitive jobs, such as sorting emails, automatically extracting keywords from the emails or messages, and recognize the time point and add it to user's calendar.

Step 1 Problem Definition

It seems like AI should be welcomed by everyone because of its good performance. In fact, there is still a lot of controversy about whether to use AI. The main reasons are:

(1) People afraid that AI will take away jobs

According to a user survey from Atlassian, 87% of respondents said AI would change their job in the next three years and the same number said that some part of their job could be done by AI⁴. This survey shows that AI technology is gradually being applied to diverse industries and many people are beginning to feel anxious, worrying that AI will replace their work.

(2) People fear failure

Because the AI system is a kind of complex system, some people worry that over-reliance on AI will lead to serious consequences, for example, the car accident caused by autonomous driving technology. AI calculation errors may cause the project to fail.

⁴ Atlassian. (2017, April 7). 3 ways AI will change project management for the better. Retrieved from <https://www.atlassian.com/blog/software-teams/3-ways-ai-will-change-project-management-better>

(3) People fear of abuse of AI

AI is now used in the advertising industry. Websites can provide customized ads for users, which makes people worry about their privacy.

After analyzing the above reasons, we can conclude that the **root cause** of the problem is: people don't know how to use AI technology properly in project management.

In this paper, the two questions below will be researched:

- (1) What is AI project management?
- (2) What are the feasible alternatives for using AI in project management?

METHODOLOGY

Step 2 Feasible Alternatives

Project management AI is called "*an integrated system that can administrate projects without requiring human input.*"⁵ Nowadays, AI can be considered as these two types: Narrow AI (or Weak AI), Artificial General Intelligence (or Strong AI)⁶.

Narrow AI, which lacks the flexibility of dealing with different tasks, are well-trained to solve a specific problem and may be more powerful than human in their domain. Famous examples are DeepMind's AlphaGo and IBM's Deep Blue which are proficient in chess and can defeat human players. Obviously, it is not appropriate to let them solve other problems.

Artificial General Intelligence, or strong AI, can be as flexible as humans and combines the advantages of a computer which means it can use massive amounts of data to get more reliable answers and reduce risks. The interesting thing is that most scientists think it will be implemented even though it's still just speculation.

From weak AI to strong AI, the technical breakthrough influences the forms of AI in project management, and it's mainly considered as four different types⁷:

- (1) Integration & Automation (IA)
- (2) Chatbot Assistant (CA)
- (3) Machine learning-based project management (MLPM)

⁵ Burger, R. (2017, June 12). I, project manager: The rise of artificial intelligence in the workplace. Retrieved from <https://blog.capterra.com/i-project-manager-the-rise-of-artificial-intelligence-in-the-workplace/>

⁶ Wirth, N. (2018). Hello marketing, what can artificial intelligence help you with?. international journal of market research, 60(5), 435-438.

⁷ Lahmann, M. (2018, September 7). AI will transform project management. Are you ready? Retrieved from <https://www.pwc.ch/en/insights/risk/transformation-assurance-ai-will-transform-project-management-are-you-ready.html>

(4) Autonomous Project Management (APM)

We are going to use the Multiple Attribute Decision Model (MADM) method to help analyze the question. To select the best alternative, we will list the possible options and attributes in the table. The options will be marked by different scores which represent different performance in each attribute. We will do further research by using quantifying methods of the MADM. We will also use the compensatory methods to rank the attributes and get the weighted score for each option by multiplication. We will explain the result at the end of this paper.

PI	TC	RD	TM	IHR	Score
Excellent	Low	Little	Mature	Little	3
Good	Fair	Fair	Developed	Ordinary	2
Fair	A lot of	A lot of	Developing	A lot of	1
Poor	Huge	Huge	Designing	Huge	0

Table 1 Different degrees of alternatives and corresponding score⁸

Step 3 Development of feasible alternative

We have four alternatives.

(1) Integration & Automation (IA)

This represents the level of narrow AI including many specific functions. Some companies use computer vision to check the product quality automatically. Natural language processing (NLP) can help extract keywords from emails. By 2030, as much as 80% of routine work could be eliminated⁹. Project Manager will have more time to deal with other complex tasks.

(2) Chatbot Assistant (CA)

This option allows AI to take over menial work such as organizing a regular meeting, analyzing the emotion of people and answering some simple question. As an assistant, AI improves the efficiency of human-computer interaction.

⁸ By author

⁹ Meulen, R. (2017, May 16). Smart machines to take over most routine PPM work. Retrieved from <https://www.gartner.com/smarterwithgartner/smart-machines-to-take-over-most-routine-ppm-work/>

(3) Machine learning-based project management (MLPM)

This option means that AI will have an impact on the decision. To analyze a project, AI needs plenty of past case data which can be a form of “experience” for AI. When project managers input the data of current project, AI can assess the progress of the project, predict whether the cost exceeds the standard, predict the probability of being behind schedule, and even find out possible problems in advance. It’s important to note that AI is good at identifying slowly ramping trends in the stream of data while humans are not. The more data AI gets, the more reliable its analysis results are. AI reports a feasible solution to the project managers based on the analysis results, but the final decision is still in the hands of humans.

(4) Autonomous Project Management (APM)

APM represents the level of strong AI. At this stage, AI can proactively get the information it needs to analyze and manage the project. AI will take the decision and take reasonable action to create value to meet key stakeholders. As mentioned before, this technology has not been implemented, but most scientists have analyzed and hold the view that it is about to be implemented. It is not sensible to ignore it.

Step 4 Selection of criteria

Project management is defined as *“The planning, scheduling, and controlling of project activities to achieve performance, cost, and time objectives, for a given scope of work, while using resources efficiently and effectively.”*¹⁰ We choose these attributes to analysis the alternatives above:

- (1) Performance Improvement (PI)
- (2) Technical Cost (TC)

There are challenges related to AI’s adoption which we need to bring into consideration as well. After some investigations, we have chosen the following terms as our attributes:

- (3) The Requirement of Data (RD)¹¹
- (4) Technical Maturity (TM)¹²
- (5) Impact on Human Resources (IHR)¹³

¹⁰ Definition of Project management from the brochure by Management Concepts Inc. 1999 Retrieved Nov 18, 2018, from http://www.maxwideman.com/pmglossary/PMG_P16.htm

¹¹ Korolov, M. (2018, February 13). AI’s biggest risk factor: Data gone wrong. Retrieved from https://www.cio.com/article/3254693/artificial-intelligence/ais-biggest-risk-factor-data-gone-wrong.html#tk.cio_rs

¹² Violino, B. (2018, February 19). Risky AI business: Navigating regulatory and legal dangers to come. Retrieved from <https://www.cio.com/article/3256031/artificial-intelligence/risky-ai-business-navigating-regulatory-and-legal-dangers-to-come.html>

¹³ Six challenges to tackle before artificial intelligence redesigns healthcare. (2017, November 23). Retrieved from <https://medicalfuturist.com/six-challenges-to-tackle-before-artificial-intelligence-redesigns-healthcare>

We have selected five attributes that describe the characteristics of each option, as detailed below:

(1) Performance Improvement (PI)

AI has significant advantages when analyzing large amounts of data and dealing with repetitive tasks. Otherwise, through analyzing data, AI can discover problems that humans can't find and propose new and creative solutions.

(2) Technical Cost (TC)

In most cases, companies will not research new technologies themselves. Instead, they will buy professional services, which will also increase the cost of the project.

(3) the Requirement of Data (RD)

The more complex the function is, the more data is needed. This may lead to privacy issues. And the resources of data can be a problem too. Not many companies have enough data to train the model.

(4) Technical Maturity (TM)

AI technology is a cutting-edge technology that is still evolving. The maturity of the technology will affect the reliability of the method and the accuracy of the prediction. Over-reliance on immature technology will lead to project failure.

(5) Impact on Human Resources (IHR)

Automation reduces employee demand and leads to unemployment. These effects will push project members to be anxious and affect the reputation of the company which eventually leads to a decline in profits.

We will measure the weight of each attribute.

	PI	TC	RD	TM	IHR
PI		1	1	1	1
TC	0		0	0	0
RD	0	1		1	1
TM	0	1	0		1
IHR	0	1	0	0	

Table 2 Pair-wise comparison of attributes¹⁴

As is showed above, the Performance Improvement is the most important attribute. Projects need to bring value to stakeholders, and a high level of performance improvement can help the company to keep competitive in the new era. The second important attribute is the Requirement of Data. About 49% of IT decision-makers reported that “their organization is unable to deploy the AI technologies they want because their data is not ready to support the requirements of AI technologies.”¹⁵

FINDINGS

Step 5 Summarize

According to the MADM method, we will measure each alternative in the table below.

	IA	CA	MLPM	APM
PI	1	1	2	3
TC	3	2	2	0
RD	2	1	2	1
TM	3	2	2	0
IHR	0	2	3	1

Table 3: Alternative scores¹⁶

Based on the table we created, we can get a new table with relative ranking as below.

	Ordinal Ranking	Relative Ranking
PI	5	APM>MLPM>CA=IA
RD	4	MLPM=IA>CA=APM
TM	3	IA>CA=MLPM>APM
IHR	2	MLPM>CA>APM>IA

¹⁴ By Author

¹⁵ Davos. (2018, January 23). Infosys research: Business leaders adapt as enterprise AI moves beyond experimentation. Retrieved from <https://www.infosys.com/newsroom/press-releases/Pages/enterprise-ai-beyond-experimentation.aspx>

¹⁶ By Author

TC	1	IA>CA=MLPM>APM
Sum	15	Na

Table 4 Relative ranking¹⁷

The relative ranking isn't clear enough, so we are going to use quantitative analysis by calculating the weighted alternative score to find the best alternative.

	Normalized weight	IA	CA	MLPM	APM
PI	5/15=0.33	0.33	0.33	0.66	0.99
TC	1/15=0.06	0.18	0.12	0.12	0
RD	4/15=0.27	0.54	0.27	0.54	0.27
TM	3/15=0.2	0.6	0.4	0.4	0
IHR	2/15=0.13	0	0.26	0.39	0.13
Sum	1	1.65	1.38	2.11	1.39

Table 5 Weighted alternative score¹⁸

Alternative	Ranking
MLPM	1
IA	2
CA	3
APM	4

Table 6 Alternatives and ranking¹⁹

Step 6 Selection of the preferred alternative

According to the tables in step 5, we can see that the Machine learning-based project management (MLPM) is the best choice and the APM is the worst.

(1) PI

By using the machine learning-based system, the software can predict the tendency of project result. It learns from the previous project experience and judges if the project will exceed the budget or delay. IA and CA will also improve performance but in some simpler work. They focus on repetitive tasks and simple task resolution, but recently, a survey shows that the most

¹⁷ By Author

¹⁸ By Author

¹⁹ By Author

common reasons for IT project failure are project management failures such as unexpected risks or inaccurate estimates²⁰. Solving repetitive tasks does not bring many benefits to the project, so the MLPM will have a higher performance improvement.

(2) RD and TM

As for the data requirement, CA and APM need a common resolution which means they need a lot of data from different domains and different companies. This will result in increased costs and, moreover, this may lead to privacy and legal issues. MLPM is different. Some researchers hold the view that MLPM shall provide suggestions or risk analysis which is dependent on each user and project type and there have been related research and papers on this issue²¹. It is entirely possible to use very little data for MLPM.

(3) IHR and TC

As mentioned above, people are worried that AI will replace their work and some jobs have already been replaced by automation and chatbot. MLPM is quite different. The MLPM system requires the right data, so the project team using MLPM needs to filter, format, and delete unwanted and erroneous information which called “data clean” by data scientists. The results produced by the MLPM system are also data which need to be analyzed. Because of this, companies will hire more people to update and analyze data or maintain programs and develop algorithms²². Besides, companies will pay more attention to the design team because of efficiency improvement. More creative work will be provided. As we discussed in PI, the benefits of AI technology will cover its cost except for APM. Scientists believe that it will bring huge benefits and they estimate the time node of its arrival, but it is true that the cost of developing it now is too high and unnecessary for the company. With a lot of paper support and software prototypes, MLPM is more realistic.

Step 7 Performance monitoring

To monitor the result of the alternative, we collect the project data for three years after implementing the alternative in this paper. If the method works well, the data will show a tendency as below:

- (1) The project failure rate shall decrease.
- (2) The cost performance index (CPI) of the project shall increase.
- (3) The schedule performance index (SPI) of the project shall increase.

²⁰ Greene, J. (2018, May 20). The top 9 reasons for IT project failure: Is your project at risk? Retrieved from <https://www.askspoke.com/blog/it/reasons-for-it-project-failure/>

²¹ Pedroso, M. (2017, May). Application of machine learning techniques in project management tools. Retrieved from <https://fenix.tecnico.ulisboa.pt/downloadFile/1689244997257463/EA.pdf>

²² Schwartz, P. (2018, May 29). Why AI will create jobs. Retrieved from <https://www.strategy-business.com/article/Why-AI-Will-Create-Jobs?gko=c2a84>

CONCLUSION

We can now answer to the questions asked at the beginning of this research:

- (1) What is AI project management?
- (2) What are the feasible alternatives for using AI in project management?

AI plays an important role in maintaining the company's competitiveness and improving profits. Applying it to project management can effectively improve the efficiency of the project team. People use AI for project management in the form of IA, CA, MLPM and APM. Considering PI, RD, TM, TC, and IHR, the best way people work with AI is MLPM. The point of this paper is that companies should pay attention to MLPM. Study MLPM or use third-party services to change traditional project management methods. Project managers should keep up with the times as well. Learn AI project management and apply it to work. AI can be a good assistant for in project management.

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With this double academic specialization, he will be able to create more value for future projects linked to IT. He worked for Hefei Huasheng Pumps & Valves co.,LTD for 4 months as a member of development team and he is passionate about his work.

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