The Rise of the Importance of Artificial Intelligence in Project Management

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Abstract

The popularity of artificial intelligence (AI) and machine learning (ML) techniques will only continue to climb. Applications in the project management space are currently growing, both in academic research and in industry. This paper starts with a brief overview of AI before taking a look at the current state of the discipline in industry as reported by top consulting firms. Continuing onto the relevance of AI techniques in project management as a way to improve combating uncertainty throughout the project management lifecycle. The paper concludes with a brief look at some recent research either comparing or combining AI techniques with established project management methods.

Keywords: project management, technology, artificial intelligence, machine learning, prediction

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Introduction

Over the last decade, artificial intelligence, machine learning, and data science have become buzz words across the business spectrum. It should not be surprising that these disciplines and techniques have begun to reach into the realm of project management. In fact, the use of artificial intelligence and machine learning were recently listed as one of the top trends in project management for 2019 from two popular online project management think spaces (Aston, 2019; Strasser, 2019). As an introduction to the purpose of artificial intelligence for project management, this paper explores what artificial intelligence is, how it can help the project management process, and show some successful use case studies.

Discussion

An Overview of Artificial Intelligence

While both artificial intelligence and machine learning tend to conjure up images of science fiction, both disciplines are not new. The former as a research discipline began in the mid-1950s, while the latter, a sub-discipline of AI, followed shortly after. Formally, artificial intelligence is "a field of computer science dedicated to solving problems which otherwise require human intelligence—for example, pattern recognition, learning, and generalization" (Zujus, n.d.). Extending the methods of AI, machine learning leans on known statistical techniques to allow computers to learn through a given set of data. It was only after hardware capabilities reached a point where these technologies could be developed quickly did the two disciplines start to take off. In today's landscape, in one form or another, the output of an AI or

ML algorithm has found its way into our general life, with business applications being no exception. With a multitude of techniques helping to drive individualized decision making throughout an organization, project managers are now looking towards these techniques to see how they can utilize them within the project management space.

Both artificial intelligence and machine learning offer a variety of techniques that project managers might find useful. While the purpose of this paper is not to break down each technique, a quick overview is necessary to help eliminate some of the mysticism of AI that tends to permeate. In his overview of AI to project managers, Zujus (n.d.) offers this clear distinction of AI versus other computer-mediated techniques: "A key takeaway of AI is that its algorithms use a large amount of data to adjust their internal structure such that, when new data is presented, it gets categorized in accordance with the previous data given." Some common AI and ML techniques include neural networks, fuzzy cognitive maps, support vector machines, and clustering analysis. Each fulfills a unique purpose ranging from trying to simulate the flow of a natural process to being able to accurately group or classify new information.

Artificial Intelligence in Enterprise Technology

As with any emerging technology, early adopters tend to see the largest return on investment, even though they are also taking larger risks. The world of AI is no exception. In their recent report around adoption of AI in enterprises, Deloitte Consulting LLP reported that 83% of early artificial intelligence adopters saw returns on investment that were rated as either "moderate" or "substantial". The report continues on to mention the majority of these early adopters are adding artificial intelligence through enterprise software offerings where AI

capabilities are included in the product. Like most out of the box solutions, companies eventually outgrow them and need to build in-house (Loucks, Davenport, & Schansky, 2018).

However, with this booming field, obtaining the appropriate resources poses a significant struggle no matter the size of the organization. In particular, in a survey around the use of AI in organizations, 20% of organizations listed lack of skilled professionals as a barrier for utilizing these kinds of techniques (Lorica & Loukides, 2018). The use of AI and ML in project management will be no exception, leading to a proliferation of out-of-the-box solutions by well-established project management software companies. Popular project management software company Atlassian already offers a plug-in to Jira that promises to find and resolve small nuisance bugs, removing the work of planning and prioritizing off the project manager's desk, as well as freeing up skilled resources for more important tasks (Atlassian, n.d.). Atlassian also predicts that "early project management AI will be a project assistant focused on a narrow area of managing a project or team" such as "assisting with estimates, budget, and sprint management" or "management of team knowledge" (Atlassian, 2017).

Managing Uncertainty in Project Management

In fact, through homegrown solutions, there has been success in utilizing AI methodologies in these smaller areas of project management. In Martínez and Fernández-Rodríguez's 2015 paper, they showcase a variety of solutions for two particular use cases: project management success and critical success factor identification. For the former use case, the two make the argument that older methods of project management that are "based on expert judgement or on other parametric analytic tools" fail to adequately support projects because they do not allow enough space for the inherent uncertainty and complexity surrounding

most projects. The flexibility of artificial intelligence techniques could make for a more accurate measure of project success.

Controlling for uncertainty and complexity has been largely the goal for creating AI and ML techniques, no matter the application. In project management, these two qualities have a great effect on the success of a project and finding solutions to minimize them has long been a goal in project management research. Authors, Pich, Loch, and De Meyer (2002), put forward the stance that uncertainty and complexity relate to what they called "*adequacy of available information,*" meaning that the key to reducing uncertainty and complexity is not simply more information, but the right kinds of information. They continue in their argument that these negative effects on projects can be improved by "a combination of *learning* (the capacity to conduct new and original planning in the middle of the project) and *selectionism* (the pursuit of multiple candidate solutions until the best can be identified)." Their definitions of learning and selectionism both lend well to artificial intelligence techniques. With respect to learning, AI can offer help modeling and singling out potential trends that can lead to more appropriate planning. Artificial intelligence also offers the data-driven iteration needed to evaluate multiple solutions and their impacts and timelines.

It's this combination of both artificial intelligence and raw human intelligence that can bring the most value when combating uncertainty and complexity in project management. Accenture studied this relationship between machines and humans in a survey of over a thousand firms. They found that companies that embraced collaborating artificial intelligence techniques with human learning saw an even larger increase in the value added from artificial intelligence initiatives. Using the results, they identified a model, which the consulting firm calls MELDS, of

five key principles of collaboration between artificial intelligence and humans. The model is repeated below as exactly from the report:

1. They have adopted the right **MINDSET** for reimagining what's possible, rather than tinkering with what's standard.
2. They have championed **EXPERIMENTATION** throughout the enterprise.
3. Their **LEADERSHIP** has taken an active role in setting goals and directing AI strategy, not leaving decisions siloed to IT practitioners.
4. They have incorporated **DATA** as an integral part of their AI strategy, always striving to obtain the right data rather than the most data.
5. They have empowered employees to cultivate new **SKILLS**, all while redefining their work around AI. (Wilson, Lavieri & Shukla, 2018).

For each principle in MELDS that a firm adopted, their value proposition increased, with firms that adopted all five principles seeing an increase of 6.5x over a non-AI based initiative (Wilson et. al., 2018). While Accenture's work looks at AI's impact in a variety of cases, to successfully add in artificial techniques, project managers would be wise to follow the MELDS method.

Case Studies

The following section presents various published case studies that utilize some kind of artificial intelligence or machine learning technique to some aspect of project management. Some are more theoretical and generalized, focusing on presenting the utility that artificial intelligence methods can offer. Most of the established literature, including the work of Martínez & Fernandez-Rodriguez mentioned above, concentrate on the applications to project duration or

project success. In general, project duration lends itself well to prediction, including more common methods such as regression have been used in the past, so there is little surprise that the first forays into artificial intelligence would be project duration.

The first study of interest, by Wauters and Vanhoucke (2016), is not a traditional case study. Instead if offers a comparison of artificial intelligence techniques versus more traditional project management forecasting methods. The purpose of the paper is to offer evidence of the validity of the included AI techniques when forecasting project duration length. Wauters and Vanhoucke compared five algorithms: decision trees, bagging, random forest, boosting, and support vector machines, with Earned Value Management (EVM) methods.

The researchers describe their methodologies in depth, as one of the main goals is to introduce how to do AI in the project management space. The analysis run in this study, however, is simulated data. While the AI methods did perform better than the EVM, the researchers make sure to note that these methods would need to "pass the test of empirical validation" by testing these methods "to real-life projects and using expert judgement or historical data as proxies" (Wauters & Vanhoucke, 2016). Nonetheless, this study offers a glimpse into a variety of AI methods and some evidence of their potential usefulness in project management.

A year later, Wauters and Vanhouke return with another paper focusing on project duration forecasting and artificial intelligence techniques. Unlike their previous paper, which compares older methods like EVM with newer techniques, this paper seeks to enhance EVM with an AI technique called k-Nearest Neighbors. By using Nearest Neighbors, the authors hope to increase the accuracy and stability of the EVM method, as well as test the usefulness of a

hybrid AI method (Wauters & Vanhouke, 2017). Unfortunately, this paper also has the drawback of only being tested on simulated data and needs to be tested in a real-life project management setting.

Continuing on the trend of merging AI techniques with popular project management theory continues in Dam, Tran, Grundy, Ghose and Kamei's 2018 paper. In this work, the authors look at how AI technologies can be used within the Agile environment to improve productivity and decision making. After an introduction to the structure of Agile, Dam et. al. highlight four areas of Agile methodology where AI shows promise for improving. They include identifying backlog items, refining backlogs, prioritizing stories and workloads during sprint planning, and tracking sprint process. Unlike many of the other papers listed, the stated goals for the next steps are to build a prototype based on the study's findings (Dam et. al., 2018).

The last paper highlighted utilizes a technique that is rarely used compared to other techniques. In Xu and Lin's work, they approach their problem by relating AI back to the original idea of the discipline:

> Since AI can be simplified as the technique of simulating human intelligence by means of computer, yet the most powerful capability of human being is its ability of treating massive fuzzy information. Therefore, using fuzzy information processing and AI technology for simulating human intelligence will have broad perspective future. (Xu & Lin, 2016)

The two authors combined Analytic Hierarchy Process (AHP) with Fuzzy set information processing with the idea that the addition of fuzzy logic will help the limitations of AHP. Unlike other classification methods, where each decision is made by a binary choice, fuzzy logic adds a

degree of uncertainty by basing choices off of a variety of loosely defined choices, similarly to how humans make their own decisions. As a method, fuzzy logic has its own difficulties, both from an interpretation point of view as well as being computationally expensive. It's a novel approach, however, may not be realistic for large scale projects.

Conclusion

While the case studies above are mostly theoretical or academic in nature, they do offer a glimpse into the potential applications of AI technologies into the project management space. As noted earlier in the paper, most organizations will see these benefits coming from project management software vendors' offerings, since acquiring the appropriate time and resources for building customized solutions will be out of reach for many. However, the initial feedback from those that implement artificial intelligence and machine learning technologies has been overwhelming positive, as noted by top consulting firms like Deloitte and Accenture. Forward thinking project managers would do well to begin their understanding of AI and ML so that when the appropriate solution comes available, they can adopt it as quickly as possible.

References

Aston, J. (2019, January 15). Prepare For These 7 Project Management Trends Transforming The PM Role [Blog Post]. Retrieved from https://thedigitalprojectmanager.com/project-management-trends-2019/

Atlassian. (n.d.). JIRA Solver. Retrieved August 1, 2019, from https://www.atlassian.com/solver

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

Dam, H. K., Tran, T., Grundy, J., Ghose, A., & Kamei, Y. (2018). Towards effective AI-powered agile project management. *ArXiv.org.* Retrieved from https://arxiv.org/pdf/1812.10578.pdf

Lorica, B. & Loukides, M. (2018). *How companies are putting AI to work through deep learning.* Retrieved from O'Reilly website: https://www.oreilly.com/data/free/how-companies-are-putting-aI-to-work-through-deep-learning.csp

Loucks, J., Davenport, T., & Schansky, D. (2018). *State of A.I. in the enterprise, 2nd edition.* Retrieved from Deloitte Consulting LLP website: https://www2.deloitte.com/content/dam/insights/us/articles/4780_State-of-AI-in-the-enterprise/DI_State-of-AI-in-the-enterprise-2nd-ed.pdf

Martínez, D.M. & Fernandez-Rodriguez, J.C. (2015). Artificial intelligence applied to project success: A literature review. *International Journal of Interactive Multimedia and Artificial Intelligence, 3*(5), pp. 77-84. doi: 10.9781/ijimai.2015.3511

Pich, M.T., Loch, C.H., & De Meyer, A. (2002). On uncertainty, ambiguity, and complexity in project management. *Management Science, 48*(8), pp. 1008-1023. doi:10.1287/mnsc.48.8.1008.163

Strasser, J. (2019). 11 Trends in Project Management and Resource Planning in 2019 [Blog Post]. Retrieved from https://www.theprojectgroup.com/blog/en/project-management-trends/

Wauters, M. & Vanhoucke, M. (2016). A comparative study of artificial intelligence methods for project duration forecasting. *Expert Systems With Applications, 46,* pp. 249-261. doi: 10.1016/j.eswa.2015.10.008

Wauters, M. & Vanhoucke, M. (2017). A Nearest Neighbour extension to project duration forecasting with Artificial Intelligence. *European Journal of Operational Research*, *259*(3), pp. 1097-1111. doi:10.1016/j.ejor.2016.11.018

Wilson, H. J., Lavieri, D. & Shukla, P. (2018). How Human + Machine are Better Together [Blog Post]. Retrieved from Accenture website: https://www.accenture.com/us-en/blogs/blogs-human-machine-better-together

Xu, F., & Lin, S. (2016). Theoretical framework of Fuzzy-AI model in quantitative project management. *Journal Of Intelligent & Fuzzy Systems, 30*(1), pp. 509-521. doi:10.3233/IFS-151776

Zujus, A. (n.d.). AI project development – How project managers should prepare [Blog Post]. Retrieved from https://www.toptal.com/project-managers/technical/ai-in-project-management