The 3rd International Conference on Economics and Social Sciences
Innovative models to revive the global economy
October 15-16, 2020
Bucharest University of Economic Studies, Romania

Artificial Intelligence Adoption in Project Management: Main Drivers, Barriers and Estimated Impact

Constanta-Nicoleta BODEA[1]*, Cosmin MITEA[2], Oana STANCIU[3]

DOI: 10.2478/9788395815072-075

Abstract

Artificial intelligence (AI) is reshaping the business world, being considered one of the most relevant disrupting factors in our days, due to its major impact on the workplace conditions. Several academic and practical studies were undertaken in order to identify the main drivers, barriers and impact adoption of AI technologies in business. But the adoption of AI in management, in general and, more specific, in project management (PM) processes is still not yet well covered by the actual research.

The paper aims to identify the characteristics of Artificial Intelligence adoption in project management, based on the theoretical frameworks related to the technology adoption. The authors also present findings of a global survey conducted by IPMA and PwC Romania during March-August 2020. By comparing the main findings of the global survey with the conclusions derived from the analysis of the theoretical frameworks, the authors discuss about the relevance of using the technology adoption frameworks in order to analyse the adoption of disruptive technologies.

Keywords: Artificial intelligence, Project Management, Adoption drivers, Adoption barriers, Adoption impact.

JEL Classification: O14, O33, O32, Q55, O31

1. Introduction

In the literature on technological change, Ricardo (1817) was one of the first economist acknowledging the importance of equipment and technological improvements, for the enhance of economic growth in the industrial sector. The technical improvement is perceived as part of the capital accumulation and not as an economic growth factor as such. It was Schumpeter (1942) who made an important contribution in the economic growth theory, by revealing the role of the

[1] Bucharest University of Economic Studies, Bucharest, Romania, bodea@ase.ro.
[2] PricewaterhouseCoopers Romania, Bucharest, Romania, cosmin.mitea@pwc.com.
[3] PricewaterhouseCoopers Romania, Bucharest, Romania, oana.stanciu@pwc.com.
* Corresponding author.

technical progress as a growth factor. Schumpeter has linked the economic development with innovation, perceived as the development of equipment, new products, new production methods and new industrial organization.

After the mid of twenty centuries, the research on technological changes was more focused on the adoption and usage of new technologies. The technological innovation is perceived as an important factor for transforming the entire society, a factor which should be better understood, controlled and promoted. By considering the technical change as an exogenous factor for the economic activities, Solow (1956) and Swan (1956) established the foundation for the modern theory of economic growth.

The theory of innovation started to connect the markets' characteristics with the behaviour of firms (Scherer & Ross, 1990). Certain characteristics of the markets, such as concentration are important for stimulating the innovative behaviour of the firms.

Due to the continuous advancements of technologies and the intensification of the information flows on the global markets, knowledge began to be perceived as one of the main drivers of the economic growth, being considered as an important economic resource. Even though knowledge was always embodied in the economic activities, the digital technologies (Information and communications technologies-ICTs) expanded the economic presence of knowledge and has leaded to the acknowledgement of knowledge, as a productive factor. The extended usage of ICTs had changed the economy: new activities emerged, new behaviours of the economic actors, new competences required for the personnel. All these changes were integrated into the concept of New Economy. Related to the diversity of the changes in economy due to the technological innovations, Edquist and Riddell (2000) defined the following taxonomy: a) continuous (or small incremental) changes; b) discontinuous (or radical/disruptive) innovations and c) techno-economic paradigms changing. The concept of disruptive technologies is highlighting the impact more than the novelty of the technologies. The disruptive technologies are those which have a significant impact on the economic activity of firms.

Artificial Intelligence (AI) technologies are considered as being one of the most relevant disrupting technologies. The adoption of AI technologies leads to significant changes in the business rules, organizational culture and organizational performance. Considering that the AI technologies adoption in management, more specific, in project management is still not yet well researched, the authors of the paper contributed to a global study (survey), conducted by IPMA and PwC Romania during March-August 2020, and having as main objectives the identification of the perceived status of AI adoption in project management (PM).

The structure of the paper is as follows: After introduction, the next section of the paper presents some of the relevant theories, frameworks and models of technological adoption. In section 3, the research methodology of the global survey AI adoption in PM is presented. Section 4 presents the main findings of the global survey and section 5 includes a discussion about the global survey findings, mainly

in connection with the technological adoption frameworks. Authors also discuss about the utility of the technological adoption frameworks in researching the disruptive technologies.

2. Technology Adoption Theories, Frameworks and Models

Considering the importance of technological changes for economic growth, researchers defined theories, frameworks and models of the technology adoption, in organizations and at individual/user level. Table 1 is presenting some of the most known technology adoption theories.

Table 1. Relevant theories for the technology adoption

Theory	Technology adoption mechanism	References
Diffusion of innovation (DOI)) Theory	Diffusion process with multiple stages: understand innovation, intention to innovate, decision to innovate, implementation and usage. Main factors: innovation characteristics (relative advantage, compatibility with existing infrastructure, complexity, possibility to observe and try it), communication, time and social environment.	(Rogers, 1962)
Theory of the firms' Behaviour	Adoption behaviour factors: limited rationality; the problematic and slack search; the operating procedures, coalitions;	(Cyert & March, 1963)
Evolutionary economic theory	Technological changes on a longitudinal perspective (evolution of the technologies with incremental changes/ breakthroughs Stochastic adoption behaviour	(Nelson & Winter, 1982)
Theory of the creative destruction	The firm survival goal explains the innovation adoption behaviour.	Schumpeter (1942)
Network externalities theory	Adoption of innovation has network effects	(Farrell & Saloner, 1985)
Theory of Reasoned Action (TRA)	It explains and predict the social behaviour in relation with the technology adoption.	(Fishbein. & Ajzen, 1975)
(Decomposed) Theory of Planned Behaviour (TPB)	Three factors determine the adoption intention: attitude, subjective norms and the perceived control behaviour. Decomposed TPB	(Taylor & Todd, 1995)

Source: Authors' own contribution

The adoption frameworks and models (table 2) are defined as to understand why and how the organizations are innovating, by adopting new technologies and products. There are many general factors explaining the technology adoption, such as: technology availability, technology readiness, difficulty in adopting/implementing the technology, the importance/ relevance and urgency of the requirements/needs possible to be fulfilled by applying the technology.

Table 2. Frameworks and models for the technology adoption

Frameworks and models	Description	References
Technology–Organization–Environment (TOE) framework	Main factors of the adoption ability: organizational learning (knowledge barriers knowledge diversity, etc.), other environmental, organizational and technology characteristics, such us: market competitiveness, firm size, financial soundness, technology complexity.	(Tornatzky, Fleischer & Chakrabarti, 1990)
Iacovou, Benbasat and Dexter's framework	Adoption decision depends on the external pressure (market position, network externalities etc.), the organizational readiness (resource availability, integration with existing technologies, operational support etc.) and perceived benefits (impact on the productivity, level of costs, etc.).	(Iacovou, Benbasat & Dexter, 1995)
S-curve diffusion models	The function's parameters: the availability of technology (the origin), the acceptance rate (the slope) and the usage level (the ceiling).	(Griliches, 1957)
Imitation (or epidemic) models	Technology adoption is modelled through a stochastic variable, defined based on the number of firms already using the technology, the investment size, expected profit.	(Mansfield, 1961)
Absorptive capacity model	The model connects the firms' ability to acknowledge and assimilate the value of technology-related information with firm's capacity to use this information in decision making.	(Cohen & Levinthal, 1990)
Dynamic capabilities model	It relates firms' capabilities and resources to competitive advantage, in relation to the technology adoption.	(Teece, Pisano & Shuen, 1997)
Task-Technology fit (TTF) model	A good fit between task and technology increases the technology level usage and its performance impact (better efficiency, effectiveness, and/or quality).	(Goodhue & Thompson, 1995)
Technology Acceptance Model (TAM)	TAM uses two factors (usefulness and ease of use) in order to explain the computer usage intention and behaviour.	(Davis, 1986)
Extensions of TAM (ETAM)	TAM2 includes two new factors: the social influence construct (including the subject norms, image and voluntariness), and the cognitive construct (including the job relevance, the result demonstrability and the output quality). TAM3 includes four additional factors: individual differences, social influences, system characteristics and the facilitating conditions.	(Venkatesh & Bala, 2008) (Venkatesh & Davis, 2000)
Unified Theory of Acceptance and Use of Technology (UTAUT)	It includes additional predictors for the acceptance intention: the effort and performance expectancy, social influence and facilitating conditions. Other four variables were identified as moderating the relationships between different variables of the model: gender, experience, age and voluntariness of use.	(Venkatesh & Morris, 2000)

Source: Authors' own contribution

In case of Information and Communication Technologies (ICTs), most of the models are centred on individuals who are taking decisions about the usage of different ICT systems and tools. Depending on the level at which the decisions about the tools to be used are usually taken, different theories, frameworks and models from those presented in tables 1 and 2 are more adequate in order to study the ITCs adoption process.

3. Global Survey AI in PM

The authors were involved in a global survey conducted by IPMA and PwC Romania during March-August 2020, having as main objective the identification of the perceived status of AI adoption in project management, the evolution of AI adoption in different project management activities, the main factors influencing directly and indirectly (as mediating factors) the AI adoption decisions in PM, the main barriers in the AI adoption in PM, and the main AI methods and tools applied in PM. The target groups of the global survey were project management professionals (project managers and project team members), executive and functional managers of companies, mainly those implementing projects and IT specialists, involved in the development of AI systems and tools for project management.

The adoption of AI is rapidly expanding. Mainly known as the ability of a machine to perform cognitive functions associated with human mind and reasoning, AI includes capabilities that enable AI to solve business problems, including in projects. Global survey AI in PM listed over 35 questions and more than 65% of the respondents mentioned their organizations as having AI embedded in at least one of their standard project management flows or planned to be adopted in the next 3 to 6 months, while 56% of respondents reported to have AI as part of their digital transformation strategy.

All over the world, companies and professionals are beginning to harness these technologies and start to feel their benefits. Almost 80% of the total 295 participants in the Global Survey live in Europe followed by 16% which are in Asia and Middle East, 4% from America and less than 1% from Australia or Africa. Most respondents whose companies have deployed AI in a specific function report achieving value from that use, embedding AI into multiple business units or functions. In terms of the results, over 67% of the respondents are working in roles within technology and business service industries; 7% are working in engineering and construction, 5% in automotive and 4% in government and public sector, the rest of 16% are in other various roles within industrial manufacturing, education, energy and utilities, healthcare, agribusinesses and food production.

In terms of the roles of the respondents within the organizations, 24% are represented by project/ programme/ portfolio managers or directors and other 24% of the respondents are currently working as IT/IS professionals which include solution architects, AI professionals, developers and testers. The executive and functional managers have represented 19% and other 25% are having experience as

team members in specialized roles such as scheduler, risk manager. There are also 8% who are currently agile leaders or PMO directors.

The ethical standards involving the human participants were met. An informed consent was obtained from all participants in the survey and data is completely anonymized.

4. Main Findings of the Global survey

While the adoption of AI is still in its early stages, the survey reveals that it's already meaningful in terms of "empowerment" rewards. When respondents were asked about the value of empowerment and when it comes to driving decisions in implementing Artificial Intelligence technologies within project management, the results are encouraging. 33% of the respondents have the perception of empowerment or are extremely empowered, 28% remain neutral and 38% don't feel empowered or feel not at all empowered.

In terms of decision level regarding the implementation of AI technologies, most respondents (45%) see the Executive as the right level of decision, followed by 19% who consider the project or programme governance level as the right decision body. Functional level was selected by 14% and only 12% consider the project team as the proper level for implementation decisions. And for only 9% of professionals it's still unclear where the decision should occur, where the clear strategy and mechanisms of communication should be developed.

The most important factors acting as drivers for adopting AI technologies in PM, based on their importance are presented in figure 1.

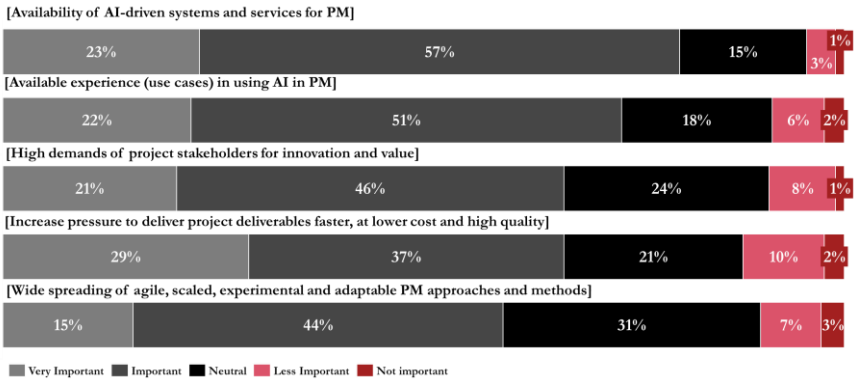

Figure 1. The main drivers of AI adoption in PM

Source: Authors' own contribution

The first three reasons for adopting AI in PM which were indicated by more than half of the participants in the survey (figure 2) are linked to the needs in increased productivity which will free up project managers allowing them to focus on more important decisions (53%), followed by better decision-making

capabilities (52%) and the necessity to improve overall project performance and reporting (51%). As a conclusion to these answers, respondents indicate the time gained for strategy related issues as an important benefit.

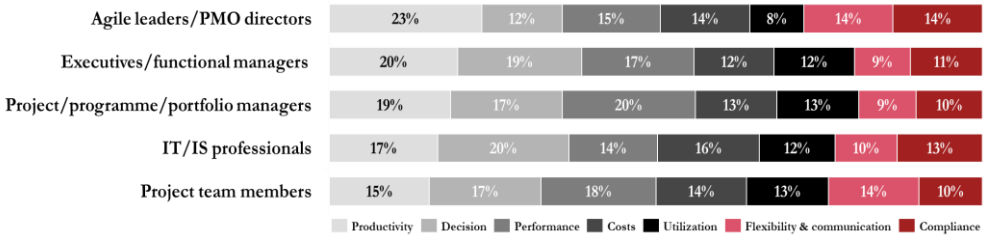

Figure 2. Expected benefits of AI adoption in PM, as perceived by respondents with different roles in organizations

Source: Authors' own contribution

Although AI adoption advances, foundational barriers remain, at least in terms of perception (figure 3). When asked about the current barriers in using AI tools in project management, a majority of 70% of the participants in the survey indicated the limited understanding of AI technologies as the main barrier, followed closely by 62% which have difficulties in deciding the best AI applications, due to limited experience. Data privacy, digital ethics and security risks represented the third identified barrier and the limited IT capabilities such as IT technical skills, standard IT processes/procedures, IT infrastructure were indicated in 58% of the answers. The fifth main barrier is the large number of AI solutions that are not mature enough for the full deployment.

Figure 3. The main barriers in adopting AI in PM

Source: Authors' own contribution

One of the key findings was related to the main project management practices that could benefit from the AI solutions which showed that time, quality, change and transformation are the first options when we speak about process automation (figure 4). One critical enabler of AI is a company's progress during its digitization journey, in order to fulfil the accomplishment of all above 3 attributes: time,

quality and change. Usually, the organizations that have made the most progress in digitizing core business processes are also on the leading edge of AI adoption. Chatbot assistants could also be a solution for better stakeholder's management and could have positive results in organization and information. When it comes to augmented analytics, risk, quality, plan and control are the main practices benefiting from the AI adoption.

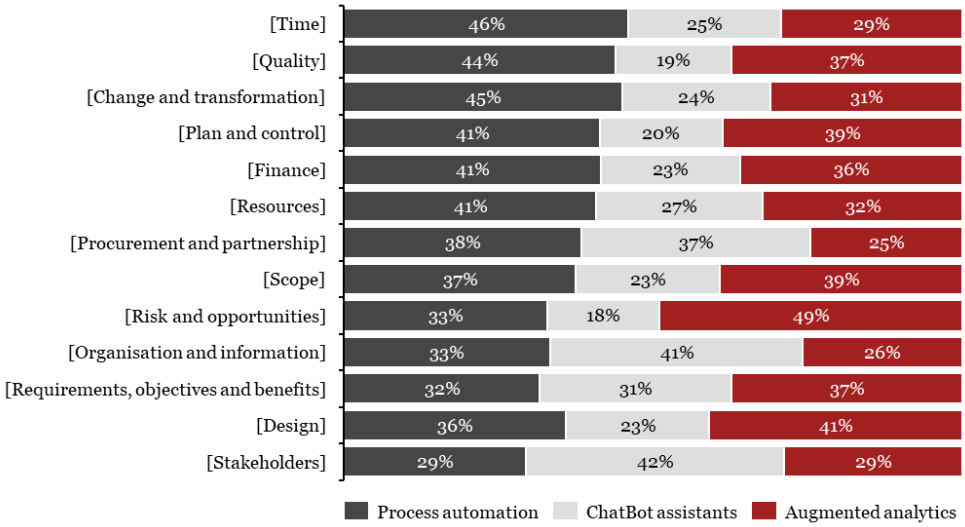

Figure 4. The expected impact of AI adoption in PM

Source: Authors' own contribution

As signalled in the survey, the most probable role that AI tools will have in project management is expected to be either that of an advisor according to 44% of the participants in the survey, or of an assistant of the project manager with more than 52% of the responses.

5. Discussions and Conclusions

Artificial Intelligence adoption is facing many challenges, from the impact of current models and associated barriers which shows signs according to which it will be overcome in the following years, to the disruptive nature of current technologies which are changing the project management models in both public and private sectors. Looking ahead, the survey results suggest that digitization and certain foundational practices are critical to creating value from AI and enabling progress. The implications related to adoption of AI are significant, but for many companies, they involve transformation-level changes to the very business processes at the core of the company and new ways in which people, with different capabilities, will work.

Considering that executive level is perceived by most of the respondents as the right level for decision taking in relation to AI adoption, the frameworks and models to be applied are mainly those addressing the organizational behaviour, such as: TOE framework, absorptive capacity models and dynamic capabilities models. It is different from other ICTS, to which the models of users' behaviour are usually preferred. The models of organizational behaviour appear to be adequate to cover the main drivers and barriers of AI adoption, which allows us to consider that there is no need to develop new frameworks and models for the adoption of disruptive technologies in the project management domain.

Acknowledgments

The contributions of the following organizations to the development and financial support of this research is noted with thanks: International Project Management Association (IPMA), PricewaterhouseCoopers Romania (PwC) and Project Management Romania Association (PMR). We also thank those who filled in the survey.

References

[1] Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly*, pp. 128-152.

[2] Cyert, R. M., & March, J. G. (1963). *A Behavioural Theory of the Firm*, Eng. Cliffs, New Jersey.

[3] Davis Jr., F. D. (1986). A Technology Acceptance Model for Empirically Testing new End-user Information Systems: Theory and results, In, *Massachusetts Institute of Technology*.

[4] Edquist, C., & Riddell, W. C. (2000). The Role of Knowledge and Innovation for Economic Growth and Employment in the Information and Communication Technology (ICT) era, In: Rubenson, K., and Schuetze, H. G. (Eds.) *Transition to the Knowledge society: Policies and Strategies for Individual Participation and Learning*. Vancouver, Canada.

[5] Farrell, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation, *The RAND Journal of Economics*, pp. 70-83.

[6] Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*, Reading, Mass., Addison-Wesley.

[7] Goodhue, D. L., & Thompson, R. L. (1995). Task technology fit and individual performance. *MIS Quarterly*, 19, pp. 213-236.

[8] Griliches, Z. (1957). Hybrid corn: An Exploration in the Economics of Technological Change, *Econometrica: Journal of the Econometric Society*, pp. 501-522.

[9] Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology, *MIS Quarterly*, pp. 465-485.

[10] Mansfield, E. (1961). Technical Change and the Rate of Imitation, *Econometrica: Journal of the Econometric Society*, pp. 741-766.

[11] Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Harvard University Press, Cambridge, MA.

[12] Ricardo, D. (1817). On the Principles of Political Economy and Taxation, In Sraffa, P. (Ed)., *The works and correspondence of D. Ricardo*, 1, Cambridge Univ. Press

[13] Rogers, E. M. (1962). *Diffusion of innovations*, Free Press of Glencoe.

[14] Scherer, F. M., & Ross D. (1990). *Industrial Market Structure and Economic Performance*, 3rd ed., Boston: Houghton-Mifflin.

[15] Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*, 36, Harper & Row, New York, pp. 132-145.

[16] Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, 70, pp. 65-94.

[17] Swan, T. W. (1956). *Economic Growth and Capital Accumulation. Economic Record*, 32, pp. 334-361.

[18] Taylor, S., & Todd, P. (1995). Decomposition Crossover Effects in the Theory of Planned Behaviour: A Study of Consumer Adoption Intentions, *International Journal of Research*, 12, pp. 137-155.

[19] Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management, *Strategic Management Journal*, pp. 509-533.

[20] Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K. (1990). *Processes of Technological Innovation*, Lexington Books.

[21] Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions, *Decision Science*, 39(2), pp. 273-312.

[22] Venkatesh, V., & Davis, F. D. (2000). A theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies, *Management Science*, 46, pp. 186-204.

[23] Venkatesh, V., & Morris, M. G. (2000). Why Don't Men Ever Stop to Ask for Directions? Gender, Social Influence, and Their Role in Technology Acceptance and Usage Behaviour, *MIS Quarterly* (24:1), pp. 115-139.