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A Process Model of Artificial Intelligence Implementation Leading to Proper Decision Making

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Abstract. This study aims to fill a gap in the literature by identifying and extracting critical success factors that impact the success of AI implementation. The factors are then categorized and presented in a process model that demonstrates the sequence of the factors and the interrelationships among them. The model is composed of three stages: pre-implementation, implementation, and post-implementation. The implementation is composed of three categories organization, process, and technology. Each of these categories contains several critical factors. The model presented helps both researchers and practitioners. Details, discussion, and future research opportunities are discussed in the paper.

Keywords: Artificial Intelligence Implementation, Decision Making, Data Intelligence, Analytics.

1 Introduction

The adoption and implementation of Artificial Intelligence (AI) is rapidly growing across global businesses [1], [2], [3]. According to Gartner's 2019 CIO Agenda survey, forty eight percent of global CIOs planned on implementing AI systems by 2020 [4]. It is forecasted that AI will grow into a \$118.6 billion industry by 2025 [5]. AI is defined as systems that mimic cognitive functions/tasks, such as learning, speech and problem solving, that are associated and performed by humans within the workplace and society in general [6]. AI offers multitude of benefits to businesses such as reducing costs, eliminating human errors, being able to work 24/7, improving customer experience, enhancing productivity and operational efficiency, and streamlining and accelerating decision-making to make the proper decisions [7], [5]. One can perhaps argue that the last one on decision-making is the most important applications in AI since decisions impact all other areas in any business. AI systems can be used to either support the human decision makers or replace them [8].

The benefits of AI for decision making have been praised by many researchers and practitioners because AI is believed to be able to help organizational decision makers to reach better decisions, to enhance employees' analytic and decision-making abilities, and to intensify creativity e.g., [9], [10]. At the same time, researchers and practitioners

admit that without a successful implementation of AI systems, organizations cannot achieve the desired outcomes including the correct and proposer decisions. For this reason, researchers in recent papers called for research that examine the critical factors affecting AI's success in decision making [6], [9]. This research satisfies the calls and attempts to answer the following research questions: What are the critical factors that will significantly affect AI's success for decision making?

The extant literature on successful AI implementation lacks comprehensive studies that combine the critical success factors. A model that demonstrates the process to achieve success in AI implementation is also missing. To our best knowledge and based on the search we conducted, there exist two peer-reviewed academic studies [11], [12], two peer-reviewed practitioners' studies [13], [14], and four practitioners reports [2], [4], [15], [16] on AI implementation. None of these papers present a comprehensive model since their aim was not to present such a model. In this paper, we intend to fill this gap in the literature by:

- Identifying and extracting the significant factors from previous studies,
- Explaining how these factors impact successful AI implementation and decision making, and
- Presenting a comprehensive model that includes the critical factors.

We argue that a successful implementation of AI needs to pass through three major stages: pre-implementation, implementation, and post-implementation. Each of these stages has different critical factors. The first stage includes planning, budget, analysis, etc. The second stage includes critical factors that have been found to be important in literature. In this study, we categorize these factors to three categories: organization, process, and technology. The last and final stage is the outcome desired including proper decisions.

The presented model is a holistic, flexible, and dynamic framework expected to help both researchers and practitioners. Practitioners will find in this study a powerful means for identifying fundamental factors that can lead to smooth AI implementation and success. This model is flexible in that it can be used in different sized organizations: large, medium, or small; and countries: emerging or developed. Different organizations have different resources and cultures; depending on its use, this model can function as an integrated tool with all the factors, or with just a few of them. For researchers, the framework presented can be used as a foundation. To our best knowledge, no study has yet presented a taxonomy model on AI's success for decision making. Future research can empirically assess this model and/or add other critical factors that may influence AI's success for decision making.

2 Background and Literature Review

As mentioned earlier, the extant literature lacks a comprehensive study that examine the success factors of AI for decision making. To collect the factors that act as barriers or those that lead to successful implementation of AI, we searched three main databases, Business Source Complete, IEEE Xplore, and Emerald Insight. We only found two peer-reviewed academic studies and two peer-reviewed practitioners' studies on AI implementation. We also searched for AI practitioners reports in Google.com and

found four reports. We briefly mention the factors indicated by these previous peer-reviewed articles and practitioners reports.

Of the two peer-reviewed journal articles, [11] suggested that lack of benefits visibility, integration complexity, and cost of AI are barriers to the success of AI. [12] indicated that resistance, ethics issues, low data quality, insufficient quantity of data, and responsibility and accountability are critical factors leading to success or failure of AI.

After interviewing more than 3000 business executives, managers, and analysts from organizations around the world, [13] found that top management, security and confidentiality, lack of technical expertise, lack of benefits visibility, and IT infrastructure play an important role in the success or failure of AI. [14] identified nine critical factors that can challenge the success of AI. These factors are organizational structure, security and confidentiality, lack of technical expertise, integration complexity, ethics issues, data governance issues, low data quality, responsibility and accountability, and high cost of AI.

[15] advised that security and confidentiality, IT infrastructure, insufficient quantity of data, and high cost of AI are important factors leading to success of AI. In their report, [2] indicated that organizational structure, lack of technical expertise, lack of benefits visibility, resistance, integration complexity, IT infrastructure, ambiguous strategic vision, low data quality, insufficient quantity of data, and project champion as critical factors to AI success. In a report published by Gartner after interviewing CEOs of different organizations, [4] mentioned twelve critical factors to AI. These factors are top management support, security and confidentiality, lack of technical expertise, lack of benefits visibility, resistance, integration complexity, ambiguous strategic vision, data governance issues, low data quality, insufficient quantity of data, responsibility and accountability, and selection of vendors. Recently, [16] suggested that lack of technical expertise, resistance, ambiguous strategic vision, and ethical issues are barriers to AI success.

3 Proposed Model and Taxonomy

The research framework introduced in this paper classifies the factors of successful AI implementation into three phases. An illustration of the AI Process Model is depicted in Figure 1.

3.1 Pre-implementation

The first is the pre-implementation, in which decision makers choose to go with the project or not. Every project, including AI systems implementation, should start by defining the goals to be achieved, the available resources, the timeline, the required budget, the scope of the project, the systems to be implemented, the vendors, and the possible methods needed to accomplish these goals. This step serves as the blueprint of the project and helps motivate the stakeholders to commit to the project and work harder towards achieve its goals.

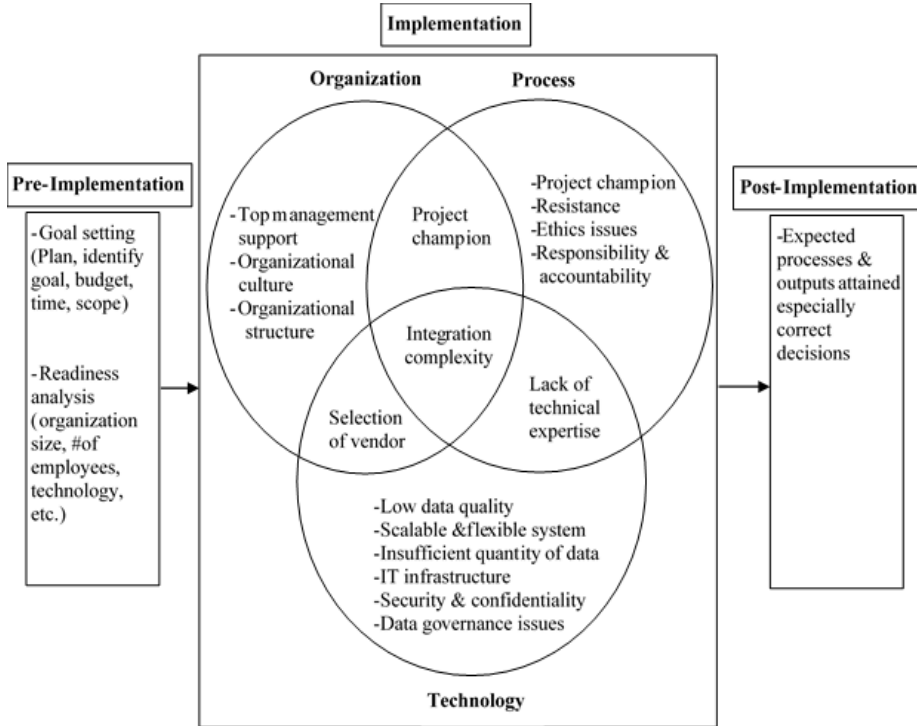


Fig. 1. A process model of AI success leading to proper decisions.

3.2 Implementation

The second stage – the implementation – is made up of three subcategories: organization, process, and technology. These categories are interrelated because AI implementation is a very complex process that touches different sections of the organizations. Factors under the category organization are top management, organizational culture, and organizational structure. Researchers and practitioners have validated the importance of top management on the success of IS and considered it to be a very critical factor leading to successful implementation of high cost and strategic value IS (e.g. [17], [18]). AI systems are like any other strategic IS and thus require top management support.

Organization's culture can be defined as the values, social ideals, and beliefs that employees of an organization share [19]. Because AI impacts all the decisions taken in an organization, it, thus, have an influence on the organizational culture and structure since the processes that are set inside the organization will change after the implementation of these systems. In their interviews with business executives, managers, and analysts, [13] found that the changes of culture and structure caused by AI are daunting.

Factors under the "process" category deal mostly with the employees inside the organization. Employees are the backbone of any organization. They are the ones who use the technology, make decisions, and advance the organizations. Factors that are

under this category are: resistance, ethics issues, and responsibility and accountability. AI systems introduce new processes and methods, causing changes in social and technical environments that can lead to confusion and inefficiency in the organization. The changes caused by the implementation of the new systems usually generate users' resistance because employees generally prefer the status-quo and avoid the changes. Employees' resistance to change has been found to be a major factor in many IS project failures [20], [21].

Technology factors are those related to the systems such as data quality and quantity, IT infrastructure, data security and governance issues. [22] emphasize that the data intelligence system's technical framework should be scalable and flexible with respect to additional data sources, attributes, and dimensions. AI are systems depend on data and technology. Data accuracy and reliability should be top priorities in the implementation of AI systems because they can lead to failure. AI systems rely on data and the quality of these data impact the output/result. Unreliable, incorrect, and poor data input impact the functionalities of the systems and lead to incorrect decisions. At the same time, these data need to be highly secured and protected to prevent misuse, fraud, or breaches. All stakeholders must feel confident that their private information will not be lost, sold, or otherwise, misused.

From the taxonomy model presented above, one can see that the three major categories are not separated. Conversely, these categories are interrelated. For instance, a project champion supervises the factors of both organization and process categories. A "champion project manager," who is a person that possesses managerial competencies in personal, technical, and business-oriented, is the one who sets all these objectives and leads the project. Without a strong managerial leader, the project will most likely fail. Also, having a technical expertise is necessary to link the technology to the process categories. Employees need to have the technical expertise necessary to use AI systems. If not, these employees need to be trained. An organization also need to select a vendor that can meet the criteria set by the management and that can have a good relationship with. Finally, three categories are linked by integration. AI systems depend on data collected from multiple databases that must be integrated. Also, outputs of AI systems impact all departments of an organization.

3.3 Post-implementation

Once the factors presented above are done correctly, the successful implementation (goal of the project) will be achieved. A successful implementation should lead to success in decision making and help organizations achieve competitive advantage and all desired outcomes of AI.

4 Discussion and Conclusion

Organizations across the globe of all sizes and sectors are interested in implementing AI systems. The enormous amount of produced data has also proliferated the need for intelligence systems. AI and data intelligence systems convert the collected data and transform them to knowledge and information that help enhancing decision making. AI

systems also make decision by themselves. Studies on the implementation of AI systems in are scarce as discussed earlier and there are calls for studies that examine this area. This paper fills a gap in the literature by identifying and extracting the most critical factors that were found to influence the implementation of AI and presenting them in a process model. To our best knowledge, no study has yet combined the factors and presented them in a taxonomy model.

This paper is expected to help both practitioners and researchers. The model presented helps practitioners in identifying fundamental factors that can lead to success of AI implementation. This model demonstrates how the factors are interrelated. For researchers, the framework presented can be used as a foundation. Future research can empirically assess this model and/or add other critical factors that may influence AI's success for decision making. For instance, the factors presented in the model can be evaluated and assessed using the analytical hierarchy process, a quantitative method of decision-making, to evaluate the importance of the factors presented in the study based on data collected from experts. Such studies can help both researchers and practitioners to understand the importance of the factors presented here.

5 Limitations and Future Research

This study has several limitations. First, the research model includes several factors and sub-factors that are the most critical factors; however, as mentioned, there may exist other factors that influence the implementation of artificial intelligence. We call for future research to investigate and find other critical success factors that may impact the implementation of artificial intelligence.

Factors that are specific for specific countries such as national culture factors, corruption, legal systems, etc. can be added to the list of factors identified in this study. Nations that suffer from high levels of corruption tend to face more resistance to IT-related projects because data analytics and intelligence systems fight the corrupt people and stop their business. Also, different nations have different levels of advancements, sizes, as well as resource capabilities. Another potential area for research is by collecting secondary or primary data on the factors included in the study and empirically examine the relationships help improving and enriching the body of knowledge.

Lastly, AI and data intelligence are evolving and changing drastically which means that new factors may become more important in the coming years. Thus, we call for future research to investigate the importance of new factors that may influence the implementation of AI systems as these phenomena evolve.

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