

AGILE PROJECT MANAGEMENT IN THE AGE OF DIGITAL TRANSFORMATION: EXPLORING EMERGING TRENDS

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Abstract: *In the context of today's dynamic environment, agility and speed are two essential characteristics that apply to project management in the software development industry, as well as in many other industries. In order to meet the complex and continuous challenges of the digital age, the principles, techniques and methods of Agile Project Management and Scrum are expected to become more widespread, especially in software development, replacing or augmenting the traditional ones. This paper aims to identify trends in project management related to digital transformation and diffusion of Industry 4.0 technologies. A bibliometric analysis was carried out by searching the WOS database. The resulting documents were exported and processed in VOSviewer to fulfil the scope. The research revealed that, in the context of digital transformation, information technology supports the agile approach, agile transformation and agile project management. Furthermore, emerging technologies specific to Industry 4.0, especially artificial intelligence, and big data, can contribute significantly to all project phases. These emerging technologies can improve data processing and analysis, project forecasting, and risks prediction, can support decision making thus contributing to the success of the project.*

Keywords: agile, artificial intelligence, big data, digital transformation, project management

1. Introduction and Methodology

The subject of project management in the context of technological change is of interest to researchers from a wide range of disciplines. Nowadays, digitalization plays a pivotal role in organisations, influencing virtually every aspect of their operations. The ability to rapidly process large volumes of data, coupled with increased internet penetration and enhanced capacity to exploit digital knowledge, are key drivers of the ongoing digital transformation within organisations [1]. The emergence of new technologies has been a driving force behind the digital transformation, which has

in turn fostered the emergence of innovative business models and the adoption of agile, iterative processes [2]. The advent of digitalization and the subsequent digital transformation have had a profound impact on the way in which project stakeholders interact, engage with one another, and communicate during project execution [3]. In view of the ever-changing context of public-private partnerships (PPPs), that require project dynamics, it is imperative for organisations to adopt a flexible structure, integrate digital tools, and cultivate advanced professional knowledge and skills among their projects managers

and the wider project team [4]. In the digital economy it becomes evident that digital information continues to transform the way projects are executed [5].

The aim of the present paper is to identify the trends regarding project management in the context of digital transformation and the promotion of Industry 4.0 technologies. A bibliometric analysis was performed by searching on WOS database, and the resulting documents were exported and processed in VOSviewer to fulfil the objective.

2. The Agile Approach

In the context of turbulent markets, organisations are required to implement ongoing adjustments to their strategies, structures, processes, and products. When the environment is characterised by continuous change, the software development industry exhibits two defining characteristics: agility and speed. The dynamic nature of the environment is conducive to the application of Agile methodology [6], which has emerged as a principal approach alongside the traditional Waterfall [7]. The use of an agile approach facilitates improved coordination and teamwork throughout the project development process.

To provide support for the organisational digital transformation, other researchers proposed that the Hybrid “Stage-Gate - Agile - Design Thinking” approach should be considered as a potential model [8]. This suggests that a model based on the principles of shared values and an innovative approach would be more effective in this context.

One of the most significant trends in today's software development is the combination of DevOps and Agile methodologies. The term DevOps refers to a software development methodology that represents a fusion of two distinct yet complementary entities: the domain of software development (Dev) and that of the operations teams (Ops). In addition to a set of tools, practices and capabilities, DevOps

also encompasses a cultural philosophy that is employed to enhance the reliability, quality, and velocity of the software development lifecycle. The use of the automation technology plays a crucial role in the implementation of DevOps. Moreover, effective communication, collaboration, and empowerment are essential for the development teams, at every stage of the process. [9]. One of the fundamental principles underlying both DevOps and Agile methodologies is the importance of cross-functional teams. There are several benefits, including faster delivery, higher quality, improved customer satisfaction, reduced costs, and increased innovation, associated with implementing these methodologies in combination.

In the Agile-Scrum methodology, the product owner, the team, and the Scrum Master are key stakeholders that collaborate throughout all phases of the sprint cycle. Adopting an agile mindset is a fundamental aspect of enhancing output, maximizing results, and achieving adaptability [10].

3. Managing Projects and Digital Transformation through Industry 4.0 Technology

The advent of the Fourth Industrial Revolution (4IR) has prompted a profound digital transformation across a multitude of sectors and affects almost every organisational process, from management to execution. This encompasses project management, among others. To remain competitive, organisations must effectively leverage technology and a vast amount of data to better inform their project strategic planning, execution, and delivery [11].

Industry 4.0 encompasses tools at the leading edge of the technological transformation. As the adoption of Industry 4.0 technologies continues to grow, it is becoming increasingly evident that a change in project management approach is necessary. The advent of artificial intelligence, big data, analytics, cloud computing, robotics, digital manufacturing

(3D), advanced sensor technology, blockchain, and the advanced Internet, among other developments, has led to a shift from traditional project management methods to new and modern approaches.

The integration of business process and portfolio management represents a strategic approach to the Industry 4.0 transformation. A project portfolio management model has been proposed to provide valuable support to organisations throughout the digital transformation process, by strategically deploying technology resources in an integrated manner. Adopting a coherent and strategic approach to the selection and prioritisation of Industry 4.0 projects, the model ensures that the value of these projects is assessed and that the technologies deployed are aligned with the strategic goals and objectives of the organisation [12].

In the face of intense competition and market shifts, it is of great importance for projects to meet time, cost, and quality objectives and constraints. In order to facilitate continuous innovation, it is essential to adopt a flexible and agile approach, supported by information technology (IT). Furthermore, a knowledge-based management decision support system can be used to facilitate the analysis of project performance and the impact of strategic decisions over time [13].

4. Results and Discussions

In order to identify the prevailing trends in research and to achieve the stated research aim, a search on Web of Science (WOS) was conducted by employing a combination of two search terms: TS = “project management” AND TS = “digital transformation”. This operation yielded a total of 888 retrieved documents. Of these, 830 were in the English language, while the remaining 58 were in Spanish (14), Russian (13), German (12), Portuguese (7), Italian (5), Chinese (3), French, Slovenian, Turkish, and Ukrainian (1 each). The

resulting sample of documents was exported from WOS and imported into VosViewer software for further processing. Once the thesaurus file has been created and uploaded, VosViewer generated 155 keywords that met the five-occurrence threshold. These keywords were distributed across nine clusters. Links to other keywords on the map were also identified (Links: 2,711, Tola Link Strengths: 5,336). Figure 1 presents the Density Visualization map, which is color-coded on a rainbow scale ranging from dark red, which represents the most central topic, to orange, yellow, green, blue, and turquoise.

In term of frequency, the first 25 keywords with occurrence ranging from 295 to 23, are: “project management” (295), “bim” (86), “management” (72), “technology” (58), “digital transformation” (55), “digitalization” (50), “system” (49), “model” (44), “design” (42), “performance” (42), “software development” (38), “construction” (35), “innovation” (34), “challenges” (33), “implementation” (33), “framework” (31), “industry 4.0” (30), “impact” (29), “project” (29), “information technology” (28), “agile” (26), “knowledge” (25), “big data” (24), “artificial intelligence” (23), and “collaboration” (23). It can be observed that, “performance management” is the most prominent and central concept. Second in terms of occurrence is Building Information Modelling (“bim”) – a concept from the construction sector and the foundation of digital transformation in AEC– Architecture, Engineering and Construction industry. It is linked with “construction industry”, “construction 4.0”, “construction management”, “construction projects management”, and “gis” (Geographic Information System). Although the subjects of construction and “bim” are of great interest and novelty, the present paper does not aim to examine such projects, but rather to focus on the project management related to software development.



Figure 1: The Density Visualization Map
Source: Authors' own computation

Source: Authors' own computation

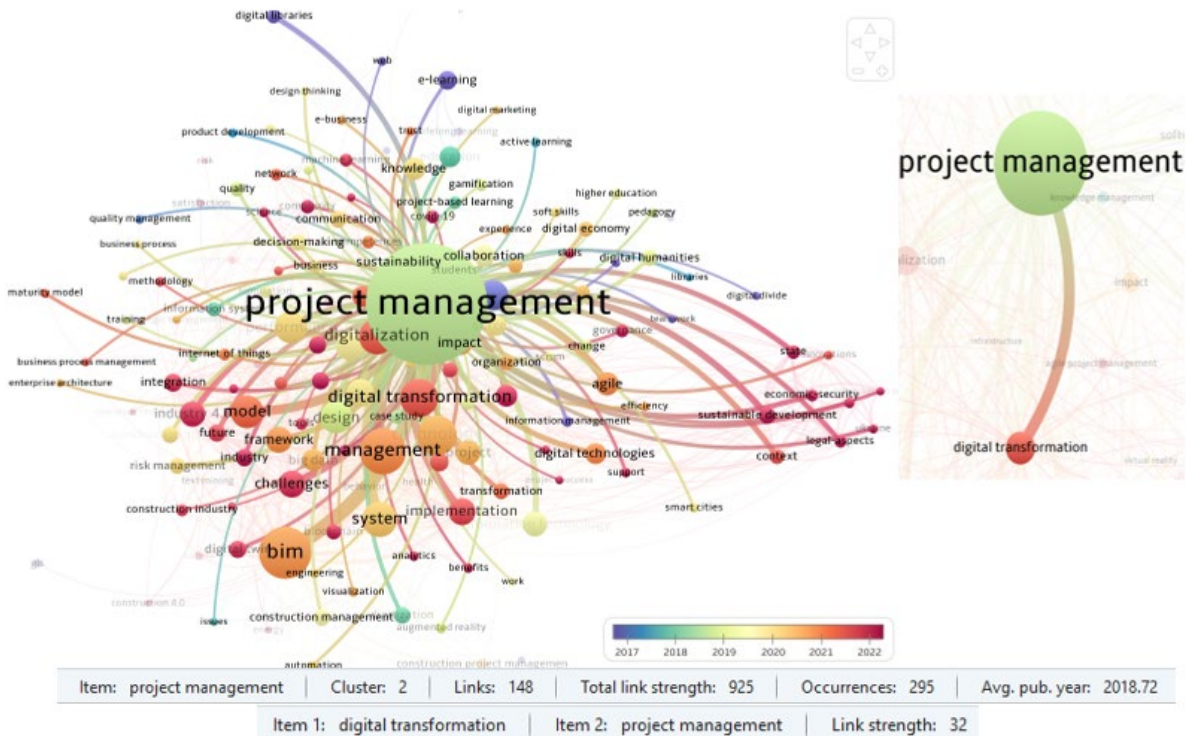


Figure 2: The “project management” concept- an Overlay Vizualization
Source: Authors’ own computation

Source: Authors' own computation

In this paper, the concept maps created with VOSviewer are represented and analysed in the Overlay visualisation, based on the Average Publication Year (APY), with colours ranging on a spectral

scale from magenta (representing the oldest concepts) to dark red (representing the newest ones).

As it can be noticed in figure 2 “project management” is the most prominent

concept (Occurrence/ Occ.: 295). The concept is central and is characterized by strong links with other keywords in the map (Links: 148; Total link strengths: 925). The strongest link is with “digital transformation” (LS: 32). The concept is not a novel one (APY: 2018.72). However, it has been refreshed by newer concepts identified after 2020, which are represented on the map with colours from orange to dark red.

As illustrated in figure 3, “software development” (Occ.: 38; APY: 2017.13) is

directly linked with “project management”. Moreover, the most recent developments in this field, with APY after 2020, have focused on the following topics: “project success” (APY: 2022.40), “agile project management” (APY: 2021.46), “digital transformation” (APY: 2021.27), “model” (APY: 2021.09), “management” (APY: 2020.78), “impact” (APY: 2020.52), “agile transformation” (APY: 2020.27), “system” (APY: 2020.22), and “agile” approach (APY: 2020.01).

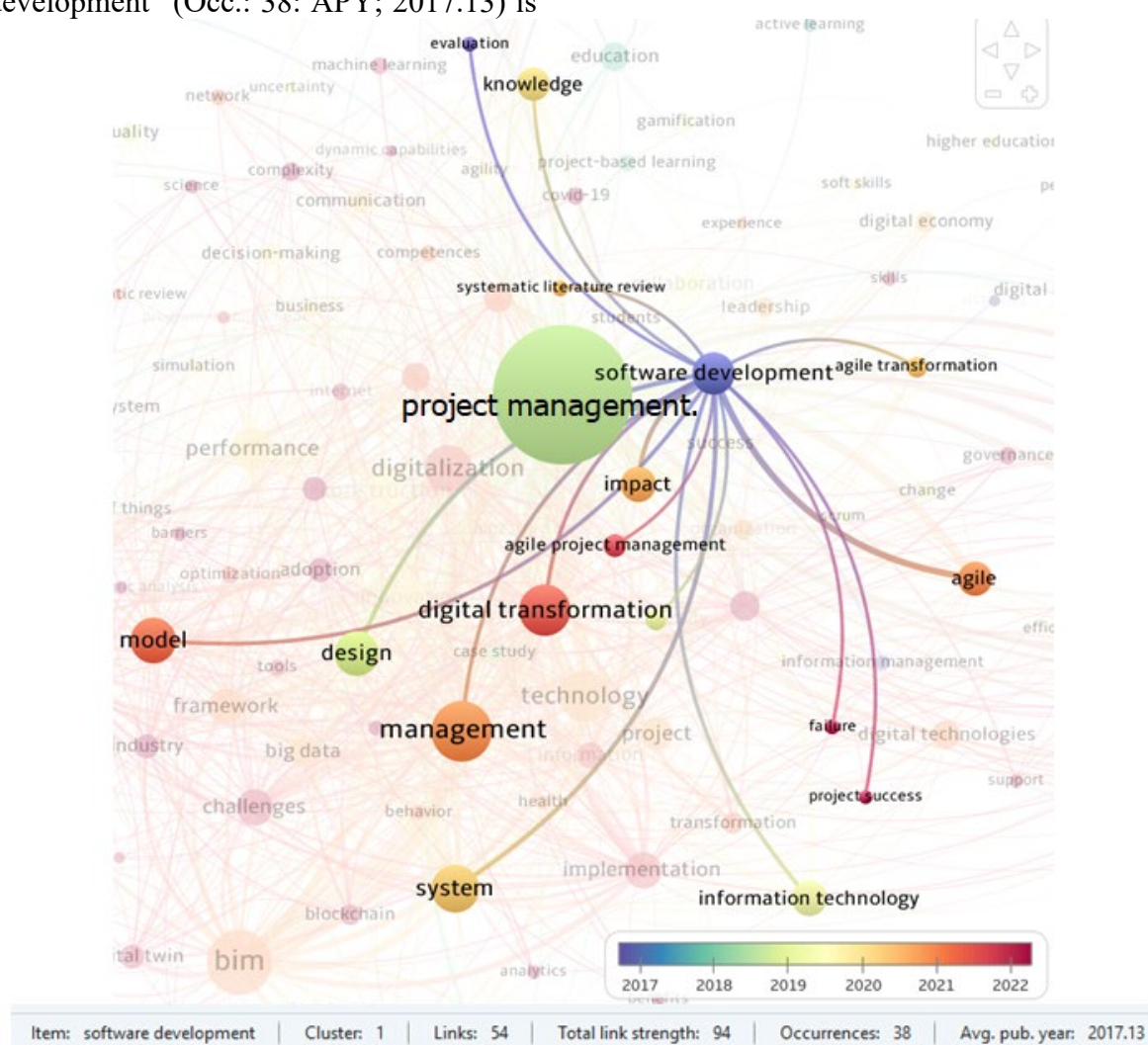


Figure 3: The “software development” concept - an Overlay Visualization

Source: Authors’ own computation

Software development projects frequently encounter difficulties in relation to time, cost, and quality. Agile software development methodologies (ASDMs) address these challenges by employing

iterative cycles and incorporating user feedback. However, several obstacles can impede the implementation of ASDMs. These include the existence of traditional organisational cultures, the lack of

In the context of today's dynamic environment, two essential characteristics, namely agility and speed, also apply to project management in the software development industry, as in many other industries. This is driven by the industry's need to react quickly and respond to changing market condition.

As can be seen in Figure 4 the concept “agile” is linked with “software development”, “digital transformation”, “digital” but also with concepts from other areas besides technology such as: “project”, “management”, “leadership”, “innovation”, “system”, “scrum”.

Figure 5 also shows that the novel concept “agile project management” (APY: 2020.78) is linked with “technology”, “information technology”, “agile transformation”, “challenges” and “adoption” (figure 5).

For “projects”, to cope with complex and continuous “challenges”, the “agile” approach is of paramount importance, especially in the context of “digital transformation”.

As also emphasized by other researchers, the Agile approach and the implementation of Agile management principles and methods have been widely adopted in software development and project management, replacing traditional project management [15, 16].

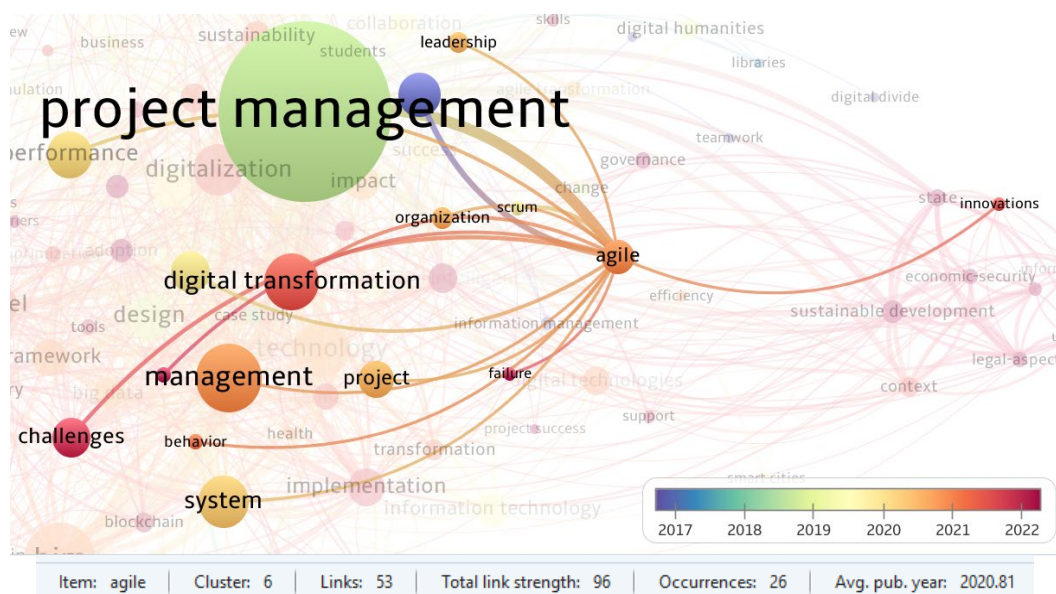


Figure 4: The “agile” approach - an Overlay Vizualization

Source: Authors' own computation

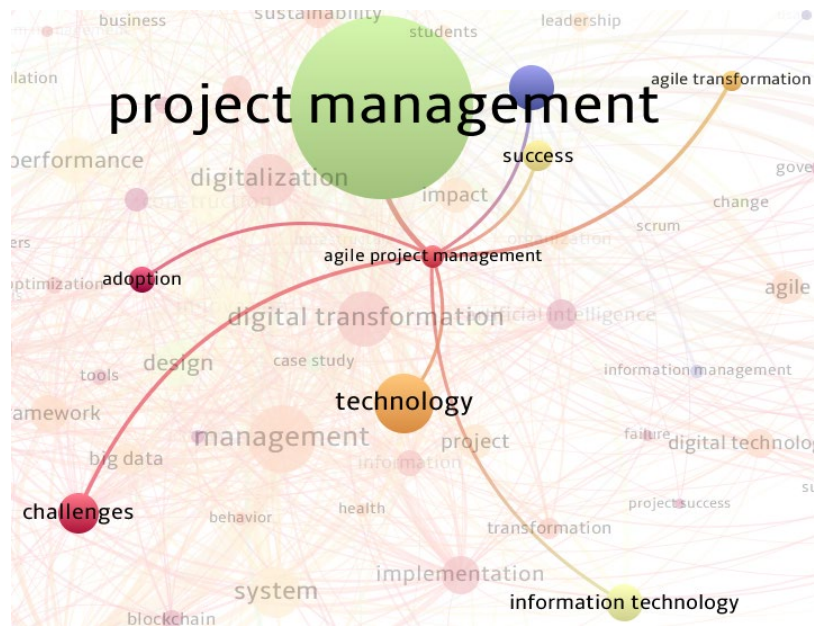


Figure 5: The “agile project management” approach - an Overlay Visualization
Source: Authors’ own computation

In order to process and analyse vast amount of data, “artificial intelligence”, “big data” (APY: 2020.50) and “analytics”

(APY: 2021.86) are playing a pivotal role (Figure 6).

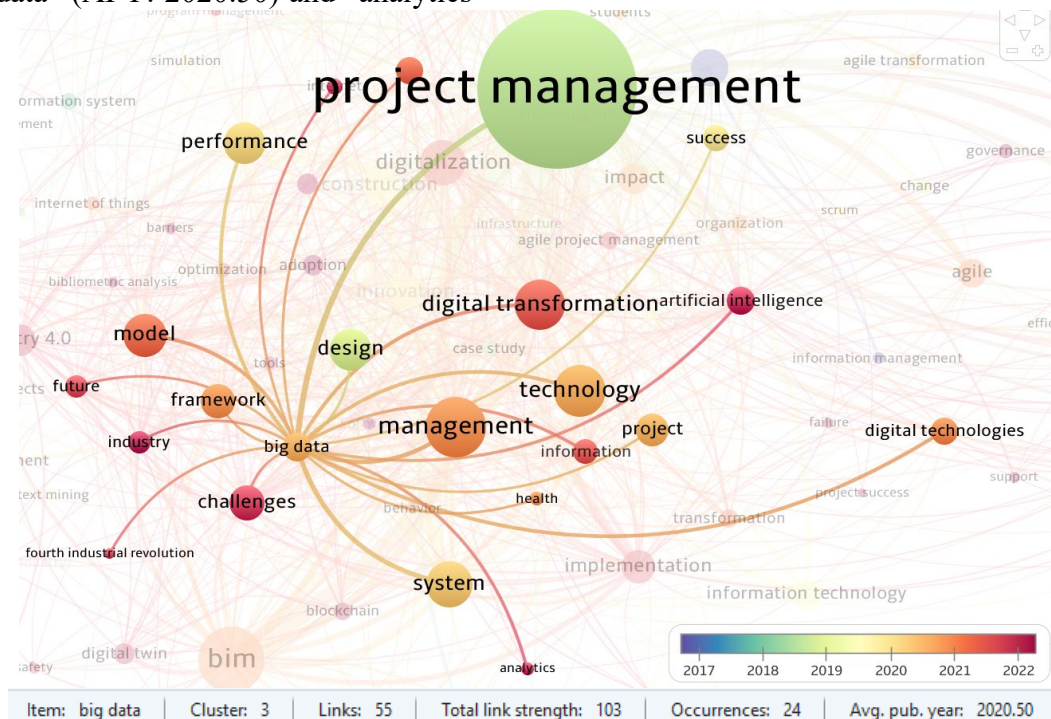
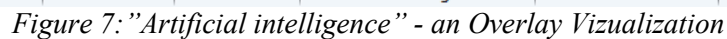


Figure 6: “big data” and “analytics”- an Overlay Visualization
Source: Authors’ own computation

The concept “artificial intelligence” (APY: 2021.83) is a topic in vogue, situated very

close to the central topic “project management”. As it can be observed in

“industry 4.0” technologies (APY: 2021.70): “digital twin” (APY: 2021.71), “machine learning” (APY: 2021.70), “big data” (APY: 2020.50) and “internet of things” (APY: 2020.09).



It is evident that projects generate substantial amount of data throughout their life cycles, which presents significant challenges for project managers and experts tasked with complex decision-making. The volume of data involved is considerable, and this can act as a significant barrier to effective decision-making. The advent of the Fourth Industrial Revolution has led to an increased demand for the application of artificial intelligence (AI) in big data technology. Machine learning (ML), which leverages data generated during project phases, can be used to predict risks and support decision-making throughout the project lifecycle.[17].

processing of vast data volumes becomes a necessity to support the development of intelligent decision-making systems. Machine learning is a key technology in this field [18].

In a world of constant change, cost overruns and time delays are common, especially in complex projects, even when are used project management tools. Addressing these issues requires a shift from traditional project management systems to modern ones that embrace design change, agile project management practices, new models, technology, knowledge, and other tangible and intangible assets. Moreover, within the complex and dynamic environment, project portfolio management should be aligned not only with the organizational strategy, but also with the national digitalisation strategy.

The adoption of Agile methodologies has shown considerable effects on the entire project management process. Moving to an Agile transformation framework is more than a change in project management methodology. It is a comprehensive set of organizational changes that includes not only processes, technology, methodology, strategy, and structure, but also changes in leadership. Moreover, Agile project management and Agile Scrum methodology also encompass cultural aspects. Transparency, commitment to the goal of the Scrum team and sprint, capacity to solve complex problems, trust in the professionalism of the team members, openness to stakeholders, capacity to respond to change are some of the cultural aspects that are pertinent to the success of the Agile Scrum methodology [19]. Furthermore, project alliance and highly collaborative methods are also required, especially in the context of new digital technology.

In order to achieve success, it is essential that project planning, execution, monitoring, and delivery integrate technology, particularly information technology and emerging technologies of

Industry 4.0. As reflected in the present research, artificial intelligence is the most important and novel technology, that can be used in synergy with big data, for a successful project management.

The modern workplace is undergoing a profound transformation, with project delivery teams being forced to adapt to a rapidly evolving landscape. To maintain a competitive edge, it is becoming increasingly important for project teams to acquire more experience, new skills, and knowledge.

To remain relevant, higher education institutions, like business, must swiftly adapt to the evolving landscape of challenges and opportunities. The agile approach and the digital transformation initiatives promote the importance of ensuring a dynamic approach to curriculum development. In this context the implementation of data science courses is of critical importance for future graduates. It is imperative that they become not only proficient in their primary field but also in areas like artificial intelligence, machine learning, big data, analytics, data mining, and others.

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