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In what ways do AI techniques propel decision-making amidst volatility? Annotated bibliography perspectives

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Abstract

This research presents a systematic review and approximation, from 2018 to 2023, of how Artificial Intelligence can support decision-making processes when business managers have to resolve between multiple alternatives for the development of new businesses using Agile Frameworks; and as well, will be addressed from the genesis concepts such as VUCA, Agile Mindset, Infinite Game Theory, Agile Frameworks, Innovation, Artificial Intelligence among others with the aim of identifying research gaps in the decision-making process under changing environments. Most of the analyzed studies are focused on Infinity Games theory to better understand innovation processes linked from early stages to deployment phases of products. Furthermore, this paper analyzes AI techniques for decision-making under volatile circumstances and raises 5 research questions that from a logical and chronological perspective in development are resolved during the research. It is important to highlight that AI-related solutions are typically used to make informed decisions; however, few studies adopt AI to support the decision-making process in unstable environments.

Keywords: Uncertainty, VUCA, Artificial Intelligence, Business model development, Agile methodologies

Introduction

A plethora of authors have made significant contributions to the development of various novel approaches for generating new business models from ideas. Many of these authors converge on several key aspects, with one of the most noteworthy being the recognition that the markets operate within a VUCA (Volatile, Uncertain, Complex, and Ambiguous) environment, making it impractical to determine conditions in the medium or long term due to their high variability (Johnson & Smith, 2018).

Consequently, the discipline of innovation has gained prominence as the pathway for organizations to create new opportunities, products or services and sustain themselves in increasingly aggressive markets, where startups emerge rapidly and abundantly (Li & Brown, 2018). In this context, various researchers have contributed to the development of agile methodologies, which fundamentally embrace the "fail fast and learn quickly" mindset and also involve continuous experimentation with small

hypotheses to facilitate rapid learning about the ideas under investigation (Kim & Lee, 2018; Sommer, 2019). By embracing these agile principles, organizations can swiftly adapt to changing market conditions, iterate on their business models, and seize emerging opportunities (Johnson & Smith, 2018). These adaptive and non-predictive approaches allow solution research teams to iteratively learn through experimentation processes, preparing personnel to navigate innovation challenges in uncertain environments.

Moreover, Sinek (2019) introduced a novel concept based on Game Theory, termed as *The Infinity Games*. This theory distinguishes between two kinds of games: Finite and Infinite Games. Finite games involve known players with fixed rules and agreed-upon objectives, where players compete to win. On the other hand, Infinite Games have an entirely different nature, where the primary objective is to keep the game going and perpetuate the play. This idea emphasizes the importance of adopting an Infinite Game mindset in the context of innovation, as it encourages organizations to focus on continuous improvement and adaptation rather than solely on short-term victories.

Nonetheless, the latter theory presents distinct features, including: (I) a mix of known (finite players) and unknown players (infinite players), (II) changeable rules, and (III) an objective to perpetuate the game. When finite players face each other, the system remains stable as they operate within the same environment. Similarly, when infinite players compete, the system is also stable as they engage in the same ongoing process, with no winners or losers (Sinek, 2019).

However, challenges arise when a finite player encounters an infinite player. The finite player seeks to win, while the infinite player's objective is to continue playing. Consequently, the finite player often finds themselves in a quagmire, struggling to keep up with the perpetual nature of the game.

Relating this concept to the business context, Sinek (2009, 2019) asserts that the game of business is an infinite game. This is because the players, including competitors, may be both known and unknown within the industry. The rules of the business game are changeable and not universally agreed upon, adding to the dynamic nature of the environment. Whereas, in finite games, technically there is not ultimate winning in the game of business; instead, the objective is to keep playing and adapt continuously to the ever-evolving landscape.

As suggested by Reim et al., (2020, p. 180), there is an academic gap related to innovative business models in conjunction with the introduction of Artificial Intelligence which could be translated into "increased risk of project failure and unwanted results". To bridge this gap, the purpose of this paper is to provide a systematic review from 2018 to 2023 with the aim of investigating how the combination of Agile methodologies and Artificial Intelligence can help organizations to work in a process of Continuous Innovation (Development of Sustainable and Sustainable Businesses).

Also, it is important to highlight that this paper focuses on how the decision-making process is conducted in unstable conditions; in other words, it focuses on how non-binary logic can further support organizations and their resilience in adapting to changing environments and adopting both Agile principles and the Infinity Games theory alike. This research seeks to provide a comprehensive comparison between traditional approaches and AI-led solutions with regard to the decision-making process.

Methodology

The research is centered around presenting a literature review of traditional and ad hoc practices related to the decision-making process through the use of ICT tools within the Project Management domain. To gather the necessary information for this study, a systematic review process requires a sound and clear method, this paper follows the method proposed by Kitchenham and Brereton (2013) which consists of the following phases: (a) elaborating hypotheses or questions; (b) searching for academic sources; (c) inclusion and exclusion criteria; (d) extraction of information; (e) interpretation and presentation of the results; (f) discussion. phases from (a) to (d) are described next in this section, while (e) and (f) in sections Results and Discussion, respectively.

a. Elaborating research questions

After extensive research into the common attributes of great leaders in inspiring action and commitment towards a shared purpose, Sinek (2019) determined that the key to their success lies in their communication style. He also unveiled the secret to eliciting commitment from everyone, demonstrating how these leaders effectively motivate people by communicating from the inside-out, starting with the "Why" and extending to the "What".

The main question that arises is what it truly means to "begin with the Why". For any organization or individual seeking success in any domain, it is essential to understand the underlying connections and shared purposes that unite them with others. This connection or common purpose serves as the foundation of the message that every leader must construct to communicate effectively with stakeholders. The key distinction of this communication style, the Golden Circle, lies in its emphasis on Emotional Engagement, establishing a strong connection between the customer and the organization's purposes. This emotional engagement serves as the cornerstone of success in any event, business, or entrepreneurial venture (Sinek, 2019).

Under these circumstances, the research team proposed the following research questions:

RQ1: How can the Infinite Games theory, formulated by Sinek (2019), connect to the changing and volatile attributes of organizations operating in unstable conditions?

RQ2: How can Agile methodologies be utilized as effective tools to design and adapt new business models in response to the challenges posed by a VUCA environment?

RQ3: How does the integration of AI support decision-making processes for investments in innovative business model development?

RQ4: What are the critical factors that organizations must consider while transitioning from Finite Games (characterized by known players, fixed rules, and agreed-upon objectives) to Infinite Games, as proposed by Sinek (2019)?

RQ5: How can organizations effectively balance and integrate the concepts of Uncertainty, Agile methodologies, AI, and Innovation to foster a culture of continuous learning, experimentation, and adaptation?

b. Searching for academic sources

During this stage, bibliographic sources were identified from top-tier databases such as: Scopus, IEEE, Springer, Emerald, ACM and Google Scholar. This bibliographic search was carried out in August 2023, and basically articles selected were from January 2018 to the first quarter of 2023. Also, technical descriptors used as search strings were as follows: [Business Model Development AND (Artificial Intelligence OR Agile Methodologies) AND Uncertainty OR Innovation]; [Business Model Development AND (Artificial Intelligence OR Uncertainty OR Design Thinking OR Scrum OR Lean) AND Agile Methodologies].

c. Inclusion and exclusion criteria

Considering that the nature of this study is multidisciplinary, the team considers relevant to retrieve scientific papers from influential databases. In addition, this stage follows a hybrid approach adopting some practices such as "study identification, screening, eligibility and inclusion" (Moher et al., 2009) and bibliometric analysis techniques (Echchakoui, 2020) (Table 1).

During this process, it is important to clarify that for the purpose of this paper, articles, book chapters and conference proceedings are included. In addition, articles that do not provide any particular focus related to this research were removed. Only articles that provide relevant data based on these two search strings are considered. Since the search resulted in a considerable number of articles, it was decided to apply exclusion criteria, remaining 381 articles. Of this amount, the selected articles are those that study the application of hybrid project management frameworks in conjunction with the application of various artificial intelligence techniques to elaborate or improve the decision-making process in changing business models. Furthermore, another filtering process was carried out by discarding studies that do not have the following characteristics: range from 2018 to 2023, project management, project governance, decisions, and

Table 1 Search results and selection criteria

Search string	Source	Found	Duplicated	Inclusion criteria	Exclusion criteria
Business Model Development AND (Artificial Intelligence OR Agile Methodologies) AND Uncertainty OR Innovation	ACM	147	0	19	128
	Emerald	93	7	29	64
	Google Scholar	200	20	42	158
	IEEE	68	9	31	37
	Scopus	26	0	22	4
	Springer	154	8	37	121
Business Model Development AND (Artificial Intelligence OR Uncertainty OR Design Thinking OR Scrum OR Lean) AND Agile Methodologies	ACM	40	10	33	7
	Emerald	72	5	51	21
	Google Scholar	81	23	69	12
	IEEE	20	9	11	9
	Scopus	3	0	3	0
	Springer	41	7	41	0
Total		945	98	381	561

Table 2 Top results by search string

Search string	Related authors
Business Model Development AND (Artificial Intelligence OR Agile Methodologies) AND Uncertainty OR Innovation	Poeppelbuss et al. (2022), Kulkov (2023), Robertson et al. (2022), Zhang et al. (2021), Hellas et al. (2020), Åström et al. (2022), Nortje and Grobbelaar (2020), Andrade and Tumelero (2022), Barata et al. (2023), Sharma and Kumar (2023), Afzal et al. (2021), Zhang and Gao (2019)
Business Model Development AND (Artificial Intelligence OR Uncertainty OR Design Thinking OR Scrum OR Lean) AND Agile Methodologies	Bresciani et al. (2021), Gupta et al. (2022), de Diego Ruiz et al. (2023), Veretennikova and Vaskiv (2018), Yadav et al. (2020), Vasilieva (2021), Chang (2023), Ahmed et al. (2022), Slama (2023), Luna et al. (2020), Yan and Feng (2018), Silva et al. (2021), Vasanthan and Suresh (2022), Bushuyev et al. (2021), Lourens et al. (2022), Cardoso Castro (2019), Althar et al. (2022), Ingvarsson et al. (2023), Raneri et al. (2023), Mendonça de Sá Araújo et al. (2019), Akkaya and Ahmed (2022), Horstmeyer (2020), Guérineau et al. (2022), Yordanova (2021), Schön et al. (2020), Patrucco et al. (2022), Buffardi (2018), Winecoff and Watkins (2022)

uncertainty. The result of both filtering processes allowed the identification of 43 articles detailed in Table 2 and Fig. 1.

d. Extraction of information

To answer each of the research questions, Table 4 was developed which contains a summary including the following characteristics:

- Type of application: risk management (R), project governance (G), decision-making process (D), business model (B).
- Research approach: quantitative (QN), qualitative (QL), mixed (MX).
- Applied techniques: fuzzy algorithms (FZ), machine learning (ML), neural networks (NN), stochastic algorithms (ST), decision trees (DT).
- Industry or domain: hardware (HW), software (SW), education (ED), logistics (LG), cybersecurity (CY), commerce (CO), hydrocarbons (HY), construction (CT), services (SE), healthcare (HC).
- Country where the study was developed.

Research question	References	Applied techniques	Industry or domain
RQ1: How can the Infinite Games theory, formulated by Sinek (2019), connect to the changing and volatile attributes of organizations operating in unstable conditions?	Humlung and Haddara (2019), Ingvarsson et al. (2023), Cardoso Castro (2019)	n/a	CY, SE

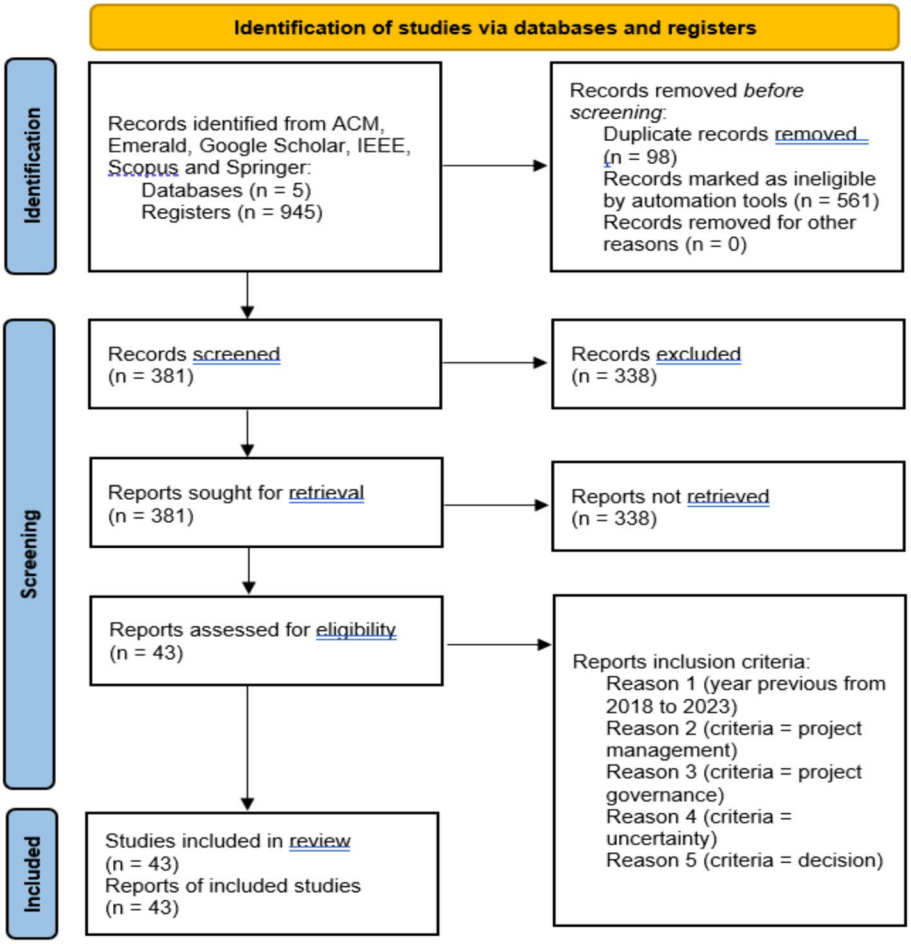

Fig. 1 PRISM graphic for systematic review

Research question	References	Applied techniques	Industry or domain
RQ2: How can Agile methodologies be utilized as effective tools to design and adapt new business models in response to the challenges posed by a VUCA environment?	Mendonça de Sá Araújo et al. (2019), Vasilieva (2021), Vereten-nikova and Vaskiv (2018), Yadav et al. (2020)	DT, ST	SW, SE, HW, ED, CO
RQ3: How does the integration of AI support decision-making processes for investments in innovative business model development?	Sharma and Kumar (2023), Nortje and Grobbelaar (2020), Kulkov (2023), Poeppelbuss et al. (2022), Ahmed et al. (2022), Akkaya and Ahmed (2022)	ML, ST, FZ, DT	CO, SE, HC, HW, SW
RQ4: What are the critical factors that organizations must consider while transitioning from Finite Games (characterized by known players, fixed rules, and agreed-upon objectives) to Infinite Games, as proposed by Sinek (2019)?	De Ruiz Diego et al. (2023), Horstmeyer (2020), Silva et al. (2021), Yan and Feng (2018), Zhang et al. (2021)	FZ, ML, NN	SE, SW, CO, CY

Research question	References	Applied techniques	Industry or domain
RQ5: How can organizations effectively balance and integrate the concepts of Uncertainty, Agile methodologies, AI, and Innovation to foster a culture of continuous learning, experimentation, and adaptation?	Buffardi (2018), Gupta et al. (2022), Schön et al. (2020)	DT	SW

As a summary, regarding Fig. 1, the various research methods used within the industries identified between the period 2018–2023 can be visualized. Also, Figure 2 shows

Fig. 2 Research focus based on industry

Fig. 3 Research methods by management model

what research methods were most used in the management model. And finally, Figure 3 displays what AI-related solution and/or non-technical approach were employed per industry (Fig. 4; Tables 3, 4, 5, 6, 7).

Results

The research questions previously formulated from the findings section are answered below based on the retrieved data.

RQ1: How can the Infinite Games theory, formulated by Sinek (2019)*, connect to the changing and volatile attributes of organizations operating in unstable conditions?*

The rationale behind the Infinite Games theory is to play continuously in unstable conditions focusing on a long-term perspective rather than "winning" in the short term. In other words, organizations embrace resiliency approaches to adapt (or keep playing) and evolve (operating under volatile markets). Additionally, Humlung and Haddara (2019) claim that gamification can be a useful strategy for maintaining higher levels of engagements if appropriately conducted; thus, creating a positive and friendly environment between employees. In order to answer this first hypothesis, it is important to highlight the theory formulated by Sinak and the study proposed by Ingvarsson et al. (2023) offer a new perspective on how organizations can thrive under volatile markets through:

- Continuous engagement can be achieved through Gamification techniques where stakeholders are involved in a positive and motivating environment focusing on long-term healthy relationships among stakeholders aligning with the theory of Infinite Games,

Fig. 4 Applied techniques by industry

Table 3 List of papers (criteria met)

Reference	Type of application	Research approach	Applied techniques	Industry	Country
Andrade and Tumelero (2022)	D, B	QL	ML, NN	CO, SE	Brazil
Åström et al. (2022)	B	QL	ML	CO, SE	Sweden
Kulkov (2023)	B	QL	DT	HC	Denmark, Finland, France, Spain, Sweden, UK
Nortje and Grobbelaar (2020),	B	QL	DT	SE	South Africa
Zhang et al. (2021)	B	QL	FZ, ML, NN	CO, SE, CY	Australia, UK
Robertson et al. (2022)	R, D	MX	ML, ST	HW, SW, CY, SE	USA
Afzal et al. (2021)	D, R	MX	FZ	CT	China, Pakistan
Poeppelbuss et al. (2022)	R	MX	ST	SE, HW, SW	Germany
Hellas et al. (2020)	R	QN	FZ	HY, HC	Algeria, Romania

Table 3 (continued)

Reference	Type of application	Research approach	Applied techniques	Industry	Country
Sharma and Kumar (2023)	D, B	MX	ML, ST, FZ	CO, SE	India
Barata et al. (2023)	D, B, G	MX	ML	CO, SE	Portugal, USA
Zhang and Gao (2019)	G	QL	n/a	ED	China
Slama (2023)	R, G, D	MX	n/a	HW, SW, ED	Germany
Vasilieva (2021)	G, B	MX	n/a	HW, SW, ED, CO, SE	Russia
Yordanova (2021)	G, B	MX	n/a	ED	Bulgaria
Guérineau et al. (2022)	G, B, D, R	MX	DT	SW, HW, CY, SE	Canada, France
Luna et al. (2020)	G	MX	ST, DT	HW, SW	Brazil
De Ruiz Diego et al. (2023)	G, B	MX	FZ	SE	Spain
Bresciani et al. (2021)	B	MX	n/a	SE	Italy
Yadav et al. (2020)	R, B, D	QN	DT, ST	SW	India
Chang (2023)	G, D	QN	FZ	SW	Taiwan
Ahmed et al. (2022)	G, D	QL	n/a	SE	Pakistan, Poland, Turkey
Silva et al. (2021)	B	QL	n/a	SW	Brazil, Italy
Vasanthan and Suresh (2022)	B	QN	FZ	SE	India
Cardoso Castro (2019)	B	QN	n/a	CY	UK
Ingvarsson et al. (2023)	B	QL	n/a	SE	Austria, Finland, Sweden
Raneri et al. (2023)	B, D	QN	ML, DT, ST	SE	Belgium
Akkaya and Ahmed (2022)	B, D	QN	n/a	SE	Pakistan, Turkey
Horstmeyer (2020)	B	QL	n/a	SE	USA
Gupta et al. (2022)	B, G	MX	n/a	SW	India
Veretennikova and Vaskiv (2018)	R	QL	n/a	SW	Ukraine
Yan and Feng (2018)	R, D	QN	ML, NN	SW	Canada
Winecoff and Watkins (2022)	R, D	QL	n/a	SE	USA
Lourens et al. (2022)	B	QL	ML	SE	India, South Africa
Bushuyev et al. (2021)	B, D	QL	n/a	SW, CT	Azerbaijan, Ukraine
Patrucco et al. (2022)	B, G	QL	n/a	SE	Iceland, Italy, USA
Buffardi (2018)	B, G	QL	n/a	SW	USA
Althar et al. (2022)	R, G, D	QN	n/a	SW, CY	India, South Korea
Mendonça de Sá Araújo et al. (2019)	G, D	QL	n/a	SW, SE	Brazil
Schön et al. (2020)	R, D	QL	DT	SW	Germany

Table 4 Summary of articles that study fuzzy logic towards agile project management

Reference	Topic	Aim	Brief description
Hellas et al. (2020)	Artificial intelligence treating the problem of uncertainty in quantitative risk analysis (QRA)	Explain how fuzzy techniques can be used for assessing risks effectively by using mathematical models	This paper compares how some AI techniques (fuzzy logic, Bayesian networks, and ML) can be used to model and quantify accurately risks factors
De Ruiz Diego et al. (2023)	What drives strategic agility? Evidence from a fuzzy-set qualitative comparative analysis	Identify main determinant factors for organizations to become agile strategic	First, the authors list key factors which enable strategic agility from a structural and decision-making perspectives. Then, these researchers compare different factors through a fuzzy-comparative analysis which boost organizational performance
Chang (2023)	Evaluation of an artificial intelligence project in the software industry based on fuzzy analytic hierarchy process and complex adaptive systems	Provide a technical framework for evaluating uncertainty and imprecision AI projects	This technical framework is called Fuzzy Analytic Hierarchy Process which follows concepts based on CAS techniques to handle adaptability and uncertainty in the software industry
Vasanthan and Suresh (2022)	Assessment of organizational agility in response to disruptive innovation: a case of an engineering services firm	Assess how organizations can become agile and innovative when facing changing and disruptive external factors in the service industry	The authors developed an agile framework which is used to measure organizational adaptability. This framework uses AI processes and agile practices for organizations to respond and evolve effectively in the face of disruptive innovations

Table 5 Summary of articles that study AI techniques towards agile project management

Reference	Topic	Aim	Brief description
Zhang et al. (2021)	Artificial intelligence in recommender systems	Introduce novel AI-based techniques into the development of recommender systems	This article studies how recommender systems can be programmed by incorporating various AI techniques (namely NLP, DL, and reinforcement learning). Also, the authors explore how recommender systems can be used in different domains (healthcare, ISPs) to enhance business models
Afzal et al. (2021)	A review of artificial intelligence based risk assessment methods for capturing complexity-risk interdependencies: cost overrun in construction projects	Study how to leverage AI methods for evaluating the relationship between project complexity and cost overruns within the construction industry	This article explores the effectiveness of AI approaches (ML, NN) so project stakeholders can identify unforeseen factors related to costs and complexity leading to enhance risk management strategies and informed decision-making process
Raneri et al. (2023)	Predictions through Lean Startup? Harnessing AI-Based predictions under uncertainty	Propose a hybrid model (Lean principles + AI models) for prediction purposes in order to facilitate the decision-making process in uncertain times	This group explored how AI can merge with Lean practices to make better and informed decision. Also, they developed a prediction model for the mitigation of uncertainty
Yan and Feng (2018)	A hybrid gomoku deep learning artificial intelligence	Create a modern board game based on AI techniques	This strategic game combines use of DL and NN techniques for an immersive experience. This game also has the technical capacity to learn and adapt its own gaming techniques depending on the complexity of the user
Robertson et al. (2022)	A cloud-based computing framework for artificial intelligence innovation in support of multidomain operations	Introduce a thorough cloud framework which incorporates AI-related techniques to facilitate the decision-making process and enhance operational capabilities within military organizations	This paper develops a cloud computing framework which focuses on scalability and interoperability issues. Also, this framework utilizes AI and data analytics algorithms for analyzing large volumes of data. Finally, this integration offers a multidomain insight across sea, land, air, and cybernetics operations
Andrade and Tumelero (2022)	Increasing customer service efficiency through artificial intelligence chatbot	Evaluate how a chatbot application can be used for improving the efficiency of customer operations	This study makes use of DL and NLP for human–robot interaction. Prior to this chatbot deployment, these authors put special emphasis on selecting the right technology and proper training. Once the chatbot has learned processes about the organization, this AI application was assessed through response time, service quality, interactions, and other variables

Table 5 (continued)

Reference	Topic	Aim	Brief description
Sharma and Kumar (2023)	Enablers driving success of artificial intelligence in business performance: a TISM-MICMAC approach	Identify main enablers for AI deployment and its impact on business performance	This study was conducted using two separate analysis: a) TISM approach, the Total Interpretive Structural Modeling used to identify dependencies and inter-relationships among AI enablers; b) MICMAC approach, The Cross Matrix Multiplication used to establish a taxonomy for AI successful factors in business performance

Table 6 Summary of articles that incorporate various techniques towards agile project management

Reference	Topic	Aim	Brief description
Kulkov (2023)	Next-generation business models for artificial intelligence start-ups in the healthcare industry	Propose AI-based innovation business models for the healthcare industry	Taking into consideration the highly regulated nature of the healthcare industry, this author proposes the diversification of this industry (e.g., telemedicine, SaaS tools, among others) via AI-driven technologies
Barata et al. (2023)	Determinants of E-commerce, artificial intelligence, and Agile methods in small- and medium-sized enterprises	Understand the driving factors for the successful adoption of AI, agile approaches and e-commerce in SMEs	This study provides useful insights about key factors that may facilitate or hinder the use of AI and agile in SMEs. Also, these authors delve into the details as to why some stakeholders might feel reluctant to adopting these tools
Nortje and Grobbelaar (2020)	A framework for the implementation of artificial intelligence in business enterprises: a readiness model	Develop a readiness model for guiding companies through the implementation process of AI tools	This research consists of two phases: (a) readiness stage, where companies are assessed depending on their preparedness for AI technologies; (b) if this first stage is successful, recommendations, best practices and actionable steps can be carried out for AI adoption
Åström et al. (2022)	Value creation and value capture for AI business model innovation: a three-phase process framework	Provide a framework which can serve as a tool for early value delivery and business model innovation making use of AI technologies	This research consists of two phases: (a) a systematical and continuous process used for identification, creation, capture of value for business model modification in conjunction with AI tools; (b) a practical manual which contains tools, strategies and examples for value delivery based on AI-driven solutions
Poeppelbuss et al. (2022)	Iterative uncertainty reduction in multi-actor smart service innovation	Present a framework for innovation within the service industry that follows an iterative process for reducing uncertainties in multi-actor settings	The authors introduce a novel framework for uncertainty reduction where there is a vast number of stakeholders. This iterative framework can guide the organization with strategies for communication and engagement management throughout the service innovation process
Zhang and Gao (2023)	Shaping the governance framework towards artificial intelligence from responsible research and innovation	Propose a governance framework that aligns with the deployment of AI solutions oriented towards research and innovation	The authors elaborated a set of guidelines addressing ethical, legal and societal implications to support the deployment of AI technologies. Once defined these norms, a responsible research and innovative-led governance framework was devised. This framework also covers topics related to engagement strategies, policy recommendations to mitigate potential AI risks

Table 6 (continued)

Reference	Topic	Aim	Brief description
Schön et al. (2020)	Improving risk management in a scaled Agile environment	Propose new strategies for risk management practices in large teams (e.g., SAFE)	These authors claim that it is feasible to adopt agile risk strategies within SAFE environments via continuous refining and optimization of risk mitigation techniques by merging common agile practices with standard risk processes
Ingvarsson et al. (2023)	Project stakeholder engagement through gamification: what do we know and where do we go from here?	Explore how Gamification and Project Management share common attributes and its usage within the stakeholder engagement process	This paper identifies research gaps on gamification applied in stakeholder engagement. Then, these authors propose theoretical and practical suggestions of gamified stakeholder engagement
Winecoff and Watkins (2022)	Artificial concepts of artificial intelligence: institutional compliance and resistance in AI startups	Investigate the relationship between institutional governance and AI startups resistance	AI startups usually analyze strategies for compliance and regulation in order to gain legitimacy in their respective industry. However, compliance may hinder AI innovation and growth; in such circumstances, startups can challenge and resist around established norms to maintain their competitive edge
Yordanova (2021)	Innovation development and R&D project management in science organizations and universities—data-driven model and analysis	Propose a data-driven model to foster innovation and R&D project management within HEIs	First, the author elaborated a data-driven model to support R&D project management. Later, this model was tested and provided insightful results towards resource allocation and R&D planning processes within HEIs
Horstmeyer (2020)	The generative role of curiosity in soft skills development for contemporary VUCA environments	Explore curiosity as a key factor in developing soft skills (especially interpersonal and intrapersonal skills) in VUCA environments	The article attempts to understand how curiosity can be useful for nurturing communication, empathy and resilience in VUCA contexts. Additionally, this article also suggests strategies to promoting curiosity as a means to enhance soft skills
Bresciani et al. (2021)	Agility for successful digital transformation	Explore the adoption of agile practices for achieving digital transformation within organizations	The study focuses on underscoring that agile is not only a methodology but a mindset as well. Also, this study explains how organizations can adopt and deploy agile techniques while promoting ongoing innovation and collaboration
Cardoso Castro (2019)	The viable system model as a framework to guide organizational adaptive response in times of instability and change	Apply the VSM (Viable System Model) framework for promoting continuous adaptability	During turbulent and instable periods, organizations can put in place the VSM model for embracing resilience, adaptability. Also, this paper explores benefits of this model and strategies to adopt VSM concepts to foster agility within the organization

Table 6 (continued)

Reference	Topic	Aim	Brief description
Lourens et al. (2022)	Agile technology and artificial intelligent systems in business development	Study the benefits of the combination of AI technologies and Agile frameworks to enhance organizational competitiveness	The first part of this research describes how concepts from the agile framework can serve as a foundational catalyst for business operations. Then, this study explores how AI solutions and agile approaches can be leveraged to support value creation and growth
Bushuyev et al. (2021)	Modeling leadership for developing information technologies based on Agile methodology	Investigate how leadership can guide Agile software development projects	The paper introduces a novel leadership model which adopts agile principles and strategies. The authors also review practical examples where this new leadership model serves to enhance IT processes and outcomes
Buffardi (2018)	Tech startup learning activities: a formative evaluation	Examine the effectiveness of learning activities to support the development needs of startup organizations	This research evaluated current learning activities (primarily, content and methods of delivery) used by startup companies. Then, learning deficiencies were identified and new approaches and strategies were proposed for improving technical knowledge and soft skills of startup team members
Gupta et al. (2022)	A comparative study of implementing Agile methodology and Scrum framework for software development	Compare the suitability and effectiveness of the scrum framework and the agile approach in the software development industry	A comparative analysis was conducted between scrum and agile approaches with special emphasis on team collaboration, project management styles and success criteria. Thus, the article explores successful use cases where practitioners supported their actions based on lessons learned
Ahmed et al. (2022)	Agile management and VUCA 2.0 (VUCA-RR) during Industry 4.0	Investigate how the agile manifesto can be used in conjunction with VUCA 2.0 to face issues and opportunities in the Industry 4.0	This study reflects how agile principles facilitate and enhance innovation and adaptability. Then, the introduction of the VUCA-RR model is detailed following an agile perspective. As a result, this paper reveals that organization pursuing Agile and VUCA-RR respond to changing conditions and foster innovation while maintaining their competitive edge
Akkaya and Ahmed (2022)	VUCA-RR Toward Industry 5.0	Explore the applicability of VUCA 2.0 to face issues and opportunities in the Industry 5.0	This article explains how the RRR principles can be used within the Industry 5.0. Also, this paper introduces dynamic strategies based on the agile manifesto in order to navigate the complexities of the 5th industrial revolution

Table 6 (continued)

Reference	Topic	Aim	Brief description
Guérineau et al. (2022)	Organizing the fragmented landscape of multidisciplinary product development: a mapping of approaches, processes, methods, and tools from the scientific literature	Conduct a literature analysis of the MDPD techniques, processes, tools and methods in order to develop a structured mapping	This paper has two phases: (a) approaches, tools, methods were identified to understand dependencies and interrelationships among the MDPD techniques; (b) research gaps and opportunities were structured in order to enhance collaboration and integration within the MDPD context
Slama (2023)	Agile AIoT	Explore the application of Agile approaches to deliver AI-driven IoT products	This chapter explains how the agile manifesto can guide the development of AI-led IoT artifacts. This study focuses on collaboration and rapid response to changing requirements in the evolving AIoT industry
Patrucco et al. (2022)	How do Scrum methodologies influence the team's cultural values? A multiple case study on Agile teams in nonsoftware industries	Explore how Scrum practices exerts strong influence on values within the Scrum team in non-software development environments	This paper identifies cultural transformations within Agile teams when the Scrum approach has been applied in non-IT contexts. The authors highlight best practices and technical recommendation for proper adoption of Scrum in non-IT contexts
Luna et al. (2020)	Agile governance theory: operationalization	Create a governance framework which follows the agile mindset within traditional organizations	This paper aims to create a robust governance framework designed to facilitate and embrace agile principles by defining roles, processes and responsibilities focused on Agile practices maintaining transparency, accountability and collaboration

Table 7 Summary of articles that follow a chaos-focused mindset towards agile project management

Reference	Topic	Aim	Brief description
Mendonça de Sá Araújo et al. (2019)	Design Thinking Versus Design Sprint: a comparative study	Compare and analyze features of Design Thinking and Design Sprint in order to facilitate complex problem-solving scenarios	This study delves into technical processes and stages of both approaches and explain comprehensively how they can be applied in certain real-world scenarios especially taking into account complexity, time, and nature of the project
Veretennikova and Vaskiv (2018)	Application of the lean startup methodology in project management at launching new innovative products	Investigate how the Lean startup methodology can be applied into project management for releasing new products	This article proposes novel techniques by merging Lean principles with standardized project management techniques for delivering innovative products. Also, this article stresses that due to this enhanced hybrid model it is feasible to reduce uncertainties, streamline innovation processes and improved learning opportunities throughout the project lifecycle
Althar et al. (2022)	Automated risk management-based software security vulnerabilities management	Develop a risk-driven automated system for managing software vulnerabilities	First, these authors developed a vulnerability management framework which identifies, tracks, and prioritizes based on risk profiles. Then, these researchers developed a software capable of automating software vulnerabilities; as a result, this translates into reduced response times and effective vulnerability management processes
Yadav et al. (2020)	Adoption of lean principles in software development projects	Explore the application and tailoring of Lean principles into the software industry	The authors first sum up how the Lean practices were created for the manufacturing industry and how these can be tailored for the software development industry. Moreover, they also compared how Lean performance metrics can be employed in software development settings
Vasilieva (2021)	Design thinking in the development of project management approaches and modeling of business processes of the organization	Investigate the role of design thinking as a transformative mechanism for creating valuable project management and business processes	This article offers insights into what design thinking practices can be employed to enhance creativity and innovation. Also, the authors review case studies where the design thinking approach succeeded to improve project management practices and organizational process alike
Silva et al. (2021)	Lean startup for opportunity exploitation: adoption constraints and strategies in technology new ventures	Explore the usage and applicability of Lean principles in technology companies	This study contributes specially to identifying roadblocks and constraints which may hinder the adoption of Lean practices. This study seeks to provide action plans on how to guide the difficulties of Lean implementation

- Sinak considers that Infinite Games are prone to ongoing improvement which translates into adapting, tailoring and evolving stakeholder relationships achieved through agile feedback and iterative engagement,
- Gamification usually offers short-term results; however, Gamification + Infinite Games can be integrated into a broader and thorough engagement strategy to create a sustainable long-term environment.

In other words, gamification and infinite games complement each other by building and maintaining adaptable, loyal and long-lasting relationships aligning with the complex circumstances of organizations.

To further develop this answer, the Infinite Games theory can also be merged with the ideas and concepts proposed by Cardoso Castro (2019):

- The VSM framework aligns with Sinak's theory by encouraging organization to adopt a holistic perspective (the ecosystem of stakeholders) and adapt accordingly to the changing circumstances at all levels,
- The VSM model introduces the nature of adaptive structures; this means that organizations can place small units to respond effectively to complex situations, a key feature in Infinite Games. Furthermore, these small units support organizations to "fail sooner and fail better" by learning from previous experiences and adjusting strategies depending on internal/external factors,
- Creating resilient feedback loops is an important aspect within the VSM model is imperative to support and stay responsive to the changing nature of the market.

RQ2: How can Agile methodologies be utilized as effective tools to design and adapt new business models in response to the challenges posed by a VUCA environment?

To properly elaborate this research question, three different studies serve as the foundational basis for identifying tools to new business models under VUCA conditions:

- Design Thinking practices such as collaborative ideation (create novel ideas or proposals for exploring new chances), empathy (usually used to understand needs and pain points of stakeholders) and problem framing (conduct root causes analysis prior to potential solutions) can be easily structured and devised in conjunction with any Agile framework to embrace new business opportunities under VUCA-related issues (Mendonça de Sá Araújo et al., 2019; Vasilieva, 2021),
- Design Sprint activities such as divergent thinking (different perspective about solving a specific problem can be highly effective for creative problem-solving), time-boxed nature (activities are to be performed during specific intervals based on an agenda), prototyping can be creatively conducted to foster rapid adaptation and enhance the organization's focus on VUCA-related problems (Mendonça de Sá Araújo et al., 2019),
- Compiling Lean startup principles with Agile frameworks provide insight about how to navigate volatile conditions for adapting or creating business models through the use of: MVP, iterative development and rapid prototyping can be used to validate assumptions, hypotheses, or any related artifact and take corrective

actions if necessary; strategic pivoting, team members need to be aware to business model adaptation if market conditions tend to change; experimentation and human-led Jidoka, applying lessons learned can guide the organization during turbulent times and trying unknown or automation approaches can be useful as well (Veretennikova & Vaskiv, 2018; Yadav et al., 2020).

RQ3: How does the integration of AI support decision-making processes for investments in innovative business model development?

AI technologies facilitate considerably decision-making processes, for example: AI systems can automate routine tasks, perform predictions, identify patterns and analyze large datasets. In addition, AI can be a useful enabler for developing innovative business models through:

- The TISM-MICMAC approach reinforces the identification of consumer preferences and new market trends by implementing sound AI algorithms (machine learning and fuzzy techniques) for predictive analytics and continuous risk management, purging for data quality, and the availability of AI expert contributing to the enhancement of new business models (Sharma & Kumar, 2023),
- AI decision systems support and automate the alignment of decision workflows and IT strategic objectives by using machine learning tools and data governance models for AI-driven personalization and tailoring experiences; thus, developing innovative business models for companies in unstable market conditions (Nortje & Grobbelaar, 2020),
- Due to standardization and compliance requirements, certain industries benefit from the deployment of AI solutions by identifying new market niches, unfulfilled needs, proper resource allocation, new trends and demands, adherence to national/international regulations, enhanced risk management approaches for investing in novel business models (Kulkov, 2023),
- Conducting iterative uncertainty reduction techniques, as recommended by Poeppelbuss et al. (2022), it is feasible to automate repetitive tasks, continuous innovation, personalization of business needs based on customer insights,
- Integrating Agile techniques and VUCA 2.0 strategies can be used to explore new business model investments focused towards Industry 4.0 and Industry 5.0 (Ahmed et al., 2022; Akkaya & Ahmed, 2022).

RQ4: What are the critical factors that organizations must consider while transitioning from Finite Games (characterized by known players, fixed rules, and agreed-upon objectives) to Infinite Games, as proposed by Sinek (2019)?

A hybrid approach can be implemented to answer this question based on:

- Fuzzy logic algorithms can be leveraged to showcase how the transition from Finite Games to Infinite Games should be achieved usually learning from past experiences, continuous refinement of risk management and the measurement of risk analysis based on quantitative techniques. Furthermore, employing fuzzy techniques and

other AI algorithms in conjunction facilitate this transition towards data-driven decision-making processes to support technological insights (De Ruiz Diego et al., 2023),

- Curiosity as a catalyst for transitioning from a rigid structure to a goal-focused organization, from a bureaucratic style to a flexible mindset, from a punishment perspective to embracing ongoing learning from successes and failures. Also, curiosity can be used for soft skills development positioning with the concept of Infinite Games (Horstmeyer, 2020),
- Creating a stakeholder-centric environment which is to consider and engage not only traditional stakeholders within the performing organization, but to also include the wider community (partners, customers, employees, affected parties from the community) aiming for a common sense of purpose and long-term win–win outcomes (Silva et al., 2021),
- Adding AI-led recommender systems for ongoing adaptability based on learning and adapting continuously recommending strategies, user feedback and cultural transformation related to how cross-cultural teams can foster innovation and experimentation to improve recommender systems (Yan & Feng, 2018; Zhang et al., 2021).

RQ5: How can organizations effectively balance and integrate the concepts of Uncertainty, Agile methodologies, AI, and innovation to foster a culture of continuous learning, experimentation, and adaptation?

Nowadays, organizations commonly operate on VUCA environments making this a vast opportunity for organizations to experimentation, learning activities (such as hackathons and training programs), optimization per se, application of proven Agile methodologies for small teams and scaled-Agile settings, among others (Buffardi, 2018; Gupta et al., 2022; Schön et al., 2020); it is feasible to draw lessons to foster adaptation, learning and experimentation under unknown circumstances.

Discussion and conclusion

Zinkin (2020) shares the antidote against the VUCA model through a new perspective and evolution about itself—the VUCA 2.0—means the new way to face the challenge of sustainability for any companies in the market. Moreover, the meaning of VUCA is Volatility, Uncertainty, Complexity and Ambiguity; however, this novel VUCA model 2.0 brings another revolutionary focus and concepts with regard to each variable. Zinkin proposes new theories and meanings such as Vision, Understanding, Courage and Commitment and Adaptability.

Every edge component in VUCA model has its reciprocal variable in VUCA model 2.0 such as Volatility is managed through Vision, Uncertainty through Understanding, Complexity through Courage and Commitment and finally Ambiguity through Adaptability. This new focus shows a new challenge for the managers in the companies because they will have to drive with the new strategies oriented to survive and guarantee the sustainability of the organizations in the VUCA market. Lastly, the author stands out the importance of making a Governance Corporate because they will be who take the responsibility of managing, leading and generating the policies which will be applied into the organizations and allow their survival in complex market.

There are many examples of companies that led the markets in their different industries and that were successful management models at the time, such as Blockbuster, Nokia, Kodak, Blackberry, Atari, among others, however, one of the greatest lessons learned in the business world is that every business model has an expiration date. Therefore, those companies that have not started working on innovation processes to renew their business models or design and develop new models are destined eventually to disappear because someone else will develop a new model that will displace the one, they have not renewed, as stated by Simon Sinek [24] in his theory of Infinite Games.

Some Agile methodologies help organizations to manage new opportunities by designing new business models, however, for these models to be scalable, it is necessary to use Artificial Intelligence as a platform that will oversee processing the data extracted during the model incubation process. In such a way that, as a result of the information processing, these provide us with projections on the sustainability of the business model and, in turn, allow us to make decisions on the feasibility of the investment.

To better manage the uncertainty that surrounds any innovation process, two key aspects must be combined, such as: (I) the use of Agile methodologies, and (II) the use of Artificial Intelligence, because the first of them discovers new business opportunities and the second validates whether that opportunity is scalable as a business model. Therefore, there is a symbiosis between both areas of knowledge, and they complement each other to help mitigate uncertainty when developing new Business Models.

Limitations

It is important to explain the limitations and constraints of this study. For instance, a restricted sample was obtained from journal articles from 2018 to the beginning of 2023. Therefore, the findings cannot be applied to other industries and its applicability at different times is unknown. Additionally, this study has selected some restrictive variables such as uncertainty, business models and project management practices. This may translate that other unknown variables, not considered for this paper, might offer in-depth analysis and description of the problem.

Author contribution
BZ analyzed and performed the literature analysis of AI and current Project Management practices, and was a major contributor in writing the manuscript. FE developed the methodological section and performed statistical analysis. CCC provided input regarding academic style and editing techniques. PN developed all the graphs. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. All data used were publicly available from open databases mentioned in "Results" section.

Declarations

Competing interests
The authors declare that they have no competing interests.

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