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20 Years of the Agile Manifesto: A Literature Review on Agile Project Management

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Abstract
Agile Project Management is a topic that has become popular both in business and academia, since the publication of the Agile Manifesto – a historic landmark in this subject. In the next 20 years, there was a relevant scientific production that must be analyzed to provoke reflection about the knowledge built up in this period. In this sense, this study aims to analyze the relevant scientific literature on Agile Project Management through a systematic review and a bibliometric analysis of articles published in scientific journals with Digital Object Identifier, in English, from the Web of Science and Scopus databases, from 2001 to 2021. The research results enable us to gain insights into the characteristics of this knowledge domain, regarding its volume and evolutionary trend, main contributors (i.e. scientific journals, authors, and their affiliations), main studies, methods used, and its central thematic axes.

Keywords
Agile project management; Systematic review; Bibliometric analysis; PRISMA; Literature review.

Introduction

In the late 1990s, software development teams started to employ new working methods that sought to improve programming processes making them more continuous and incremental based on aspects such as adaptability, personal and group autonomy, modularity, and self-collaboration (Hidalgo, 2019).

At the beginning of the 2000', seventeen professionals published the so-called "Agile Manifesto," seeking to define basic values and principles to improve software development. During the two decades that followed this declaration, agile project management was consolidated, surpassed the boundaries of the Information Technology area, from which it originated, and is currently well consolidated and popular in different sectors.

Agile project management represents a paradigm shift concerning the previously prevailing thinking, which was heavily based on specifications, extensive planning, detailed documentation, and the search for "immaculate" execution of its processes, known as Waterfall (Shastri et al., 2021).

This is because, according to Serrador and Pinto (2015), the methods used by agile project management are designed to use minimal documentation to facilitate flexibility and responsiveness to changes, requiring less planning effort and greater flexibility compared to traditional management.

Lindsjørn et al. (2016) claim that agile project management is characterized by collaborative work, which requires multidisciplinary skills, pluralistic decision-making, and the use of small teams in projects, whereas traditional management focuses on individual work, specialized skills, managerial decision-making, and the use of large teams on their projects.

According to Conforto et al. (2016) – in the years that followed the publication of the agile manifesto – the agile project management approach has evolved considerably and currently constitutes a well-defined set of methods, tools, and techniques, which was created to improve project performance by promoting its "agility", fundamentally involving the ability to plan quickly for change and to provide active customer involvement.

Fernandez and Fernandez (2008) suggest that the popularization of agile project management seems to be due to its potential to optimize the operational capacity of the project team with the implementation of

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small cycles and to the positive influence it promotes on the team's work dynamics.

The increasing number of academic publications per year in the scientific literature reflects the growing interest in agile project management, and many practitioners and academics have come to believe that the use of this proposal increases productivity and efficiency in their projects (Lechler & Yang, 2017).

For Stettina and Hörz (2014), the growing interest in agile project management suggests that there is room for new research seeking to indicate patterns of evolution, trends, and gaps on this topic.

Similarly, Hoda et al. (2017) argue that, just as agile project management is currently very popular in organizations, its growth has generated a huge number of scientific publications as a response. In this sense, studies that aim to understand the intellectual structure of this scientific production can help to consolidate the frontier of knowledge about this phenomenon.

Another important aspect is that analyzing the existing literature on agile project management and its relationships provides a comprehensive understanding of the central research themes and their association, revealing promising research questions in this area.

Considering these arguments, in this study we explore the following research questions:

RQ1: How has scientific production on agile project management developed since the agile manifesto?

RQ2: Who are the prominent contributors (e.g., journals, scholars, schools, and countries) to the agile project management literature?

RQ3: Which studies can be considered central in the scientific literature on agile project management?

RQ4: What are the research methods adopted by the studies found in the scientific literature on agile project management?

RQ5: What are the main thematic axes that emerge from the scientific literature on agile project management?

Due to the rapid growth of this topic, objective review techniques are preferable to other methods because they provide transparent, replicable protocols that can be periodically reproduced to measure both the consistency and the accuracy of the results obtained. In this sense, we can highlight the systematic review of the literature, which, according to Inamdar et al. (2020), is an approach that allows secondary data to be identified, selected, and evaluated objectively, due to its principles, which include the heuristic, exploratory, and inclusive nature, allowing the removal of errors and biases in the selection of documents.

As a complement to the systematic review, bibliometric analysis works with a highly effective approach by its ability to summarize, in a succinct, efficient, and objective way, the available knowledge on a given topic, being ideal for mapping the intellectual structure of a given theme (Khanra et al., 2021).

Thus, to answer the research questions formulated above, we carried out a systematic review, followed by a broad bibliometric analysis of the international scientific literature on agile project management, whose results allow us to structure the scientific knowledge about the area and expand the understanding of the scientific frontier on this topic.

The remainder of this text is organized as follows: section 2 presents a theoretical background over agile project management, section 3 shows the methodological details of the study, section 4 presents the results and discussions, and section 5 ends the study with the conclusions, limitations, and suggestions for future works.

Literature review

The cornerstone for understanding agile project management is certainly the Agile Manifesto, which presented four core values to guide software development projects. According to Beck et al. (2001), the core values stated in the Agile Manifesto were: "Individuals and their interactions about processes and tools"; "Working software on comprehensive documentation"; "Customer collaboration on contract negotiations"; and "Responding to changes about following a plan".

In addition, the Agile Manifesto presented 12 fundamental principles, which, according to Santos and Carvalho (2021), can be summarized in consumer satisfaction by collaborative work between motivated and self-organized teams, which include business representatives and developers who value simplicity, sustainable development, technical excellence, and agility.

According to Schwaber (2004), agile principles are supported by three philosophical beliefs:

- Visibility – the parts of the process that affect the outcome must be visible to those controlling the process.
- Adaptation – the project team has to recognize and respond quickly to what the situation requires, seeking to accommodate necessary changes and minimize disruptions in product specifications;
- Inspection – team members responsible for checking for deviations need to do so regularly and be able to detect aspects that violate specifications.

The combination of the elements mentioned in the first paragraphs of this section forms the conceptual basis of the set of methods, techniques, and tools that are currently known as Agile Project Management.

According to Conforto et al. (2014), the term "Agile Project Management" became known as a result of the dissemination of a set of methods developed for the software industry, including Scrum, Lean Software Development, Crystal, Feature Driven Development (FDD), Adaptive Software Development (ASD), Dynamic System Development Method (DSDM), and Extreme Programming (XP).

Among the methods contained in the "umbrella" of agile project management, Scrum is undoubtedly the most widely used and consists of activities done interactively, where each interaction is called a "sprint". Sprints are performed to create and test functional parts of the product until acceptance criteria are met, and ends when a delivery is completed (Nichols et al. 2015).

Vietland (2015) states that the Scrum lifecycle typically consists of short interactions, lasting from two to four weeks, which allow for quick feedback from users and other stakeholders on the delivered product. Furthermore, according to Srivastava and Jain (2017), Scrum is run by self-organized and cross-functional teams, which brings decision-making to the level of operational problems, increasing the speed and accuracy of the solutions found.

Lean originally emerged in the manufacturing area as a way to create products while minimizing waste in all its forms. Lean Software Development, in turn, according to Petersen and Wohlin (2011), focuses on an end-to-end perspective of the entire value stream throughout the development process (i.e., from the first concepts and ideas to the characteristics of the finished software). To support this proposal, Lean uses a conceptual basis that involves value stream mapping, inventory management, and the system pulled through Kanban.

In addition, Poppendieck and Cusumano (2012) highlight that Lean Software development has seven fundamental principles that guide its execution: Optimize the whole; Eliminate waste; Build quality; Learn constantly; Deliver fast; Involve everyone; and Do better and better.

Crystal is a family of methodologies (Crystal Clear, Crystal Yellow, Crystal Orange, and others) whose fundamental characteristics are driven by several factors, such as team size, project priorities, and its critical aspects, including the need for tailoring policies, practices, and processes to meet unique needs. The main features of Crystal include simplicity, team communication, reflection to continuously improve processes and other methodologies, fast delivery of working software, user involvement, adaptability, and reduced bureaucracy (Wadhwa and Sharma, 2015).

Feature Driven Development (FDD) is a highly adaptive software development model that focuses on quality during all stages of the project. FDD consists of five sequential processes that are performed iteratively to build the software in increments. It starts with the process of developing a general model for the software, then a list of desirable features and a plan for obtaining these features are created, followed by an interactive design step, which generates packages that must be inspected and validated. Finally, a software construction step is carried out from the approved packages and a new iteration is performed to include more features (Anwer et al., 2017).

Adaptive Software Development (ASD), in turn, according to Meso and Jain (2006), emphasizes the production of results of some value from the rapid adaptation to internal and external events instead of using process optimization techniques, with the team competing with each other for results, which creates extreme pressure to deliver results quickly.

According to Baruah and Ashima (2012), ASD consists of three phases: the first is the "Speculating" phase, which involves the initiation of the project with the definition of objectives, what will be done, and a general schedule, in a very quality and result-oriented way; the second is the "Collaborating" phase and involves a series of interactive, incremental, and concurrent development cycles, where the constant creation of prototypes is stimulated, in addition to a quality review with the presence of the customer; finally, the third is the "Learning" phase and involves launching the product and recording lessons learned.

Regarding the Dynamic System Development Method (DSDM), it is a proposal based on eight principles: Focus on business needs; On-time delivery; Collaboration; Never menacing quality; Building the product incrementally from the company bases; Developing interactively; Communicating clearly and continuously; and Showing control (Saragih et al., 2021).

According to Mekni et al. (2018), the DSDM has five stages: the first two are the feasibility analysis and the analysis of the business that involves the project; the third stage involves an interactive cycle that seeks to develop a functional model; the fourth stage involves developing and testing prototypes of the developed product; and the fifth and final step involves reviewing the business objectives, training users, approving the product, and implementing it.

Finally, Extreme Programming (XP) is a method that deeply focuses on human relationships, having

as main values communication, simplicity, feedback, and courage. In addition, as practices, it presents the need for the customer to be "on-site," the use of planning game (which is how the project schedule is elaborated), Metaphor (naming each part of the software in a way that all stakeholders understand), Pair Programming, Refactoring, and continuous integration (Tolfo and Waslawick, 2008).

Although this study does not focus on the analysis or characterization of the methods that are part of agile project management, this section is important because it describes some of its nuances, improving the understanding of the study objects of the works analyzed in this research.

The next section presents the research stages and justifies the methodological choices made by the authors for carrying out this study.

Materials and methods

The methodological proposal adopted in this study to answer the proposed research questions consists of a systematic literature review followed by bibliometric analysis.

The systematic review seeks to collect evidence systematically and offer an evaluation against criteria predetermined in a protocol, instead of presenting random results, subject only to the researcher's appreciation. Thus, the systematic review can offer a balance between comprehensively identifying a large number of publications and systematically reducing it to a smaller set, which fits the inclusion and exclusion criteria proposed in the research (Linnenluecke et al., 2020).

The systematic review carried out in this study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) as a guide, whose steps are described below.

As Figure 1 shows, the systematic review consisted of three stages. In the first stage (identification), only the keywords and "Agile" and "Project Management" were used to retrieve the widest possible amount of documents on the subject. The search was carried out in the Scopus (652 documents) and Web of Science (462 documents) databases, and only considered scientific articles published between 2001 and 2021.

The second stage (screening), started with the union of the results in the same database and the exclusion of articles that were duplicated, without Digital Object Identifier (DOI), and not written in English. Subsequently, an analysis was conducted regarding the titles and abstracts of the documents, excluding those that were not inside the scope of the researched topic. Finally, the remaining texts were read in full, excluding those that were outside the scope or that only touched on the topic of interest in this study. Therefore, in the third and final stage, 313 articles were chosen, which seem to represent the relevant scientific production on agile project management in the period considered for this study.

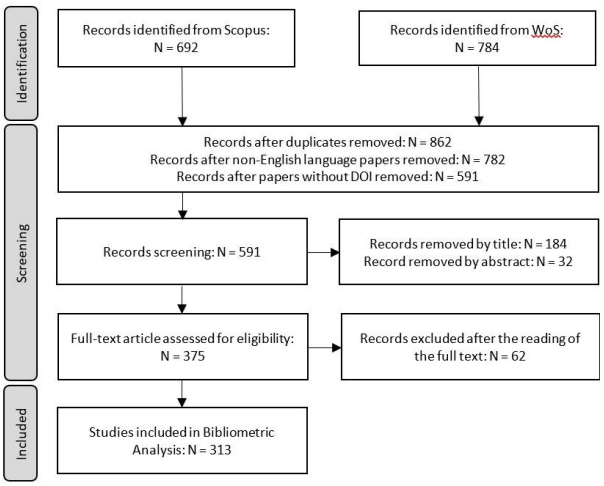

Fig. 1. PRISMA flow diagram

From the results found following the PRISMA protocol, the bibliometric analysis began. This method is strongly indicated for mapping the intellectual architecture of literature because it is quantitative, systematic, transparent, and replicable (Rauch, 2020).

The bibliometric analysis was structured using the Bibliometrix package (RStudio) to answer the research questions proposed in the introduction of this study, considering the number of publications per year, publications per source, main authors, and their affiliations. Then, the most cited studies within the database were analyzed, to identify those considered central. Other points analyzed were the research methods used by the works found in the database and finally the co-occurrence network, seeking to establish the main thematic axes that make up the scientific literature on the subject from the identified clusters. The results found in the bibliometric analysis are presented in the next section.

Results

The results obtained from the analysis of the database built with the systematic review were organized to answer the research questions presented in the introductory section, as can be seen in the next subsections of this article.

Publications per year

The first result to be explored is related to the first research question proposed in this study (RQ1), which involves the evolution of scientific production on Agile Project Management. In this sense, Figure 2 below shows the number of scientific publications from the release of the Agile Manifesto (published in 2001) until 2021.

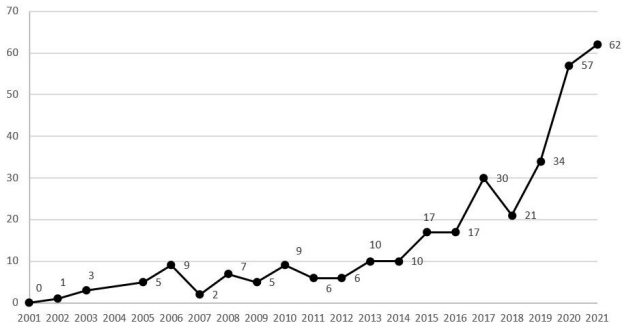

Fig. 2. Publications per year

As can be seen in Figure 2, Agile Project Management was not a very popular research topic in the first years after the publication of the Agile Manifesto, which is reflected by a small number of publications from 2001 to 2012.

In the period from 2001 to 2006, there is a timid but consistent increase in published works on the subject, followed by an abrupt drop in 2007 and a relatively constant number, with few fluctuations until 2012. From 2013, there is a notable interest from academia in the phenomena involving agile project management, reaching the level of 62 articles published in 2021.

In total, 313 articles published in the period considered in the study were found, with an annual average of 15.55 articles/year. Although the average is relatively low for a topic considered quite relevant among researchers in the areas of project management, software engineering, and others, the large growth in the number of publications in recent years must be considered, which indicates a strong trend of increasing intellectual production on phenomena related to this theme.

Proeminent contributors

To answer the second research question (RQ2), some analyses are necessary, the first being the scientific production considering its main sources, presented in Table 1.

Table 1 shows that the journal with the highest number of publications on the subject is the Project Management Journal (16), followed by the Journal of Systems and Software (15), IEEE Software (13), Journal of Modern Project Management (12), International Journal of Project Management (11), and In-

Table 1
Scientific production per source

Ranking	Source	Papers	Total Citations	Citations/ paper
1	Project Management Journal	16	380	23,75
2	Journal of Systems and Software	15	1124	74,93
3	IEEE Software	13	430	33,08
4	Journal of Modern Project Management	12	22	1,83
5	International Journal of Project Management	11	544	49,45
6	Information and Software Technology	10	335	33,50
7	Int. Journal of Information Technology Project Management	9	12	1,33
8	Empirical Software Engineering	8	482	60,25
9	IEEE Access	6	26	4,33
10	IET Software	6	64	10,67
11	International Journal of Managing Project in Business	6	101	16,83
12	Int. Journal of Information Systems and Project Management	5	30	6,00
13	Computer	3	432	144,00
14	Engineering Management Journal	3	15	5,00
15	Int. Journal of Agile Systems and Management	3	2	0,67

formation and Software Technology (10). A relevant aspect to be highlighted is that, among the first six sources that publish articles on the topic, three are from the Project Management area and three are from the Software area, which indicates that the topic is relevant to both areas and the studies carried out tend to occur largely at their intersection.

Another important aspect to be observed in the table is the number of citations per article, being possible to highlight the Journal of Systems and Software, with 1124 citations (more than double than the second place), the International Journal of Project Management (544), and others such as Empirical Software Engineering (432) and IEEE Software (430). In this sense, the data seem to indicate that the most relevant articles on the topic have been published in sources associated with the Software area.

This last statement is corroborated when looking at the numbers related to citations per article. The highest values are from the publications Computer (144), Journal of Systems and Software (64.93), Empirical Software Engineering (60.25), with the International Journal of Project Management (49.45) only in fourth. However, it is important to highlight that, in general, many Software journals have project management in their scope, something that does not takes place the other way around.

The second item analyzed regarding the main contributors to the scientific production on Agile Project Management is the authors of the works found in the analyzed sample, listed in Table 2.

Table 2
Scientific production per author

Ranking	Authors	Papers	h-index
1	Hoda, R.	6	10
2	Amaral, D.C.	6	18
3	Aaltonen, K.	4	20
4	Drury–Grogan, M.L.	4	6
5	Conforto, E.	4	7
6	Cooper, R.	3	65
7	Akbar, M.A.	3	64
8	Conboy, K.	3	55
9	Dingsøyr, T.	3	29
10	Omar, M.	3	9
11	Berlec, T.	3	7
12	Rathod, U.	3	6
13	Shrivastava, S.S.	3	3
14	Ali, S.	3	3
15	Kurniawan, R.	3	2

Table 2 shows the 15 authors with the highest number of articles in the set selected in the systematic review. The biggest highlights are Hoda, R. and Amaral, D.C., who participate in six publications, and Aaltonen, K., Drury–Grogan, M.L., and Conforto, E., with four publications each.

An interesting aspect to be highlighted is the observation of the Scopus h-index of the authors mentioned in Table 2. As can be seen, most authors have an index lower than or equal to 10, which may indicate that due to the theme being relatively new in the scientific literature, it tends to attract younger researchers (an important observation is that there is also the presence, in smaller numbers, of senior researchers, with many published works and a high number of citations, such as Cooper, R., Akbar, M.A., and Conboy, K.).

The third and final topic to be analyzed in this section is related to the main affiliations of the authors who contributed to research on Agile Project Management, as presented in Table 3.

Table 3 shows that the main affiliations highlighted are the University of São Paulo, with 10 publications, the Federal University of Santa Catarina (7), and the Victoria University of Wellington (7). Another important aspect is that the list is made up mostly of universities, except for the Product Development and Management Association (4), which is a non-profit professional association created in the United States, but that operates internationally, with branches in different countries.

Another relevant aspect to be observed is the list of countries of origin of these organizations. The main highlights are the United States, with four affiliations, and Brazil, with two (but they are the first two on the list). Nevertheless, the list itself is quite diverse, with countries from four different continents, which indicates that researchers from organizations from different parts of the world are interested in this theme.

Most cited studies

This section aims to present the main studies of the analyzed database, to answer the third research question (RQ3). Thus, Table 4 shows a list of the 15 most cited articles by the analyzed studies, both in absolute values and in citations/year. Although only the first author is highlighted, the table also presents the Digital Object Identifier (DOI), which can be consulted for more details.

As can be seen in Table 4, the work with the highest number of total citations and citations/year is by Tsun Chow and Dac-Buu Cao, a survey on critical success factors in agile software development, which identified the influence of these elements on suc-

Table 3
Scientific production per Affiliation

Ranking	Affiliation	Country	Articles
1	São Paulo University	Brazil	10
2	Federal University of Santa Catarina	Brazil	7
3	Victoria University of Wellington	New Zealand	7
4	Aalborg University	Denmark	5
5	Bina Nusantara University	Indonesia	5
6	Penn State University	United States of America	5
7	St. Louis University	United States of America	5
8	University of Auckland	New Zealand	5
9	Deakin University	Australia	4
10	Georgia State University	United States of America	4
11	Product Development and Management Association	United States of America*	4
12	University of Oslo	Norway	4
13	University of Engineering and Technology	Pakistan	4
14	University of Ljubljana	Slovenia	4
15	University of Minho	Portugal	4

Table 4
Most cited articles

Ranking	Article	DOI	Total citations	Citations /year
1	Chow, T., 2008, Journal of Systems and Software	10.1016/j.jss.2007.08.020	485	34,64
2	Maruping, L.M, 2009, Information Systems Research	10.1287/isre.1090.0238	251	19,31
3	Boehm B., 2003, Computer	10.1109/MC.2003.1204376	243	12,79
4	Serrador P., 2015, Int. Journal of Project Management	10.1016/j.ijproman.2015.01.006	234	33,43
5	Pikkarainen, M,, 2008, Empirical Software Engineering	10.1007/s10664-008-9065-9	201	14,36
6	Conforto, E.C., 2014, Project Management Journal	10.1002/pmj.21410	152	19,00
7	Cohn, M., 2003, Computer	10.1109/MC.2003.1204378	130	6,84
8	Karlstrom, D., 2005, IEEE Software	10.1109/MS.2005.59	111	6,53
9	Mahnic V., 2012, IEEE Transations on education	10.1109/TE.2011.2142311	109	10,90
10	Lindsjrn Y., 2016, Journal of Systems and Software	10.1016/j.jss.2016.09.028	108	18,00
11	Lvrdy, V., 2009, IEEE Transacions on Eng. Manag.	10.1109/TEM.2009.2033144	104	8,00
12	Daneva, M., 2013, Journal of Systems and Software	10.1016/j.jss.2012.12.046	101	11,22
13	Ceschi, M., 2005, IEEE Software	10.1109/MS.2005.75	101	5,94
14	Hoda, R., 2016, Journal of Systems and Software	10.1016/j.jss.2016.02.049	96	16,00
15	Drury, M., 2012, Journal of Systems and Software	10.1016/j.jss.2012.01.058	92	9,20

cess attributes of the projects. This paper was published in the Journal of Systems and Software (which is the journal with the highest number of works in Table 4), with 485 total citations and 34.63 citations/year, almost twice more than the second place in total citations, by Likoebe M. Maruping, Viswanath Venkatesh, and Ritu Agarwal, who developed a model of the interplay between control, agile methodology use, and requirements change, and their effects on software development project quality. This study was

published in 2009 by Information Systems Research, with 251 total citations and 19.31 citations per year. However, it is important to highlight that these researchers do not appear among those with the highest number of articles published on the subject (Table 2). This may indicate occasional productions carried out by these authors, but which have become very relevant in the area due to their quality.

Another study that stands out among the most cited in the database, but considering only citations/year, is by Pedro Serrador and Jeffrey K. Pinto, published in 2015 by the International Journal of Project Management, with 234 total citations (fourth most cited) and 33.43 citations/year. In this study, the authors explored the efficacy of agile through a survey of projects that were developed with varying levels of agile approaches and their subsequent likelihood of success.

Among the most cited articles, it is still possible to highlight the study by Barry Boehm and Richard Turner, published in 2003 by the journal Computer, with 243 total citations and 12.79 citations/year, and the study by Pikkarainen, M. et. al., published in 2008 by Empirical Software Engineering, with 201 total citations and 14.36 citations/year. This research sought to increase the understanding of communication in agile software development, internally (among the developers and project leaders) and also externally, in the interface between the development team and stakeholders.

Although all the articles highlighted in Table 4 are relevant in the analyzed database, the five previously cited can be considered central, since they account for 47.81% of the total citations and have an average of 15.22 citations/year, compared to 11.72 for the rest of the studies mentioned.

Research methods description

In this section, the methods used by the articles present in the database will be described, to answer the fourth research question (RQ4). The results found are shown in Figure 3.

As can be seen in Figure 3, the most used method in the articles of the database is the single case study (25.88%), followed by the survey (25.24%) and the multiple case study (14.38%). Theoretical studies are in fourth place (10.54%), followed by literature reviews (8.63%), simulation (4.79%), action research (2.88%), and grounded theory (2.24%). In addition, Design Research Methodology, Ethnographic Research, Collaborative Practice Research, Meta-Analysis, and other methods were also identified in the base studies to a lesser extent and therefore were grouped in the "Other" category.

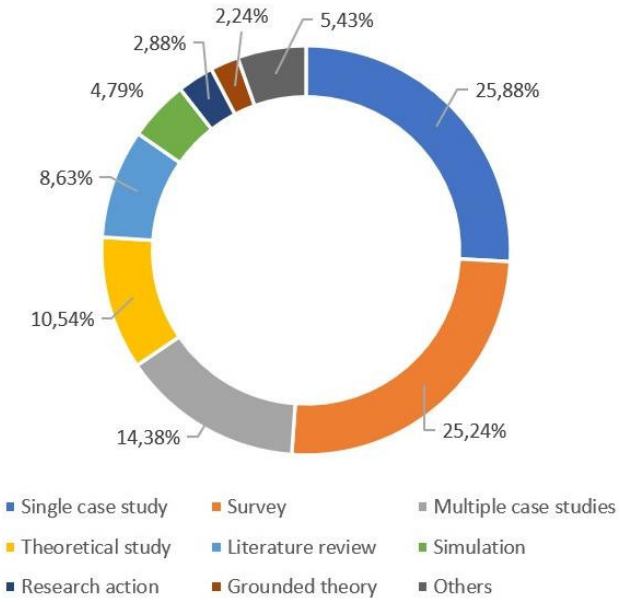

Fig. 3. Research methods description

The results provide important insights for new studies, indicating the preference of researchers in the field (who have been successful in publishing studies in reference journals, as already highlighted in the section on research methods) for more traditional methods such as the Case Study and the Survey. Another relevant point is the researchers' predilection for investigating empirical aspects associated with phenomena related to Agile Project Management, and the methods that are suitable for this type of study represent almost 80% of the methods used by the selected works.

Main thematic axes

To answer the last research question presented in the first section of this study (RQ5), a co-occurrence analysis was performed, based on the keywords of the articles found in the database. This type of analysis allows the creation of a network, which shows the links between the keywords, determining clusters that indicate the main thematic axes researched. Figure 4 presents the co-occurrence network of the main keywords used.

The network shown in Figure 4 was built based on 50 nodes (to confirm the result, an analysis was performed up to 150 nodes, in which the same clusters were found, but the figure with only 50 nodes is clearer and easier to observe) and has four clusters, which are described regarding their five main keywords and their respective occurrences in the network shown in Table 5.

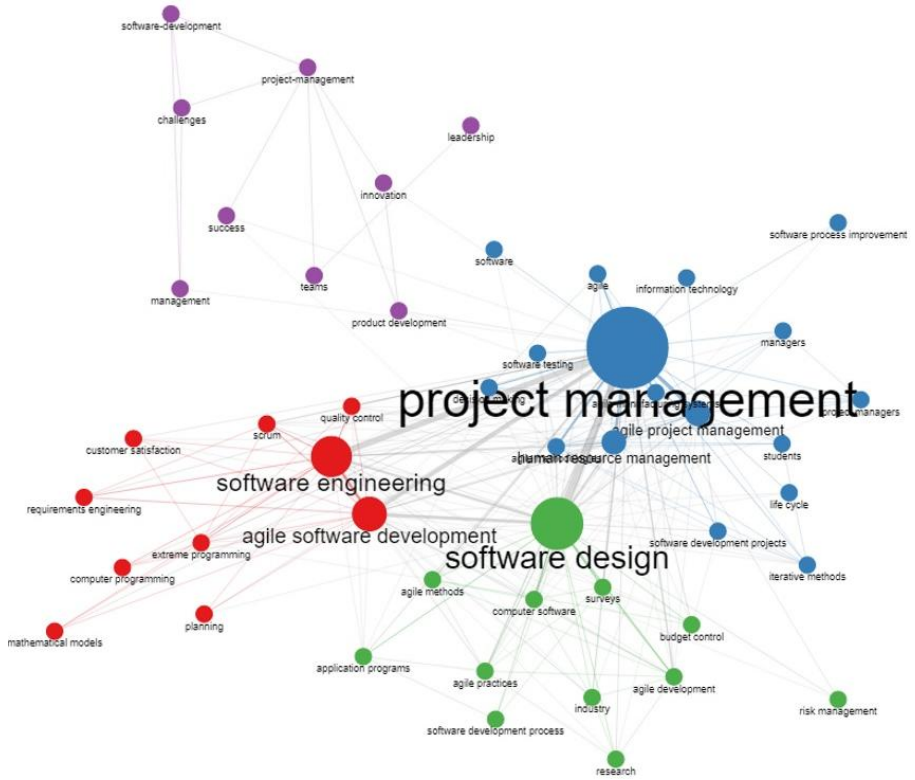

Fig. 4. Keywords co-accurrences network

Table 5
Clusters description by keywords and occurrences

Cluster	Title	Keywords	Occurrences
Blue	Project management and agile methodologies	Project management	138
		Agile project management	30
		Human resource management	24
		Agile methodologies	17
		Decision making	12
Red	Software engineering and agile development	Software engineering	48
		Agile software development	34
		Scrum	13
		Quality control	10
		Extreme programming	9
Green	Software design and agile practices	Software design	63
		Agile methods	14
		Computer software	14
		Agile practices	12
		Budget control	7
Purple	Product development and team management	Product development	9
		Challenges	8
		Innovation	7
		Leadership	7
		Team	6

In general, it is possible to see from the co-occurrence network and from Table 5 that two major themes are addressed in the studies found in the base: the first is project management and the second is software development. Although both are in part associated, the first involves works more concerned with managerial decision-making, while the second addresses aspects of agile management with a focus on software development processes.

In this sense, of the four clusters found, two are associated with the first group, more linked to project management (blue and purple clusters) and two are associated with the second, with greater adherence to software development processes (red and green).

The first and largest cluster is the blue, with 221 co-occurrences and named "Management of agile projects and methodologies," involving keywords of studies related to decision-making in agile projects, human resources management, and application of agile methodologies on the management context of any type of project. The work "Does Agile work? – A quantitative analysis of agile project success, published in the International Journal of Project Management in 2015, by Pedro Serrador and Jeffrey K. Pinto is a good representative of this cluster. In this paper, the authors conducted a survey to evaluate the impacts of agile methods on the project success achievement.

The second largest cluster is red, with 114 co-occurrences and named "Software engineering and agile development". Software engineering is typically an area of knowledge associated with the specification, development, maintenance, and creation of software, and the studies with keywords in this cluster have this characteristic, considering the context of agile management. A good representative research of this cluster is the work "Exploring software development at the very large-scale: a revelatory case study and research agenda for agile method adaptation", published by Empirical Software Engineering in 2018, from Torgeir Dingsøyr, Nils Brede Moe, Tor Erlend Fægri and Eva Amdahl Seim. The authors conducted a case study to verify if the agile principles can be adopted in very large scale software development.

The third cluster is the green, with 110 co-occurrences and named "Software design and agile practices"; its keywords are associated with more technical aspects of software development, but using agile methodologies. This cluster can be represented by the work "An empirical study of system design instability metric and design evolution in an agile software process", published in the Journal of Systems and Software in 2005, by Mohammad Alshayeb and Wei Li. The main purpose of this research was to test if the System Design Instability (SDI) metric can be used to evaluate and re-plan software projects in an XP agile process and also to study the system design evolution in the Agile software process.

The last and smallest cluster found is the purple, with only 37 co-occurrences and named "Product development and challenges"; it has keywords from studies associated with the use of agile methodologies in the context of product development processes in general (not related to software) and its main challenges, such as team management, leadership, and others. Representative research of this cluster is the work entitled "Agile project management and stage-gate model – A hybrid framework for technology-based companies", published in the Journal of Engineering and Technology Management in 2016, by Edivandro C. Conforto and Daniel C. Amaral. This study reports an empirical analysis of a hybrid management framework combining agile project management and a stage-gate model implemented in the product development process of a technology-based company, which showed a positive impact on its performance.

Conclusions

This study aimed to investigate the scientific literature produced between 2001 and 2021 on Agile Project Management. To achieve this objective, a systematic review was carried out, followed by a bibliometric analysis that sought to answer five research questions that structured the study. In this sense, a database was built, composed of 313 scientific articles on the subject, published only in scientific journals with Digital Object Identifier (DOI) and in English, in the Web of Science and Scopus databases, which allowed us to identify relevant and quality scientific production on the theme.

Based on the results, it was possible to conclude, first, that this is a topic rapidly expanding in terms of scientific production, showing strong growth from 2013, reaching 62 articles produced in 2021 (which represents about 20% of the total number of articles analyzed in the database).

Another relevant conclusion that the study showed is related to the most important contributors, highlighting, journals, the Project Management Journal, the Journal of Systems and Software, and IEEE Software. Concerning the main authors on the subject, Hoda, R.; Amaral, D.C.; Aaltonen, K.; Drury–Grogan, M.L.; and Conforto, E. stand out. For the main affiliations of the authors, one can highlight the University of São Paulo and the Federal University of Santa Catarina (both in Brazil), as well as the Victoria University of Wellington (New Zealand). These

results offer insights to researchers on where to publish their work and potential partners to develop research on the topic.

The third conclusion that this study provides is that the main published studies on agile project management are "A Survey Study of Critical Success Factors in Agile Software Projects" by Tsun Chow and Dac-Buu Cao, published in 2008 in the Journal of Systems and Software; "A Control Theory Perspective on Agile Methodology Use and Changing User Requirements" by Likoebe M. Maruping, Viswanath Venkatesh, and Ritu Agarwal, published in 2009 by the Information Systems Research; and "Does Agile work? – A quantitative analysis of agile project success" by Pedro Serrador and Jeffrey K. Pinto, published in 2015 by the International Journal of Project Management. Due to the high number of citations, these can be considered the central works within the analyzed database.

The fourth conclusion about the scientific production on Agile Project Management is related to the research methods used in the studies. One can conclude that the researchers' greatest interest is to analyze empirical aspects of the phenomena associated with the theme, using as main methods the Single Case Study, the Survey, and the Multiple Case Study. These results offer methodological references for new studies, either as an option for "safer" avenues of investigation or suggesting that methodological innovations are rare and should be proposed in new works.

Finally, the fifth conclusion of the study refers to the thematic axes of the published works. From the results obtained with the co-occurrence network, we have found four clusters: two of them more associated with managerial aspects on the subject, without being directly related to a specific type of project, which was named "Management of agile projects and methodologies" and "Product development and challenges"; and two others more directly associated with software development, whether about development processes or more technical aspects, which were named "Software engineering and agile development" and "Software design and agile practices". The results allow the conduction of new studies on the subject, aligning them to the thematic axes presented, or even suggesting to researchers that they develop innovative work, outside the clusters identified in this study.

It is important to point it out that this study increases the comprehension over the scientific production on agile project management mainly in two aspects. First, it provides a wide perspective of the evolution of the subject over time, since the publication of agile manifesto and also among several and important scientific journals, joining Scopus and Web of Sciences databases, which, at our best knowledge, have never been done. Second, it provides a more profound comprehension of the relationships among the researches, identifying the most significant thematic axes regarding this subject, which were not provided by any research known by the authors.

Another relevant aspect to be highlighted is that the methodological options of the this study generate some limitations. In particular, the fact that the database does not present books, articles from scientific events, technical works, or even theses and dissertations, may have excluded studies that would add to the results found.

Finally, based on this research, the authors indicate two paths for future studies. The first one aims to deepen the understanding, by systematic reviews and meta-analyses, of the studies of each of the thematic axes found, to consolidate the knowledge present in each one. The second path, more directed to empirical work, is to analyze phenomena associated with the theme, in the different types of organizations that use Agile Project Management, but that are not inside the thematic axes described in this study, to contribute for diversifying the body knowledge built so far in the scientific literature.

References

Anwer F., Aftab S., Waheed U. and Muhammad S.S. (2017), Agile software development models tdd, fdd, dsdm, and crystal methods: A survey, *International Journal of Multidisciplinary Sciences and Engineering*, No. 2, Vol. 8, pp. 1–10

Beck K., Beedle M., Van Bennekum A., Cockburn A., Cunningham W., Fowler M., Grenning J., Highsmith J., Hunt A., Jeffries R., Kern J., Marick B., Martin R.C., Mellor S., Schwaber K., Sutherland J. and Thomas D. (2001), *Agile manifesto*, Retrieved from http://agilemanifesto.org/ [access in 10/05/2022].

Baruah N.A. (2012), A survey of the use of agile methodologies in different Indian small and medium scale enterprises (SMEs) *International Journal of Computer Applications*, No. 20, Vol. 47, pp. 38–44, doi: 10.5120/7307-0521.

Conforto, E.C., Amaral, D.C., Silva, S.L., Felippo and A. Kamikawachi, D.S.L. (2016). The agility construct on project management theory, *International Journal of Project Management*, No. 04, Vol. 34, pp. 660–674, doi: 10.1016/j.ijproman.2016.01.007.

Fernandez D.J. and Fernandez J.D. (2008), Agile project management – agilism versus traditional approaches, *Journal of Computer Information Systems*, No. 2, Vol.49, pp. 10–17.

Hidalgo E.S. (2019), Adapting the scrum framework for agile project management in science: case study of a distributed research initiative, *Heliyon*, No. 3, Vol. 5, pp. 1–32.

Hoda R., Salleh N., Grundy J. and Tee H.M. (2017), Systematic literature reviews in agile software development: A tertiary study, *Information and Software Technology*, No. 1. Vol. 85, pp. 60–70. doi: 10.1016/j.infsof.2017.01.007.

Inamdar Z., Raut R., Narwane V.S., Gardas B., Narkhede B. and Sagnak M. (2021), A systematic literature review with bibliometric analysis of big data analytics adoption from period 2014 to 2018, *Journal of Enterprise Information Management*, No. 1, Vol.34, pp. 101–139, doi: 10.1108/JEIM-09-2019-0267.

Khanra S., Dhir A., Kaur P. and Mantymaki M. (2021), Bibliometric analysis and literature review of ecotourism: Toward sustainable development, *Tourism Management Perspectives*, Vol. 37, pp. 100777, doi: 10.1016/j.tmp.2020.100777.

Lechler T.G. and Yang S. (2017), Exploring the role of project management in the development of the academic agile software discourse: A bibliometric analysis, *Project Management Journal*, No. 1, Vol. 48, pp. 3–18, doi: 10.1177/875697281704800101.

Lindsjørn Y., Sjøberg D.I., Dingsøyr T., Bergersen G.R. and Dybå T. (2016), Teamwork quality and project success in software development: A survey of agile development teams, *Journal of Systems and Software*, No. 1, Vol. 122, pp. 274–286. doi: 10.1016/j.jss.2016.09.028.

Linnenluecke M.K., Marrone M. and Singh A.K. (2020), Conducting systematic literature reviews and bibliometric analyses, *Australian Journal of Management*, No. 2, Vol. 45, pp. 175–194, doi: 10.1177/0312896219877678.

Mekni M., Buddhavarapu G., Chinthapatla S. and Gangula M. (2017), Software Architectural Design in Agile Environments, *Journal of Computer and Communications*, No. 1, Vol. 6, pp. 171–189, doi: 10.4236/jcc.2018.61018.

Meso P., Jain R. (2006), Agile Software Development: Adaptive Systems Principles and Best Practices, *Information Systems Management*, No. 3, Vol. 23, pp. 19–30, doi: 10.1201/1078.10580530/4610823.3.20060601/93704.3.

Nicholls G.M., Lewis N.A. and Eschenbach T. (2015), Determining when simplified agile project management is right for small teams. *Engineering Management Journal*, No. 1, Vol. 27, pp. 3–10, doi: 10.1080/10429247.2015.11432031.

Petersen K. and Wohlin C. (2011), Measuring the flow in lean software development, *Software: Practice and Experience*, No. 9, Vol. 41, pp. 975–996, doi: 10.1002/spe.975.

Poppendieck M., Cusumano M.A. (2012), Lean Software Development: A Tutorial, *IEEE Software*, No. 5, Vol. 29, pp. 26–32, doi: 10.1016/j.tmp.2020.100777.

Rauch A. (2020), Opportunities and Threats in Reviewing Entrepreneurship Theory and Practice, *Entrepreneurship Theory and Practice*, No. 5, Vol. 44, pp. 847–860, doi: 10.1177/1042258719879635.

Santos P.D., de Carvalho M.M. (2021), Exploring the challenges and benefits for scaling agile project management to large projects: a review, *Requirements Eng*, No.1., Vol. 27, pp. 117–134, doi: 10.1007/s00766-021-00363-3.

Saragih L.R., Dachyar M. and Zagloel T.Y.M. (2021), Implementation of telecommunications cross-industry collaboration through agile project management, *Heliyon*, No. 5, Vol. 7, pp. 1–28, doi: 10.1016/j.heliyon.2021.e07013.

Schwaber K. (2004), *Agile project management with scrum*, Microsoft Press, United States.

Serrador P., Pinto J.K. (2015), Does Agile work? – A quantitative analysis of agile project success, *International Journal of Project Management*, No. 5, Vol. 33, pp. 1040–1051, doi: 10.1016/j.ijproman.2015.01.006.

Shastri Y., Hoda R., Amor R. (2021), The role of the project manager in agile software development projects, *Journal of Systems and Software*, No. 1, Vol. 173, pp. 1–16, doi: 10.1016/j.jss.2020.110871.

Srivastava P. and Jain S. (2017), A leadership framework for distributed self-organized scrum teams, *Team performance management: An international journal*, No. 6, Vol. 23, pp. 293–314, doi: 10.1108/TPM-06-2016-0033.

Stettina C.J., Hörz J. (2014), Agile portfolio management: An empirical perspective on the practice in use, *International Journal of Project Management*, No. 1, Vol. 33, pp. 140–152, doi: 10.1016/j.ijproman.2014.03.008.

Tolfo C., Wazlawick R.S. (2008), The influence of organizational culture on the adoption of extreme programming, *Journal of Systems and Software*, No. 11, Vol. 81, pp. 1955–1967.

Wadhwa M., Sharma N. (2015), Review of agile software development methodologies, *Advances in Computer Science and Information Technology*, No. 4, Vol. 2, pp. 370–374,

Vlietland J., van Vliet H. (2015), Towards a governance framework for chains of Scrum teams, *Information and Software Technology*, No. 1, Vol. 57, pp. 52–65, doi: 10.1016/j.infsof.2014.08.008.