Scrum: A Systematic Literature Review

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***Abstract*—This study presents a Systematic Literature Review on an agile project management tool. The study offers a brief comparison between traditional and agile project management methodologies. Their respective concepts and characteristics are laid out to highlight and explain their main differences. The agile methods include quantitative and qualitative data, showing Scrum framework characteristics. This study highlights the importance of project management in function of its emergence as a response to problems encountered during improperly conducted projects. Furthermore, this study provides relevant information for professionals in the Industrial Engineering area and computer science. The results allowed us to conclude that Scrum is an agile framework for empirical-based project development; it was developed in the 1990s by Jeff Sutherland. It is a flexible and adaptable methodology. Scrum research peaked in 2020, and continues to be studied, mainly in the field of computer science. Finally, Brazil is well-positioned in third place for works published.**

***Keywords*—Project management; agile methods; agile manifesto; scrum**

I. Introduction

Project Management (PM), as a practice, has grown rapidly worldwide, and is now globally recognized for its strategic competency for organizations [1]. Projects are employed to revamp business processes, support global customer-focused strategies, and coordinate information and decision-making flows across organizations [2].

PM is a set of management tools that allows a company to develop a set of skills, including individual knowledge and skills, all of which are aimed at controlling non-repetitive, unique and complex events, within a given time frame scenario, with predetermined costs and quality metrics [3].

Many projects are conducted improperly, and consequently, failures can occur. PM is a tool for conducting these projects successfully, without suffering losses. PM tools have been effective in achieving desired results within defined time frames and budgetary limitations within organizations. The author also states that PM is not only used for highly complex and costly large-scale projects [4].

Over the last decades, several design methods have been developed and adopted by project managers [5]. One is the Project Management Body of Knowledge Guide – (PMBOK®), which is the most influential book in the area [2]. The PMBOK® guide consists of standards that identify and conceptualize project management processes, knowledge areas, tools, and techniques [6].

The main PM methodologies can be classified as either traditional (predictive) or agile approaches. Traditional approaches, for the most part, follow PMBOK® principles, while agile methods are based on the Agile Manifesto, which unites agile method principles and characteristics [7].

The Agile Manifesto was developed amid troubled projects, given dissatisfaction caused by high costs and long scope periods, where software developers needed to restructure project methodologies to focus on programming development and project testing. In 2001, seventeen software professionals, including developers and managers, met in Utah, where the Agile Alliance was created, to create the Agile Manifesto, to make software development lighter, more flexible, and cheaper [8, 9].

Agile project management seeks fast planning with active participation from the whole team and from customer stakeholders at all stages of the project. This is done by fostering an environment of collaboration among the whole team, and by rapidly integrating changes during the project life cycle [8, 10]. Focus and values are what set agile methodologies apart from traditional methodologies. Agile focuses on people, and not on processes or algorithms. Also, less time is spent on documentation, and more on implementation and success [11].

Of the many agile project management methodologies, there are Extreme Programming (XP) created by Beck and Cunningham in 1999 [7, 12]. It is a methodology for projects with requirements that change frequently, for projects that use object-oriented development, for teams comprising up to 12 developers, and for projects that use incremental development [13]. Scrum is another agile project management methodology created by Schwaber and Sutherland in 1990 [14]. It is suitable for companies that conduct product development in environments characterized by uncertainty, self-organization, moderate control, and knowledge transfers [15].

Another important tool is Lean software, which applies principles from the Toyota Production System for software development [16]. The Toyota Production System is a production philosophy created by a Japanese automaker that seeks to eliminate any production processes that do not add product value, or so-called waste [17]. The Kanban methodology, proposed by David J., is defined as a framework for incremental process and system improvements within organizations [18], and seeks to improve processes, teams, and projects. It is useful for companies that are constantly seeking to improve, while also improving productivity and their customer relationships [19].

Scrum is focused on teamwork, to improve communication and enhance cooperation among team members, resulting in increased future productivity. Furthermore, Scrum allows for

short-term problem solving, reduced project risks, greater customer participation throughout processes, and delivers more functional products or services more frequently [20].

Scrum is used in complex projects that cannot predict everything that will happen. This methodology offers a framework, since it is an aggregation of practices that promote visibility, so Scrum practitioners can see all project stages, make corrections, and offer improvements that keep the project moving forward by focusing on achieving the goals [21].

Some of the advantages of using this methodology are adaptability, transparency, continuous feedback, continuous improvement, and motivation [22]. The author in [22] applied Scrum for PM in the naval industry, and concluded that "the responses to problems were more agile, since problems identified in the previous day were discussed the next day in a quick meeting". The author in [11] also proved these advantages by applying this methodology to a tech startup, and by conducting a survey, wherein "most people highlighted visible management, which is a technique whereby controls, as to what is being done, are easily visible to everyone".

In this sense, the general objective of this study is to carry out a Systematic Literature Review on the agile Scrum methodology, which has been studied since the 1990s, and is still one of the main methodologies used in several areas.

This study is structured in five sections. The first section contextualizes the study. The second section presents a brief theoretical framework. The third section details the research methodology used here. The fourth section applies the SLR method. The fifth section analyses the results. The paper finishes with the conclusions, followed by the bibliographic references.

II. Methodology

A. Systematic Literature Review (SLR)

Literature Review (LR) is a very relevant method for researchers who analyze numerous fields of study [23]. Many articles use more descriptive LR models, and do not follow a systematic approach. One other method that is widely used in exploratory research is Systematic Literature Review (SLR). SLR develops guidelines, since it encompasses searching, selecting, critically evaluating, and creating synopses of primary research results [24]. The authors in [25] and [26] developed structures that contain the main SLR steps, to standardize SLR as a method, and to avoid distortions in the research and data analyses. The author in [27] executed a paper to gather the critical success factors of motivator and demotivator of agile software development.

SLR is a branch of LR, but SLR goes far beyond gathering and discussing important scientific works on a topic of interest. SLR seeks to verify what works, and what does not work, within a given context, using an explicitly presented bibliographic database, so reproducibility is possible. The search and selection parameters for articles, and the reason for the inclusion or exclusion of these parameters, are also explained, along with the limitations that are found in the articles, and in the review itself [28].

One relevant SLR point is its systematic methodology, which allows for necessary critical analysis in carrying out all stages of research. For the purposes of this study, the method applied in the article was based on [29], since it offered a more recent reference, and proposed a structure that fit well with this present study. The proposal consists of three stages, as follows:

1) *Planning the Review (The Preparation Stage);*
2) *Conducting the Review (The Operational Stage)*
3) *Documenting the Review (The Information Stage).*

The first step, i.e., planning the review, consists of two steps:

a) specifying the research question; and
b) developing the review protocol.

In the first step, research questions that are relevant to the subject being studied are defined to guide the next steps. Next, a standard is created to search for documents that will be used to answer the questions from the previous step.

The second step leading to the review is divided into five steps. The first three steps focus on defining the database that will be used to answer the research questions from the previous step. Researchers must apply review protocol (identifying relevant research). Next, the documents that do not address the subject will be excluded (selecting primary studies), and finally, the remaining documents will be studied in-depth, to decide which documents will comprise the SLR database (assessing the quality of the study). In the next steps, all the necessary data and information that will be useful in answering the research questions must be extracted from the documents and synthesized.

Finally, the third step, i.e., documenting the review, uses the information obtained in the previous steps to answer the questions outlined in the first step to complete the SLR.

III. Method Application

The SLR steps, as proposed by [29], will be described here, starting with planning the review.

A. Planning the Review (Preparation Stage)

According to [29] the first SLR stage deals with review planning. The authors mention two initial points that are important for prepping the review stage as: a) Specifying the research question; and b) Developing a research protocol.

The author in [30] was used as a basis for specifying the research questions. The authors propose interesting questions that can be answered using SLR. Thus, the guiding questions from [30], and the questions themselves were elaborated for this study.

Q1. How many Scrum publications are there per year? Q2. Who are the main authors writing on Scrum? Q3. What are the main countries publishing on Scrum? Q4. Who are the main publishers on Scrum? Q5. Which major universities publish on Scrum? Q6. What are the main areas studying Scrum? Q7. What is Scrum's history? Q8. How is Scrum defined? Q9. What are Scrum's principles? Q10. What are the Scrum steps? Q11. What are the Scrum elements? Q12. Is Scrum expensive?

Q13. Is Scrum complex? Q14. How is Scrum scoped? Q15. How are the teams structured? Q16. What is the role of the project manager in Scrum? Q17. What are the advantages of Scrum? Q18. What are the disadvantages of Scrum? Q19. What are the future directions for Scrum?

Table I was created based on the above research questions, creating SLR categories. This categorization was meant to simplify the analyses, by taking the number of questions previously established into account. Furthermore, the categorization will make it easier to describe the results later.

TABLE I. SEARCH CATEGORIES

State of the Arts	Questions	Nature of the Research	Questions
Articles per Year	Q1	General concepts	Q7, Q8, Q9
Top 5 Authors	Q2	Structure	Q10, Q11
Top 5 Countries	Q3	Work Mode	Q12, Q13, Q14
Top 5 Publication Sources	Q4	Time	Q15, Q16
Main Universities	Q5	Advantages and Disadvantages	Q17, Q18
Top 5 areas of Study	Q6	Future Study	Q19

As to the second point pointed out by the authors, which consists of developing a research protocol, the data in this study will be obtained via a systematic search, to obtain bibliographies relevant to the subject in question. The Scopus Ⓡ database was selected because it stands out given the number of data available, the quality of its resources, and its ease of use. The author in [31] state that the ScopusⓇ database is one of the main sources of data for citations.

A search was performed using the term "Scrum" in the Scopus database. Then filters were applied, like "open access", "article type document", "English and Portuguese". There were no restrictions as to the year or area of study, for possible future comparisons.

After the initial planning, defining the research questions, and forming the data collection for this study, it was preceded to the next SLR stage, which is conducting the review.

B. Conducting the Review (Operational Stage)

This stage seeks to effectively conduct the research, and is an operational stage. The first two points established by [29], are to identify relevant research and to select the main studies. On April 28, 2021, it was made a search in the ScopusⓇ database, as defined in the previous step, to develop these two sub-steps.

The term "Scrum" was searched for in the ScopusⓇ database, searching only the title. 999 articles were returned from the database. Then it was applied filters like "open access", "article type document", and "English and Portuguese", to narrow the search and focus in on the subject of interest. After applying these filters, 77 articles were found.

After applying the filters, it was moved on to the third step, which is evaluating the quality of the articles. This sub-step consists of conducting a more in-depth analysis of the articles, to identify which articles really contain the characteristics that were seeking in this study. The articles were analyzed by the authors by reading the titles, the abstracts, and the keywords, to exclude any articles that were not relevant to this subject. At the end of this analysis, 50 articles remained for a full reading.

27 articles were excluded from the 77 articles by reading the abstracts and analyzing the theme. "SCRUM" was found to be an abbreviation for certain medical questions, e.g., "Scalp and Cranium Radiation Therapy Using Modulation", or "Studying Concussions in the Rugby Union using MicroRNAs", and also for school-related questions, like "School Clinical Rugby Measure", along with articles that relate scrum to Rugby, and these medical/sports-related works did not fit in this paper, so they were discarded.

After reading the articles, it was found that 9 articles did not include studies addressing Scrum for the following reasons:

- they did not present information about Scrum;
- they were no longer open access; or
- they were not found.

Therefore, they were removed from the analysis. Thus, the SLR focused on 41 articles to answer the research questions. Table II gives a summary of the filters that were used to select the 41 articles in this SLR.

TABLE II. SLR FILTERS

Database	Filter	Results
Scopus	*Title: "Scrum"*	*999 documents*
	Open access	≅ 198 documents
	Articles Only	≅ 89 articles
	English and Portuguese	77 articles
	Reading and Analyzing the Titles	50 articles
	Full read and analysis	41 articles

After defining the number of articles that would be included in the SLR, it was moved on to the analysis and extraction phases for the data necessary for answering the research questions detailed in the first stage. This sub-step consisted of the fourth point, as proposed by the SLR authors, i.e., extracting necessary data. Microsoft ExcelⓇwas used for the data extraction, and for future quantitative analyzes (Synthesizing the data), which will be presented in the next step of the method. After the analyses, it was moved on to the third SLR stage, which describes the conclusions and evidence.

C. Documenting the Review (Information Stage)

After the review step, the documentation review began, using information obtained from the previous steps to answer the research questions from the first step, and thereby complete the SLR. This stage sought to remove relevant information to answer the aforementioned research questions.

An Excel spreadsheet was developed, wherein the research questions were set in columns, and the selected articles in lines, so the information that might answer the research questions could be record. Furthermore, extra columns were added for

non a priori information. The complete list of articles from the systematic literature review of this article can be found by contacting the authors.

Finally, regarding the results and finishing the SLR, the next section presents these discussions in greater detail.

IV. Analyzing the Results

The results analysis for this study focused on analyzing the two pillars of this study, as shown in Table II. The first pillar investigated the State of the Arts, providing information on publications according to year, the main authors, the publishers, the universities, etc. The second pillar focused on investigating the nature of research, by analyzing general concepts, the structure, the way of working, the team, etc. This analysis began with the State of the Arts.

It is worth mentioning that the analyses were based on reading the 41 articles related to Scrum, so the conclusions of this study refer to SLR, and not the extent of the topic in literature.

A. Analysis of the State of the Arts

Regarding the analysis on the State of the Arts, Q1 deals with the number of publications per year on Scrum. It is worth remembering that a time filter was not applied in this analysis, i.e., the data refers to the first and last publications on Scrum. Fig. 1 summarizes this and shows publications dealing with Scrum.

Fig. 1 shows that from the articles considered in the SLR, the first study published on Scrum was in 2010. Over the years the number of works on Scrum has oscillated, and the biggest growth was between 2018 and 2019. 2020 had the most publications, at 12 articles.

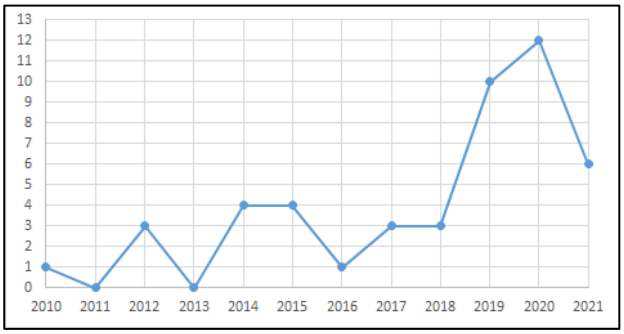

Fig. 1. Publications per year.

The next analysis dealt with the main authors on Scrum, responding Q2. The five most published authors in the database selected for this SLR are: Zada, I.; Vogelzang, J.; Shahzad, S; Gandomani, T. J.; and Admiraal W. F. These authors have their names published in two articles. The other authors have only one published article. Thus, it was noted that no single author focused on the theme, but rather these authors were dispersed.

Regarding the question on the country of publication (Q3), publication sources (Q4), and universities (Q5), for the State of the Arts, it was decided to condense the data into a single table. The results for these three analyzes are shown together in Table III.

TABLE III. Top 5 Countries

Top 5 Countries	Number of articles
Pakistan	6
The United States	5
Brazil	4
India	4
Australia	3

Table III shows that the main publishing country in the database was Pakistan, followed by the United States. Brazil was tied for third place along with India, at 4 articles, while Australia appeared last, with 3 articles.

Regarding the publishers (Q4) (Table IV), it was noticed that the number of publications was very close to each other. The International Journal of Advanced Computer Science and Applications came in first, with four publications on Scrum. Second was the International Journal of Advanced Trends in Computer Science and Engineering, with 3 articles. Three publications sources, the Bulletin of Electrical Engineering and Informatics, IFIP Advances in Information and Communication Technology, and Scientific Programming came in third place, with 2 articles each.

TABLE IV. Top Five Publications

Top 5 Publications	Number of articles
International Journal of Advanced Computer Science and Applications	4
International Journal of Advanced Trends in Computer Science and Engineering	3
Bulletin of Electrical Engineering and Informatics	2
IFIP Advances in Information and Communication Technology	2
Scientific Programming	2

The main universities found with publications on the subject in question is presented in Table V. Regarding Q5, it can be seen that the largest number of publications was four papers published by Leiden University. The other universities published 2 articles per year. It is interesting to note that the Federal University of Itajuba was among these main universities with publications on Scrum. The study was from Breno Tavares, Carlos Eduardo Sanches, and Adler de Souza, entitled: Risk management in Scrum projects: A bibliometric study, published in 2017.

TABLE V. MAIN UNIVERSITIES

Main Universities	Number of articles
Leiden University	4
Greijdanus College	2
Federal University of Itajuba	2
University of Melboume	2
Univerza v Ljubljani	2
Islamic Azad University	2
University od Peshawar	2
Kohat University os Science and Technology KUST	2
Universidad de Ciencias y Humanidades	2
Melboume Graduate School of Education	2

The last analysis performed for the State of the Arts was identifying the main areas of study that use Scrum (Q6). The main areas of study that use Scrum are: Computer science; Math; Business, Management and Accounting; Engineering; Social Sciences. The main area of study was Computer Science, with 33 publications on Scrum, representing approximately 47% of the top 5 areas of study. This was followed by engineering, at 18 articles on the subject, representing approximately 25% of all publications among the 5 main areas of study. This was followed by Mathematics at 10 articles, Social Sciences at 6 articles, and Business, Management, and Accounting at 3 articles. Some articles were present in more than one area of study, so the total number of articles seems to be greater than the amount studied; however, this is due to the fact that the same article can address multiple areas.

In general, the SLR showed that Scrum was mentioned in literature for the first time in a 2010 in an article called "A teamwork model for understanding an agile team: A case study of a Scrum project [32]. Over time, the area has grown. 2020 had the most publications on the subject, at 12 articles related to Scrum.

Regarding the authors, five main authors had two publications on Scrum, which shows a non-centrality of the topic, considering that most authors had only one publication on the subject. Considering the analyses on the country of origin, Pakistan had the most published articles on the topic, and Brazil ranked third tied with India, with 4 articles on Scrum. Regarding the publication sources, the five main publication sources had similar publication numbers. The International Journal of Advanced Computer Science and Applications had the most publications, at 4 articles. Regarding the universities, the greatest number of publications was four articles by Leiden University, and the rest of results were homogenous, since no university had an expressive number of publications. Federal University of Itajuba was among the universities found in this study.

Finally, regarding the area of study, Computer Science had the most published articles on Scrum. It is interesting to note that this area was also responsible for starting Srum, and this trend continues to the present day. This was followed by Engineering, Mathematics, Social Sciences, and Business, Management, and Accounting, respectively.

B. Analysis of the Nature of the Research

Here will be described the observations and studies on the nature of the research, which was also divided into categories, as shown in Table I. First, it was intended to highlight information on the general Scrum concepts.

Questions Q7, Q8, and Q9 sought to understand the history, definitions, and principles of Scrum, respectively.

Regarding its history, the Scrum methodology was first developed in the 1990s, as a project management framework used in business and industry to manage complex projects, especially for software development [33].

Furthermore, [34] states that the term Scrum originates from Rugby (a team sport of intense physical contact), and refers to a powerful team of Rugby players, positioned specifically to win the ball. Scrum provides for ceremonies, roles, and artifacts to monitor progress, to adjust to changing circumstances, and to reflect on product quality.

Scrum was developed in 1993 by Jeffrey Sutherland at the Easel Corporation, to deliver quality software products in small time intervals known as sprints [35].

Regarding the definition of Scrum, according to [36], Scrum is a framework composed of functions performed by team members, artifacts in documentation, delivery standards, and events that consist of essential actions for communication and delivery for a product. The author in [37] add to this, and state that Scrum is an iterative and incremental project management framework. It is a flexible and comprehensive development strategy, wherein a team works as a unit to achieve a common goal, challenging traditional approaches to product development.

For some authors, Scrum is defined as an agile methodology for developing software and information systems with a focus on project management, and on iterative and agile development processes, transparency, visibility, and cooperation among team members and customers [21, 38].

After the conceptual analysis on Scrum, it was able to identify many authors that define Scrum as a methodology or method. However, most authors define Scrum as a framework, and not just as a project management method, constituting the common way of defining Scrum.

Answering the question on Scrum principles (Q9), [33] state that the Scrum framework is based on three main principles, i.e., transparency, inspection, and adaptation. Transparency clearly defines the objectives and gives visibility to the involved processes, while inspection involves frequent reviews to verify team processes, and adaptation refers to adjustments that can be made during the processes to make effective changes to the project when a product does not meet desired requirements. All three pillars are essential so that the staff can learn from their experiences and adapt their activities to meet demands in an ever-changing environment.

Questions Q10 and Q11 sought to detail the Scrum structure, highlighting the main principles and steps. Answering the question on the Scrum stages (Q10), Scrum life cycle begins with the Product Owner's vision, i.e., the vision he/she has in relation to the product he/she wants to create. From this, a list of resource items by priority level is created, called the Product Backlog. Then, the Sprint Planning and the Sprint Backlog are started, which include all the tasks that the team will perform. In the sprint planning, tasks and weights are chosen from Product backlog items. The Sprint backlog is carried out, where tasks are divided for the whole team, and their respective goals are defined for each cycle. Daily meetings last around 15 minutes, and are organized to track project progress. At the end of each sprint cycle, there is a sprint review, where products are inspected by stakeholders, including customers, and the project team, to get feedback and conduct product analysis. Finally, there is the sprint retrospective step, which is carried out before the next sprint that includes the team, and seeks to bring about improvements and better results for the next stage [39, 40]. Fig. 2 shows the Scrum lifecycle by [41].

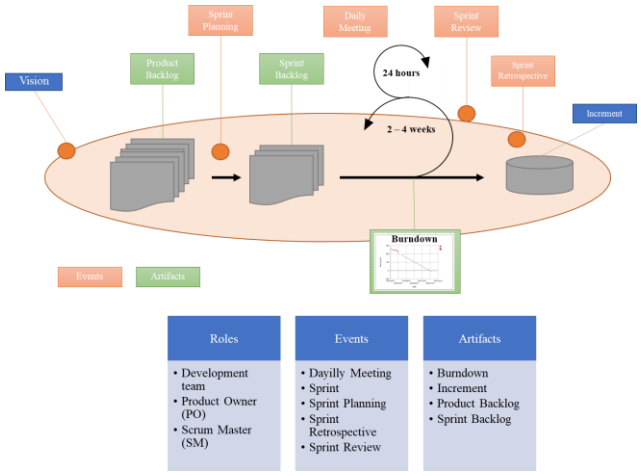

Fig. 2. Scrum lifecycle.

To answer Q11 (What are the Scrum elements?), the Scrum framework includes elements like ceremonies, functions, and artifacts that provide a structure and overview [34]. Scrum framework comprises a Scrum team, roles, and responsibilities, for all members that comprise the team, in addition to events, artifacts, and specific rules that unite all components [42].

The next analysis answered the questions on ways of working with Scrum (Q12, Q13, and Q14). Regarding whether Scrum is expensive (Q12), there are no authors that had made citations on the cost of applying Scrum or values related to it. Thus, it is suggested that future research be carried out on Scrum costs to answer this question.

Regarding the complexity of implementing Scrum (Q13), Scrum adopted by academics and experts used to research or evaluation methods is an easy concept for transference and experience, although some specific particularities need to be adapted [43]. It is also worth mentioning that the Scrum configuration is easy to implement, but its functionality is complex in the team domain [44].

Answering question Q14, on the scope of Scrum, [33] state that Scrum focuses on project management, and is used as a method for dealing with complex projects with imprecise results to minimize risks related to development. Scrum helps resolve uncertainties and respond to changes, providing a set of principles and guidelines to be more productive.

The next questions (Q15 and Q16) focused on the team conceptualization within the framework, and on how the Scrum team composition and the roles of the project manager are defined, respectively. With regard to team composition (Q15), Scrum has three different roles, i.e., a Scrum master, a product owner, and a development team. The Scrum master is responsible for ensuring that the processes run smoothly and that everyone understands and adheres to the Scrum principles. The product owner is responsible for product development focused on customer goals and requirements, and directs the work of the entire team, in addition to defining the product backlog items. The development team comprises professionals from different areas. It is very important that team members work well together, and be focused on the same goal. Another Scrum team characteristic is self-organization. The team has autonomy to make collective decisions, manage their own work, and shift work among themselves, as they see fit [45].

The responsibilities of the traditional project manager (Q16) are divided between three roles in Scrum, i.e., the Scrum master, the product owner, and the development team [46]. The project manager introduces him-/her-self as a Scrum master, and is responsible for the entire project [47].

Questions Q17 and Q18 demonstrate what the SLR authors see to be the main advantages and disadvantages of the Scrum method.

The author in [48] highlights advantages (Q17), as empirical feedback, team self-management, and struggles to build increments of fully tested products in short time frames. Scrum stands out as an agile methodology with the most standardized way of introducing agility, because it is flexible, simple, and a popular agile management method. Furthermore, it facilitates better ways of developing projects, and promoting individual work and teamwork. The Scrum method can generate benefits like increased customer satisfaction, improved communication, increased productivity, reduced production costs, and increased collaboration among everyone involved in the projects, in addition to increasing motivation among the development team [49].

Regarding disadvantages (Q18), the Scrum framework does not formally describe project risk management. Therefore, it is essential that risk management processes be included in the framework according to the project requirements [50]. Another difficulty is linked to large projects, where large numbers of Scrum sprints mean that the development team must manage more complex tasks. The author in [37] also states that one of the weaknesses of Scrum is the strong dependence of the development team on team members.

Finally, Q19 deals with the future directions for Scrum that was addressed by the authors in the SLR. The author in [32] states that future work should focus on identifying and solving problems that may arise during the introduction of agile

development. Another research factor is an extended teamwork model that should be used to study mature agile development teams, to identify and analyze the main challenges encountered by these teams. The flexibility that the Scrum framework offers in terms of compatibility when working together with other agile methodologies for project development is well known, values teamwork, and consequently brings about greater quality, and greater customer satisfaction. One study opportunity would be to analyze the advantages of working with Scrum compared to other agile methods.

Given out analyses for ascertaining the nature of the research topic, the main results are that Scrum was developed as a project management framework in 1993, by Jeffrey Sutherland at the Easel Corporation, and its main objective is to manage complex projects with quality in small time intervals, especially for software development.

Furthermore, the Scrum framework provides for ceremonies, functions, and artifacts, and consists of three main principles, which are transparency, inspection, and adaptation, providing structure and overviews. The purpose of the Scrum scope is to focus on project management, and it is used as a method for dealing with complex projects with inaccurate results, and minimizing risks related to project development.

Scrum's main advantages are flexibility, self-organization, and adaptability. However, disadvantages include informality in risk management processes, the fact that sometimes tasks are too complex for the team, and the fact that all the work is dependent on the development team.

Finally, future directions for Scrum would be studies aimed at improving identifying and solving problems in applying agile concepts, studying mature development teams, studying Scrum frameworks associated with agile methodologies in project development, and analyzing the advantages of working with Scrum relative to other agile methods.

V. CONCLUSIONS

The study conducted a Systematic Review on literature on Scrum to deepen knowledge on the subject, and to obtain a register that could be used to add knowledge for future research. The study was structured following a SLR framework using three stages, i.e., planning the review, conducting the review, and documenting the review.

For the results, it was focused on answering the questions according to the categories into which they were separated, i.e., the State of the Arts, and nature of research. Regarding the State of the Arts, it can conclude that most articles were published in 2020, and the first study found in the database was “A teamwork model for understanding an agile team: A case study of a Scrum project. Regarding the authors, no author had more than two published articles, showing that there is no main author addressing the topic. Moreover, most articles showed an author appearing only once. Regarding the country of publication, Brazil is well-positioned in third place, at two articles published, behind Pakistan in first place. Regarding universities and source of publication, the number of publications was very close, and that there was no main reference. Regarding the publication sources, no single publication had published more than 2 articles.

Finally, regarding the areas of study, more emphasis was given to computer science. It is worth noting that this area gave rise to Scrum, and is still remains at the forefront of research.

The main results from the analyses carried out to ascertain the nature of the research are that the Scrum methodology was developed as a project management framework in 1993, by Jeffrey Sutherland, at the Easel Corporation, and its main objective is to manage complex projects with quality in small time frames, especially for software development.

The Scrum framework provides for ceremonies, functions, and artifacts, and consists of three main principles, which are transparency, inspection, and adaptation. The purpose of the Scrum scope is to focus on project management, and is used as a method for dealing with complex projects with inaccurate results, and to minimize risks related to project development.

Scrum's main advantages are flexibility, self-organization, and adaptability. For future studies on the Scrum framework, authors pointed to improvements in solving problems identified in the applicability of agile development, studying identifying and analyzing problems identified by mature agile teams, and investigating Scrum relative to other agile methods for project management.

Literature points to numerous authors who cite Scrum as a method or methodology for project management. As much as Scrum presents several tools for project development, the term methodology is not the most common term used, as it is based on empiricism. After the analyses in the SLR, we can conclude that Scrum is conceptualized as an agile framework.

This study concluded that Scrum is an agile framework aimed mainly at software development, but can be used in several other areas, e.g., engineering, mathematics, and business, if it is adapted to the context of the specific projects that will be managed.

It was also found that Scrum, as a topic, has grown over the years, and the number of studies has been increasing. Thus, this tool has been consolidated for managing complex projects, which can be better defined as the project is developed. Furthermore, the role of the project manager is more of that of a facilitator, focusing on directing the steps, and eliminating bottlenecks so that the team can develop and self-manage its own work.

It was also concluded that Scrum has some disadvantages, which can be used as themes for developing proposals that could help minimize losses when using the framework. Finally, the results show that future studies still need to greatly develop the Scrum concept, so that Scrum can be increasingly applied within the project management area.

In short, it was able to reach the objectives of this study using a Systematic Literature Review, and by selecting the database for research and analysis, to answer the points defined at the beginning of this study. Studies in literature on Scrum, and the main Scrum concepts, were also detailed here. Finally, this study presents information that could be useful for future studies, as it serves as a simple and direct way of acquiring knowledge about Scrum.

For future studies, the authors suggest that studies deal with financial issues, and complexity when applying Scrum. Another recommendation would be carrying out a new SLR on other agile methods, or conducting a SLR that addressed the most well-known agile methods, offering a comparative analysis to offer the reader a focused approach on each of these methodologies, and what type of project these methodologies would best fit.

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