Agile portfolio management and knowledge management in digital transformation: a systematic literature review

Gestão ágil de portfólio e gestão do conhecimento na transformação digital: uma revisão sistemática da literatura

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ABSTRACT
As a challenge of Digital Transformation in companies, projects are a source of significant changes in processes, products, systems and business models. In this context, portfolio management plays a significant role in coordinating and prioritizing initiatives that need to overcome traditional practices. Another significant pillar for Digital Transformation to be sustainable is the need for effective Knowledge Management in the process of digitizing organizations. The objective of this study is to carry out a systematic review of the literature on agile portfolio management in Digital Transformation, in order to identify which frameworks or practices are adopted in companies and how Knowledge Management impacts them. Preferred reporting guidelines for systematic reviews (PRISMA) in Scopus, Web Of Science and IEEE databases were used. The methodology was prepared considering the following steps: (1) research design, (2) data collection, (3) data analysis and (4) review. The research resulted in 34 articles mapped and analyzed and little explored gaps were identified, such as themes related to financial structure, relationship with suppliers, performance indicators related to the subject of agile portfolio management. It was also identified that there are few scientific studies addressing how Knowledge Management can be used in portfolio management.

Keywords: digital transformation, agile portfolio management, scaled agile, systematic literature review, prisma, knowledge management.

RESUMO
Como um desafio da Transformação Digital nas empresas, os projetos são uma fonte de mudanças significativas nos processos, produtos, sistemas e modelos de negócios. Neste contexto, a gestão de portfólio desempenha um papel significativo na coordenação e priorização de iniciativas que precisam superar as práticas tradicionais. Outro pilar significativo para que a Transformação Digital seja sustentável é a necessidade de uma
Gestão do Conhecimento eficaz no processo de digitalização das organizações. O objetivo deste estudo é realizar uma revisão sistemática da literatura sobre gestão ágil de carteiras na Transformação Digital, a fim de identificar quais estruturas ou práticas são adotadas nas empresas e como a Gestão do Conhecimento as impacta. Foram utilizadas diretrizes preferenciais de relatórios para revisões sistemáticas (PRISMA) nos bancos de dados Scopus, Web Of Science e IEEE. A metodologia foi preparada considerando os seguintes passos: (1) projeto de pesquisa, (2) coleta de dados, (3) análise de dados e (4) revisão. A pesquisa resultou em 34 artigos mapeados e analisados e foram identificadas lacunas pouco exploradas, tais como temas relacionados à estrutura financeira, relacionamento com fornecedores, indicadores de desempenho relacionados ao tema da gestão ágil de carteiras. Também foi identificado que há poucos estudos científicos abordando como a Gestão do Conhecimento pode ser usada na gestão de carteiras.

**Palavras-chave:** transformação digital, gestão ágil de portfólio, gestão ágil de portfólio, revisão sistemática da literatura, prisma, gestão do conhecimento.

1 INTRODUCTION

In recent years, Digital Transformation (DT) has become essential for companies to reevaluate their products, processes and business models. To carry out a DT, one of the most important roles is projects [1], [2]. The traditional way of managing DT projects can leave companies without a transparent view from yours projects portfolio [3]. DT starts with small isolated initiatives that can go unnoticed by portfolio management and therefore, it is necessary to align all initiatives [4]. In addition, projects may have many interdependencies that need to be identified and managed, as this type of management lacks ways to address these challenges [1], [3].

Given this scenario, and with a Systematic Literature Review (SLR), this research studies how companies apply and adapt the portfolio management model for DT, linked to Knowledge Management (KM).

Studies based on SLR can capture different views on the theory of the researched topics, offering parameters for integration, combination and considerations on the concepts, as well as promote new ideas [5]. There are different studies of systematic reviews that are used or carried out by researchers who seek to understand a particular phenomenon or theory.

The objective of this study is to identify which agile process frameworks are used and how they interact with the traditional portfolio management model, highlighting the main difficulties and limitations. As a complement, it seeks to obtain how KM is used to support the management of DT projects portfolio.
2 LITERATURE REVIEW

To support the matter, the study presents below, the concepts involved in the research Digital Transformation, Agile Portfolio Management and Knowledge Management in the Agile Portfolio process.

2.1 DIGITAL TRANSFORMATION

Digital Transformation is described as the use of innovations and new technologies to promote and leverage companies’ current business and open up new business possibilities [6]–[8]. This is an approach that integrates all impacted business areas of the company, whether operational or functional, so that there is an effective transformation [8]. Berman claimed that DT involve new operating models to accommodate improvements and new value propositions for customers and will even enable customers to redefine them [6].

The impacts of DT can result in the outdating or discontinuation of existing services or offers to give rise to new products and services to be promoted on the various existing digital platforms [9]. The DT process is known for being challenging and time consuming to be complete and efficient [10]. The value of DT arises when it makes use of the joint work of several organizational areas through the use of technology, and co-creation of processes in which the customer is the center of attention [11]–[13].

The organization's leadership, whether in the business or technology areas, must be aware that they depend on a clear and robust transformation strategy, including those linked to business strategy and not only, or exclusively, applying technology to the existing model [9], [11], [14]. Also, referring to the role of leadership, it is highly recommended that company executives perform strong and full-time leadership for digital transformation [7].

For digital transformation to occur, it must be supported by the following pillars: (a) capacity and specific ways to exploit digital transformation; (b) transparency and clear strategy on how digital transformation will reshape the company's value creation; (c) need to restructure internal processes to readjust and accommodate new technologies and the value generated; and (d) digital transformation financing structure [8].

2.2 AGILE PORTFOLIO MANAGEMENT

The agile practices applied in software development project management diverge substantially from traditional project management and portfolio management [15].
Although there is some symmetry about agile management at the project level, at the portfolio level the management processes still need to be established [15], [16].

The superficial definition of a company's project portfolio is that it is a set of projects that share the same structure or resources [17] and this structure presents great difficulties in adhering to traditional portfolio management processes [18].

Agile portfolio management resembles the theory of complex adaptive systems (CAS), originating from the science of complexity [19]. Among its main characteristics are the great capacity for learning, reacting and interacting with other agents. This great interaction was a management system in the form of a network, an extremely flexible feature capable of adapting to challenging environments [20]–[22]. Agile projects have a high level of autonomy and self-organization, since their members decide for themselves what will be done in periodic meetings. In the portfolio phase, the selection of projects takes place according to the expected benefit against the company's strategy and when supported by the pillars of agility. Both the projects and the portfolio have an interactive and flexible work structure, with a great capacity to adapt to new circumstances or the new reality of the moment [19], [23].

It is of fundamental importance that project portfolio management allows the company to have the capacity to absorb or react to changes in the environment and be dynamic [24].

2.3 KNOWLEDGE MANAGEMENT IN AGILE PORTFOLIO MANAGEMENT IN SOFTWARE DEVELOPMENT

Knowledge Management comprises mapping, use and reuse of knowledge and/or experiences acquired during the execution of the work, in different forms and disciplines [25]. The project team, in particular software developers, have a great deal of valuable knowledge related to product development, the software development process, project management and the technologies inherent to the challenge. Faced with these challenges, the organizational culture and the need for change make this knowledge dynamic and constantly evolving [25]. These authors also state that, given these characteristics, the main challenge of KM is to keep this knowledge clear for the entire organization and not just within groups or individuals.

Agile software development processes are accompanied by metrics that help stakeholders make decisions according to their needs [26]. Metrics also allow development teams to improve the process and, consequently, improve project deliveries.
Another topic also used in agile software development processes is collaboration with the customer, through continuous interaction between technical teams and business customers, allowing the exchange of knowledge and thus enabling the rapid progress of understanding between the areas [26].

The connection between KM topics and agile portfolio project management is evident in many ways. Both face barriers to their application in companies and, although not new, they deal with disciplines such as organizational change and change management [27]–[29].

3 RESEARCH METHOD AND MATERIALS

The guidelines for the systematic review of the literature, suggested by the authors [30], [31], the systematic mapping of [32] and the guidelines proposed in the PRISMA Statement were used in the present study according to [33].

Carrying out a systematic mapping, it is possible to get an overview of the state of the art on the specific subject [31] that will be studied, which in this study is agile portfolio management in the DT process, in order to investigate the processes adopted in companies, rules and agile frameworks used, in addition to understanding how they relate to traditional portfolio management. The use of the PRISMA system helps to highlight some research gaps, concepts or specific approaches to this topic, given that it is usually used as a starting point for the development of more specific studies [33].

The process used in this study consists of: (1) define the research question; (2) search scientific studies databases; (3) consolidate the results and remove duplicate items; and (4) analyze the studies found.

3.1 RESEARCH QUESTION DEFINITION

The first step of a systematic mapping is defining the research questions necessary to identify what is the state of the art on the subject addressed in the study, which were or will be structured:

a. What are the most used frameworks to carry out agile portfolio management in companies that are going through the Digital Transformation process?

b. How do these frameworks interact with traditional portfolio management?

c. What are the challenges faced by companies when using these methods?

d. What are the limitations imposed by these methods?

e. How does Knowledge Management impact agile portfolio management?
3.2 STUDY IMPLEMENTATION

The implementation of the systematic mapping study deals with searches the databases of selected scientific studies, using keywords. For this study, three databases were selected: (a) Scopus; (b) Web Of Science and (c) IEEE Xplore. We chose to choose these databases to find peer-reviewed articles, which were published in reputable journals. The following keywords were used in the research: “Digital Transformation”, “Agile Portfolio Management”, “Knowledge Management”, “Scaled Agile” and “Lean Portfolio Management”. These last two terms were added as they are commonly associated with the acronym “Agile Portfolio Management”. Searches were restricted to the document type “article” No time frame were defined for the searches, nor any other criteria not described above. Given these characteristics, the strings described below were defined for the searches.

In the Scopus database, the research was carried out following the following steps: (1) the first string is characterized by searching all fields containing the acronym “Digital Transformation” limiting only the document type “article”, which resulted in 9480 articles; (2) the second string is characterized by searching all fields that contain the acronym “Lean portfolio management” limiting only the document type “article” which led to the result of 1 article; (3) the third string is characterized by searching all fields that contain the acronym “Scaled Agile” limiting only to the document type “article” which led to the result of 101 articles; (4) the fourth string is characterized by the search in all fields that contain the acronym “Agile Portfolio Management” limiting only to the document type “article” which led to the result of 61 articles; (5) the fifth string sought study with the acronym “Knowledge Management” using the same parameters which resulted in 131798 and finally (6) the sixth string is represented by the combination of the strings which resulted in 2 articles.

In the Web of Science (WoS) database, the research was also carried out following the following steps: (1) the first string is characterized by searching all fields containing the acronym “Digital Transformation” limiting only the document type “article”, which resulted in 2191 articles; (2) the second string is characterized by searching all fields that contain the acronym “Lean portfolio management” limiting only the document type “article” which did not generate results; (3) the third string is characterized by searching all fields that contain the acronym “Scaled Agile” limiting only to the document type
“article” which led to the result of 10 articles; (4) the fourth string is characterized by the search in all fields that contain the acronym “Agile Portfolio Management” limiting only to the document type “article” which led to the result of 1 articles; (5) the fifth string sought study with the acronym “Knowledge Management” using the same parameters which resulted in 16552 and finally (6) the sixth string is represented by the combination of the strings which resulted in 1 articles.

At IEEE Xplore, the research carried out followed the same steps, but as there was no option to display just the article, it was decided to restrict it to studies published in Journals, Magazines, Early Access Articles and Standards: (1) the first string is characterized by searching all fields containing the acronym “Digital Transformation” which resulted in 1752 articles; (2) the second string is characterized by searching all fields that contain the acronym “lean portfolio management”, which resulted in 3 articles; (3) the third string is characterized by searching all fields that contain the acronym “Scaled Agile”, which resulted in 161 articles; (4) the fourth string is characterized by searching all fields containing the acronym “Agile Portfolio Management” which resulted in 9 articles; (5) the fifth string searched for studies with the acronym “Knowledge Management” using the same parameters which resulted in 5761 and finally (6) the sixth string is represented by the combination of the strings which resulted in 170 articles.

The survey results are summarized in Table 1.

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<th>Result</th>
<th>String</th>
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<td>Combination of previous research</td>
<td>2</td>
<td>(ALL (&quot;Digital Transformation&quot;) AND (ALL (&quot;Knowledge Management&quot;)) AND ((ALL (&quot;lean portfolio management&quot;) OR (ALL (&quot;Scaled Agile&quot;) OR (ALL (&quot;Agile Portfolio Management&quot;) ))) AND (LIMIT-TO (DOCTYPE, &quot;ar&quot;)))</td>
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</tr>
</tbody>
</table>

### 4 PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

RSL results based on the search protocol, when the result of the combination of strings was displayed, and using of the option of exporting the data, were combined in a single worksheet. The information contained therein was standardized to facilitate understanding and analysis of the result. During the results consolidation stage, no duplicate articles were identified (with the same DOI number and title) and with this, 173 articles were analyzed.

The next step is content analysis. For this, first, an analysis of the titles was carried out in order to verify their relevance to this study and to verify if there were articles that were not aligned with the objectives of the research and that were not written in English. From this analysis, 112 articles were discarded, resulting in 61 scientific works to be analyzed through their abstract. After analyzing the abstracts, another 27 articles were discarded because they did not effectively address the subjects or objectives of this research and with that, 34 articles were reached that were relevant for the continuity of the analysis. All these steps are briefly described in Figure 1.
4.1 PUBLICATIONS BIBLIOMETRICS

The analysis of the articles was organized in two stages: basic information of the study and content classification.

4.1.1 Analysis of basic information

This analysis is carried out based on the registration information of the publications and does not take into account their content.

Even though there were no publication year limit, no studies were found prior to the year 2003 and a large part, above 65% of publications, are concentrated in the last 4 years, with 40% being concentrated in the year 2019 as we can see in Figure 2. Taking into account that the year 2020 was an atypical year all over the world due to the Covid-19 pandemic and that 2021 is not over yet, it is possible to demonstrate that the topic is in evidence in the community and that it is also an extremely current topic.
It is noticed that there is a great concentration of studies in one of the databases, IEEE Xplorer, which has 28 articles against 2 from Scopus and Web Of Science with 1 article, as shown in Figure 3.

Another analysis carried out was the identification of the publishers with the concentration of the largest number of publications. For this analysis, it was necessary to edit the fields in order to normalize the field content, given that there was a lack of standardization in identification due to abbreviations and the use of acronyms. After these adjustments, it can be seen in Figure 5 that the IEEE publishers stand out with 24 publications and Elsevier and Taylor and Francis with 2 studies each.

As for the volume of publications by author, in the analysis it was not possible to identify any author that stands out given that 82 different authors were mapped in the publications and only 4 of them have more than 1 publication and no more than two. Those are: M. Paasivaara, K. Conboy, C. Ebert and J. M. Bass. Still on the aspect of
authors relevance, it was not possible to analyze the references of the articles in order to
demonstrate which are the most influential authors on the subject, as these were not made
available by all databases in the extraction files.

4.1.2 Content analysis

From the perspective of relevance or significance of the articles, we identified 12
articles with a good volume of quotes and that concentrate 97% of the total volume of
mentions, described below.

The article “Management challenges to implementing agile processes in
traditional development organizations” by [34] has 219 quotes so far. This study describes
the main challenges of agile management compared to the traditional one, where major
barriers to be resolved were identified: development processes and business processes,
both correlated with scope management and how to scale the model.

The second most quoted study with 60 indications is “Primavera gets agile: a
successful transition to agile development” by [35], which treats the agile development
model as a better way to develop software and explores the use of the Primavera tool.

The case study described in “Agile portfolio management: An empirical
perspective on the practice in use” by [16], was quoted 55 times from 2015 to date and
can be evaluated as the most adherent to this study for dealing with subjects such as agility
outside the technology area and the descriptive approach of how projects are distributed
according to the company’s strategies.

Another article with 51 significant quotes “Context-adaptive agility: managing
complexity and uncertainty”, describes how the company Landmark Graphics, by the
authors [36], deals with the uncertainties and complexities in the software development
process. Following the line of case studies, with 40 quotes, the document “Agile software
testing in a large-scale Project” by the authors [37], portrays the challenges and gains in
applying the concept of agile tests and their planning at scale. Another case study
portrayed in “Scaling Agile” addresses the use of the SAFe framework [38], and studying
this framework the article “Assessing the adoption level of scaled agile development: a
maturity model for Scaled Agile Framework”, from [39], develops a maturity model.

In the article “Scaling agile in large organizations: Practices, challenges, and
success factors” in 2018, the authors carried out a vast literature search to support an
action search within a software development company and so far, obtained 21 quotes [40].
Also, with this perspective of processes, the article “Scaling agile methods” from 2003 explores how to handle the cadence of many agile teams working simultaneously [41].

The recent article, published in 2020 and already with 10 quotes “Reconciling alignment, efficiency, and agility in IT project portfolio management: Recommendations based on a revelatory case study” by the authors [42], portrays the difficulties of managing the IT project portfolio from the perspective of the Activity Theory.

Digital transformation is the subject of the study “Future software organizations - agile goals and roles” where the author explores the way in which systems are developed and the alignment with business processes [43]. Scope management and prioritization of backlog items are addressed in the authors' article “Calculating Completeness of Agile Scope in Scaled Agile Development” [44]. Adding to the subject of digital transformation, another subject of equal importance, industry 4.0, is the focus of the article “The Demands of Industry 4.0 on Project Teams” which deals with the profile of the professionals involved in this journey with great capacity for innovation, integration of technologies, project management and great ability to solve complex problems [45].

5 CONCLUSIONS

After carrying out the Systematic Literature Review (RSL) it is possible to affirm that the topic has relevance and is on the rise in the scientific community, especially in the area of technology.

The first question of the survey “Which frameworks are most used to perform agile portfolio management in companies that are going through the process of digital transformation?” is answered through the aforementioned studies, where Scaled Agile Framework (SAFe), Large-Scale Scrum (LeSS), Scrum of Scrums (SoS), and Disciplined Agile Delivery (DAD) frameworks were identified.

These frameworks interact with traditional management still adaptively. Cases have been reported that there are adaptations of frameworks to adapt to the traditional reality and these new modeling of processes generate numerous inconveniences for management, especially for project managers. These difficulties were portrayed in the study “Reconciling alignment, efficiency, and agility in IT project portfolio management: Recommendations based on a revelatory case study” [42].

Regarding KM, only from the evident relationship with agile methods of developing software projects, studies were found at the team level or single projects. When researching KM topics at the agile portfolio level, no specific studies were found.
In this way, gaps were identified that were not, or were little explored, in the analyzed studies with, for example: (1) No studies were found that demonstrate the financial structure of the portfolios; (2) relationship and contracting suppliers or service providers involved in the portfolio and (3) portfolio performance indicators guiding agility and not adapted to traditional management; (4) agile portfolio governance at operational, tactical and executive levels (5) no study directly addresses knowledge management as an asset in agile portfolio management, although there are studies that deal with the subject in an accessory or secondary way, or still as a team-level subject.

It can be seen, when analyzing the studies, that in the vast majority the agile portfolio management is treated as an adaptation to the methods used at the project level for traditional governance and not the use of structured models for this purpose. In fact, it is a limitation of this study that there is not a great diversity of articles from case studies to demonstrate this way of management. Despite being found in the literature inputs that solidify and emphasize that agile methods have great strength in using Knowledge Management and using its benefits at the team levels or even to projects, we did not find studies demonstrating its use in portfolio management.

This study contributes to companies that are going through the DT process. Mainly because it is necessary to implement a portfolio management method with characteristics that adhere to agile methods to avoid adaptations and conflicts with traditional management. This prevents decision-making from negative feedback loops and friction between peers from being potentiated. It is also noteworthy that it is necessary that KM, which is widely used in project management and agile teams, be studied and implemented in portfolio management. Although no studies have been found that show the correct use of portfolio and knowledge management, it would enable companies to become adherent to the DT process, and thus quickly take advantage of emerging business opportunities in the market. These concepts are widely discussed at lower levels both in companies and in project and team management and, alone, in organizational departments.

The limitation of this study lies in the fact that only three bases of scientific studies were analyzed and that there are several acronyms used in the market to address these topics, which could lead to adverse results.
REFERENCES


