





WHAT ARE THE ESTABLISHED EXPECTATIONS FOR THE ARTIFACTS ADDRESSED IN PROJECT PORTFOLIO MANAGEMENT?

O QUE SE ESPERA DE NOVOS ARTEFATOS VOLTADOS PARA GESTÃO DE PORTFÓLIO DE PROJETOS?

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Abstract

The objective of this research was to evaluate elements present in 75 academic articles and 308 patents to propose a research agenda considering the following question: What is expected from new artifacts aimed at Project Portfolio Management? As a method, we decided to carry out a Systematic Review of Literature and Patents and as results we identified artifacts such as models, methods and software distributed in two dimensions: (1) Plurality, built for specific situations and problems, present in the literature and not tested in the field, which demonstrate the path taken so far; (2) Prospecting, care that directs mapped needs to the development of new studies with greater practical application. As a guiding proposal, we propose the following factors Dynamic Portfolio, Simplification, Integrative Approach, and Integrated Tools to support future studies when there is a need to develop new studies focused on Project Portfolio Management.

Keywords: Project portfolio management. Models. Methods. Software. Systematic review of literature and patents.

Resumo

O objetivo desta pesquisa foi avaliar artefatos presentes em 75 artigos acadêmicos e 308 patentes para propor uma agenda de pesquisa considerando a seguinte questão: O que se espera de novos artefatos voltados para a Gestão de Portfólio de Projetos? Como método, adotou-se a Revisão Sistemática de Literatura e Patentes e como resultados, identificou-se artefatos como por exemplo modelos, métodos e softwares distribuídos em duas dimensões: (1) Pluralidade, artefatos construídos para situações e problemas específicos, presentes na literatura e não testados no campo, que demonstram o caminho percorrido até momento; (2) Prospecção, artefatos que direcionam as necessidades mapeadas para o desenvolvimento de novos estudos com maior aplicação prática. Como proposta direcionadora sugere-se a aplicação dos fatores Portfólio Dinâmico, Simplificação, Abordagem Integrativa e Ferramentas Integradas para apoiar estudos futuros quando da necessidade de desenvolvimento de novos artefatos voltados à Gestão de Portfólio de Projetos.

Palavras-chave: Gestão de portfólio de projetos. Modelos. Métodos. Softwares. Revisão sistemática de literatura e patentes.

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1 Introduction

Project Portfolio Management (PPM) is a dynamic decision process, through which a list of a company's projects is constantly updated and revised, and in which projects are evaluated, selected, prioritized, or eliminated (Alexandrova, 2021). This same process is characterized by uncertain, multiple objectives, strategic considerations and interdependence between projects and decision making (Cooper et al., 2001).

Although some Project Management approaches, such as agile, traditional and hybrid, have allowed companies to respond to changes, the implementation of these approaches also presents new challenges for portfolio management (Maceta & Berssaneti, 2020). This is because, when there is conflict in the way of measuring, evaluating, and managing projects, companies must reassess how portfolios are managed, how decisions and executions are conducted and how performances are measured (Cooper & Sommer, 2020).

Project Portfolio Management and optimization are considered critical activities for organizations in different industrial and business sectors (Hadjinicolaou & Dumrak, 2017). The scientific literature on the subject is vast, which makes it more complex to understand the connections between existing approaches and perspectives (Saiz et al., 2022).

The academic literature presents methods, methodologies and other support tools that are somewhat consolidated. However, it seeks to encourage future research with a focus on new thoughts and current needs (Pinto & Winch, 2016). Along the same lines, there is a growing discussion about academic studies in project management regarding the practical side of interpreting and understanding social interactions to obtain better results (Geraldi & Söderlund, 2018). This leads to a reflection on how an artifact should develop, since it aims to support and solve empirical problems (Aier & Fischer, 2011).

Artifacts can be considered as models, methods, processes, or instantiations built with scientific rigor to solve a particular problem or a set of problems, which characterizes a solution (Gregor & Hevner, 2013) and are also regarded as something developed by the human being that allows an interaction by some type of system to obtain a certain functionality (Dresch et al., 2015).

Through a Systematic Review of Literature and Patents (SLR&P), we analyze artifacts present in the scientific literature and patents to understand the emerging needs and propose a research agenda focused on the development of new artifacts geared to PPM. The research

aimed to answer the following question: What are the established expectations for the artifacts addressed in Project Portfolio Management?

This article is structured in five parts, beginning with this introduction, the second part being a brief overview of Project Portfolio Management, followed by materials and research methods, then the analysis of results, concluding with the final considerations.

2 Project Portfolio Management (PPM)

Portfolio theory was first proposed in 1952, opening a new era of approaches to resource allocation problems, project selection definition, project prioritization and some others problems (Markowitz, 1976). Portfolio theory is widely used too in project research and development, to define the better way to manage the portfolio in order to prioritize the most important and strategic projects (Wei et al., 2020).

According to the PMBOK Guide (Project Management Institute, 2017), define project portfolio as a set of priority demands properly organized and managed to meet the strategic objectives of the organization. Even prioritizing the strategic context, companies also manage projects with low added value, so that a company can choose to organize its projects into several portfolios and manage them (Alexandrova, 2021).

Project portfolios are sets of projects implemented, financed and managed simultaneously (Kaczorowska et al., 2019). The portfolio management decision process is characterized by uncertainties, constant changes, opportunities, multiple objectives and strategic considerations, as well as interdependencies between projects (Simplício et al., 2017).

Organizations define portfolios as a group of projects that are carried out under the management of a specific area and that serve as a means of sharing resources between several simultaneous projects that are perhaps too small to justify the dedication of specific resources (Petro et al., 2020). The vast literature on project portfolios and the limited theoretical reflection in the practitioner's context indicate that portfolios are treated strategically (Martinsuo & Geraldi, 2020)

In modern organizations, especially those that are project-based companies focused on Research and Development, Information Technology and Construction, the Project Portfolio Management area is considered a dynamic decision-making environment that supports the handling of uncertainties and project success (Elbok & Berrado, 2020). It is understood that there is a peculiar field when talking about projects and portfolio companies in retail and that

requires attention (Hayes & Rahman, 2020). The dynamism in retail means that projects are reconsidered at every moment, depending on the market (Morioka & de Carvalho, 2014).

The relationship between strategy and PPM is a solid pillar in academic literature and there is a limitation on the management of projects focused on other needs that affect not only culture, but also actors in general, such as stakeholders (Patanakul, 2022). The wide range of PPM tools developed to enable and automate processes, has a limited understanding of the factors that affect the adoption and deployment of these same tools in organizations (Daradkeh, 2019).

The search for PPM models that have a breadth in terms of interdependence between projects and that incorporate a single approach in a single model is constant in search of integrated management (Jafarzadeh et al., 2018). Furthermore, this search should not be limited to strategic issues because there are other contexts of great importance not yet explored in the field of practitioners (Clegg et al., 2018).

PPM has been an important factor for companies, and this is one of the reasons that these same companies are adopting PMOs as an organization for the integrated management of these projects. In many organizations, even where the number of projects is limited, PPM is hardly carried out as initially proposed, due to ineffective implementation of methodologies, inadequate structure or lack of an evaluation of the performance of this same portfolio (Alexandrova, 2020).

Although project control activities have been applied for decades, limited evidence shows how to continually solve problems originating at the portfolio level and indicates that only half of organizations using PPM regularly track portfolio benefits, which refers to the need for research, applicable solutions and results (Wang et al., 2020).

3 Materials and methods

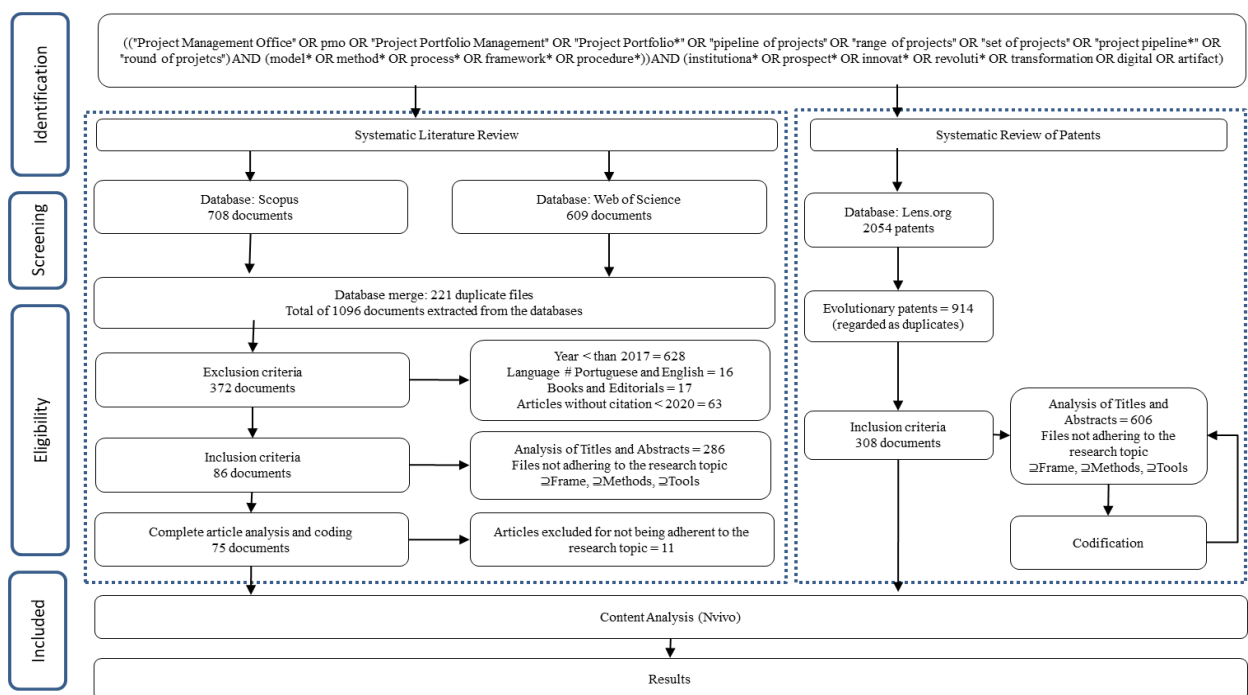
This research was carried out in a two-stage Systematic Review, seeking to understand artifacts aimed at PPM. Systematic Review is a way of gathering evidence through a protocol as an essential part of the review process because it must include enough information to enable independent replication of methods (Pollock & Berge, 2018). Other authors, such as Petticrew and Roberts (2008), also highlight the importance of a process for a Systematic Review and point out that a protocol must be presented clearly, as shown in Figure 1.

By exploring the concept of artifacts, it was possible to perceive that there is a range of models, processes, instantiations and software present in patents, whose origin is scientific research, while others originate in companies. Therefore, this study considered a patent database to obtain the maximum number of artifacts and thus be able to extract the data present in this research.

Systematic Review took place in two stages, with Stage 1 an analysis of documents from scientific bases Scopus and Web of Science and Stage 2 of patent registrations from the Lens.org database. These two stages are characterized as a Systematic Review of Literature and Patents (RSL&P) following the Pollock and Berge (2018) protocol.

Figure 1.

Systematic Review Protocol



Source: Adapted from Pollock and Berge (2018).

3.1 Step 1 - Systematic literature review

The first step consisted of a Systematic Literature Review, carried out from two databases: Scopus and the Web of Science (WoS) during the period of November and December 2021. The following terms were used: ("Project Management Office" OR pmo OR "Project Portfolio Management" OR "Project Portfolio*" OR "pipeline of projects" OR "range of projects" OR "set of projects" OR "project pipeline*" OR "round of projects") AND (model*

OR method* OR process* OR framework* OR procedure*)) AND (institutiona* OR prospect* OR innovat* OR revoluti* OR transformation OR digital OR artifact). The selected terms encompass not only the keywords recognized in PPM but also such terms as PMO that work directly with PPM. This enabled us to obtain the largest possible number of articles related to the research topic. The Scopus database resulted in 708 articles and the WoS resulted in 609. At first, no filter was applied, and the initial phase focused on comparing the documents from the two databases.

Database comparison resulted in 221 duplicate documents, which were excluded to obtain a concise database for analysis and, from this same database, to adopt the exclusion and inclusion criteria for a selection of articles relevant to the research. In a Systematic Review, the selection criteria are decisive for an effective result and must be aligned with the form of evaluation to build a solid base of articles, thus allowing the development of a concise discussion (Russo & Camanho, 2015).

The following exclusion criteria were considered: (1) Books – no books were considered, (2) Languages other than English and Portuguese, (3) Articles referring to the last 5 years, recent discussions on the research topic were chosen, (4) Articles without citation, that is, articles published but not mentioned by other authors, considered not relevant, with the exception of publications in 2020 and 2021, which are still too recent to have citations (5) Cross-keywords and journals disregarding articles that are not directly related to the research topic. As inclusion criteria, articles whose artifacts were related to the research topic were considered.

3.2 Step 2 - systematic review of patent records

The second step in searching for documents for analysis was carried out from the Lens.org patent database, using the same search terms for protocol consistency: ("Project Management Office" OR pmo OR "Project Portfolio Management" OR "Project Portfolio *" OR "pipeline of projects" OR "range of projects" OR "set of projects" OR "project pipeline*" OR "round of projects") AND (model* OR method* OR process* OR framework* OR procedure*)) AND (institutiona* OR prospect* OR innovat* OR revoluti* OR transformation OR digital OR artifact), which resulted in 2054 records from academic students and companies.

As duplicate records, we consider patents with the same name, same applicant, and same class, because they refer to evolutions or inclusion of facilities in previously mapped patents.

Therefore, this analysis resulted in 914 duplicate patents, which were excluded to obtain a concise database for analysis. From this same base, the following inclusion criterion was applied: patents with themes related to PPM Models, Methods and Software were maintained.

After applying the criteria mentioned and presented systematically in Figure 1, we obtained a result of 308 patent registrations. Records were selected for reading titles and abstracts in order to classify each of the recorded artifacts.

Paranhos and Ribeiro (2018) emphasize that the choice for the best result depends on the best strategy used, the applications of methods and techniques for every situation. At this case we followed the Pollock and Berge (2018) for an in-depth reading and search for information aimed at the research objective. The information in patent's classification is possible to map the function, the application, and procedures in use of patents (Penha et al., 2015). Following the research questions and objective of this research, this analysis involved the G06Q patent class because it is a specifically addressed research and covered the range of systems and methods.

4 Analysis and results

NVivo software was used for data analysis to increase the rigor of the qualitative study and the analysis process, as well as the proper use of reports in the analysis process and proper use of reports and graphs and, consequently, the interpretation of information (Leech & Onwuegbuzie, 2011). NVivo also helps the exploration of reports and analyses so as not to generate research biases. These resources provided by Nvivo are supported by data structuring, report extraction and validation of propositions (QSR International Inc, 2021).

After applying the criteria presented in the chapter on Materials and Methods and after reading the documents, two dimensions, Plurality and Prospecting, were inductively defined. The term Plurality means the act of existing in large quantities, which in this research demonstrates what is being developed in high volume, and the term Prospecting means what is expected and what leads to future needs in research, according to the criticisms exposed in the analyzed documents.

The first dimension, Plurality, considers the diversity of models, methods and software to address the same problem. It demonstrates that the artifacts developed in research are focused on a particular problem or are specific to a particular need. In this dimension, categories were identified that indicate the purpose of the artifact developed.

The second dimension, Prospecting, presents as a result the needs not met by the proposed solutions characteristic of a research agenda aimed at solutions which broadly absorb all or most of the needs, seeking a uniqueness when developing artifacts for PPM. Each of these dimensions has been detailed in categories, as shown in Table 1. The categories represent the focus of documents and patents face of emerging needs.

Table 1.

Map of Categories x Document Type x Dimensions

Categories	Documents			Dimensions		
	Articles	Patents	Total	Plurality	Prospection	Total
Specificities	17	168	185	185	0	185
Focus on traditional methodologies	17	78	95	93	2	95
Integrative tools	17	40	57	1	56	57
Integrative Approaches	36	5	41	0	41	41
Simplification	25	11	36	1	35	36
Dynamic Portfolio	7	2	9	0	9	9
Maturity	5	1	6	4	2	6
Governance	3	2	5	5	0	5
Focus on agile methodologies	3	1	4	4	0	4

Source: Authors.

Specificities: These are artifacts aimed at the specific needs of a given problem, as in the following examples: Project selection is a complex decision-making problem with several criteria, with significant uncertainty and high risks. A Fuzzy-based approach is recommended to deal with these uncertainties (Mohagheghi et al., 2021); in addition, properly managing project interdependencies between diverse and concurrent projects is considered critical for the successful implementation of project portfolios and, to this end, work was carried out to address interaction patterns, cost impact and benefits (Bathallath, Smedberg & Kjellin, 2016); Selection methods and resource allocation in projects to optimize these same resources both in planning and during project execution (Santos et al., 2011) and the automation of this type of method through software so that the resource allocation calculation can be automatic (Nakhayi et al., 2017).

Focus on traditional methodologies: These are artifacts aimed at traditional methodologies for the most diverse needs. The collection, evaluation, prioritization, and selection of projects are part of portfolio management and must consider the availability of resources and cover ongoing projects (Condé & Martens, 2020). Song et al. (2019) presents a

method for the project selection problem that helps decision makers to obtain an optimal project portfolio when little or no relevant information is available based on previously defined attribute values. The need for portfolio managers and other stakeholders to be able to visualize an entire portfolio has become common, at least in part because the practice of standardizing reporting formats and tools that simplify the process follows a set of broad recommendations from PMI (Hopmere et al., 2020). Techniques and mechanisms that provide centralized communication for a project portfolio management platform are considered (Pierre & Amélie, 2021). This comprises portfolio prioritization methodologies that include assigning relative weight to each of a set of criteria to rank projects in a project portfolio (Ray & Oxborough-Powell, 2017).

Integrative tools: This factor seeks instantiations that allow the application of different concepts in Portfolio Management, but in a single tool. The creation of a digital management system for the formation of an innovative project portfolio consists of a set of necessary and sufficient indicators for decision-making and must be used by employees from all departments (Dmitrievsky et al., 2021). It is noted that a large amount of research does not require a specific management instrument as a management method or structure. On the other hand, of the methods found, a small number moves towards tools that have greater coverage of tasks and unified controls (Linares et al., 2018). In many companies, innovation takes the form of a project rather than activities and processes, and it becomes necessary to create a corporate management system that guarantees an integrated approach to project implementation, decision making, agility in project management processes and risk reduction (Ramenskaya & Savchenko, 2019). Methodology, processes, and a system for selecting and optimizing collaborative project management opportunities between internal and external organizations so that the return on investments can be maximized (Ray & Oxborough-Powell, 2017). A method and system for synchronizing and consolidating tasks across multiple applications such as Personal Information Management (PIM) software and PPM software centralized systems (Mitesh, 2018).

Integrative Approaches: This category addresses the need to develop approaches in Project Portfolio Management in a hybrid and adaptive way. While agile development approaches for physical products have allowed companies to respond more quickly to changes and increase R&D productivity, implementing these approaches also presents new challenges for new product portfolio management. Some authors focus on improving interaction with

decision makers, while others focus on providing better solutions. However, there is a tendency to consider richer and more realistic models, which can integrate aspects such as realistic constraints at portfolio levels and projects with multiple objectives, shorter times, and robustness (Saiz et al., 2022). Project portfolios cannot be viewed merely as serving a strategy by the parent organization because this view is limiting, oversimplifies the problem and may explain the persistence of the gap between strategy design and execution. There is a need to develop future research to clarify and help manage the complexity of portfolios, to develop new approaches and to reveal the dynamics in institutional acceptance and rejection (Martinsuo & Geraldi, 2020). Methods for devising a restructuring of organizations that allow planning a project with resource management capability and time management capability to provide collaborative resources according to project deadlines (Sven et al., 2004).

Simplification: This category demonstrates a need for artifacts that are easy to understand and apply. While there are over 100 different methods that can be used to calculate, examine, and select decision options, most are rarely employed because they are complex and involve an excessive amount of information, provide insufficient management of risk and uncertainty (Danesh et al., 2017). In project management, the existing data are often limited and vague, for example the selection of multi-criteria projects that requires addressing often conflicting factors in a vague way (Mohagheghi et al., 2019). In the context of project management, the attention given to portfolio management has increased in recent years and seeks to integrate the demands of different departments and their different objectives (Albano et al., 2021). A method for holistic project management might include presenting a graphical interface for a user to enter project information and feed a project portfolio (Tim et al., 2006). Facilitating the management of multiple projects using throughput measurement, a method for providing critical chain-based project management that includes a list of sequential time periods for a project comprising a plurality of tasks and calculating a number of tasks for each period (Sanjeev et al., 2006).

Dynamic Portfolio: This category presents the need to understand that the demands are diverse, and that the portfolio does not depend on the type of approach, in addition to the need for a consolidated view of the portfolio. It is proposed that the process of forming a dynamic portfolio be carried out in two phases: in the first phase, the strategic task of forming a dynamic portfolio is solved and in the second phase, portfolio management means changing the composition of the portfolio according to changing policies over the years of the planning

period (Moskalenko et al., 2020). The growing dynamism in business environments generally refers to an interactive work structure that is carried out in highly autonomous, self-organizing teams and with a high level of communication between team members and stakeholders (Kaufmann et al., 2020). A method for optimized project portfolio with parameters, which define the constraints on a project portfolio by critical path and critical chain projects (Hess & Ricketts, 2014). A software allocation generator for a project based on a skill comparison, with one or more predefined roles as a base, where each role includes one or more skills associated with the project (Fliess et al., 2005).

Maturity: Focus on assessing the maturity of PPM. Maturity is the starting point for comparing the current level of quality of portfolio management activities with best practices. It represents a path towards an increasingly organized and systematic way of doing business in organizations (Nyandongo & Mshweshwe, 2017). Richard et al. (2021) argues that there is a wide range of project maturity models focused on different aspects, such as Industry 4.0 based on an organization's set of project management best practices. To assess an organization's project management maturity, an assessment scope is defined within a set of organizational project management best practices (Larry & Baca, 2008).

Governance: These are artifacts specifically aimed at Governance in Project Portfolios. The success of portfolio management in R&D systems projects depends directly on management actions defined as the composition of governance elements for projects that organize demands aimed at the portfolio (Ramenskaya & Savchenko, 2019). The concept of governance is understood as the interaction between actors within a formal or informal model, which determines how decisions are made and how actions are carried out, with a view to maintaining organizational values in the face of change (Cordeiro et al., 2020). It is an innovation mechanism to select subject matter experts and facilitate collaborative solutions, a project governance mechanism configured to optimize the development path (Alan & Stephen, 2021).

Focus on agile methodologies: These are solutions specifically focused on agile methodologies. Agile practices have become increasingly popular for projects and project portfolios, offering companies greater flexibility to adapt to dynamic environments (Kaufmann et al., 2020). Garcia et al. (2021) point out that entrepreneurship can explain 19.7% of the use of agile methods in project management, with 80.3% not explained, evidencing the complexity of the context of agile methods, and suggesting the development of new studies to better

understand agility in the context of projects. It is a software development that supports and connects elements present in agile methodologies (Kattathara, 2018)

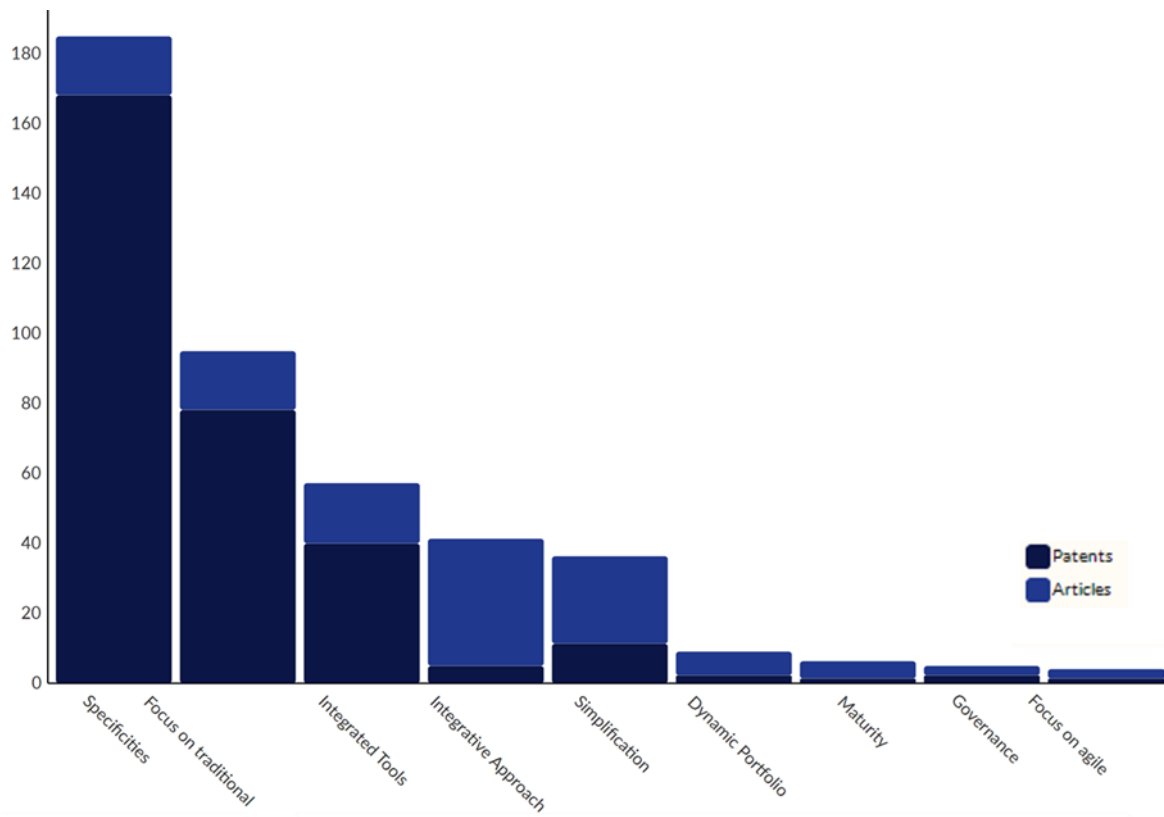
The graph presented in Figure 2 demonstrates the result of mapping the artifacts from the perspective of patents and articles. This delivers an overview of the production of artifacts from academic research (which have generated patents or not) and practitioners (patents deposited by companies).

Regarding patents, there is a predominant volume in the generation of artifacts aimed at specific and non-integrated solutions, that is, solutions to a problem in isolation, which meet a certain need. In a second larger block of records, there is an intensity of artifacts related to traditional project portfolio methodologies, which, in turn, aim at a single approach that does not cover new approaches. On the other hand, there are two other classifications in a smaller proportion focused on artifacts aimed at integrativity and simplification that deal with portfolio management regardless of the methodology applied that are, however, easier to use. Despite being a smaller proportion, they are more recent and demonstrate a possible path to new patents.

Analyzing the articles, there is a greater movement in the elaboration of artifacts aimed at integrative approaches as well as artifacts with greater ease of use. These categories addressed in articles demonstrate that there is an academic concern to produce more comprehensive artifacts that meet the broad needs of organizations.

Figure 2.

Classifications of Categories By Patents X Articles



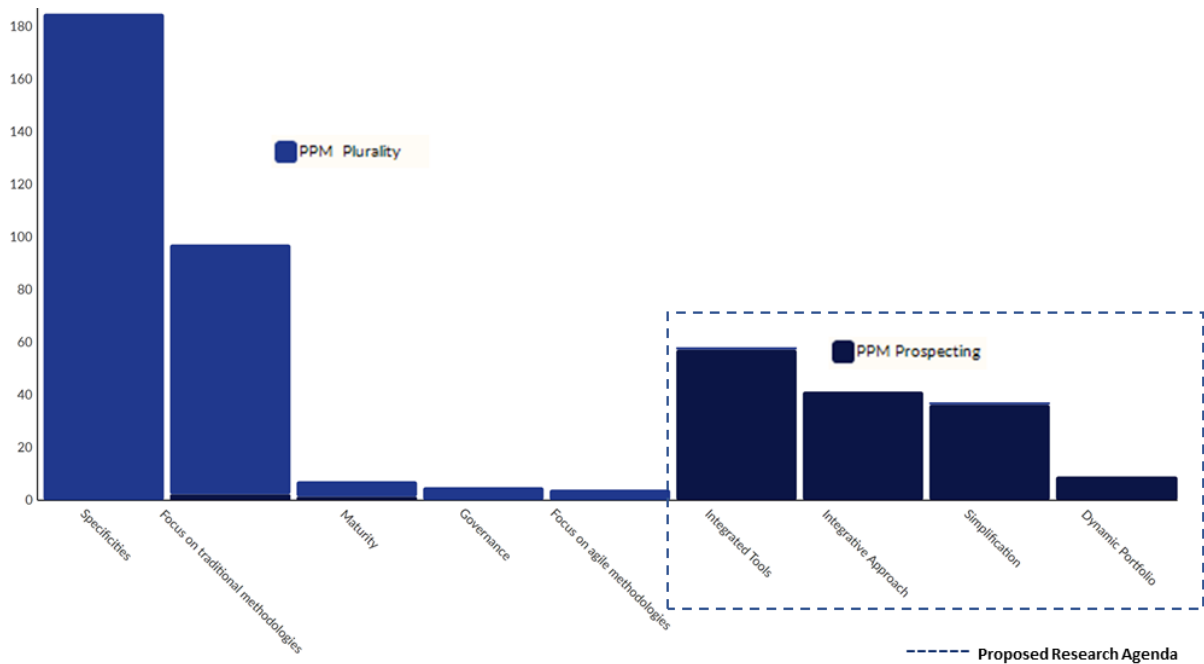
Source: Authors.

In that analysis of the categories present in each of the dimensions, there is a comparison based not on the number of classified codes, but on the discussion of the needs that the authors place as future.

The left side of Figure 3 represents the current categories, considered as the path taken in the studies so far, and from the Integrated Tools category, the needs for research and development aimed at new artifacts. These new artifacts must be integrative to cover all project portfolio management needs, but at the same time must have a simplicity in the form of use, which is to say, less robustness.

Figure 3.

Categories by Plurality x Prospecting



Source: Authors.

The development of artifacts to meet specific needs that generate plurality are of great importance due to the volume of research and categories presented in this research. Even with the presented number of artifacts categorized in the Plurality dimension, the research question focuses on understanding what is expected in the development of new artifacts. The Prospecting dimension proves to be a new driver for the development of new artifacts, whose focus should be directed to models, methods or tools that seek an integration for the use of a single Project Portfolio Management approach or tool, but at the same time are artifacts simple enough to reach all the actors present in the project and that artifacts meet the volatility and dynamism of the portfolios.

Once all the classifications have been grouped together and considering the premise of the codes aimed at the criticisms or needs considered by the authors, a research agenda focused on Project Portfolio Management in the Prospecting dimension is recommended, with the objective of developing research focused on integrative artifacts, whether they are models, methods, or instantiations, that are simple to use.

This research agenda suggests studies focused on artifacts that aim at integration and dynamism in the project portfolio and at the same, ease of use. On the right side of Figure 3,

the result of the proposed research agenda is highlighted and distributed proportionally to each of the characteristics. These same characteristics were described earlier in this same chapter and are pointed out as necessary to be incorporated in the development of new artifacts aimed at PPM.

5 Final considerations

In line with the proposed objective, this research answers the following question: What is expected of new artifacts aimed at Project Portfolio Management? In response, the mapping of four categories that make up the research agenda is presented as follows:

Integrative artifacts – research that seeks to develop artifacts that enable an integration between a portfolio of projects from different areas of the same organization, providing a unified view of project portfolios supporting management and decision-making.

Integrative approaches: deals with the development of artifacts that are not only focused on traditional project portfolio management, or just agile project portfolios, or even hybrid, but that can be adapted to proprietary methodologies developed by organizations.

Simplification: development of artifacts that are friendly used by employees, stakeholders, project participants in general and not just people who are directly working on the projects.

Dynamic Portfolio: Artifacts that allow quick adaptability in decision making in the face of changes caused by the market or specific needs of the organization. This type of artifact should consider rapid changes in the portfolio without the need for in-depth project reviews.

This proposed research agenda is oriented towards empirical work for these categories to be validated in the field of practitioners, so that artifacts can evolve based on the needs of organizations and with scientific rigor. As these are studies aimed at generating artifacts for practitioners, we recommend intervention research methodologies such as Design Science Research (DSR). As an academic contribution, this article guides researchers in the development of research aimed at application in the field of practitioners in order to avoid the development of artifacts that do not evolve in academic field or are not applied in the field due to opposing issues to the presented categories.

The documents and records mapped are not just about project-based companies, and we therefore understand that this is a limitation of the research. Project-based companies can make

use of specific or traditional artifacts and so this topic is also proposed for future studies, precisely because of the dominant focus of this type of organization.

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