METHOD TO DEVELOP HYBRID MANAGEMENT MODELS FOR R&D PROJECTS BY USING A MORPHOLOGICAL ANALYSIS MATRIX

Laura-Florentina BOANȚĂ[1], Alexandru MARIN[2], Miron ZAPCIU[3]

Rezumat. *Profesioniștii în management adoptă tot mai des modele de implementare hibride pentru proiectele aplicative de cercetare și dezvoltare, specifice unor medii dinamice, pentru a se adapta rapid la diverse provocări. În acest articol, conștienți de inadecvarea modelelor tradiționale de management în peisajul socio-economic volatil și inovator al zilelor noastre, am realizat un exercițiu de analiză a stadiului cunoașterii pe baza căreia am adaptat o metodă care, bazată pe utilizarea unei matrice de analiză morfologică, ne-a permis să pregătim, prin implementarea, într-o primă etapă, a unui exercițiu de tip focus-grup, elaborarea de modele hibride personalizate, vizând în principal, ca o abordare originală, proiectele de cercetare – dezvoltare – inovare (CDI). În viitor, intenționăm ca abordarea noastră să fie validată printr-o evaluare a unui studiu de caz, oferind profesioniștilor soluții manageriale adecvate și dezvoltând un ghid pentru selectarea celor mai bune practici și adoptarea de modele de management hibrid performante.*

Abstract. *Management professionals are increasingly adopting hybrid implementation models for applicative R&D projects, specific to dynamic environments, for rapidly adapting to various challenges. In this paper, being aware of the inadequacy of traditional management models in today's volatile and innovative socio-economic landscape, we made somehow a literature review and we adapted a method that, based on the use of a morphological analysis matrix, allowed us to prepare, by implementing in the first phase a focus-group pilot, the elaboration of personalized hybrid models, targeting mainly, as an original approach, research – development - innovation (RDI) projects. In the future, we intend to validate the method, through a case study evaluation, aiming to provide professionals with appropriate managerial solutions by developing a guide for selecting the best practices and adopting high-performing hybrid management models.*

Keywords: Hybrid Management Models; R&D Projects; Morphological Analysis Matrix; Focus Group

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1. Introduction

There are two well-founded approaches in project management, known as "waterfall" and "agile", as discussed and extensively being documented from scientific literature, and taking into account practical expertise of many authors, one example being Bianchi, Michael J. and Daniel Capaldo Amaral; some results of their research were published in the paper: "A Method to Create Hybrid Models Using a Morphological Matrix", The Journal of Modern Project Management 9 (2021).

So, as unanimously recognized, "waterfall" management method relies on a "step-by-step progression", with detailed forecasting of activities and estimation of constraints incorporated into comprehensive planning at the project's outset. This plan serves as a roadmap throughout any project, ensuring that each task is finished before proceeding to the next, thereby preventing overlaps between different stages. In contrast, the "agile" management approach embraces "iterative and incremental" development, delivering partial results in short bursts known as iterations. Thus, agile methodologies offer enhanced flexibility, adaptability, and responsiveness by promoting customer engagement, self-management, and simplicity in both methods and documentation.

Nevertheless, in these days, project management is experiencing a significant shift, rendering traditional managerial expertise inadequate in today's rapidly evolving landscape, particularly in the realm of developing innovative products and technologies, as results of applicative research projects. Hence, agility devoid of structure can precipitate chaos, particularly within projects entailing vast and intricate environments, whereas excessive structure without agility can breed rigidity, detrimentally impacting project outcomes. Consequently, a plethora of research endeavors have emerged, advocating for theoretical frameworks and practical amalgamations of agile and waterfall management methodologies. This endeavor to blend principles and practices from disparate theories has been coined as "hybrid" management models.

Moreover, organizations are increasingly recognizing the significance of project management practices (Badewi, 2016; Kwak & Anbari, 2009; Zhai, Xin, & Cheng, 2009). However, despite its well-defined framework in generic bodies of knowledge, project management remains fraught with challenges (Mir & Pinnington, 2014). This is because project management effectiveness is heavily influenced by the specific organizational context, including factors like business structure, sector, size, and environment (Besner & Hobbs, 2008, 2012a, 2012b; Cooke-Davies, Crawford, & Lechler, 2009; Hobbs, Aubry, & Thuillier, 2008; Zwikael, 2009).

In this respect, Besner and Hobbs (2013) highlighted several limitations of existing project management bodies of knowledge and standards, noting their lack

of empirical foundation and failure to prioritize practices or provide guidance on adaptation to different contexts.
Research done and published by Tereso, A., Ribeiro, P., Fernandes, G., Loureiro, I., & Ferreira, M. (2019) – "Project Management Practices in Private Organizations", Project Management Journal, 50(1), seeks to address these gaps by focusing, among others, on the following research questions:
1. Which project management practices are most employed within organizations?
2. How do the prevalence of project management practices differ across various sectors of activity?
3. Is possible that the most frequently utilized project management practices be categorized into distinct groups or clusters?
Finally, empirical investigations have pinpointed the predominant tools utilized in project management, as exemplified by studies conducted by White and Fortune (2002) and Besner and Hobbs (2006). In this respect, White and Fortune (2002) administered a survey aimed at assessing the practical application and efficacy of various methods and techniques by project managers. They presented a list of 44 methods, methodologies, tools, and techniques to respondents, requesting them to indicate which ones were employed in the projects under scrutiny in the survey.
In the same spirit, and continuing their data collection efforts initiated in 2004, Besner and Hobbs (2012a) extended their research through two additional studies in 2007 and 2009. Their subsequent study pursued two primary objectives: firstly, to illustrate that project management practitioners employ tools and techniques in cohesive sets or toolsets, and secondly, to analyze and compare the utilization of these toolsets across various project types. Their findings indicated discernible differences in practice across four distinct project categories: engineering and construction, business and financial services, IT and telecommunications, and software development. The dataset for Besner and Hobbs (2012a) comprised a larger inventory of tools and techniques (totaling 108) compared to their 2004 survey. Notably, additional tools listed in their expanded inventory pertained to portfolio management, a domain beyond the scope of Tereso et al. research (2019), which focuses on individual project management, relying on the framework established by Besner and Hobbs (2006) as a foundational reference.

2. Hybrid models in project management

In the present paper, being aware of the inadequacy of traditional management models in today's volatile and innovative socio-economic landscape, we wish to develop and prepare for testing a method that, based on the use of a morphological analysis matrix (Bianchi, Michael J. and Daniel Capaldo Amaral, 2021), will allow us to elaborate personalized hybrid models, applicable to research, development, and innovation projects. Our approach, which we intend to validate through a case study evaluation, aims to provide professionals with

appropriate managerial solutions by developing a guide for selecting the best practices and adopting high-performing hybrid management models. The increasing quest for strategies to surmount the prevailing challenges posed by market dynamics and the diverse array of projects within organizations has spurred the call for "hybrid" management models, and due to the distinctiveness of each project, there's a necessity to tailor management approaches accordingly. Beyond software development, other sectors, more recently including scientific applicative research, segment innovative products into discrete modules, necessitating collaboration across various departments. Economic dynamics challenges the fundamental tenets of agile management, prompting the exploration of novel work paradigms. Embracing a purely singular model can entail risks and yield suboptimal outcomes for projects or organizations.

So, hybrid models offer a viable avenue for addressing this challenge by striking a balance between flexibility and control tailored to each specific case, based on the opportunities to harness synergies and benefits through this amalgamation. The managerial dilemma lies in discerning what to rigorously structure and what to leave flexible, thereby achieving equilibrium between these two realms.

In practical scenarios, we will accept that organizations contend with diverse project types and environments, each possessing unique characteristics warranting distinct life cycles and solutions. Despite existing hybrid models proposed in literature, none offer a systematic and robust procedure, capable of adapting to varying business environments, organizational contexts, team dynamics, or project types.

To conclude, such an approach requires a "solid" response to the question: is it feasible to devise methods enabling the customization of hybrid models to suit different projects? Addressing this query poses a significant challenge for advancing hybrid model development. To address this gap, above mentioned authors (Bianchi, Michael J. and Daniel Capaldo Amaral, 2021) have devised a method for customizing hybrid models, relying on a morphological matrix designed to facilitate the selection of project management practices in tailoring hybrid models to specific contexts.

3. Morphological matrix

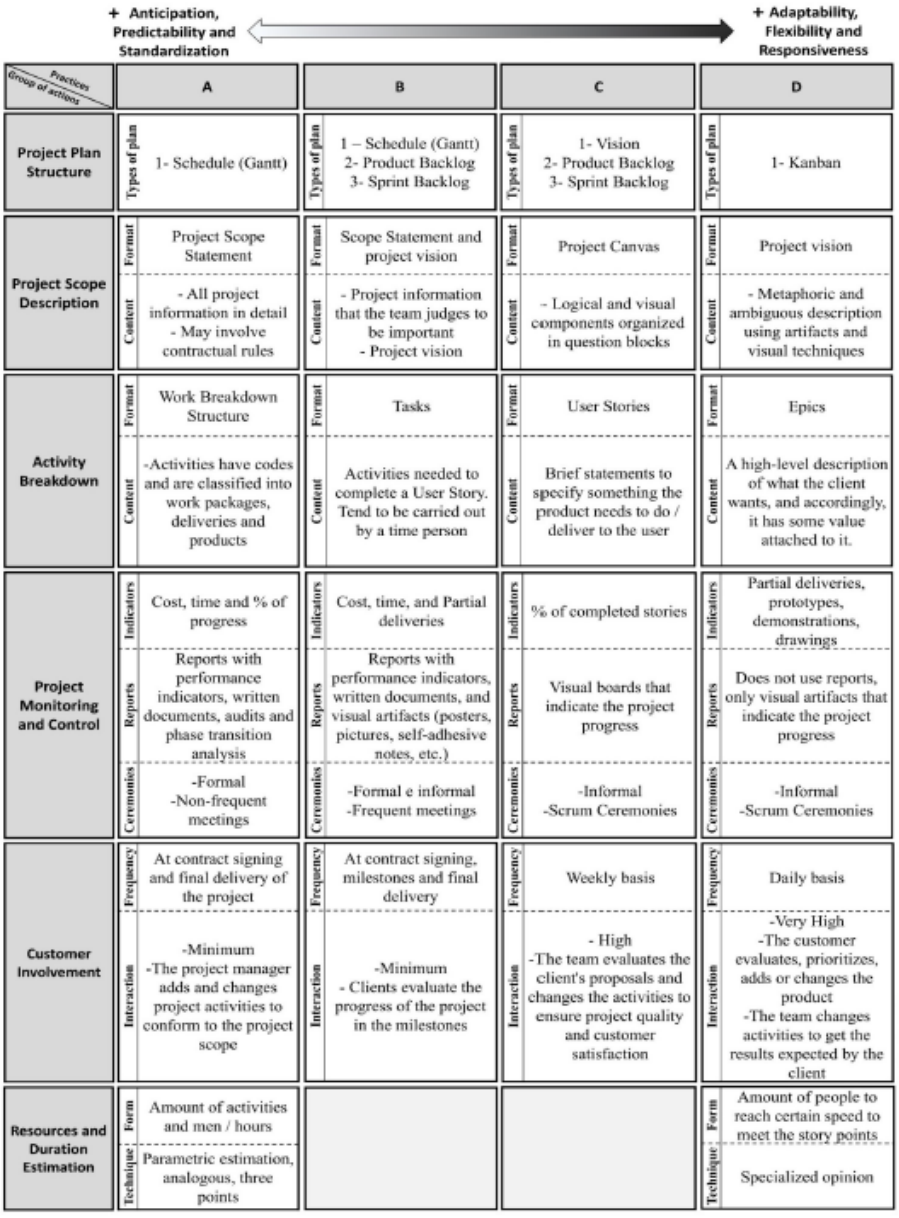
The morphological matrix, a technique rooted in product development theory (see https://www.intechopen.com/chapters/59751), entails decomposing intricate problems into more manageable components. This process aids product development teams in delineating a range of potential solution alternatives for each component, facilitating analysis of the eventual configuration of the product.

In the present paper, starting from the experience gained by Bianchi, Michael J. and Daniel Capaldo Amaral (2021), we wish to employ this technique to establish a catalog of diverse practice possibilities applicable to innovative projects; in

Figure 1 we present the morphological matrix of project management practices developed by Bianchi, Michael J. and Daniel Capaldo Amaral (2021). In their study, mentioned authors followed a detailed research methodology, divided into phases, briefly described as follows.

Phase 1 - Dimension Definitions. This initial phase pursues two main objectives: a) pinpointing dimensions suitable for categorizing project management practices to construct a morphological matrix facilitating future practice combinations, and b) identifying dimensions to evaluate project characteristics and environment to align its needs with various management practice possibilities.
Given the extensive nature of the theory and the multitude of project management processes, in our approach we will extend the focus beyond Scope, Schedule (Time), Resources, and Customer management (Bianchi, Michael J. and Daniel Capaldo Amaral, 2021) to encompass Cost, Quality, and Risk factors. This broadened scope is particularly pertinent due to our research organizations primarily under consideration. By integrating scientific applicative research into project cost, quality, and risk management processes within new product development, organizations can harness evidence-based insights to optimize decision-making, resource allocation, and stakeholder confidence, entailing integrating research-backed methodologies and tools to inform cost estimation, quality assurance protocols, and risk mitigation strategies, thereby bolstering project performance and outcomes. Moreover, it cultivates a culture of continuous improvement by refining management practices based on empirical evidence, culminating in more successful product launches and heightened competitiveness in the market.

Phase 2 - Artifact Development. Building upon the dimensions delineated in the preceding phase, we will also proceed to deconstruct them into variables to operationalize the method's artifacts. Within the morphological matrix framework, we took a slightly modified approach, identifying seven categories of practices aimed at steering the creation of hybrid models.
Subsequently to elaborating a standard questionnaire, the above mentioned seven dimensions will be furtherly refined into supplementary questions, tailored to scrutinize the project's characteristics and environment.



Practices / Group of actions		A	B	C	D
Project Plan Structure	Types of plan	1- Schedule (Gantt)	1 – Schedule (Gantt) 2- Product Backlog 3- Sprint Backlog	1- Vision 2- Product Backlog 3- Sprint Backlog	1- Kanban
Project Scope Description	Format	Project Scope Statement	Scope Statement and project vision	Project Canvas	Project vision
	Content	- All project information in detail - May involve contractual rules	- Project information that the team judges to be important - Project vision	– Logical and visual components organized in question blocks	- Metaphoric and ambiguous description using artifacts and visual techniques
Activity Breakdown	Format	Work Breakdown Structure	Tasks	User Stories	Epics
	Content	-Activities have codes and are classified into work packages, deliveries and products	Activities needed to complete a User Story. Tend to be carried out by a time person	Brief statements to specify something the product needs to do / deliver to the user	A high-level description of what the client wants, and accordingly, it has some value attached to it.
Project Monitoring and Control	Indicators	Cost, time and % of progress	Cost, time, and Partial deliveries	% of completed stories	Partial deliveries, prototypes, demonstrations, drawings
	Reports	Reports with performance indicators, written documents, audits and phase transition analysis	Reports with performance indicators, written documents, and visual artifacts (posters, pictures, self-adhesive notes, etc.)	Visual boards that indicate the project progress	Does not use reports, only visual artifacts that indicate the project progress
	Ceremonies	-Formal -Non-frequent meetings	-Formal e informal -Frequent meetings	-Informal -Scrum Ceremonies	-Informal -Scrum Ceremonies
Customer Involvement	Frequency	At contract signing and final delivery of the project	At contract signing, milestones and final delivery	Weekly basis	Daily basis
	Interaction	-Minimum -The project manager adds and changes project activities to conform to the project scope	-Minimum - Clients evaluate the progress of the project in the milestones	- High -The team evaluates the client's proposals and changes the activities to ensure project quality and customer satisfaction	-Very High -The customer evaluates, prioritizes, adds or changes the product -The team changes activities to get the results expected by the client
Resources and Duration Estimation	Form	Amount of activities and men / hours			Amount of people to reach certain speed to meet the story points
	Technique	Parametric estimation, analogous, three points			Specialized opinion

Fig. 1. Morphological matrix of project management practices (Reprinted from [7], p. 54)

Phase 3 - Method Development. Validation of artifacts, defined at Phase 2, will make use of professional support, coming from a project management expert, considering the predetermined objectives and anticipated outcomes of a case study project.

Phase 4 - Feasibility Evaluation. The proposed method's viability will be assessed through an in-depth case study, part of a strategy commonly used to either validate or challenge theoretical frameworks, or to highlight unique or extreme scenarios. The selected case study will take place within an applicative research organization, chosen for three primary reasons:
a) The organization has a proven history of effectively implementing various project management methodologies, including both agile and waterfall approaches, in its project development initiatives.
b) In specific projects, the organization is steadfast in its commitment to amalgamating practices from diverse approaches to optimize outcomes and ensure success.
c) The chosen applicative research organization houses a specialized department dedicated to innovating products and services, complementing its existing portfolio of activities.

4. Proposed method to customize hybrid models

In this section, we present in detail the artifacts of the method to customize hybrid models, and the corresponding application process.

4.1. Project diagnostic questionnaire

One of the pivotal challenges in crafting hybrid models lies in diagnosing and comprehending the primary characteristics of the organization, project, and team. This understanding is crucial for delineating the "optimal point" for integrating practices, as it serves as the cornerstone for practice selection. The information gleaned from this diagnosis is indispensable for tailoring solutions to each case.
The dimensions incorporated into one questionnaire will be derived from some diagnostic methodologies prevalent in the field of project management. When selecting dimensions for inclusion in the questionnaire, we adhere to two key criteria:
1) The dimension should assess the overarching characteristics of the project that remain independent of its execution, allowing for measurement before project commencement.
2) The dimension should exert an influence on project management practices, techniques, or tools, aiding in the configuration of hybrid models.
The dimensions significantly influence the conduct of project management. For instance, organizations characterized by informality, decentralization, and a flat hierarchy tend to align well with the inherent uncertainties of dynamic business environments. Conversely, centralized, specialized, and bureaucratic organizations often thrive in more predictable settings. Furthermore, close-knit team members foster enhanced communication, leading to greater interaction. Smaller teams typically exhibit higher levels of communication, integration, and

alignment among members. Regarding team member skills, a broader range of expertise translates to reduced uncertainties, risks, and challenges throughout the project, as it enables the integration of diverse areas and departments within an organization.

We also posit that team members' experience in developing related products correlates with their ability to navigate changes throughout the project, thus contributing to greater agility. Furthermore, greater experience among team members in similar product development enhances their capacity to adapt to project changes, further bolstering agility.

The dimensions of novelty and technological maturity are intertwined with the technological challenges inherent in project development; innovative projects often entail heightened levels of uncertainty. An organization's proficiency in technological development inversely correlates with the uncertainties and challenges encountered throughout the project.

Regarding complexity, projects become increasingly challenging to manage as their complexity escalates, necessitating potential adaptations to management procedures by the organization. Lastly, time availability directly impacts the team's level of autonomy.

Collectively, these insights aid in selecting appropriate management practices for projects, thereby shaping the configuration of management models.

4.2. Morphological matrix of project management practices

The morphological matrix, like the one presented in Figure 1, will comprise seven rows representing groups of actions necessary for effective project planning and control; each column presents alternative solutions (practices) corresponding to these actions, serving as a catalog of practices during the creation of hybrid models. Thus, the morphological matrix offers a streamlined and targeted approach to accessing a spectrum of project management solutions.

For instance, in Project Plan Structure (see Figure 1), practices range from employing a comprehensive single project plan covering the entire project duration, including phases, milestones, products, deliverables, work packages, and activities, to hybrid approaches like combining a macro plan (schedule) with short-term plans (iterations) focusing on key deliverables for each phase. Additionally, practices derived from agile methodologies such as Product Vision (see https://www.scrum.org/resources/what-product-vision), with a Product Backlog (see https://www.scrum.org/resources/what-is-a-product-backlog), and Sprint Backlog (see https://www.scrum.org/resources/what-is-a-sprint-backlog), as well as the utilization of a Kanban board (see https://www.atlassian.com/agile/kanban/boards), could be also included.

To establish a correlation between rows (action groups) and columns (management practices), we will devise a scale ranging from practices

emphasizing anticipation, predictability, and standardization to those emphasizing adaptability, flexibility, and responsiveness. This structured approach enhances the organization of the matrix, which we refer to as a reference matrix. This matrix will be tailored to suit each organization's unique requirements. While the matrix contains four columns of practices for each row (see Figure 1), it can be expanded, or reduced, as needed to accommodate a broader array of management practices, depending on each organization's needs.

4.3. Process to create hybrid models

Each project possesses its own distinct life cycle, level of complexity, degree of innovation, and strategic requirements, thereby necessitating diverse management approaches. Below, we outline the series of steps and tools required to create hybrid models using the proposed method.

Step 1 - Matrix Adaptation: It is likely that the organization employs specific practices, techniques, and tools not encompassed within the reference matrix, or that the matrix includes practices unsuitable for the company's needs. Consequently, it becomes imperative to tailor the reference matrix to suit the organization's requirements. This adaptation involves identifying the project management practices utilized by the company and integrating them into the fundamental structure of the matrix (rows and columns).

One important step when tailoring the reference matrix is the elaboration of a "Project Model Canvas", as an innovative tool to transform an idea into a project plan (see https://www.projectmodelcanvas.eu/), and to stimulate collaboration and communication between all involved parties (project team, sponsor, stakeholders, etc.).

For matrix adaptation, when discussing project management practices, is essential to carefully analyze the specific tools and techniques. In this respect, out of the 70 tools and techniques identified in the Besner and Hobbs (2006) study, 15 overlapped with those included in the Papke-Shields et al. (2010) study, while 10 were also addressed in the White and Fortune (2002) study. In Tereso et al. (2019), were retained 68 tools and techniques from the Besner and Hobbs (2006) study, excluding project management software for multi-project scheduling/leveling due to its relevance to portfolio management. Additionally, it was disaggregated risk management documents into risk identification, qualitative risk analysis, and quantitative risk analysis, resulting in a total of 71 tools and techniques. One selection comprises eight tools and techniques, presented by Fernandes et al. (2013), including handover (from the proposal team to the project team), design of experiments, requirements traceability matrix, project issue log, progress meetings, risk reassessment, close contracts, and project closure documentation. In the section of the questionnaire, used by Tereso et al. (2019), concerning project management practices, which encompassed the 79 selected

tools and techniques, respondents were instructed to assess the frequency of usage for each tool and technique on a scale from 1 to 5. In this respect, a rating of 1 indicated "never used," 2 signified "rarely used," 3 denoted "occasionally used," 4 represented "often used," and 5 indicated "always used."

Given the diverse application of project management across various sectors, Tereso et al. (2019) study focused on the following sectors:

- Information and Communication: Encompassing activities associated with the advancement of technological resources, hardware, and software aimed at facilitating communication across different domains.
- Construction: This sector includes the development and construction of buildings, civil engineering projects, and specialized construction activities.
- Services: Encompassing a range of activities such as personal services, meal services, office services, administrative support, and transportation services.
- Manufacturing: Comprising industries involved in transforming raw materials into finished products for the market.

To address one initial research question—"What are the most frequently utilized project management practices in private organizations?"— Tereso et al. (2019) ranked the 79 surveyed project management tools and techniques in descending order; Table 1 highlighted the top 20 tools and techniques.

Table 1. The 79 Project Management Tools and Techniques Ranked by Usage in Descending Order (Reprinted from [14], p. 14)

V1 Kick-off Meeting	28 Stakeholders Analysis	56 Database for Cost Estimating
V2 Activity List	29 Cost-Benefit Analysis	57 Database of Lessons Learned
V3 Progress Meetings	30 PM Software for Resource Scheduling	58 Network Diagram
V4 Gantt Chart	31 Team Member Performance Appraisal	59 Work Authorization
V5 Baseline Plan	32 Quality Plan	60 Critical Chain Method
V6 Progress Report	33 Product Breakdown Structure	61 Life Cycle Cost
V7 Client Acceptance Form	34 Quality Inspection	62 Probabilistic Duration Estimate (PERT)
V8 Milestone Planning	35 Critical Path Method	63 Team-Building Event
V9 Work Breakdown Structure	36 Bid/Seller Evaluation	64 Database of Risks
V10 Project Closure Documentation	37 Control Charts	65 Graphic Presentation of Risk Information
V11Requirements Analysis	38 Requirements Traceability Matrix	66 Quality Function Deployment
V12 Change Request	39 Qualitative Risk Analysis	67 Value Analysis
V13 Project Scope Statement	40 PM Software for Monitoring Cost	68 Self-Directed Work Teams
V14 Customer Satisfaction Surveys	41 Feasibility Study	69 PM Software for Simulation
V15 Project Issue Log	42 Re-baselining	70 Database of Contractual Commitment Data
V16 Project Charter	43 Risk Reassessment	71 Decision Tree
V17 Close Contracts	44 Financial Measurement Tools	72 Cause-and-Effect Diagram
V18 Lessons Learned	45 Quantitative Risk Analysis	73 Design of Experiments
V19 Risk Identification	46 PM Software for Cost Estimating	74 Bidders Conferences
V20 PM Software for Monitoring Schedule	47 Configuration Review	75 Pareto Diagram
21 Communication Plan	48 Database of Historical Data	76 Learning Curve
22 Responsibility Assignment Matrix	49 Top-down Estimating	77 Parametric Estimating
23 Handover	50 Bid Documents	78 Trend Chart or S-Curve
24 PM Software for Task Scheduling	51 PM Software for Resource Leveling	79 Monte Carlo Analysis
25 Bottom-up Estimating	52 Ranking of Risks	
26 Project Statement of Work	53 Project Website	
27 Contingency Plans/Risk Response Plan	54 Earned Value Management	
	55 Project Communication Room	

The positioning of the ranked by usage in descending order 20 tools and techniques (see Table 1), in Tereso et al. (2019) study, was categorized according to the following Process Groups:
1. Initiating Process Group: Kick-off meeting and project charter (ranked 1st and 16th, respectively).
2. Planning Process Group: Work breakdown structure (ranked 9th); requirements analysis (ranked 11th); project scope statement (ranked 13th); baseline plan (ranked 5th); activity list, Gantt chart, and milestone planning (ranked 2nd, 4th, and 8th, respectively); risk identification (ranked 19th).
3. Executing Process Group: Project issue log and lessons learned (ranked 15th and 18th, respectively).
4. Monitoring and Controlling Process Group: Progress meetings, progress report, change request, project management software for monitoring schedule, and customer satisfaction surveys (ranked 3rd, 6th, 12th, 20th, and 14th, respectively).
5. Closing Process Group: Client acceptance form, project closure documentation, and close contracts (ranked 7th, 10th, and 17th, respectively).
Another research question addressed in Tereso et al. (2019) study was: "How do the usage patterns of project management practices differ across various sectors of activity?" Analysis of the results, distributed by sector of activity through exploratory analysis, revealed the contextual dependency of project management.
Thus, the services sector emerged as the most diversified user of project management tools and techniques, employing 27 out of the total 79 surveyed. Following closely, the construction sector utilized 23 tools and techniques, while the manufacturing sector utilized 18, and the information and communication sector utilized 14. In terms of frequency, the results indicated that, on average, the services sector demonstrated the highest utilization of project management tools and techniques, followed by the manufacturing sector and the information and communication sector. Conversely, the construction sector exhibited the lowest frequency of usage. Thus, while all 79 tools and techniques were employed across the four activity sectors, their usage varied significantly. In this respect, Table 2 presents the top 10 most utilized tools and techniques across activity sectors, with shading indicating their alignment with Process Groups. Notably, among the top 10, the kick-off meeting is the sole tool from the Initiating Process Group, although curiously absent from the top 10 within the construction sector responses.

Table 2. The Top 10 Most Used Project Management Tools and Techniques by Activity Sector, Shaded in Gray by Process Groups (Reprinted from [14], p. 15)

Information and Communication	**Construction**	**Services**	**Manufacturing**
Kick-off Meeting	Activity List	Activity List	Kick-off Meeting
Progress Meetings	Baseline Plan	Kick-off Meeting	Activity List
Gantt Chart	Close Contracts	Milestone Planning	Bid/Seller Evaluation
Activity List	Cost-Benefit Analysis	Progress Report	Quality Inspection
Baseline Plan	Gantt Chart	Gantt Chart	Baseline Plan
Progress Report	Progress Meetings	Progress Meetings	Client Acceptance Form
Change Request	Client Acceptance Form	Baseline Plan	Progress Report
Client Acceptance Form	Project Closure Documentation	Project Closure Documentation	Milestone Planning
Project Scope Statement	Bottom-up Estimating	Requirements Analysis	Progress Meetings
Requirements Analysis	Milestone Planning	Work Breakdown Structure	Feasibility Study

Process Groups	Initiating	Planning	Executing	Monitoring and Controlling	Closing

It's noteworthy that the Planning Process Group predominates in this list (see Table 2), with all activity sectors employing the activity list and baseline plan. This finding is consistent with Zwikael and Globerson's (2006) study, which underscored the significance of these practices for project success. Thus, the most frequently used project management practices also appear yielding the greatest impact on project performance.

Additionally, bid/seller evaluation stands out as the sole tool from the Executing Process Group within the top 10, exclusively represented in the manufacturing sector. Its absence from the construction sector, where one might anticipate its presence, is notable.

As anticipated, observations from the Closing Process Group reveal that close contracts rank among the top 10 tools and techniques in the construction sector, reflecting the sector's substantial reliance on subcontracting.

The final research question investigated whether the most frequently utilized project management practices exhibit clustering. To explore this, factor analysis was conducted to examine the relationships among the top 20 project management practices.

The analysis revealed a structured framework comprising four distinct clusters, representing four toolsets of project management practices. Figure 2 depicts the outcomes of the clustering resulting from factor analysis. Notably, each of these toolsets shares a common thread: the integration of planning practices with those associated with the four Process Groups—Initiating, Executing, Monitoring and Controlling, and Closing.

For identifying the project management practices within the organization, in the present study, we propose to use a Focus Group Guide (see Appendix). The

results of applying the Focus Group will support the retrieval of important clarifications, when deciding which project management practices to be recommended to each organization implementing applicative research projects, destined to develop innovative products / services / technologies.

Step 2 - Define the Unit of Analysis: The focal point for hybrid model development is a specific project within the organization or a cluster of projects sharing similar characteristics.

Step 3 - Implement the Questionnaire: The above-mentioned questionnaire will be employed to scrutinize the project's characteristics and contextual factors, including organizational structure, novelty, complexity level, technology, and available time for execution.

Step 4 - Data Analysis and Practice Selection: Utilizing the information gathered in the preceding step, the matrix will be employed to select practices (columns) for each action group (rows) that best align with the project's unique attributes. At least one practice must be chosen for each row. These practices will be systematically organized, culminating in the formulation of a tailored project management model.

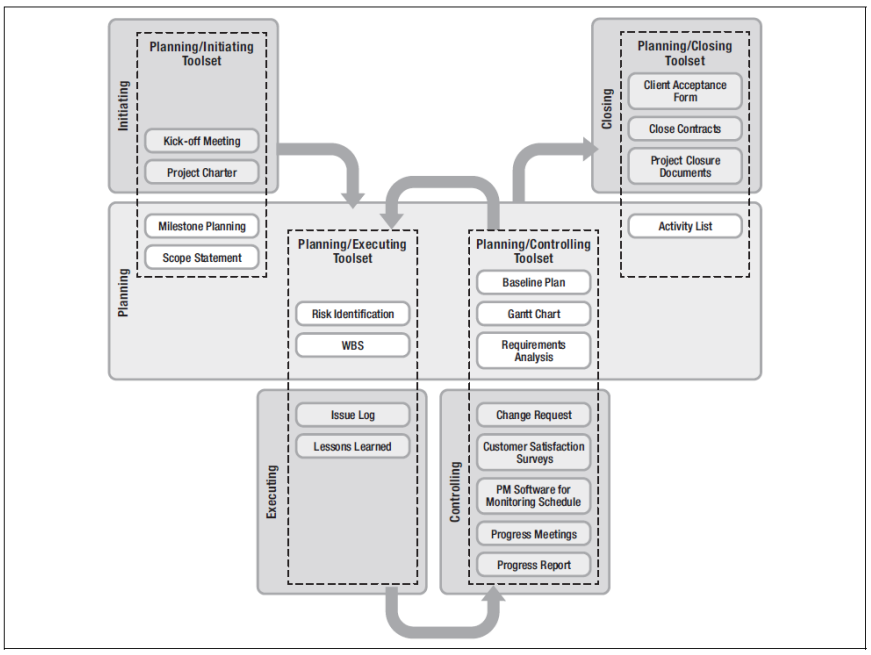


Fig. 2. Project management practice toolset relationships (Reprinted from [14], p. 17)

5. Future case study preparation

The aim of the forthcoming case study is to validate the practicability of implementing the method to formulate hybrid models within an actual company

setting. Specifically, our study will concentrate on a project characterized by a high degree of innovation, which typically benefits from a broad scope approach. The challenge lies in addressing an ambiguous problem statement, complicating the establishment of a detailed scope.

6. Conclusions and future research

This study represents an initial endeavor to address the challenge of tailoring hybrid models to specific projects, especially targeting research organizations. By making somehow a literature review and adapting one already proposed and tested method that, based on the use of a morphological analysis matrix, allowed us to prepare, by implementing in the first phase a focus-group pilot, the elaboration of personalized hybrid models, targeting mainly, as a new original and innovative approach, research – development - innovation (RDI) projects.

Furthermore, in the future, we intend to validate our innovative method, through a case study evaluation, aiming to provide professionals with appropriate managerial solutions, by developing a guide for selecting the best practices and adopting high-performing hybrid management models.

So, the proposed method establishes a connection between project characteristics and management practices to devise an appropriate solution. Rather than adhering to predefined models for an organization, it advocates for the creation of tools enabling the customization of management models for individual projects.

For any organization, and especially the research focused ones, the taken from literature and adapted morphological matrix offers a means to strike a balance between “standardization” and “flexibility”. In this respect, managers should have the freedom to choose from a variety of practices, albeit within the constraints of a predefined set established during the organization's matrix preparation.

The concept of customizing practices on a project-by-project basis could emerge as a significant theme in this domain. So, it would be particularly intriguing to explore following methodological aspects: a) the development of mechanisms to aid professionals in adopting project management practices conducive to agility; b) the feasibility of employing recommendation algorithms to adapt management practices for specific projects; c) the identification of intelligent algorithms for extracting data from project management information systems to enhance management processes.

Expanding the research scope beyond project Scope, Schedule (Time), Resources, and Customer management to encompass Cost, Quality, and Risk underscores the need for further investigations into mechanisms capable of automatically correlating questionnaire responses with the matrix to generate corresponding management models. Moreover, we will consider applying the proposed method across a broader spectrum of projects and organizations, spanning various contexts and industries, to enrich its applicability and efficacity.

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