INNOVATION PORTFOLIO UNDER CONSTRAINTS: STRATEGIC BUCKET DESIGN IN A PROCESS INDUSTRY

Tea **BOROZAN**
University of Belgrade, Faculty of Organizational Sciences, Serbia
tea.borozan@fon.bg.ac.rs
Biljana **STOŠIĆ**
University of Belgrade, Faculty of Organizational Sciences, Serbia
biljana.stosic@fon.bg.ac.rs
Radul **MILUTINOVIĆ**
University of Belgrade, Faculty of Organizational Sciences, Serbia
radul.milutinovic@fon.bg.ac.rs
Marko **MIHIĆ**
University of Belgrade, Faculty of Organizational Sciences, Serbia
marko.mihic@fon.bg.ac.rs

Abstract
In capital-intensive process industries, where innovation is strongly linked to operational continuity, regulatory requirements, and long-term asset investments, managing innovation projects portfolios can be especially difficult. The design and adaptation of strategic buckets to specific industrial contexts have received little attention in prior research, despite their widespread recognition as a helpful tool for project portfolio management. This study fills this gap by investigating how strategic buckets are created to manage innovation projects portfolio in the paper industry. This study employs a qualitative case study methodology, utilizing semi-structured interviews and document analysis. It draws on innovation portfolio management theory and an established conceptual framework for strategic bucket design. Key dimensions and related factors are identified within the proposed framework. Furthermore, the study demonstrates the application of strategic buckets in the case company. The findings contribute to a more context-sensitive understanding of strategic bucket design and provide practical insights for managing innovation project portfolios in capital-intensive process industries.

Keywords: *strategic buckets, project portfolio management, innovation management, process industry*

1. Introduction

Projects are widely recognized as a key mechanism through which organizations achieve strategic success and create competitive advantage (Barbosa & Carvalho, 2024). However, as (Vieira et al., 2024) explain, individual initiatives seldom fulfill strategic objectives. Instead, strategic intent is realized through interconnected project portfolios in which multiple initiatives compete for limited organizational, technical, and financial resources (Arratia-Martinez et al., 2021; Bekker & Steenkamp, 2024). From this perspective, project portfolio management (PPM) has emerged as a vital discipline for aligning strategic objectives with operational projects, thereby driving organizational success (Suvvari, 2023).

Managing portfolios becomes even more difficult when it comes to innovation. Akcigit (2024) emphasize that many businesses struggle to achieve the intended business impact from innovation, even with substantial investments and access to cutting-edge tools. As a result, innovation project portfolio management (IPPM) has emerged as an important but still under researched area (Si et al., 2022), which requires development of new frameworks and practices.

At the same time, prior research emphasizes that successful innovation portfolios require a continuous balancing of exploration and exploitation, combined with frequent resource reallocation in response to environmental and organizational change (Nguyen et al., 2018).
IPPM can be especially difficult in process industries. This industry differs significantly from other manufacturing sectors due to its continuous production processes, substantial asset intensity, and extended, highly integrated supply and value chains (Chirumalla, 2021; Lager, 2016). Chirumalla (2021) further states that innovation within this industry is primarily internally driven, characterized by significant process changes and ongoing advancements in production techniques and technologies. Reseach and development (R&D) is carried out in pilot, production, or laboratory settings, where test runs are used for experimentation rather than prototyping (Lager, 2016). Because of these features, innovation portfolios in process industries are particularly complex, requiring thoughtful, context-sensitive approaches to resource allocation and portfolio structuring.

Aligning strategy with project selection and resource allocation in R&D portfolios is still a significant challenge, despite the fact that innovation is widely acknowledged as a driver of sustainable competitive advantage (Baláž et al., 2023; Si et al., 2022). By converting strategic priorities into clear funding decisions, the strategic buckets method provides an organized solution to this issue (Hutchison-Krupat & Kavadias, 2015). Strategic buckets are useful for safeguarding innovation initiatives in project portfolios from the standpoint of innovation management. Strategic buckets lessen the chance that short-term financial or operational criteria will deprioritize innovation by integrating innovation considerations directly into the portfolio structure (Chao & Kavadias, 2008). How innovation is managed at the portfolio level is directly influenced by choices about which buckets are defined, how they are framed, and how resources are distributed among them (Fügener et al., 2025). Therefore, it is crucial to comprehend how organizations design these buckets.

According to Edgett (2012) there is still a lack of guidance on how to design strategic buckets, even though they are widely recognized as a helpful tool for coordinating project portfolios with organizational strategy. By demonstrating how businesses create sets of strategic buckets to direct resource allocation and project selection, Santiago and Soares (2020) fill this gap in a significant way. Actually, their framework highlights four design dimensions, technology, market, capabilities, and organizational processes while accounting for the external environment. Crucially, the authors stress that these factors are context-specific and don‘t have the same weight in various industrial and organizational contexts. However, empirical insights into how this framework is operationalized in capital-intensive, process-oriented industries remain limited. Based on the strategic bucket design framework proposed by Santiago and Soares (2020), and enriched by the practical recommendations of Gomes et al. (2023) and the theoretical foundations provided by Stošić and Milutinović (2017), this study contributes to this discussion by examining how the underlying factors are adapted in the context of a capital-intensive, process-oriented industry.

In light of the above, the following research question is addressed:
RQ: How are strategic buckets designed to manage innovation project portfolios in a capital-intensive process industry?

2. Literature Review

1. Project portfolio management and strategic alignment

A project portfolio represents a set of projects managed under the sponsorship of a specific organization, where the projects compete for limited resources such as time, budget, and workforce, as it is rarely possible to implement all proposed initiatives (Archer & Ghasemzadeh, 2004). The Project Management Institute describes portfolio as a group of projects, programs, or operations managed together to achieve strategic objectives. While individual projects have a defined start and end, portfolios are ongoing and evolve over time, as new projects are approved and included (Project Management Institute, 2013).

Project portfolio management (PPM) has emerged as a structured approach to strategically and holistically manage groups of projects (Clegg et al., 2018). It was introduced in the 1950s through (Markowitz, 1952) work on managing inventory portfolios and since then has evolved into a very important discipline for organizations competing in dynamic environments (Danesh et al., 2017). The Project Management Institute defines PPM as the process of evaluating, selecting, and prioritizing projects, as well as allocating limited resources in alignment with organizational strategy (Project Management Institute, 2013). In practice, PPM requires informed decision-making regarding which projects to initiate, continue, or discontinue, with the objective of maximizing organizational value (Lappi et al., 2019). We can conclude that the primary mission of PPM is twofold: to ensure the selection of appropriate projects and the effective execution of those projects (Filippov & Mooi, 2012).

Within PPM, strategic alignment serves as a fundamental principle that guides project selection by ensuring that selected projects are directly connected to the organization's overarching strategy (Martinsuo & Anttila, 2022). Today's organizations face constant pressure to innovate and grow. PPM helps meet these challenges by linking strategy planning with action, so organizations can balance their portfolios, get the most value, and use resources wisely (Oosthuizen et al., 2016).

Beyond its technical aspects, PPM functions as a strategic decision-making framework designed to generate value for a diverse range of organizational stakeholders (Lazar, 2019). In most organizations, the volume of potential initiatives surpasses the available physical, financial, and logistical resources required for implementation (Etgar & Cohen, 2022). Therefore, managers and executives must select an optimal subset of projects from a broader pool, often evaluated using multiple and sometimes conflicting criteria (Jafarzadeh et al., 2022). Accordingly, PPM depends on formalized decision-making processes that ensure consistent and transparent project selection and resource allocation in alignment with strategic objectives (Solares et al., 2025).

2. Key features of innovation project portfolio management

Innovation refers to the creation of new processes, designs, structures, products, or services (Zaman et al., 2020). The Oslo Manual (OECD & Eurostat, 2005) classifies innovations into product or service innovations, process innovations, organizational innovations, and marketing innovations. The most recent Oslo Manual fourth edition refines these categories to product Innovations and business process innovations (OECD & Eurostat, 2018).

On the other hand, innovations can be categorized as radical or incremental by their nature, regarding level of novelty (Stošić & Milutinović, 2017). Which of these types of innovation organizations will choose depends on an organization's size, goals, and abilities. Innovation

activities can include improving products or services, using advanced production technologies, streamlining logistics, or changing organizational strategies, structures, information systems, and management skills (Talíř & Straková, 2023).

Innovation within organizations typically occurs through multiple concurrent projects rather than isolated initiatives (Gemünden et al., 2013). The same author emphasizes that organizations require a portfolio-level perspective to achieve effective innovation management (Gemünden et al., 2013). Because of this, organizations need clear methods to organize their innovation portfolios (Si et al., 2022).

A primary challenge in managing innovation portfolios is achieving a balance between stability and renewal (Killen et al., 2023; Martinsuo et al., 2024). Incremental innovations typically improve existing products, processes, or capabilities and are associated with lower risk and more predictable outcomes (Sevil et al., 2022). On the other hand, exploratory initiatives entail higher levels of uncertainty but provide opportunities for long-term strategic renewal (Coad et al., 2012). This situation is often explained by the exploration–exploitation framework, which highlights the need to use existing knowledge while also seeking new opportunities (Huang et al., 2025). Research shows that relying on only one approach is not enough; instead, organizations perform best when they balance exploration and exploitation in their innovation portfolios (Zhao et al., 2021).

3. Strategic buckets

In the PPM literature, strategic buckets are frequently identified as a mechanism for translating strategic priorities into specific resource allocation decisions (Hutchison-Krupat & Kavadias, 2015). This method requires senior management to decide how limited financial resources are allocated across predefined categories. Projects are then assigned into these categories and ranked, creating a portfolio that aligns with corporate goals (Cooper et al., 2002; Fügener et al., 2025).

Surveys by Markham and Lee (2013) and Müller et al. (2019) found that successful companies often use strategic buckets as a portfolio tool. By grouping projects that use the same resources, it avoids comparing very different initiatives with one another and allows each group of projects to be evaluated using appropriate criteria. According to Hutchison-Krupat and Kavadias (2015) the use of strategic buckets reduces information asymmetry between senior management and project managers. However, the approach can be demanding for senior managers, as it requires time-consuming discussions and resource allocation decisions that are sometimes made without detailed knowledge of individual projects (Cooper et al., 1997).

Chao and Kavadias (2008) proposed a framework for deciding when and how to use strategic buckets. They explain that the effectiveness of strategic buckets depends on the specific context, which affects the value and risk of different innovation projects. These factors determine whether a portfolio should focus more on incremental or radical innovations, so portfolio balance cannot be set in advance. As a result, the design of strategic buckets should be adjusted to fit the situation instead of using a single standard approach (Chao & Kavadias, 2008).

Building on earlier conceptual work, Santiago and Soares (2020) shift the focus from the use of strategic buckets to their design. They propose a theoretical framework for designing strategic buckets based on four key dimensions — technology, market, capabilities, organizational processes in addition to external environment. The proposed framework

distinguishes between strategies that focus on technology and market positioning and those that aim to use and develop organizational capabilities efficiently. The authors also note that these strategies can work together to shape bucket design.

3. Methodology

This study uses a qualitative case study approach to explore how strategic buckets are created and applied to manage innovation in project portfolios in the paper industry. The case study method is well-suited for studying complex, context-dependent issues and helps gather detailed qualitative data (Priya, 2021).

Data were collected through semi-structured interviews with the senior project manager, who provided the operational perspective, and the general director, who provided the strategic perspective. The interviews covered innovation management, project portfolio structure, and the design and use of strategic buckets. Each interview lasted 90 minutes. All interviews were recorded, transcribed, and supplemented with researcher notes.

Data were analyzed using an iterative thematic approach. The analysis was guided by the strategic bucket design framework proposed by Santiago and Soares (2020) and integrated with the practical recommendations of Gomes et al. (2023) and the theoretical foundations of Stošić and Milutinović (2017). We also reviewed public sources, such as annual reports and websites, and internal documents like portfolio tables, budgets, and project plans to provide context. To strengthen credibility, we discussed our initial interpretations with key people in the organization and adjusted them based on their feedback.

4. Case Study

1. Company and operational context

Company A is a multinational paper manufacturer operating in more than 40 countries and managing over 660 facilities. The company reports annual net sales exceeding 32 billion USD and employs approximately 100,000 people worldwide. Its 63 mills collectively produce over 24 million tons of paper each year. In support of sustainability, Company A utilizes approximately 15 million tons of recycled fiber annually.

The focus of this study is on Company A Serbia, representing the company's local operations within this European structure. Company A Serbia operates within a closed-loop circular economy model. The core raw material is recovered paper, which is processed into new packaging paper. This paper then serves as the input for converting companies that manufacture cardboard packaging placed on the market. Once used, the packaging is collected again as recovered paper, thereby closing the production–consumption–recycling cycle.

A distinctive feature of this industry is its continuous production model. The mill operates 24 hours a day, 7 days a week, organized in three shifts. Production halts only during planned maintenance activities. Out of 365 days in a year, at least 330 must be effectively operational, as any significant reduction has a considerable impact on financial performance.

2. Innovations in paper industry

Paper is considered one of the most important inventions in the world that shaped society for centuries (Furszyfer Del Rio et al., 2022). Paper industry is one of the world's most economically significant sectors. It ranks as the fourth largest industrial energy user (Furszyfer Del Rio et al., 2022; Julkapli & Bagheri, 2016). The industry is also the largest consumer of virgin wood, which has a considerable impact on human health. The industry is currently

changing because of digitalization and growing sustainability demands (Vivas et al., 2024). Considering these environmental and economic pressures, innovation is essential for maintaining sustainability and staying competitive (De la Vega Hernández & Barcellos de Paula, 2021).

In the paper industry, innovation typically involves redesigning and adapting existing systems to enhance performance over time, rather than developing entirely new technologies. Due to high costs, companies often implement innovations only after testing them in real-world settings. Frequently, innovation consists of applying or integrating methods already proven in other factories.

Innovation in the paper industry is found more in the production process than in the final product. Although paper itself is fairly standardized, real progress comes from how machines are designed, adapted, and combined to boost efficiency, quality, and sustainability. Each paper machine is unique, so experts must use creative problem-solving to fit equipment to each facility's needs. For instance, new rolls, motors, cooling systems, and pneumatic lubrication all need to be carefully planned and installed so the press section works as intended and the paper meets the right standards. This ongoing process calls for constant innovation in both engineering and daily operations.

From 2019 to the end of 2024, 141 innovative projects were approved. Figure 1 presents the annual distribution of investment in these projects and shows the percentage of the total portfolio budget allocated to innovative projects over time.

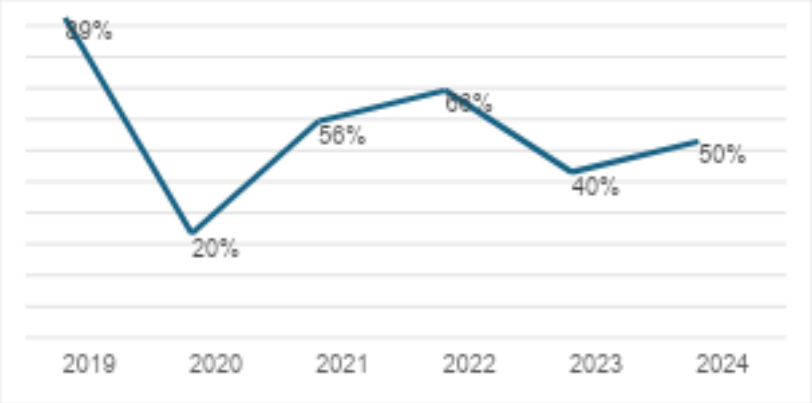

Figure 1. Share of the total portfolio budget allocated to innovative projects (2019–2024)

Figure 1 shows that a large share of the total portfolio budget is allocated to innovative projects throughout the observed period. A pronounced decline is observed in 2020, which can be associated with the ongoing COVID-19 pandemic and its impact on organizational investment priorities. In the years following 2020, the share of investments in innovative projects shows a noticeable recovery and growth. In addition, according to the company's director, further increases are expected in 2026 and beyond, with an even stronger strategic emphasis on innovation-oriented initiatives.

3. Strategic bucket design in the case company

Framework for strategic bucket design proposed by Santiago and Soares (2020) is employed in this study as an analytical lens for interpreting the interview data. Rather than being applied directly, the framework is used as a guiding structure for identifying relevant dimensions and

factors shaping strategic bucket design. The analytical process is additionally informed by the practical recommendations proposed by Gomes et al. (2023) and by the theoretical foundations provided by Stošić and Milutinović (2017). The framework is adapted to reflect industry-specific constraints and decision-making logics, resulting in a tailored framework for strategic bucket design in process industry. The adapted framework is presented in Table 1.

Table 1. Strategic bucket design framework for the paper industry, adapted from Santiago and Soares (2020)

Dimension	**Conceptual factors to assist strategic buckets design**
Technology	Innovation level
	Technology complexity
Market	Market Niche
Capabilities	Core competences
	Dynamic capabilities
Organization process	Value chain
	Functions/operations
	Process
External environment	Regulatory environment
	Environmental protection

1. **Technology**

Within Company A, strategic buckets at the **innovation level** are structured around two main categories: incremental and semi-radical innovation.

Incremental innovation mainly takes the form of continuous improvement initiatives in daily operations. To support this, the company has a structured system, for production employee proposals, categorized into safety, continuous improvement, and human resources. Workers are encouraged to submit suggestions and near-miss observations throughout the year. The most innovative idea is rewarded monthly as an incentive. Grassroots innovation within production complements the formal project portfolio.

Semi-radical innovation refers to strategic projects with larger budgets and long-term impact. These initiatives strengthen the company's competitive position and support strategic differentiation in the market. In this case, semi-radical innovation projects primarily involve major upgrades to the paper machine, leading to substantial improvements in production capabilities and product characteristics. Large-scale process innovations aimed at achieving energy independence also fall under this category, especially given recent energy market disruptions.

Regarding **technology complexity**, Company A classifies projects as either basic or strategic. Strategic projects are very complex and usually start with decisions from the top leaders. The board sets the main goals and important steps, while the local team handles the detailed planning and carrying out the work. The local team can also suggest new strategic projects if they see a need. Strategic projects always cost more than one million euros and are part of the company's five-year plans. These projects have a much more complicated management setup. For each one, three special groups are created: a Steering Committee, a Project Team, and a Quality Assurance Team. All the people needed for the project are chosen just for that project, and they

are expected to spend all their working time on it until it is finished. Also, the tasks and responsibilities for each person are clearly set at the beginning. By setting up the structure and roles first, the company reduces the risk of misusing resources and lays a strong foundation for delivering the project well. The biggest investment and new project Company A Serbia has done so far is Project X, which is part of the company's five-year plan. Project X is expected to cost about €40–50 million and is a major effort to improve the paper machine and final product so the factory can handle all steps of production itself.

Basic projects encompass a range of activities essential for maintaining and enhancing core business operations. These projects are categorized by cost: up to €200,000, between €200,000 and €1 million, and above €1 million. Basic projects may involve significant technology upgrades, as well as minor process improvements and the implementation of simple digital tools.

2. **Market - Market Niche**

From a market perspective, the company's A Serbia strategy shows its dual focus on both internal and external markets. Right now, half of production goes to the corporate group, and the other half is sold outside. Project X aims to change this by fully integrating production into the group's supply chain, making internal projects a top priority in this market segment.

3. **Capabilities**

The company distinguishes between professional and soft skills within its **core capabilities**. Professional skills are typically technical and required for specific roles. In contrast, soft skills are increasingly recognized as essential for daily operations, fostering improved relationships among employees, facilitating knowledge transfer, and enhancing productivity.

In 2025, the company placed particular emphasis on internal training, with 15% of all training sessions conducted internally. The company aims to empower employees to train one another through Trainer to Trainer programs. While some employees possess significant technical knowledge but lack communication skills, these workshops are designed to develop soft skills in some participants and technical skills in others. The workshops emphasize the importance of a structured approach to knowledge sharing, which fosters innovation within the organization.
Within the **dynamic capabilities**, the company defines both mandatory and open training programs. Managers identify mandatory training programs through a needs assessment process conducted in collaboration with the Human Resources Learning and Development Specialist. This process typically takes place from August through the end of the year to plan for the following year. Managers specify the necessary competencies, and Human Resources develops the corresponding training programs.

Open training programs are offered to all employees through formal channels, allowing individuals to select sessions based on their interests and perceived relevance. The primary objective of these programs is to provide employees with the freedom to choose and pursue learning opportunities, as this supports the emergence of innovation and creativity. Examples of open training topics include mastering new technologies and tools such as Copilot, Canva, and AutoCAD.

The company allocates between 3% and 5% of its resources to employee skill development.

4. Organization process

Value chain

The paper industry comprises three segments within its value chain. The first segment is recycling, which involves the procurement and optimization of the recovered fiber supply chain. The second segment is the production of packaging paper, considered a semi-finished product. The third segment is the production of corrugated finished products, such as transport or commercial packaging. These segments are highly interrelated, and the outcomes of one segment significantly influence the others within the value chain.

Key innovative projects within the value chain are concentrated in the initial stages, including procurement, preparation, logistics, and treatment of recovered fiber. Company A has implemented some innovative and very high investment projects in this part of the chain. These initiatives include the installation of specialized photovoltaic panels on warehouse roofs to generate electricity for the presses, which require substantial energy. Additionally, Company A converted all forklifts and all motor vehicles into e-vehicles and installed solar panels to charge those vehicles. The goal is to reach CO2 neutrality. The potential project also includes the installation of a special rainwater collection system to prevent and eliminate water shortage problems.

Additionally, as the recovered fiber required manual sorting (and still does today in less developed countries), key innovation projects were aimed at full automation. To address the associated health and safety risks, such as exposure to hazardous materials and potential injuries, key innovation projects have focused on achieving full automation. Company A developed a specialized automated sorter that operates without human intervention. When mixed paper is placed on the conveyor belt, the machine uses infrared sensors and air channels to identify and separate materials: impurities, dirt, and plastic are removed, cardboard is separated and magazines are sorted. The resulting streams are directed to two separate processing areas. One area bales cardboard, while the other processes remaining paper types. This automation significantly reduces manual labor, enhances worker safety, and improves both efficiency and cost-effectiveness.

At the **functional level**, strategic buckets are structured according to organizational departments. Projects are classified based on core functions, including recovered fiber, sales, operations, finance, health and safety, maintenance, procurement, human resources, project management, ecology, quality, and continuous improvement.

Departments compile lists of proposed projects in the final quarter of the year for the following year. For each project, a preliminary budget is developed based on prior experience and initial supplier quotations. Once proposals are defined, they proceed to the initiation phase, which requires preparing a Motivation document. This standardized document includes project assumptions, a concise scope description, sketches and technical drawings, current and future-state diagrams, technical specifications, safety and occupational health approvals, objectives, timelines, risks, a detailed budget breakdown, and anticipated benefits and outcomes. Sector managers prepare the document with input from operational staff who possess direct knowledge of the relevant processes and equipment.

In the **process dimension**, strategic projects are grouped into three categories: mandatory projects, maintenance of competitiveness, and business development.

Mandatory projects include investments and equipment purchases needed to keep production running. These projects are essential and ensure basic operations continue. On average, they make up about 10% of the total project portfolio.

Maintenance of competitiveness projects reflect the company's efforts to remain viable under changing market conditions. From 2022, geopolitical and economic developments, along with a sharp increase in European energy prices, significantly reshaped the strategic agenda. Priorities shifted to energy efficiency improvements and process optimization, driven by volatile energy markets and stricter environmental regulations. The project portfolio became largely oriented toward maintenance of competitiveness initiatives, with innovation focused on process improvements for cost control and energy efficiency. In earlier years, maintenance of competitiveness was also driven by capacity growth. During 2020 and 2021, expanding production capacity and improving efficiency were seen as the primary strategic options across the group. This orientation was reinforced by increased demand for packaging materials during the COVID-19 pandemic and broader growth in online shopping and consumer goods consumption. In 2021, projects in this bucket accounted for 54.9% of the total portfolio budget, while in 2022 they represented 27.2%.

Business development projects became especially important after the company acquired the Serbian subsidiary in 2019. In 2019 and 2020, the main goal was to set up and stabilize operations, with 85.1% of the 2019 project portfolio budget going to business development.

5. External environment

In the **regulatory requirements** area, strategic priorities highlight the need to keep up with evolving laws and safety standards. While these projects focus on compliance, they often yield new ideas and changes to processes, equipment, and infrastructure. Examples include health and safety improvements, fire protection, emission reduction, and investments in utilities. On average, about 5% of the portfolio budget is allocated to regulatory compliance.

Environmental protection is a significant component of the investment portfolio. A large share of investment goes to water treatment and recycling, accounting for about 20% of the budget each year. In 2023, Company A Serbia opened a €5 million industrial biological wastewater treatment plant. The facility treats Danube water for industrial use and returns it to the river cleaner than before, underscoring the company's commitment to sustainability.

5. Discussion

This study investigates the establishment of strategic buckets for managing innovation project portfolios in capital-intensive process industries.

According to Santiago and Soares (2020) and Jansen et al. (2006), companies usually follow two main R&D strategies. The first is differentiation, which means creating products or services with key technologies or for specific markets. The second focuses on using and developing organizational resources and skills efficiently. This helps companies compete by managing costs, improving processes, or building new capabilities. The findings of this study indicate that Company A, which is in paper industry predominantly aligns with the second strategic orientation.

Given that the paper industry involves a highly complex production system with numerous elements and activities (Marković & Mihić, 2022), it is essential to categorize different projects

and needs. In this regard, strategic buckets proved to be an important tool for portfolio management and project selection (Coulon et al., 2009), especially considering their extensive and well-established use in heavy process industries (Killen, 2008). An adapted framework for strategic bucket design, based on the model proposed by Santiago and Soares (2020), was developed to address the specific characteristics of the paper industry.

The findings of this study largely support the core assumptions of the framework proposed by Santiago and Soares (2020). In line with this framework, the case analysis confirms that resource-focused, strategically oriented organizations place their primary emphasis on technology and processes. In the paper industry, innovation is mostly process-oriented and evolves gradually through continuous investment and incremental change (Grubb et al., 2021) and incremental change. Semi-radical innovations occur less frequently and are mainly associated with technological advancements, including improvements in production methods, energy independence, and adaptations of paper machines, particularly given that no two paper machines worldwide are identical. In such semi-radical innovations, business models typically remain unchanged or closely aligned with existing ones (Davila et al., 2006). Recent technological developments have significantly expanded the range of possible innovation projects and improvement initiatives. Some promising technologies are using nanotechnology to improve paper properties and membrane methods to recover valuable by-products like lignin from wastewater (Humpert et al., 2016; Julkapli & Bagheri, 2016; Worku et al., 2026).

This study confirms that both core and dynamic capabilities are important for encouraging innovation in project portfolios in the paper industry. Dynamic capabilities help organizations stay agile, innovate, and succeed, especially in constantly changing environments (Teece et al., 2016). Project portfolio managers can improve their processes by challenging current capabilities, spotting new trends, and encouraging new project ideas with strong sensing mechanisms (Bechtel et al., 2023). Tools such as roadmapping, foresight methods (Kock & Gemünden, 2019), and collaboration with external partners can support this process (Melo et al., 2021). Core agile values may guide the process without requiring a full transition to agile portfolio management, for example through regular PPM reviews and stakeholder feedback (Bechtel et al., 2023).

Overall, the findings confirm that the framework proposed by Santiago and Soares (2020) provides a useful basis for understanding strategic bucket design. However, its application in paper industry requires a different emphasis across dimensions. Following the practical recommendations of Gomes et al. (2023) and the theoretical foundations of Stošić and Milutinović (2017), this study introduced several adjustments.

First, the brand factor within the market dimension was excluded. In the observed case, the company does not operate with differentiated product brands, nor does it target retail markets or engage in customer segmentation in this sense, making this factor irrelevant for strategic bucket design. However (Hämäläinen et al., 2015) argue that even in paper industry, firms can still pursue differentiated pricing strategies and adopt a more customized market focus.

Similarly, the partnerships factor was excluded since collaborative partnerships aimed at joint product development or innovation projects are rare (Chesbrough & Crowther, 2006). Existing partnerships are mainly based on supplier–customer relationships, which influence supplier selection and project execution after projects have already been approved. However, as suggested by Davila et al. (2006), the primary unit of innovation is not the individual, but rather

the network that spans both internal functions and external actors, including customers, suppliers, partners, and other stakeholders. In this regard, collaboration with customers, suppliers, consultants, and other relevant actors plays a central role in enabling and sustaining innovative activity (Davila et al., 2006).

Finally, an additional factor, environmental protection, was introduced within the external environment dimension in accordance with (Chesbrough & Crowther, 2006). Not all companies focus equally on environmental responsibility, but heavy process industries like paper manufacturing have a significant impact on the environment (Abushammala et al., 2023) and now face growing pressure to address sustainability. When environmental protection is made a clear priority, it becomes part of the decision-making process for choosing projects.

6. Conclusions

This study contributes to the literature on the design of strategic buckets for managing innovation project portfolios. Given the unique characteristics of capital-intensive process industries and the limited research on innovation management in these sectors, a case study from the paper industry is employed. The research identifies five primary dimensions and ten industry-specific factors that influence strategic bucket design in this context.

The dimensions identified in this study cover technology, market, capability, organizational process, and external environment as key influences on innovation decisions. The related factors highlight the main decision-making patterns found in practice. The results show that, in this context, process stability, resource efficiency, and environmental protection have a greater impact on strategic bucket design than market differentiation.

The way a company organizes and manages its project portfolio affects the kinds of innovations it produces and its chances for growth and staying competitive. That is why it is important to have a clear approach to building a project portfolio. Using proven tools like strategic buckets and creating frameworks that fit the organization’s needs can help. This study offers practical insights based on real-world evidence.

This study contributes to existing knowledge by examining how strategic buckets can be tailored to meet the needs of different industries. It adapts an established framework from literature to the context of a capital-intensive process industry, which helps improve understanding of innovation and project portfolio management in these settings. The findings indicate that strategic buckets are influenced by the distinctive decision-making approaches of each industry, rather than by universal innovation principles. When it comes to main managerial implications, the findings indicate that in capital-intensive process industries, strategic buckets should align with specific operational requirements, rather than relying on generic portfolio categories. Strategic buckets also support budgeting and foster innovation.

Several limitations should be acknowledged in this study. First, the research is based on a single case study from the paper industry, which may limit the generalizability of the findings. Second, the model reflects Company A Serbia's current practices and priorities, which are subject to change and may require future updates. Third, the study primarily relies on qualitative data from interviews and document analysis, which may introduce bias. Future research should examine strategic bucket design in additional companies within the paper industry or in other capital-intensive sectors such as chemicals, steel, or cement. Comparing across industries could help illustrate how unique sector features affect strategic bucket configurations. Long-term

studies could also show how strategic buckets change as markets, regulations, and technology shift. Using both qualitative and quantitative methods in future research may help explain how strategic bucket design relates to innovation and portfolio performance,

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this manuscript, the authors used Grammarly to improve the overall quality and clarity of the English language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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