



Embedding Sustainability in Project Portfolios: Drivers, Barriers, and Learning Mechanisms in the Extractive Sector

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Executive Summary

Sustainability is no longer optional for extractive firms (mining, oil, and gas); it is central to competitiveness, social license, and long-term value. This white paper shows how companies can embed sustainability into project portfolio management (PPM), moving beyond compliance to make it a driver of efficiency, innovation, and stakeholder trust.

Drawing on 24 in-depth interviews with senior practitioners across strategy, portfolio, and project delivery levels in major extractive firms, the study pursues two objectives. First, it identifies the main barriers and drivers that shape the integration of sustainability into PPM. Second, it examines how organizational learning mechanisms (search, knowledge creation, knowledge retention, and knowledge transfer) enable or constrain the uptake and institutionalization of sustainability across portfolios.

The findings reveal multiple drivers and barriers at different organizational levels:

Key drivers:

- Visible executive commitment and environmental, social, and governance (ESG)¹ scorecards embedded in portfolio gates.
- Investor, regulator, and community expectations that shape portfolio choices.
- Adoption of global sustainability frameworks (e.g., United Nations' Sustainable Development Goals (SDGs) and ESG disclosure requirements).
- Collaborative knowledge-sharing cultures supported by cross-project forums and peer reviews.
- Use of sustainability dashboards, standardized key performance indicators (KPIs), and checklists integrated into stage-gate reviews.

Key barriers:

- Short-term financial logics and capital discipline crowd out long-term sustainability value.
- Regulatory ambiguity and shifting mandates create uncertainty and encourage risk aversion.

¹ESG is a framework used to assess a company's performance on sustainability and ethical issues.

- Cultural resistance and change fatigue are particularly prevalent in engineering-dominated environments.
- Fragmented knowledge systems and weak retention/transfer mechanisms limit learning.
- Underdeveloped sustainability competencies, as recruitment and training continue to prioritize technical and economic expertise over social and environmental capabilities.
- Conflicting priorities, resource constraints, and operational complexity reduce the ability to embed sustainability criteria consistently.

The research also highlights that how organizations learn (or fail to learn) matters as much as strategy. Using Argote et al.'s (2021) organizational learning lens, the study shows that sustainability lessons are often lost because search is ad hoc, knowledge creation is fragmented, retention is weak, and transfer depends on word of mouth rather than structured systems.

Overall, sustainability is not a one-off initiative but a cycle of experimentation, learning, and alignment across all organizational levels. To institutionalize it, firms need practical interventions that reinforce both governance and learning.

Five recommendations for action emerged from the study:

1. Embed sustainability criteria in every portfolio decision gate with formal checkpoints.
2. Strengthen knowledge governance with digital sustainability taxonomies.
3. Appoint portfolio-level sustainability knowledge custodians.
4. Use dashboards and digital nudges for just-in-time learning.
5. Recalibrate incentives to reward long-term sustainability value.

This research provides evidence-based guidance for extractive firms to move sustainability from the margins into the core of portfolio governance and project execution. By doing so, companies can reduce risk, improve efficiency, and strengthen legitimacy in a sector under growing scrutiny.

Background and Problem Statement

Project portfolio management (PPM) is central to achieving corporate sustainability goals, as it provides the framework for evaluating, prioritizing, and adjusting projects in line with strategic priorities (Aghajani et al., 2023b; Silvius & Marnewick, 2022). However, embedding sustainability in PPM is difficult.

Environmental and social objectives extend beyond the life of individual projects, involve diverse stakeholders, and require coordination across multiple organizational processes and time horizons (Marcelino-Sádaba et al., 2015; Schipper & Silvius, 2018). Addressing these complexities requires identifying the barriers and drivers that influence portfolio choices and understanding how organizational learning can support the integration of sustainability across the portfolio system (Dyllick & Hockerts, 2002; Karman et al., 2024).

These challenges are especially acute in the extractive industries. Mining, oil, and gas firms contribute about a quarter of global gross domestic product (GDP) (Baba & Brunet, 2024; United Nations, 2021; Zheng et al., 2023), but face strong criticism for high greenhouse gas emissions, environmental degradation, and recurring social conflicts (Katz, 2020; Martins-Oliveira et al., 2021). Their operations are complex, shaped by logistics networks; strict health, safety, and environmental (HSE) regulations; and scrutiny from communities, regulators, and investors (Fraser, 2021; Kunz et al., 2017). Balancing economic, ecological, and social objectives under these conditions poses a significant governance challenge (Bond, 2018).

Firms that fail to secure a social license for their projects often face delays and community opposition (Deonandan et al., 2024). Such risks weaken corporate credibility and demonstrate why portfolio governance must move beyond short-term financial returns to include long-term environmental and social considerations (Lima et al., 2021). While the *PMI Standard for Portfolio Management* recognizes sustainability as a principle (Project Management Institute [PMI], 2017), it offers little guidance on how to embed it into portfolio governance. Recent tools such as multicriteria green project screening and portfolio carbon accounting help integrate environmental metrics (Malik et al., 2023; Swinkels & Markwat, 2023), but they do not fully address how social and ecological factors can be integrated into everyday portfolio processes (Aghajani et al., 2023b; Schipper & Silvius, 2018).

Beyond these methods, translating sustainability ambitions into portfolio-level governance remains a major challenge. Many organizations lack clear sustainability targets at the portfolio level and, even when these targets exist, they are difficult to operationalize through consistent governance mechanisms and routine practices (Muhirwa et al., 2023; Winch et al., 2023).

At the *project level*, studies have identified numerous barriers and drivers that directly affect how sustainability ambitions are implemented on the ground. Drivers include leadership commitment, clear sustainability objectives, cross-functional collaboration, and training programs that build sustainability capacity among project managers. Incentives and recognition for strong sustainability performance also motivate project teams to prioritize long-term environmental and social outcomes (Banihashemi et al., 2017). At the same time, several barriers persist: limited financial and human resources, a lack of sustainability expertise, competing priorities that privilege short-term financial returns, and cultural resistance to new practices (Fathalizadeh et al., 2021; Martens & Carvalho, 2017). Project managers also struggle with measurement and reporting challenges, such as inconsistent data and the absence of standardized metrics for sustainability performance (Eskerod & Huemann, 2024; Martens & Carvalho, 2017). However, it remains unclear whether these factors primarily influence individual projects in isolation or extend more broadly to shape project portfolio governance.

Prior research has also examined sustainability integration at the *strategic level*, where leadership commitment, evolving regulations, and stakeholder engagement are recognized as enablers. At the same time, cultural norms and resource constraints act as barriers (Engert et al., 2016). In contrast, the *portfolio level*, which serves as the bridge between strategy and projects, remains underexplored. Critical questions persist about how board-level sustainability commitments and external pressures shape portfolio selection criteria and governance processes, and how project outcomes feed back into corporate strategy (Bechtel et al., 2025). While leadership, regulatory mandates, and stakeholder pressure are acknowledged drivers, they rarely explain how these forces influence the daily governance of project portfolios. Empirical studies show that portfolio-level stage-gate processes can include sustainability checkpoints (Aghajani et al., 2023b). However, few studies investigate how lessons learned at the project level inform portfolio choices or

strategic decision-making. Together, this highlights a persistent research gap: *While sustainability has been studied extensively at strategic and project levels, its integration at the portfolio level is not yet fully understood.*

Research Objectives

The purpose of this study is to determine how sustainability can be systematically embedded into PPM in extractive industries by: (i) identifying the key barriers and drivers that shape portfolio governance and decision-making, and (ii) examining how organizational learning mechanisms (search, knowledge creation, knowledge retention, and knowledge transfer) enable or constrain the uptake and institutionalization of sustainability across projects and portfolios.

Research questions:

1. What barriers and drivers do extractive companies face in integrating sustainability into their project portfolio management systems?
2. How do organizational learning mechanisms enable or constrain sustainability integration in PPM?

To guide the reader, Figure 1 presents a research roadmap that connects the background problem and research questions with the methodology, findings, and implications. The roadmap illustrates how the study conceptualizes sustainability integration as a multilevel organizational transformation, linking strategic intent, portfolio governance, and project execution.

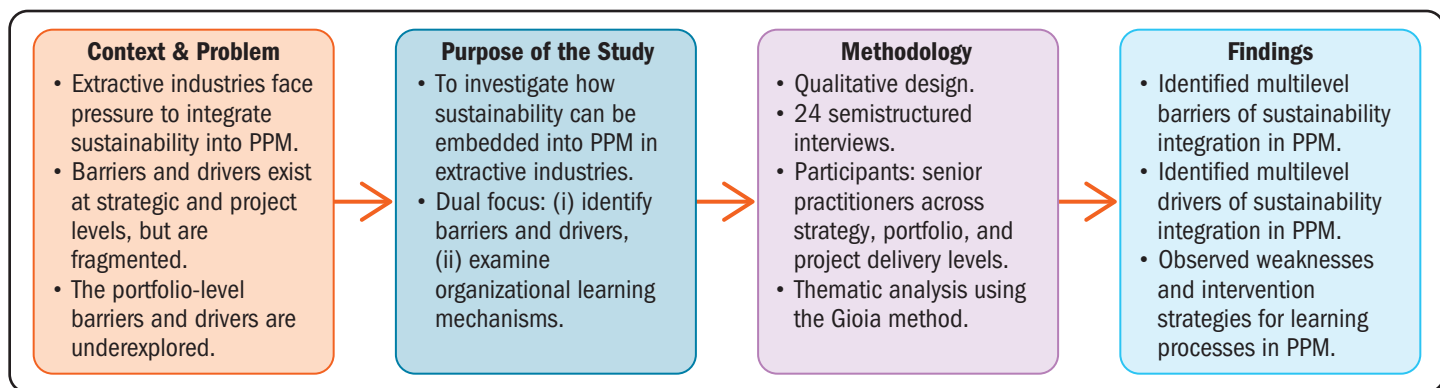


Figure 1. Research roadmap.

Research Methodology

This study adopts a qualitative research design to examine how sustainability is integrated into PPM within extractive organizations. A qualitative approach is well suited to capture the complexity and contextual dynamics of sustainability-related decisions across organizational levels (Creswell & Creswell, 2017). Ethical approval was granted by Edith Cowan University’s Human Research Ethics Committee, and all procedures complied with the *Australian National Statement on Ethical Conduct in Human Research 2023*.

Given their significant environmental and social impacts, mining, oil, and gas companies were selected as the focus, providing a critical context for studying sustainability integration. Semistructured interviews were conducted with professionals working at strategic, portfolio, and project delivery levels to capture how sustainability is interpreted, applied, and shared across the portfolio life cycle.

Data Collection

A purposive, stratified sampling strategy was employed to capture variation across organizational levels and functions, focusing on upstream extraction operations within Australian extractive companies. This provided a consistent regulatory context while still allowing variation in governance practices and project types. We conducted 24 semistructured interviews with sustainability managers, engineers, portfolio leads, and capital project specialists from leading extractive firms. Interviews ranged from 45 to 95 minutes

Table 1. Overview of Interview Participants by Role, Experience, and Organizational Level

Participant ID	Position	Experience (years)	Organizational Unit	Level
P_p1	Specialist technical support	20	Mining, sustaining capital projects	Project
$P_{pf}2$	Superintendent program delivery	24	Mining, sustaining capital portfolio	PPM
$P_{pf}3$	Senior engineer projects	16	Mining, sustaining capital portfolio	PPM
$P_{pf}4$	Superintendent project control	20	Mining, sustaining capital portfolio	PPM
P_s5	Principal project studies	24	Mining, capital investments	Strategic
P_s6	Sustainability manager	20	Oil & gas, sustainability office	Strategic
P_p7	Senior specialist	12	Mining, capital project	Project
P_p8	Project manager	8	Mining, capital project	Project
$P_{pf}9$	Portfolio manager	25	Mining, oil & gas, delivery energy, and decarbonization portfolio	PPM
P_s10	Operations Manager	20	Mining, operations management	Strategic
P_p11	Project director	30	Mining, oil & gas, infrastructure project	Projects
$P_{pf}12$	Project controls manager	20	Mining, oil & gas, infrastructure projects	PPM
P_s13	Sustainability manager	12	Mining, oil & gas, environment, and sustainability	Strategic
P_p14	Superintendent capital and projects	18	Mining, capital projects	Project
$P_{pf}15$	Senior Superintendent program delivery	22	Mining, iron ore portfolio	PPM
P_s16	Principal sustainability advisor	15	Mining, sustainability, and projects	Strategic
$P_{pf}17$	Project delivery manager	14	Mining, capital investment portfolio	PPM
$P_{pf}18$	Portfolio planning and controls	17	Mining, oil & gas, capital studies, and projects	PPM
$P_{pf}19$	Portfolio lead	10	Mining, sustaining capital portfolio	PPM
P_p20	Project manager	12	Mining, capital project	Project
P_s21	Sustainability strategy lead	11	Oil & gas, subsea energy	Strategic
P_s22	Senior sustainability adviser	12	Oil & gas, strategic sustainability planning	Strategic
P_p23	Project lead	18	Oil & gas, capital project	Project
$P_{pf}24$	Superintendent project controls	21	Oil & gas, sustaining capital portfolio	PPM

Note: The prefixes in the Participant ID denote organizational level: P_p = project-level practitioner; P_{pf} = program or portfolio-level practitioner; P_s = strategic-level practitioner.

(average: 67 minutes) and followed a protocol designed to trace sustainability considerations from capital allocation to project execution. All interviews were recorded and transcribed verbatim. To ensure accuracy, transcripts were returned to participants for verification only when factual inconsistencies or ambiguities were identified. Participant roles, experience, and organizational levels are summarized in Table 1.

Data Analysis

All transcripts were coded in NVivo (Version 12) qualitative data analysis software, which supported systematic data organization, query functions, and cross-case comparisons. The software also facilitated the creation of visual data structures and ensured full traceability between raw data and emergent categories.

Data were analyzed using a structured, multistage coding process informed by the approach outlined by Gioia et al. (2013).

In the first stage, *open coding* was applied to generate first-order concepts grounded in participants' language. This allowed for a detailed capture of practices, decision logics, and sustainability-related challenges within portfolio contexts (Saldaña, 2021). The first two authors coded the data independently and then compared classifications to ensure consistency. Iterative discussions refined the coding schema and clarified emerging themes. The third author audited the process by spot-checking codes, themes, and the search strategy, while the fourth author acted as a devil's advocate, challenging assumptions and guarding against groupthink (Creswell & Creswell, 2017). All authors contributed to developing the analytical framework and refining the thematic structure for theoretical coherence.

In the second stage, *axial coding* was used to group conceptually related first-order codes into second-order themes (Saldaña, 2021). Coding was initially conducted independently by two researchers and then compared through iterative discussions to ensure coherence and reliability. Discrepancies were resolved in adjudication meetings, which refined thematic boundaries and strengthened analytic consistency.

In the final stage, themes were mapped onto two analytical structures aligned with the research questions. For Research Question 1 (RQ1), second-order themes were categorized across three organizational levels—strategic, project portfolio, and project delivery—to identify key barriers and drivers of sustainability integration. The same dataset was reanalyzed using an organizational learning lens (Argote, 2013; Argote et al., 2021), with themes coded against four mechanisms: search, knowledge creation, knowledge retention, and knowledge transfer.

This dual-mapping approach enabled a cross-level, process-oriented analysis of how sustainability becomes embedded (or blocked) within PPM. The resulting midrange framework captures the dynamic interplay between governance mechanisms and organizational learning in shaping sustainable PPM outcomes.

Key Findings and Discussion

Before analyzing barriers, drivers, and learning mechanisms, it is important to clarify how sustainability is understood in this study. For the participants, sustainability was not a narrow environmental concept but a *multidimensional construct* that combined environmental, social, governance, and economic considerations. Across the interviews, practitioners consistently emphasized four dimensions:

- *Environmental stewardship*, i.e., reducing emissions, minimizing waste, protecting biodiversity, and embedding resource efficiency into projects and portfolios. Participants highlighted practical initiatives, such as recycling construction materials, energy efficiency, and decarbonization targets.
- *Social license and community responsibility*, i.e., earning legitimacy through Indigenous procurement, community consultation, and workforce development. Sustainability was described as inseparable from building trust with local communities and avoiding costly opposition and delays.
- *Governance and compliance*, i.e., aligning with external sustainability frameworks (e.g., SDGs, International Organization for Standardization [ISO] quality certifications) and embedding these into portfolio decision gates, KPIs, and corporate audits.
- *Organizational endurance and efficiency*, i.e., ensuring that systems, processes, and portfolios contribute to long-term viability by reducing costs, creating consistency, and increasing resilience.

This practitioner's view is consistent with recent research. Aghajani et al. (2023b) demonstrate that sustainability in PPM is best understood as a multilevel, multidimensional construct, balancing environmental, social, and economic dimensions, while governance mechanisms institutionalize these principles. Both the literature and our interviews highlight sustainability as an embedded portfolio logic, linked to legitimacy, efficiency, and long-term value creation, rather than as a peripheral add-on. This shared understanding provides the foundation for interpreting the barriers, drivers, and organizational learning mechanisms that follow.

Barriers and Drivers of Sustainability Integration in PPM

To answer RQ1, we analyzed interview data to identify organizational factors that either hindered or facilitated the integration of sustainability into PPM practices. These factors were coded inductively and grouped by organizational levels (strategic, project portfolio, and project delivery) to reflect the structural layering of decision-making in the participating firms. Table 2 presents a summary of these multilevel barriers and drivers.

Strategic-Level Barriers

Economic pressures and constraints emerged as a dominant strategic barrier to sustainability integration in PPM. Participants emphasized the prioritization of capital efficiency, rapid returns, and net present value (NPV) metrics in portfolio decisions, which discouraged the selection of sustainability-oriented projects ($P_{pf}4$, P_s6). Projects delivering long-term environmental or social benefits were often viewed as too risky, particularly when they offered no immediate financial payoff: *“If it [sustainability benefit] significantly impacts the economics of a project, then it will be parked”* (P_s13).

Intense demands for rapid financial returns and the entrenched “Iron Triangle” of cost, time, and scope steer portfolios toward projects with near-term profits, sidelining environmental and social value (Bechtel et al., 2025). In mining, oil, and gas, feasibility screenings favor cost efficiency, making sustainability initiatives appear uncompetitive for scarce capital (Baba et al., 2021; Cui et al., 2016). The perception that sustainability “costs but does not pay” discourages investment and entrenches a profit-first mindset. However, the interview

data suggests this view is not uniform. Managers with limited exposure to sustainability tended to frame it as a financial burden, whereas those with a broader understanding were able to connect sustainability to efficiency, risk reduction, or legitimacy benefits. For example, one participant ($P_{pf}12$) highlighted that Indigenous procurement requirements strengthened project bids, while others pointed to emissions-reduction and efficiency measures that lowered costs over the project life ($P_{pf}12$, $P_{pf}15$). These managers effectively built business cases that justified sustainability investments, showing that knowledge depth influences whether sustainability is perceived solely as cost or as a source of long-term value.

Historical emphasis on economic growth reinforces this skew. For example, the World Bank’s Extractive Industries Review criticized excessive focus on private-sector expansion at the expense of ecosystems and communities (Extractive Industries Review, 2003). These constraints foster defensive attitudes; managers view sustainability proposals as a threat to profitability and demand exceptional justification. As a result, governance systems reward short-term gains and marginalize projects whose benefits accrue over longer horizons (Smulowitz et al., 2023; Xu & Liu, 2023). Until evaluation criteria fully capture long-run social and environmental returns, economic pressures will continue to crowd out sustainability goals.

Regulatory ambiguity further compounded this challenge. Several interviewees described policy environments marked by inconsistent requirements or weak enforcement, which created uncertainty and led to risk-averse decision-making (P_p7 , $P_{pf}9$). In the absence of stable mandates, firms hesitated to invest

Table 2. Multilevel Overview of Barriers and Drivers Influencing Sustainability Integration in PPM

Organizational Level	Identified Barriers	Identified Drivers
Strategic	<ul style="list-style-type: none"> Economic pressures and constraints Regulatory ambiguity Cultural resistance and change fatigue 	<ul style="list-style-type: none"> Leadership and strategic vision Stakeholder expectations and societal demands Global sustainability frameworks
Project Portfolio	<ul style="list-style-type: none"> Inefficient knowledge management Conflicting priorities and resource constraints Operational challenges 	<ul style="list-style-type: none"> Collaborative knowledge sharing Data-driven decision-making Innovation, efficiency, and social impact
Project Delivery	<ul style="list-style-type: none"> Cost and logistical challenges Training and awareness gap Resistance to change 	<ul style="list-style-type: none"> Localized solutions and practical adaptation Workforce training and engagement Technology-driven advancements

proactively in sustainability, fearing that their efforts might be rendered obsolete or irrelevant by shifting regulatory expectations ($P_{pr}18$, P_s21 , $P_{pr}24$).

Unclear, inconsistent, or weak environmental and social rules create uncertainty that blocks sustainability across project portfolios. When governmental oversight is vague or poorly enforced, firms receive mixed signals about how much to invest, so they often keep commitments low. Scholars describe “insufficient regulation, policy, or market demand” as a strategic barrier to the uptake of sustainability practices in projects (Sabini et al., 2019; Takacs et al., 2022). Without mandates requiring measurable sustainability objectives or incentives rewarding them, managers apply criteria sporadically, if at all. The risk of investing now only to face shifting rules later, or the temptation to exploit weak regulatory environments where oversight is minimal to reduce costs, further discourages action. Extractive operations highlight the challenge: they span multiple jurisdictions with varying standards, and regulatory gaps or conflicts can stall initiatives. Research on industry governance shows that strong public policy is a prerequisite for sustainable outcomes, but these conditions are often missing (Wiewiora et al., 2019). In some settings, governments themselves undermine progress by rushing approvals, chasing quick economic gains, or allowing corruption to erode enforcement. This uncertainty pushes project teams toward minimum compliance and delays sustainability decisions (Deonandan et al., 2024; Vijge et al., 2019).

Cultural resistance and change fatigue also undermined integration. Organizational cultures grounded in engineering efficiency and technical delivery were skeptical of sustainability interventions, which were perceived as transient “flavors of the month” rather than enduring strategic imperatives ($P_{pr}3$, P_s10 , P_p20). Even when sustainability received senior-level endorsement, middle managers frequently reverted to traditional, profit-focused metrics and routines (P_s16 , P_p23). In contexts where previous change initiatives had failed to produce lasting results, employees expressed skepticism and disengagement, often treating new efforts as superficial or performative ($P_{pr}3$, $P_{pr}24$).

Entrenched norms and exhaustion from frequent transformation efforts hamper the integration of sustainability in project portfolios. In many extractive firms, staff and managers perceive sustainability as an expensive, unnecessary diversion from core objectives, revealing a cultural resistance rooted in limited awareness of its value (Engert et al., 2016;

Hengst et al., 2020). Repeated initiatives also create change fatigue; employees who have endured numerous top-down campaigns become skeptical when earlier programs fade or appear superficial. Studies from Brazil and China show that the shift to sustainable project management can overwhelm organizational capacity, leaving personnel unprepared for new routines (Martens & Carvalho, 2016; Tao et al., 2024). Safety and productivity have long dominated extractive industry culture, so requirements such as community consultation or extended environmental review feel like burdensome extras. Without genuine engagement, targeted education, and structured support, sustainability frameworks achieve only surface compliance (Troje, 2023). Lasting integration demands consistent leadership involvement, clear explanations of relevance, and resources that help teams adopt new practices (He et al., 2022). Otherwise, inertia and fatigue will continue to block strategic sustainability goals, exposing portfolios to recurring resistance and stalled progress.

Strategic-Level Drivers

Conversely, *leadership and strategic vision* played a critical enabling role. Firms where executive leaders visibly endorsed sustainability, through formal scorecards, policy charters, or dedicated sustainability roles/office, reported stronger alignment across project portfolios ($P_{pr}2$, P_s5). In these contexts, sustainability was not viewed as an external compliance burden but as a source of legitimacy and strategic direction. This top-level commitment translated into clearer expectations, dedicated resources, and greater consistency across governance layers, creating organizational conditions more favorable to sustainability integration (P_s5 , $P_{pr}19$, P_s21).

These empirical observations align with prior work emphasizing the importance of leadership in embedding sustainability within strategic frameworks. Kantabutra and Ketprapakorn (2020) argue that senior leaders must articulate a clear sustainability vision, integrate it into governance processes, and align culture and incentives with long-term environmental and social goals. Similarly, Söderholm and Svahn (2015) contend that sustainability must be embedded within portfolio governance to ensure coherence between strategy and execution. However, both contributions highlight that vision alone is insufficient. Without accountability mechanisms and adequate resource support, cultural inertia and short-termism can undermine implementation. Leadership, then, is most

effective when it goes beyond rhetoric to actively support operationalization through sustained reinforcement, monitoring, and adaptation.

Stakeholder expectations and societal demands were also powerful strategic drivers of sustainability integration. Several participants noted growing pressure from local communities, Indigenous stakeholders, institutional investors, and global supply chain partners to embed sustainability into project and portfolio governance (P_s6 , P_p11 , P_s22). One participant remarked, “We’re working more closely with traditional owners, particularly on land management and caring for Country” P_s6 , highlighting rising expectations from Indigenous communities. These expectations often served as catalysts for internal reforms, prompting firms to reconsider how they defined project success and how portfolios aligned with social and environmental values (P_s16 , P_p20).

Although external in origin, these pressures increasingly operate at the level of strategic management, reshaping the conditions under which project portfolios are governed. Companies in extractive industries face mounting scrutiny from ESG-oriented investors, regulators, nongovernmental organizations (NGOs), and civil society, prompting senior leadership to reposition sustainability as a core strategic concern rather than a project-level add-on (Baumgartner & Rauter, 2017; Bechtel et al., 2025). In this context, stakeholder demands inform high-level strategy, which then cascades down into portfolio-level decisions. Organizations respond by embedding sustainability metrics into investment appraisal gates, redefining success criteria, and aligning portfolios with frameworks such as the SDGs (Horan, 2022; Silvius & Marnewick, 2022). These external forces thus act as strategic levers, reshaping not only corporate priorities but also how project portfolios are structured, funded, and evaluated.

Finally, *global sustainability frameworks* such as the SDGs and the International Council on Mining and Metals (ICMM) (2025) performance expectations guide responsible mining by helping firms justify initiatives that supply the metals needed for the net-zero transition while protecting communities, ecosystems, and long-term value (P_p1 , $P_{pf}19$). Several participants noted that such frameworks offered a shared language for internal alignment and allowed project decisions to be framed in relation to broader societal expectations (P_p1 , P_p8). By referencing internationally recognized standards, organizations were able to signal legitimacy to stakeholders and create internal momentum for

change, particularly when such standards were explicitly cited in strategy documents or reporting structures (P_p1 , P_p14 , $P_{pf}18$).

These frameworks, ranging from the SDGs to ISO 14001 and sector-specific protocols, establish shared benchmarks for environmental, social, and governance performance, thereby exerting strategic pressure on firms to integrate sustainability within their portfolio decisions (Sabini et al., 2019). Prior studies note that firms increasingly disclose their contributions to such frameworks through sustainability reporting and corporate accountability mechanisms, using them both to signal legitimacy and to align portfolio justifications with external expectations (Pranugrahaning et al., 2021). However, researchers caution that organizations often target those indicators that are easiest to measure, such as efficiency gains, recycling programs, or waste reduction, while avoiding more complex and transformative goals like biodiversity protection, Indigenous participation, or long-term decarbonization (Meuer et al., 2020). The extractive sector illustrates both the promise and the challenge of such standards: financiers like the International Finance Corporation (IFC) condition funding on compliance with environmental and social safeguards, while initiatives like the Extractive Industries Transparency Initiative (EITI) impose additional layers of accountability (de Almeida Vittori Ferreira et al., 2024; Lujala, 2018). However, tension persists between global criteria and local implementation realities, which can dilute the transformative potential of these standards in practice.

Portfolio-Level Barriers

At the project portfolio level, *inefficient knowledge management* emerged as a recurring barrier to sustainability integration. Participants noted that lessons learned systems were generally weak, with insights rarely transferred beyond individual projects or functional boundaries (P_p7 , $P_{pf}12$, $P_{pf}17$). This limitation was not confined to sustainability knowledge; however, it was particularly acute in this domain. Sustainability-related knowledge, such as effective approaches to Indigenous procurement, community engagement, or resource-efficient technologies, was often undocumented, excluded from existing templates, or stored in inaccessible formats, making it difficult to circulate across the portfolio (P_s13 , P_p14). A few participants offered insights into why these gaps persist, noting that those tasked with documenting lessons were typically project controls or engineering staff who lacked the depth of sustainability knowledge needed to recognize or codify relevant practices.

One participant ($P_{pf}17$) also highlighted that a tight labor market constrained the availability of sustainability professionals, suggesting that scarcity of specialized expertise may further limit firms' capacity to embed knowledge across portfolios. As a result, promising innovations, such as material recycling, emissions-reduction pilots, or community engagement models, often remained isolated within teams, restricting replication, organizational learning, and institutionalization of sustainable practices.

This pattern reflects persistent challenges in project-based organizations, particularly in the extractive sector. Managers often rely on personal experience and resist knowledge sharing, reinforcing silos that impede diffusion (Pemsel & Wiewiora, 2013). Tacit knowledge is especially difficult to capture, and repositories built for procedural documentation rarely accommodate it (Bresnen et al., 2003). As a result, successful practices remain localized, while similar mistakes recur elsewhere (Wiewiora et al., 2020). Geographic dispersion and functional divides between engineering, environment, and community teams intensify the problem. Sustainability competencies are especially underdeveloped among project and portfolio staff, reflecting training and recruitment practices that continue to privilege technical and economic expertise over sustainability skills (Fathalizadeh et al., 2021). In parallel, the scarcity of sustainability professionals in the broader labor market compounds the challenge, though this appeared less frequently in participant accounts. Together, these factors weaken organizational memory and prevent sustainability knowledge from being embedded in portfolio governance. Strengthening the project management office (PMO) as a knowledge broker, through structured reviews, peer forums, and mentorship, could help transform isolated insights into portfolio-wide routines that improve sustainability performance.

Conflicting priorities and resource constraints significantly limited sustainability integration. Portfolio managers often described trade-offs between scope, schedule, cost, and sustainability, with the latter typically deprioritized under delivery pressure ($P_{pf}4$, $P_{pf}9$). As one participant put it, *"Timing, resources, availability to do the works . . . The clock is always ticking"* $P_{pf}9$. Another noted, *"Cost-wise, being a remote team makes it more challenging. Resourcing and availability in the current labor market are tight"* $P_{pf}4$. Others highlighted the difficulty of building sustainability into workflows: *"You have to consider so many factors: resourcing, availability, labor market experience, and then also find the time to incorporate*

sustainability into the business" $P_{p}23$. In this context, sustainability goals were frequently framed as "nice to have" and were often the first to be dropped when timelines tightened or budgets came under strain ($P_{pf}4$, $P_{p}14$, $P_{p}23$).

This pattern reflects systemic tensions in extractive industries, where capital discipline, volatile markets, and shareholder demands shape portfolio decisions (Baba et al., 2021). Even with executive support, managers delayed investments in environmental controls or stakeholder programs when immediate returns were uncertain (Hengst et al., 2020). Sustainability requires additional resources, i.e., specialized staff, longer lead times, and complex coordination, making it vulnerable when capacity is stretched. A "no money, no interest" mindset prevailed in some contexts, especially where fiscal or regulatory constraints were pronounced (Banihashemi et al., 2017; Fathalizadeh et al., 2021). Many added sustainability metrics as burdensome, contributing to initiative fatigue. In the absence of strong market or regulatory incentives, portfolio boards defaulted to traditional metrics, limiting the integration of sustainability into decision-making (Banihashemi et al., 2017; Stanitsas et al., 2021).

Operational challenges at the portfolio level further exacerbated sustainability integration barriers. Several participants noted that existing portfolio governance systems, including stage-gate processes and decision support tools, did not consistently incorporate sustainability considerations, leaving sustainability peripheral to project selection and portfolio review structures (P_s6 , P_s10). As a result, portfolio decisions continued to prioritize short-term financial and delivery metrics over long-term environmental and social value (P_s13).

This reflects structural misalignments in PPM frameworks, which often treat cost and schedule as primary success indicators while overlooking sustainability impacts (Schipper & Silvius, 2018; Silvius & Marnewick, 2022). Portfolio-level screening and appraisal processes often include sustainability criteria, but these are frequently outweighed by economic indicators, allowing extractive projects to advance primarily on immediate financial feasibility (Aghajani et al., 2023b; Stanitsas et al., 2021). Rather than adding new roles, the critical issue lies in enhancing the sustainability competence of existing portfolio staff, particularly those responsible for early-stage planning. Given the scale of investments in extractive projects, firms can realistically support training and capability building to ensure environmental and social

considerations are embedded into investment decisions (Sabini et al., 2019; Vijge et al., 2019). Incentive systems reinforce this gap: portfolio managers are rewarded for allocating capital efficiently and meeting delivery targets, not for advancing long-term sustainability objectives. It is worth investigating whether embedding sustainability checkpoints into portfolio processes, enabling interdisciplinary inputs at key decision gates, and adopting performance metrics that credit environmental and social contributions on the portfolio scale can redress these constraints. Each mechanism is likewise worth investigating for its individual contribution to strengthening sustainability oversight within project portfolio management. Without such reforms, sustainability will remain an aspirational add-on rather than a core criterion of project portfolio governance (Ika & Pinto, 2022; Silvius & Marnewick, 2022).

Portfolio-Level Drivers

Collaborative knowledge sharing emerged as a promising enabler of sustainability at the portfolio level. Peer reviews, interproject forums, and project portfolio offices that facilitated knowledge exchange across projects helped disseminate good practices and avoid duplication (P_s5 , P_p8). Systematic knowledge flows are essential for embedding sustainability into portfolio governance. While individual projects often generate valuable technical insights and social innovations, these lessons frequently remain siloed due to overreliance on personal expertise and limited incentives for cross-project learning ($P_{pr}3$). In extractive project portfolios, this fragmentation means that effective sustainability practices, such as resource efficiency or stakeholder engagement strategies, rarely scale beyond their origin, reducing overall impact.

Although project portfolio managers are positioned to broker such knowledge (Killen et al., 2008), many fall short of enabling the relational and collaborative processes required to connect teams. Static repositories and procedural databases are not enough. A culture that supports open exchange, facilitation, and peer learning is critical to converting project-level lessons into portfolio-wide improvements (Aghajani et al., 2023a; Unger et al., 2014). When insights from both successes and failures are routinely shared, organizations avoid repeating mistakes, accelerate adoption of sustainable practices, and enhance performance outcomes (Wiewiora et al., 2019). Active knowledge sharing also promotes innovation, refreshing the organizational knowledge base and

enabling the evolution of sustainability capabilities over time (Kantabutra & Ketprapakorn, 2020).

A further enabler was the growing shift toward *data-driven decision-making* in PPM. Several participants described how dashboards and performance-tracking systems have begun to incorporate sustainability metrics, such as emissions, water usage, Indigenous engagement, and community investment ($P_{pr}2$, P_s6). These tools provided portfolio managers with real-time visibility into sustainability outcomes, supporting more systematic and evidence-based trade-offs in project selection, prioritization, and balancing ($P_{pr}2$, $P_{pr}18$, P_p23).

Integrating such data into project portfolio routines is essential for aligning immediate production goals with long-term social and ecological imperatives. Extractive firms increasingly rely on structured systems to track key indicators and adjust portfolio choices accordingly (Kivilä et al., 2017; Sabini et al., 2019). Brook and Pagnanelli (2014) proposed a five-step process to align innovation project portfolios with sustainability goals, while the conceptual framework developed by Perrini and Tencati (2006) helps to institutionalize stakeholder-related reporting at the organizational level. External pressures also reinforce these practices. For instance, the World Bank's Extractive Industries Review demands that SDGs be treated on par with financial targets, calling for transparent disclosure of sustainability results (Extractive Industries Review, 2003; Kich, 2024). By embedding robust data systems and aligning them with governance expectations, firms are better equipped to integrate sustainability into portfolio decision-making and pursue projects that deliver both short-term performance and long-term value.

Finally, *innovation, efficiency, and social impact* were recognized as mutually reinforcing drivers of sustainability integration. Several participants cited examples where sustainability initiatives, such as solar energy pilots, circular waste solutions, or community codesign practices, generated both operational benefits and meaningful impact ($P_{pr}3$, P_p11). One participant explained, “We’ve executed solar farm projects and are now bidding for others in remote areas. . . Everyone’s excited about these kinds of projects” $P_{pr}9$. When sustainability goals aligned with core performance imperatives such as cost control, risk mitigation, or stakeholder trust, they were adopted more readily and sustained over time. These examples also illustrate how direct experience with sustainability can alter managerial perceptions: once the benefits are seen in practice, there is usually enough justification to

continue investing. However, such cases remained relatively rare across the interviews, suggesting that the limited prevalence of experiential evidence contributes to why sustainability is still often overshadowed by short-term economic logics at the portfolio level of extractive firms.

Innovation that delivers both operational and societal value is increasingly seen as a strategic asset in portfolio decision-making. While extractive firms once prioritized productivity and cost, many now recognize that sustainability can drive creative problem-solving, reduce dependencies, and build trust (Boiral et al., 2023; Fraser, 2019). Projects targeting emissions, energy efficiency, or local procurement achieve multiple objectives, cutting costs, enhancing legitimacy, and improving resilience (Lapeyronie & Szedlacsek, 2025; McDougall & Davis, 2024; Zou et al., 2024). Scholars argue that project performance (and consequently PPM success) must account for environmental and social outcomes, not just cost, time, and quality (Ika & Pinto, 2022). Midler (2019) found that tensions between profit and sustainability can spark innovation, especially in adaptive cultures. However, where short-term cost control dominates, sustainability is often dismissed as burdensome (Hengst et al., 2020). Embracing these tensions enables “both-and” strategies that align operational goals with long-term value creation, reinforcing the social license to operate and positioning sustainability as a source of competitive advantage (Argote et al., 2021; Cui et al., 2016; Vijge et al., 2019).

Project-Level Barriers

At the project delivery level, participants frequently raised *cost and logistical challenges* (P_p1). Implementing sustainability measures, such as local procurement targets or sourcing lower impact materials, led to procurement delays, increased costs, or added risk, particularly in remote or technically constrained sites (P_p1 , $P_{pf}4$). One participant described how retrofitting solar infrastructure delayed timelines and required scarce technical expertise ($P_{pr}3$). Others noted that community-driven initiatives strained limited budgets and schedules, prompting some teams to deprioritize these elements under delivery pressure (P_s6 , $P_{pf}9$). As a result, sustainability was often viewed as optional rather than integral to project execution (P_p1 , P_s16). Several of these barriers reflect not only project delivery constraints but also broader ecosystem challenges, such as underdeveloped supply chains for sustainable materials, limited pools of technical expertise, and funding models that prioritize short-term delivery over long-term value.

These concerns highlight how sustainability remains subordinated to the prevailing logic of time, cost, and quality in extractive portfolios. Cleaner technologies and community programs demand upfront investment and complex coordination, appearing burdensome in resource-constrained environments (Sabini et al., 2019). Fragmented knowledge systems mean that effective practices are rarely shared across projects, limiting replication and innovation (Wiewiora et al., 2020). A short-term focus discourages adaptive routines and weakens the dynamic capabilities needed for sustainability transitions (Xu & Liu, 2023). Scholars argue for longer term evaluation frameworks and dedicated sustainability budgets to counteract these constraints. Embedding such mechanisms into project portfolio governance can reduce delivery-level resistance and promote resilient, socially responsive outcomes (Ika & Pinto, 2022; Silvius & Marnewick, 2022).

A training and awareness gap was identified as a critical constraint by several participants. Many project teams lacked familiarity with sustainability frameworks or found it difficult to translate high-level sustainability goals into operational practices (P_p7 , P_s10). This gap often meant that sustainability considerations were overlooked during planning and delivery, especially when teams were under time or budget pressure ($P_{pr}15$). One participant noted, “*We’ve got training for HSE, human resources (HR), and machinery, but not from a sustainability point of view*” P_p8 . Another remarked on broader capacity constraints: “*Resources are tight, and it’s hard to find the time to incorporate sustainability into the business*” $P_{pr}3$. Few respondents reported that project leads “*hardly cared about*” core concepts like circular procurement or net-zero targets, e.g., P_p1 , while others highlighted the absence of sustainability expertise in project decision-making ($P_{pr}3$, P_p8). These deficiencies diminished the likelihood of embedding sustainability into project execution processes (P_s13).

The findings reflect a broader lack of sustainability competencies across project portfolio stakeholders. Standard project management training rarely addresses environmental or social dimensions, leaving managers ill equipped to move beyond compliance (Ingason & Eskerod, 2024; Stanitsas et al., 2021). As a result, selection criteria, budgeting, and scheduling often fail to accommodate sustainability priorities. Siloed teams and poor knowledge transfer compound the problem. While PMOs and interproject networks can act as knowledge brokers, they require targeted support through mentoring, local champions, and structured

communities of practice (Wiewiora et al., 2019, 2020). Embedding sustainability into governance demands training programs, certification pathways, and peer learning opportunities that build shared understanding. Over time, these initiatives can cultivate the persistent behaviors and decision logics required for long-term sustainability integration (Kantabutra & Ketprapakorn, 2020).

Resistance to change remained a persistent constraint. Several participants observed that sustainability measures were frequently perceived as externally imposed, especially when they were not aligned with project KPIs or delivery priorities (P_s6 , $P_{pf}12$). In such cases, teams deprioritized sustainability, treating it as an add-on rather than a core requirement (P_s16). One interviewee noted that “unless sustainability is linked to delivery metrics, it is seen as someone else’s job,” emphasizing the disconnect between strategic commitments and operational practices ($P_{pf}3$, P_s22). Resistance was particularly evident when initiatives lacked dedicated resources or incentives, reinforcing the perception of sustainability as an unwelcome burden ($P_{pf}15$).

Even where resources and capabilities exist, profit-focused routines in extractive firms often clash with sustainability objectives. Project teams may resist unfamiliar processes or stakeholder engagement requirements, fearing added complexity, loss of control, or delays (Banihashemi et al., 2017; Fathalizadeh et al., 2021). Such resistance can be passive, e.g., “this is not how we do things,” or active, particularly in rigid hierarchies with standardized workflows. Without targeted change management, sustainability is seen as risky or incompatible with efficiency goals, and novel ideas are dismissed as costly or uncertain (Kiani Mavi et al., 2021). This dynamic suppresses learning: when pilot successes contradict dominant norms, they are ignored, reinforcing the status quo (Sabini et al., 2019). Overcoming resistance requires leadership that frames sustainability as integral to the corporate vision, along with supportive measures such as incentives for innovation, structured change programs, and participatory governance that enables staff to reshape routines (Kantabutra & Ketprapakorn, 2020).

Project-Level Drivers

Several drivers enabled sustainability adoption at the project level. *Localized solutions and practical adaptation* were seen as especially effective. Interviewees emphasized the importance of localized, context-specific strategies, such as Indigenous

engagement models, local procurement targets, and site-specific biodiversity plans, as critical enablers of sustainability ($P_{pf}3$, $P_{pf}9$, P_s21). These approaches were described as not only improving implementation feasibility but also strengthening legitimacy and community trust. Participants noted that generic frameworks often failed to gain traction, whereas locally adapted initiatives, codesigned with affected communities, led to more enduring outcomes (P_p11 , P_p14). By aligning sustainability measures with environmental conditions and social expectations on the ground, project teams were better positioned to integrate them into operations.

Research confirms that sustainability strategies in extractive portfolios are most effective when adapted to local conditions. Universal mandates, such as free, prior, and informed consent or benefit sharing, often falter without contextualization (Banihashemi et al., 2017; Stanitsas et al., 2021). Regulatory, cultural, and market differences shape what works on the ground (Fathalizadeh et al., 2021; Hermano & Martín-Cruz, 2016), requiring firms to empower local teams and foster communities of practice to translate high-level goals into fit-for-purpose initiatives (Midler, 2019). Examples include off-grid power solutions, custom water systems, or codesigned procurement targets (Baumgartner & Rauter, 2017; Wiewiora et al., 2020). Persistent social challenges and unmet employment goals reveal the limits of generic approaches (Cui et al., 2016), reinforcing the need for deeper investment in education, healthcare, and capacity building (Söderholm & Svahn, 2015). Capturing these local lessons and feeding them into portfolio-level governance creates a learning loop that strengthens social license, resilience, and long-term sustainability outcomes (Pemsel & Wiewiora, 2013).

Workforce training and engagement also played an important role in driving sustainability adoption at the project level. Several interviewees noted that when firms introduced sustainability-focused training programs or supported employee-led initiatives (e.g., site-based sustainability committees or energy-saving campaigns), there was a marked increase in local engagement and ownership of sustainability practices (P_s5 , P_p8). One participant noted, “It’s now part of our project management training” $P_{pf}3$. Another explained, “We assess project ideas from team members or managers based on their sustainability value (minor, moderate, or major) over 1, 3, or 5 years. That influences whether we proceed” $P_{pf}17$. These initiatives not only improved awareness but also fostered a sense of

agency among staff, enabling them to integrate sustainability into everyday decisions ($P_{pf}12$, $P_{pf}17$).

A capable, motivated workforce is essential for translating strategic commitments into operational behavior. However, many teams still lack the knowledge to act beyond basic compliance (Al-Saleh & Taleb, 2010). Specialized training in environmental and community domains equips staff to identify sustainability risks, reduce waste, and engage constructively with stakeholders. Engagement further amplifies learning: on-site initiatives and peer mentorship foster the real-time adaptability emphasized in complexity theory (Kantabutra & Ketprapakorn, 2020). Project managers' values and knowledge, critical integration enablers, are reinforced through certifications, reflective debriefs, and recognition systems (Barreto, 2010; Daniel et al., 2014). Such practices embed sustainability into portfolio governance by circulating grounded knowledge from projects upward, while disengaged teams perceive it as an added burden, stalling progress.

Finally, *technology-driven advancements* played a notable role in enabling sustainability integration. Several interviewees highlighted the adoption of digital tools such as satellite-based emissions tracking, predictive analytics for water use, and automated compliance reporting, which helped embed sustainability into core project delivery without adding excessive administrative burden ($P_{pf}2$, $P_{pf}11$). These tools enhanced responsiveness and decision-making by making real-time sustainability data readily accessible to frontline teams ($P_{pf}2$, $P_{pf}18$).

Beyond equipment, effective use of such technologies depends on firms' dynamic capabilities to sense challenges and reconfigure responses (Barreto, 2010). Digital platforms allow teams to pool environmental and social indicators, compare practices across sites, and scale successful approaches. Internet of Things (IoT) sensors, artificial intelligence (AI) analytics, and blockchain tools not only improve environmental performance but also strengthen governance and transparency, aligning with stakeholder expectations (Sonmez et al., 2023). Companies have deployed innovations such as mercury capture devices and solar pumps to reduce local impacts (Miller et al., 2024; Mulvaney et al., 2020). Nevertheless, sustained value emerges only when these technologies are embedded within adaptive learning cultures that integrate new insights with operational routines (Wiewiora et al., 2020).

Organizational Learning Mechanisms and Knowledge Dynamics

To address Research Question 2 (RQ2), we investigated how organizational learning mechanisms enabled or constrained the integration of sustainability into PPM. Guided by the four-process model of organizational learning (search, knowledge creation, retention, and transfer) proposed by Argote et al. (2021), we reanalyzed the coded data to identify critical learning bottlenecks and leverage points across participating firms. Figure 2 presents the key themes that emerged from this analysis, categorizing the most frequently *observed weaknesses* and corresponding *high-level interventions* across the four learning processes. Drawing on empirical examples, the following subsections examine each learning mechanism in turn, illustrating how they shaped sustainability-related knowledge dynamics within the investigated extractive-sector firms.

The mechanisms in Figure 2 highlight the low maturity of sustainability knowledge management in PPM. Many of the identified barriers in RQ1, such as fragmented knowledge systems, lack of codification of sustainability knowledge, underdeveloped competencies, and resistance to change, directly manifest as weaknesses in the four learning processes. Search for sustainability knowledge remains largely ad hoc, driven by individuals rather than systematic portfolio routines. Knowledge creation is often fragmented, with pilot projects poorly evaluated and rarely codified into transferable practices. Retention is constrained by documentation systems designed primarily for financial or technical data, which exclude or marginalize sustainability insights. Transfer relies heavily on informal networks, leaving sustainability knowledge siloed within teams and vulnerable to attrition.

At the same time, the identified drivers, such as executive sponsorship, digital dashboards, and collaborative cultures, point to potential interventions. For example, digital sustainability taxonomies can structure search and retention, knowledge custodians can steward creation and transfer, and leadership mandates can embed sustainability checkpoints into portfolio reviews. However, unless these measures are institutionalized as enduring routines, sustainability initiatives risk remaining isolated pilots rather than becoming embedded practices across portfolios.

This low maturity contrasts with other project management concepts, such as safety,

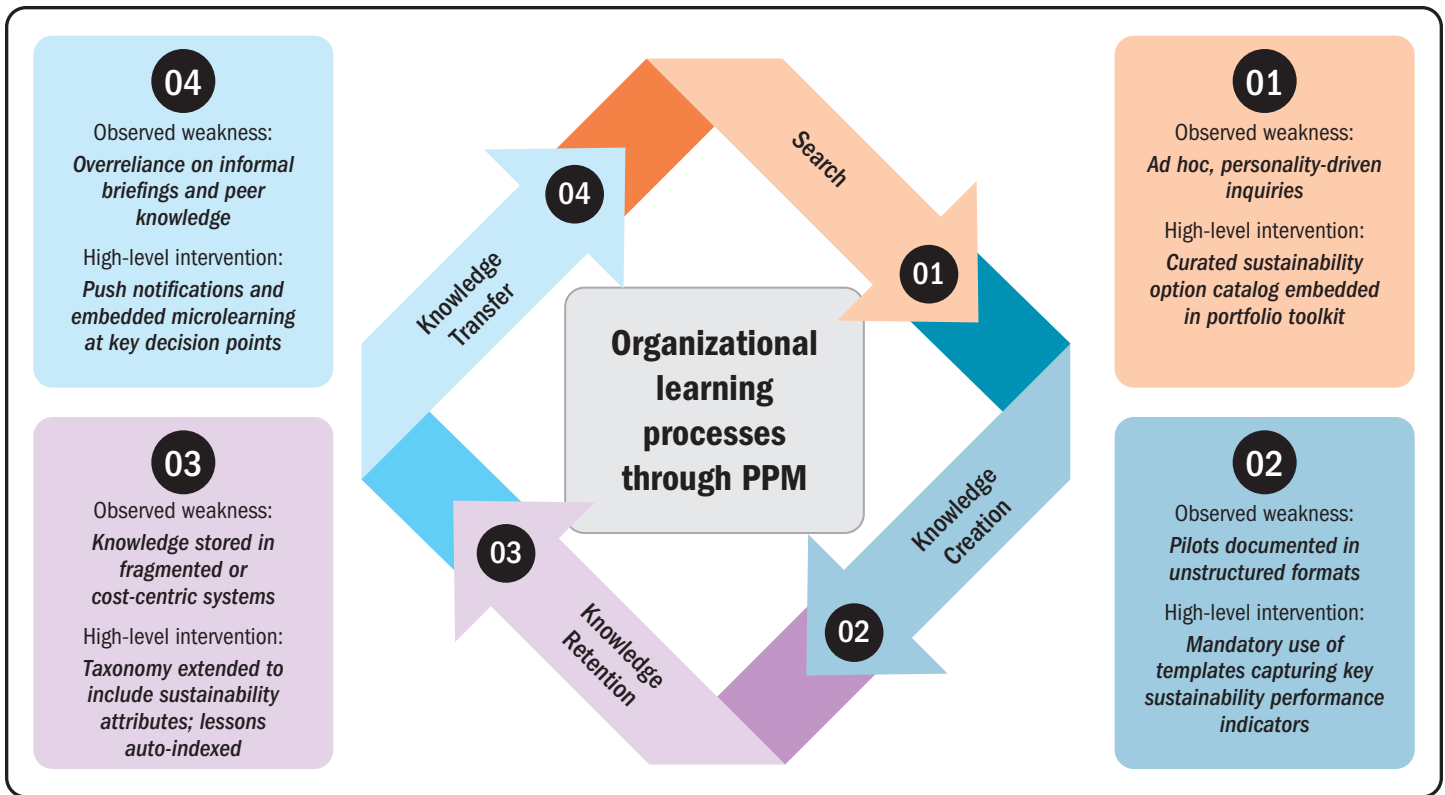


Figure 2. Organizational learning mechanisms in project portfolios of extractive firms.

quality management, or digital transformation, which evolved from peripheral concerns to embedded organizational logics through iterative learning, standardization, and cultural adoption. Comparing sustainability learning to these trajectories highlights both common challenges and unique features, such as its normative foundations and legitimacy demands (Kampf et al., 2023; Söderlund & Sydow, 2019). This underscores that progress toward improving sustainability knowledge requires not only identifying weaknesses and proposing interventions but also embedding them systematically into portfolio governance and organizational learning routines.

Search

Interviewees described search activities as *ad hoc, personality-driven inquiries*, often reliant on individual champions with prior sustainability exposure ($P_{pr}4$, $P_{pr}9$). In the absence of formal mechanisms, sustainability-related inquiries typically emerged reactively rather than systematically. One participant explained: “I’m across most projects and share lessons at the end, but to be honest, the industry still lacks maturity when it comes to learning, especially around sustainability” $P_{pr}4$.

Another noted the absence of targeted search tools: “There’s nothing bespoke for sustainability—just a dropdown in the lessons learned database. It needs better structure and categorization” $P_{pr}9$.

These insights reflect what Argote et al. (2021) define as localized, problemistic search, where learning is triggered by immediate issues rather than deliberate exploration of new possibilities. In such contexts, firms tend to exploit known solutions rather than explore unfamiliar or higher impact alternatives, particularly when sustainability is not embedded in strategic scanning routines.

Consistent with prior studies (Pensel & Wiewiora, 2013; Sense, 2011), unstructured and individually driven search weakens the capacity of firms to identify sustainability opportunities in a timely and consistent manner. Without *curated processes to surface emerging technologies or stakeholder engagement models*, promising sustainability options often go unnoticed or fail to scale across portfolios.

To address this gap, scholars advocate for the integration of structured scanning tools, such as a *sustainability option catalog embedded within*

PPM toolkits (Kivilä et al., 2017). These catalogs, which include vetted technologies, social innovation templates, and environmental safeguards, help systematize the search by linking it to appraisal gates and project selection criteria. When regularly updated and institutionally supported, such mechanisms promote broader exploration and enable project teams to align local sustainability innovations with portfolio-level priorities.

Knowledge Creation

Interviewees described sustainability-related knowledge creation as fragmented and inconsistent. Pilot projects, such as trials in low-carbon construction (P_s10 , P_p23) or local codesign for procurement ($P_{pr}2$) were rarely evaluated beyond their initiating context, and *documentation was typically unstructured or ad hoc* ($P_{pr}3$, P_p7). As one participant explained: “*We test things, but nobody captures what worked or why*” (P_s6). This reflects a key concern in organizational learning literature: the absence of structured evaluation processes limits the transformation of tacit experience into transferable knowledge (Schilling & Kluge, 2009; Wiewiora et al., 2020). Argote et al. (2021) similarly argue that knowledge creation without codification results in rapid loss, preventing organizations from developing repeatable routines.

Another risk lies in *overreliance on individual expertise*. While some firms employed highly skilled sustainability professionals, their insights often remained undocumented and left with them upon departure. As a result, critical learning resided in individuals rather than in the organization, a pattern that weakened institutional memory and adaptive capacity.

To address this, several firms introduced structured digital repositories supported by *mandatory use of templates capturing key sustainability performance indicators*. These templates standardize the documentation of pilot outcomes and make sustainability data comparable across projects and timeframes. As one project lead described: “*We’ve got an online portal—anyone can search by tags like sustainability or project type. You can pull lessons learned into your own design and execution plans*” (P_p14). Another participant noted that the system also supports replication: “*You can flag whether an initiative is project specific or can be replicated elsewhere, so we know what’s scalable*” ($P_{pr}12$).

These systems operationalize what Argote et al. (2021) describe as structured creation environments (settings

where experiential insights are routinely captured, evaluated, and made available to others). When embedded in portfolio review cycles, such mechanisms ensure that pilot innovations become part of the organization’s shared knowledge base. Over time, they enable dynamic adaptation of project portfolios to emerging sustainability challenges.

These tools align with organizational learning literature that emphasizes deliberate structuring of knowledge creation environments (Sense, 2011), enabling experiential insights to be systematically documented and evaluated across the project portfolio. When embedded in portfolio review cycles, such mechanisms ensure that pilots are not one-off experiments but become sources of shared capability. Over time, they help transform localized innovation into organizational learning, supporting dynamic alignment with evolving sustainability goals (Schilling & Kluge, 2009).

Knowledge Retention

Among all learning mechanisms, knowledge retention emerged as the most persistent weakness. Participants described how *knowledge was stored in fragmented or cost-centric systems*, limiting visibility and reuse beyond individual projects (P_s5 , $P_{pr}12$, P_p20). Project databases were primarily designed around financial and scheduling data, while sustainability-related insights were often buried in unstructured documents, siloed folders, or personal drives. As one participant noted: “*Project documents go into our change management system, and I can access them—even for projects I didn’t work on. I usually check lessons learned to see what others would’ve done differently before starting my own*” (P_p20). Despite such individual efforts, the lack of structure and sustainability-specific tagging significantly constrained organizational memory. As another respondent emphasized: “*We try to share best practices, especially across countries, and organize lessons learned, when possible, but it really depends on whether [project] leads have time or initiative*” (P_p6).

These observations echo findings by Argote et al. (2021), who emphasize that knowledge retention is not just about archiving information, but also about maintaining accessible pathways for retrieval and use. In the absence of formal retrieval mechanisms, even documented sustainability lessons remained underutilized, particularly when reliant on informal networks or individual initiative (Wiewiora et al., 2019).

A high-leverage intervention observed in several project portfolios involved extending the *taxonomy to include*

sustainability attributes and implementing systems where lessons were auto-indexed using standardized sustainability categories (e.g., carbon footprint, biodiversity, Indigenous engagement). One participant described how this worked in practice: “We have a centralized register of lessons learned that’s part of our project management framework. [Project] leads are expected to consult it at initiation and at each stage gate” (P_{pr}19).

When integrated into portfolio review routines, these improvements transformed static archives into a *living knowledge system*, one that supports early-stage planning, encourages evidence-based design, and promotes replication of effective sustainability practices. By moving from ad hoc retrieval to structured access, these mechanisms enhanced organizational memory and enabled dynamic adaptation to sustainability priorities across the project portfolio (Irani et al., 2009; Walsh & Ungson, 2009).

Knowledge Transfer

Interviewees described knowledge transfer in extractive-sector portfolios as fragmented and inconsistently practiced, often relying on informal briefings, peer mentoring, or individual initiative (P_{pr}3, P_s6). This reflects the *over-reliance on informal briefings and peer knowledge*, which made sustainability learning vulnerable to attrition, particularly in geographically dispersed portfolios or in contexts with high staff turnover. As one participant noted: “I doubt we’re different from others . . . There’s a tendency to focus on the positive things, but sometimes you’ve got to admit what went wrong to actually learn from it” (P_s7). Other participants acknowledged that, while lessons were captured, they remained siloed: “We’ve got a SharePoint folder for each project. All the things we avoided and all the things that went wrong are in there—but they stay within the team” (P_{pr}19).

This disconnect between storage and diffusion is well documented in the literature. Argote et al. (2021) emphasize that effective knowledge transfer requires both codification and activation mechanisms. Without structured reinforcement, captured lessons often fail to shape decision-making across projects, leading to repeated mistakes or underutilized innovations (Ajmal & Koskinen, 2008; Bakker et al., 2011).

A key solution emerging from both literature and practice is the use of *push notifications and embedded microlearning at key decision points*. Several participants called for lightweight, context-sensitive prompts

embedded in portfolio workflows, particularly at stage gates or major handover points, to ensure that relevant sustainability insights are retrieved and applied (P_{pr}4, P_{pr}19). These digital nudges reduce cognitive overload while increasing the likelihood that teams will engage with lessons learned at the moment of relevance.

Such mechanisms address the project learning paradox, where the urgency of delivery crowds out reflection and reuse (Bakker et al., 2011; Landaeta, 2008). When combined with centralized platforms that recommend relevant lessons based on project characteristics, they enable targeted, just-in-time knowledge activation across portfolios.

To be effective, knowledge transfer systems must move beyond passive archiving toward active delivery: *digitally integrated, repeatedly surfaced, and timed to critical phases*. This shifts sustainability learning from isolated events to embedded routines, enhancing the portfolio’s adaptive capacity and organizational resilience.

Conclusion

This study investigated how sustainability can be systematically integrated into PPM in extractive industries. It addressed two questions: RQ1—What barriers and drivers do extractive companies face in integrating sustainability into their project portfolio management systems? and RQ2—How do organizational learning mechanisms enable or constrain sustainability integration in PPM?

For RQ1, the findings show that sustainability integration is shaped by a persistent tension between strong external and internal drivers on the one hand and entrenched structural barriers on the other. Drivers include visible executive commitment, growing stakeholder expectations, global sustainability frameworks (e.g., SDGs and ICMM), and the adoption of data-driven dashboards and ESG scorecards. These pressures created both legitimacy incentives and internal momentum for sustainability. However, integration was hindered by short-term financial logics, regulatory ambiguity, cultural resistance, fragmented knowledge systems, and limited sustainability competencies. Collectively, these barriers reinforced a view of sustainability as a secondary or optional concern in portfolio selection and execution.

For RQ2, the study found that organizational learning plays a decisive role in determining whether

sustainability initiatives remain isolated pilots or become institutionalized across portfolios. Four recurring weaknesses were identified. Search was largely ad hoc and personality driven, with little structured scanning for sustainability opportunities. Knowledge creation was fragmented: pilot projects produced valuable insights, but documentation was inconsistent and rarely codified into transferable practices. Knowledge retention was weak, as sustainability information was buried in financial databases, siloed folders, or personal drives without standardized tagging or indexing. Knowledge transfer depended heavily on informal networks, leaving lessons confined within teams or sites.

At the same time, participants identified interventions with the potential to close these gaps. Structured sustainability catalogs and scanning tools could strengthen searches. Standardized sustainability templates would improve codification of knowledge creation. Digital repositories with taxonomies that include sustainability attributes could enhance retention. Just-in-time digital prompts and dashboards could embed sustainability into decision points, improving transfer. Together, these strategies represent practical levers for transforming fragmented learning into systematic organizational capability.

Theoretical Contributions

This study makes two key contributions to theory. First, it reframes sustainability integration in PPM as a recursive and multilevel process rather than a linear cascade from strategy to projects. PPM functions as a mediator that aligns top-level sustainability commitments with project execution and creates feedback loops through which project-level experiences inform portfolio governance and strategic priorities. This perspective highlights PPM not only as a coordinating mechanism but also as a site of institutional work, where competing logics are negotiated and sustainability practices are either embedded or eroded (Kampf et al., 2023; Söderlund & Sydow, 2019).

Second, by applying Argote et al.'s (2021) framework, the study extends organizational learning theory to the domain of sustainability in project portfolios. It shows how weaknesses in search, creation, retention, and transfer undermine institutionalization and highlights the importance of embedding sustainability knowledge into governance routines. The findings thus strengthen understanding of how organizational learning processes condition whether sustainability is sidelined or embedded in project portfolio practice.

Practical Implications

For practitioners in extractive industries, this study highlights several pathways to embed sustainability more systematically into PPM. Each recommendation directly addresses the barriers and weaknesses observed in the research:

- 1. Embed sustainability in portfolio decision processes:** Ensure that sustainability considerations are incorporated as standard criteria at all portfolio gates. This counters the dominance of cost and schedule metrics, which often sideline sustainability even when endorsed at the strategic level.
- 2. Strengthen knowledge governance:** Develop structured systems for codifying, storing, and sharing sustainability knowledge across projects and portfolios. This addresses the reliance on informal, person-dependent transfer and fragmented documentation, which limited organizational learning and the reuse of effective practices.
- 3. Formalize knowledge stewardship roles:** Designate knowledge custodians or sustainability “champions” at portfolio and project levels. Without dedicated stewards, experiential knowledge was frequently lost or siloed, undermining efforts to scale sustainability practices.
- 4. Leverage digital tools for learning and nudges:** Implement platforms with standardized sustainability metadata, searchable taxonomies, and push notification microlearning at key decision points. These tools tackle the underutilization of available data systems and ensure that sustainability knowledge is surfaced in a timely, context-relevant manner.
- 5. Recalibrate evaluation and incentive systems:** Integrate long-term sustainability value into investment appraisals and performance assessments; for example, through carbon shadow pricing or social impact scoring. This helps counter short-termism and initiative fatigue, aligning behaviors with sustainability goals.
- 6. Invest in targeted capability building:** Provide tailored training for portfolio managers and teams on sustainability and ESG analytics, stakeholder engagement, and cross-project learning. Building these capabilities supports institutionalization of sustainability-oriented decision-making and fosters a culture of continuous improvement.

Together, these interventions reinforce both governance and learning, equipping extractive firms to move beyond symbolic commitment toward embedded sustainability practices that strengthen legitimacy and resilience.

Future Research Directions

This study is subject to several limitations beyond those typical of qualitative research. Focusing on Australian extractive industries provided valuable context-specific insights into one of the world's most scrutinized resource sectors, but this scope limits generalizability to other sectors and regions. The sample of 24 practitioners achieved thematic saturation across strategic, portfolio, and project delivery levels, including professionals with direct responsibility for sustainability decisions. However, it may be biased toward larger firms with dedicated sustainability functions, overlooking challenges faced by smaller operators. Reliance on self-reported experiences introduces subjectivity and possible recall bias, and the cross-sectional design provides only a snapshot in time rather than capturing how sustainability integration evolves across portfolio cycles. Nevertheless, combining senior practitioner perspectives with systematic coding generated rich, multilevel insights into barriers, drivers, and learning dynamics that would be difficult to obtain through other methods. These constraints frame the findings as exploratory and context-bound, offering a foundation rather than a definitive account of sustainable PPM practices.

Building on these limitations, several research avenues emerge that can further advance understanding of sustainable PPM and the role of organizational learning:

- *Longitudinal studies of portfolio cycles:* Future research should trace how organizational learning mechanisms and sustainability logics interact and evolve across multiple portfolio cycles (Uriarte et al., 2019; Winch & Maytorena-Sanchez, 2020). Such work could clarify how early-stage sustainability experimentation becomes embedded (or dissipates) over time, and how organizations institutionalize sustainability in routine portfolio governance.
- *Institutional theory perspectives:* Applying institutional theory more systematically could enrich understanding of how coercive and mimetic pressures (e.g., regulatory mandates, industry norms) dominate early decision-making, while normative logics (ethics, legitimacy, stakeholder engagement) become more salient during implementation (Miterev, 2024; Miterev et al., 2017; Söderlund & Sydow, 2019). Further research could test how these logics shape the convergence or divergence of sustainability practices across organizations.
- *Digital technologies as learning enablers:* The role of digital platforms, data analytics, and AI-driven sustainability tools warrants closer examination. These technologies may enhance codification, transfer, and institutionalization of sustainability knowledge at both project and portfolio levels (Kivilä et al., 2017; Wiewiora et al., 2019).
- *Scaling learning across portfolios:* Future work should investigate how sustainability lessons from individual projects diffuse across portfolios and feed back into strategic governance. This remains a critical gap, as pilot successes often fail to inform portfolio selection or capital allocation (Argote et al., 2021; Schilling & Kluge, 2009).
- *Future studies should also investigate the mechanisms driving industry-level transformation.* Understanding what enables sustainability innovations to scale across the extractive sector, and what barriers continue to constrain them, represents an important next step. This would complement organizational- and portfolio-level insights by highlighting how sector-wide enablers and constraints shape the diffusion of sustainable practices (Baba et al., 2021; Bechtel et al., 2025).

By addressing these directions, scholarship can deepen theoretical understanding and provide more actionable guidance on how project-based organizations build the dynamic learning capabilities required to embed sustainability into PPM, moving from isolated initiatives to sustained, portfolio-wide transformation.

References

- Aghajani, M., Ahsan, K., & Whiteside, N. (2023a). When agility meets a project portfolio: A study of success factors in large organisations. *Australasian Journal of Information Systems*, 27, 1–48. <https://doi.org/10.3127/ajis.v27i0.4113>
- Aghajani, M., Ruge, G., & Jugdev, K. (2023b). An integrative review of project portfolio management literature: Thematic findings of sustainability mindset, assessment, and integration. *Project Management Journal*, 54(6), 1–22. <https://doi.org/10.1177/87569728231172668>
- Ajmal, M. M., & Koskinen, K. U. (2008). Knowledge transfer in project-based organizations: An organizational culture perspective. *Project Management Journal*, 39(1), 7–15. <https://doi.org/10.1002/pmj.20031>
- Al-Saleh, Y. M., & Taleb, H. M. (2010). The integration of sustainability within value management practices: A study of experienced value managers in the GCC countries. *Project Management Journal*, 41(2), 50–59.
- Argote, L. (2013). Organizational learning. In *Organizational learning: Creating, retaining and transferring knowledge* (2nd ed.). Springer. <https://doi.org/10.1007/978-1-4614-5251-5>
- Argote, L., Lee, S., & Park, J. (2021). Organizational learning processes and outcomes: Major findings and future research directions. *Management Science*, 67(9), 5399–5429. <https://doi.org/10.1287/mnsc.2020.3693>
- Baba, S., & Brunet, M. (2024). Project legitimacy: Towards a theoretical framework. *European Management Review*, 21(4), 887–901. <https://doi.org/10.1111/emre.12620>
- Baba, S., Mohammad, S., & Young, C. (2021). Managing project sustainability in the extractive industries: Towards a reciprocity framework for community engagement. *International Journal of Project Management*, 39(8), 887–901. <https://doi.org/10.1016/j.ijproman.2021.09.002>
- Bakker, R. M., Cambré, B., Korlaar, L., & Raab, J. (2011). Managing the project learning paradox: A set-theoretic approach toward project knowledge transfer. *International Journal of Project Management*, 29(5), 494–503. <https://doi.org/10.1016/j.ijproman.2010.06.002>
- Banihashemi, S., Hosseini, M. R., Golizadeh, H., & Sankaran, S. (2017). Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries. *International Journal of Project Management*, 35(6), 1103–1119. <https://doi.org/10.1016/j.ijproman.2017.01.014>
- Barreto, I. (2010). Dynamic capabilities: A review of past research and an agenda for the future. *Journal of Management*, 36(1), 256–280. <https://doi.org/10.1177/0149206309350776>
- Baumgartner, R. J., & Rauter, R. (2017). Strategic perspectives of corporate sustainability management to develop a sustainable organization. *Journal of Cleaner Production*, 140, Part I, 81–92. <https://doi.org/10.1016/j.jclepro.2016.04.146>
- Bechtel, J., Sabini, L., & Kock, A. (2025). When do sustainability tensions harm or benefit innovation portfolios? A paradoxical perspective. *Journal of Product Innovation Management*, 0(0), 1–17 (in press). <https://doi.org/10.1111/jpim.12792>
- Boiral, O., Heras-Saizarbitoria, I., & Brotherton, M. C. (2023). Sustainability management and social license to operate in the extractive industry: The cross-cultural gap with Indigenous communities. *Sustainable Development*, 31(1), 125–137. <https://doi.org/10.1002/sd.2378>
- Bond, P. (2018). Ecological-economic narratives for resisting extractive industries in Africa. In *Environmental impacts of transnational corporations in the global south* (pp. 73–110). Emerald Publishing Limited.
- Bresnen, M., Edelman, L., Newell, S., Scarbrough, H., & Swan, J. (2003). Social practices and the management of knowledge in project environments. *International Journal of Project Management*, 21(3), 157–166.
- Brook, J. W., & Pagnanelli, F. (2014). Integrating sustainability into innovation project portfolio management: A strategic perspective. *Journal of Engineering and Technology Management*, 34, 46–62.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.

- Cui, J., Jo, H., & Velasquez, M. G. (2016). Community religion, employees, and the social license to operate. *Journal of Business Ethics*, 136(4), 775–807. <https://doi.org/10.1007/s10551-015-2865-0>
- Daniel, E. M., Ward, J. M., & Franken, A. (2014). A dynamic capabilities perspective of IS project portfolio management. *The Journal of Strategic Information Systems*, 23(2), 95–111.
- de Almeida Vittori Ferreira, M., Morgado, C. do R. V., & Estellita Lins, M. P. (2024). Organizations and stakeholders' roles and influence on implementing sustainability requirements in construction projects. *Heliyon*, 10(1), e23762. <https://doi.org/10.1016/j.heliyon.2023.e23762>
- Deonandan, K., Schoenfeld, J., Salim, A., & Bourassa, M. (2024). Social license to operate (SLO): Private governance and barriers to community engagement. *The Extractive Industries and Society*, 17, 101404.
- Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, 11(2), 130–141. <https://doi.org/10.1002/bse.323>
- Engert, S., Rauter, R., & Baumgartner, R. J. (2016). Exploring the integration of corporate sustainability into strategic management: A literature review. *Journal of Cleaner Production*, 112, Part 4, 2833–2850. <https://doi.org/10.1016/j.jclepro.2015.08.031>
- Eskerod, P., & Huemann, M. (2024). Engaging project stakeholders. In *The handbook of project management* (pp. 372–391). Routledge.
- Extractive Industries Review. (2003). *Striking a balance: The World Bank and extractive industries* (Vol. 1).
- Fathalizadeh, A., Reza Hosseini, M., Silvius, A. J. G., Rahimian, A., Martek, I., & Edwards, D. J. (2021). Barriers impeding sustainable project management: A social network analysis of the Iranian construction sector. *Journal of Cleaner Production*, 318, 128405. <https://doi.org/10.1016/j.jclepro.2021.128405>
- Fraser, J. (2019). Creating shared value as a business strategy for mining to advance the United Nations Sustainable Development Goals. *Extractive Industries and Society*, 6(3), 788–791. <https://doi.org/10.1016/j.exis.2019.05.011>
- Fraser, J. (2021). Mining companies and communities: Collaborative approaches to reduce social risk and advance sustainable development. *Resources Policy*, 74, 101144.
- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, 16(1), 15–31. <https://doi.org/10.1177/1094428112452151>
- He, Q., Wang, Z., Wang, G., Xie, J., & Chen, Z. (2022). The dark side of environmental sustainability in projects: Unraveling greenwashing behaviors. *Project Management Journal*, 53(4), 349–366. <https://doi.org/10.1177/87569728211042705>
- Hengst, I.-A., Jarzabkowski, P., Hoegl, M., & Muethel, M. (2020). Toward a process theory of making sustainability strategies legitimate in action. *Academy of Management Journal*, 63(1), 246–271.
- Hermano, V., & Martín-Cruz, N. (2016). The role of top management involvement in firms performing projects: A dynamic capabilities approach. *Journal of Business Research*, 69(9), 3447–3458.
- Horan, D. (2022). Towards a portfolio approach: Partnerships for sustainable transformations. *Global Policy*, 13(1), 160–170. <https://doi.org/10.1111/1758-5899.13020>
- Ika, L. A., & Pinto, J. K. (2022). The “re-meaning” of project success: Updating and recalibrating for a modern project management. *International Journal of Project Management*, 40(7), 835–848. <https://doi.org/10.1016/j.ijproman.2022.08.001>
- Ingason, H. T., & Eskerod, P. (2024). Using simulations in project management education: Impact on awareness and ability to navigate projects in a sustainable way. *International Journal of Managing Projects in Business*, 17(2), 278–301. <https://doi.org/10.1108/IJMPB-08-2023-0179>
- International Council on Mining and Metals. (2025). *Responsible mining*. ICMM. <https://www.icmm.com/en-gb/mining-metals/responsible-mining>
- Irani, Z., Sharif, A. M., & Love, P. E. D. (2009). Mapping knowledge management and organizational learning in support of organizational memory. *International Journal of Production Economics*, 122(1), 200–215. <https://doi.org/10.1016/j.ijpe.2009.05.020>
- Kampf, C. E., Brandt, C. J., & Kampf, C. G. (2023). Using action research in innovation project management: Building legitimacy and organizational learning in an SME during a merger process. *International Journal of Managing Projects in Business*, 16(1), 92–118. <https://doi.org/10.1108/IJMPB-02-2020-0044>

- Kantabutra, S., & Ketprapakorn, N. (2020). Toward a theory of corporate sustainability: A theoretical integration and exploration. *Journal of Cleaner Production*, 270, 122292. <https://doi.org/10.1016/j.jclepro.2020.122292>
- Karman, A., Prokop, V., Giglio, C., & Rehman, F. U. (2024). Has the COVID-19 pandemic jeopardized firms' environmental behavior? Bridging green initiatives and firm value through the triple bottom line approach. *Corporate Social Responsibility and Environmental Management*, 31(1), 375-395.
- Katz, M. (2020). The need for socially responsible university educated professionals in the extractive industries. *The Extractive Industries and Society*, 7(4), 1351-1353.
- Kiani Mavi, R., Gengatharen, D., Kiani Mavi, N., Hughes, R., Campbell, A., & Yates, R. (2021). Sustainability in construction projects: A systematic literature review. *Sustainability (Switzerland)*, 13(4), 1-24. <https://doi.org/10.3390/su13041932>
- Kich, D. A. (2024). *The corporate sustainability reporting directive: Transforming corporate reporting landscapes*. UiT Norges arktiske universitet.
- Killen, C. P., Hunt, R. A., & Kleinschmidt, E. J. (2008). Learning investments and organizational capabilities: Case studies on the development of project portfolio management capabilities. *International Journal of Managing Projects in Business*, 1(3), 334-351. <https://doi.org/10.1108/17538370810883800>
- Kivilä, J., Martinsuo, M., & Vuorinen, L. (2017). Sustainable project management through project control in infrastructure projects. *International Journal of Project Management*, 35(6), 1167-1183. <https://doi.org/10.1016/j.ijproman.2017.02.009>
- Kunz, N. C., Kastle, T., & Moran, C. J. (2017). Social network analysis reveals that communication gaps may prevent effective water management in the mining sector. *Journal of Cleaner Production*, 148, 915-922.
- Landaeta, R. E. (2008). Evaluating benefits and challenges of knowledge transfer across projects. *Engineering Management Journal*, 20(1), 29-38. <https://doi.org/10.1080/10429247.2008.11431753>
- Lapeyronie, H., & Szedlacsek, E. (2025). Mining in Africa: Are local communities paying the price of the global energy transition? *Extractive Industries and Society*, 21, 101565. <https://doi.org/10.1016/j.exis.2024.101565>
- Lima, L., Trindade, E., Alencar, L., Alencar, M., & Silva, L. (2021). Sustainability in the construction industry: A systematic review of the literature. *Journal of Cleaner Production*, 289, 125730. <https://doi.org/10.1016/j.jclepro.2020.125730>
- Lujala, P. (2018). An analysis of the Extractive Industry Transparency Initiative implementation process. *World Development*, 107, 358-381. <https://doi.org/10.1016/j.worlddev.2018.02.030>
- Malik, M., Ali, M., Latan, H., & Chiappetta Jabbour, C. J. (2023). Green project management practices, green knowledge acquisition and sustainable competitive advantage: Empirical evidence. *Journal of Knowledge Management*, 27(9), 2350-2375.
- Marcelino-Sádaba, S., González-Jaen, L. F., & Pérez-Ezcurdia, A. (2015). Using project management as a way to sustainability: From a comprehensive review to a framework definition. *Journal of Cleaner Production*, 99, 1-16. <https://doi.org/10.1016/j.jclepro.2015.03.020>
- Martens, M. L., & Carvalho, M. M. (2016). The challenge of introducing sustainability into project management function: Multiple-case studies. *Journal of Cleaner Production*, 117, 29-40. <https://doi.org/10.1016/j.jclepro.2015.12.039>
- Martens, M. L., & Carvalho, M. M. (2017). Key factors of sustainability in project management context: A survey exploring the project managers' perspective. *International Journal of Project Management*, 35(6), 1084-1102. <https://doi.org/10.1016/j.ijproman.2016.04.004>
- Martins-Oliveira, A. T., Zanin, M., Canale, G. R., da Costa, C. A., Eisenlohr, P. V., de Melo, F. C. S. A., & de Melo, F. R. (2021). A global review of the threats of mining on mid-sized and large mammals. *Journal for Nature Conservation*, 62, 126025.
- McDougall, N., & Davis, A. (2024). The local supply chain during disruption: Establishing resilient networks for the future. *Journal of Cleaner Production*, 462, 142743. <https://doi.org/10.1016/j.jclepro.2024.142743>
- Meuer, J., Koelbel, J., & Hoffmann, V. H. (2020). On the nature of corporate sustainability. *Organization and Environment*, 33(3), 319-341. <https://doi.org/10.1177/1086026619850180>
- Midler, C. (2019). Projectification: The forgotten variable in the internationalization of firms' innovation processes? *International Journal of Managing Projects in Business*, 12(3), 545-564. <https://doi.org/10.1108/IJMPB-07-2018-0126>

- Miller, M., Appling, C., Ellis, N., & Bartram, J. (2024). External support for solar-powered water pumping systems in rural areas: A systematic review. *Environmental Science and Technology*, 58(41), 18053–18063. <https://doi.org/10.1021/acs.est.4c01264>
- Miterev, M. (2024). Raison d'être of organization design arrangements in project-based organizations. *Project Management Journal*, 55(5), 541–557. <https://doi.org/10.1177/87569728241270588>
- Miterev, M., Engwall, M., & Jerbrant, A. (2017). Mechanisms of isomorphism in project-based organizations. *Project Management Journal*, 48(5), 9–24. <https://doi.org/10.1177/875697281704800502>
- Muhirwa, F., Shen, L., Elshkaki, A., Hirwa, H., Umuziranenge, G., & Velepini, K. (2023). Linking large extractive industries to sustainable development of rural communities at mining sites in Africa: Challenges and pathways. *Resources Policy*, 81, 103322.
- Mulvaney, K. M., Selin, N. E., Giang, A., Muntean, M., Li, C. T., Zhang, D., Angot, H., Thackray, C. P., & Karplus, V. J. (2020). Mercury benefits of climate policy in China: Addressing the Paris agreement and the Minamata convention simultaneously. *Environmental Science and Technology*, 54(3), 1326–1335. <https://doi.org/10.1021/acs.est.9b06741>
- Pemsel, S., & Wiewiora, A. (2013). Project management office a knowledge broker in project-based organisations. *International Journal of Project Management*, 31(1), 31–42. <https://doi.org/10.1016/j.ijproman.2012.03.004>
- Perrini, F., & Tencati, A. (2006). Sustainability and stakeholder management: The need for new corporate performance evaluation and reporting systems. *Business Strategy and the Environment*, 15(5), 296–308.
- Pranugrahaning, A., Donovan, J. D., Topple, C., & Masli, E. K. (2021). Corporate sustainability assessments: A systematic literature review and conceptual framework. *Journal of Cleaner Production*, 295, 126385. <https://doi.org/10.1016/j.jclepro.2021.126385>
- Project Management Institute (PMI). (2017). *The standard for portfolio management—Fourth edition*. PMI.
- Sabini, L., Muzio, D., & Alderman, N. (2019). 25 years of 'sustainable projects': What we know and what the literature says. *International Journal of Project Management*, 37(6), 820–838. <https://doi.org/10.1016/j.ijproman.2019.05.002>
- Saldaña, J. (2021). *The coding manual for qualitative researchers* (2nd ed.). SAGE Publications.
- Schilling, J., & Kluge, A. (2009). Barriers to organizational learning: An integration of theory and research. *International Journal of Management Reviews*, 11(3), 337–360. <https://doi.org/10.1111/j.1468-2370.2008.00242.x>
- Schipper, R. P. J. R., & Silvius, G. (2018). Towards a conceptual framework for sustainable project portfolio management. *International Journal of Project Organisation and Management*, 10(3), 191–221. <https://doi.org/10.1504/IJPOM.2018.093977>
- Sense, A. J. (2011). The project workplace for organizational learning development. *International Journal of Project Management*, 29(8), 986–993. <https://doi.org/10.1016/j.ijproman.2011.01.012>
- Silvius, G., & Marnewick, C. (2022). Interlinking sustainability in organizational strategy, project portfolio management and project management: A conceptual framework. *Procedia Computer Science*, 196, 938–947. <https://doi.org/10.1016/j.procs.2021.12.095>
- Smulowitz, S. J., Cossin, D., & Lu, H. (2023). Managerial short-termism and corporate social performance: The moderating role of external monitoring. *Journal of Business Ethics*, 188(4), 759–778. <https://doi.org/10.1007/s10551-023-05498-7>
- Söderholm, P., & Svahn, N. (2015). Mining, regional development and benefit-sharing in developed countries. *Resources Policy*, 45, 78–91. <https://doi.org/10.1016/j.resourpol.2015.03.003>
- Söderlund, J., & Sydow, J. (2019). Projects and institutions: Towards understanding their mutual constitution and dynamics. *International Journal of Project Management*, 37(2), 259–268. <https://doi.org/10.1016/j.ijproman.2019.01.001>
- Sonmez, R., Sönmez, F. Ö., & Ahmadiheykhsarmast, S. (2023). Blockchain in project management: A systematic review of use cases and a design decision framework. *Journal of Ambient Intelligence and Humanized Computing*, 14(7), 8433–8447. <https://doi.org/10.1007/s12652-021-03610-1>

- Stanitsas, M., Kirytopoulos, K., & Leopoulos, V. (2021). Integrating sustainability indicators into project management: The case of construction industry. *Journal of Cleaner Production*, 279, 123774. <https://doi.org/10.1016/j.jclepro.2020.123774>
- Swinkels, L., & Markwat, T. (2023). Corporate carbon emissions data for equity and bond portfolios. *Managerial Finance*, 50(1), 118-139.
- Takacs, F., Brunner, D., & Frankenberger, K. (2022). Barriers to a circular economy in small- and medium-sized enterprises and their integration in a sustainable strategic management framework. *Journal of Cleaner Production*, 362, 132227. <https://doi.org/10.1016/j.jclepro.2022.132227>
- Tao, S., Pang, X., Qiu, Y., Xu, Q., & Xue, P. (2024). Green innovation in megaprojects: A capacity-based analysis of the Shenzhong Link Project in China. *Project Leadership and Society*, 5, 100144. <https://doi.org/10.1016/j.plas.2024.100144>
- Troje, D. (2023). Social sustainability in projects: Using social procurement to create employment in the Swedish construction sector. *Project Management Journal*, 54(1), 52-69. <https://doi.org/10.1177/87569728221126907>
- Unger, B. N., Rank, J., & Gemünden, H. G. (2014). Corporate innovation culture and dimensions of project portfolio success: The moderating role of national culture. *Project Management Journal*, 45(6), 38-57. <https://doi.org/10.1002/pmj.21458>
- United Nations. (2021). *Transforming extractive industries for sustainable development* (May Issue). <https://unece.org/sustainable-energy/publications/policy-brief-transforming-extractive-industries-sustainable>
- Uriarte, Y. T., DeFillippi, R., Riccaboni, M., & Catoni, M. L. (2019). Projects, institutional logics and institutional work practices: The case of the Lucca Comics & Games Festival. *International Journal of Project Management*, 37(2), 318-330. <https://doi.org/10.1016/j.ijproman.2018.09.001>
- Vijge, M. J., Metcalfe, R., Wallbott, L., & Oberlack, C. (2019). Transforming institutional quality in resource curse contexts: The Extractive Industries Transparency Initiative in Myanmar. *Resources Policy*, 61, 200-209. <https://doi.org/10.1016/j.resourpol.2019.02.006>
- Walsh, J. P., & Ungson, G. R. (2009). Organizational memory. *Knowledge in Organisations*, 16(1), 177-212. <https://doi.org/10.5465/amr.1991.4278992>
- Wiewiora, A., Chang, A., & Smidt, M. (2020). Individual, project and organizational learning flows within a global project-based organization: Exploring what, how and who. *International Journal of Project Management*, 38(4), 201-214. <https://doi.org/10.1016/j.ijproman.2020.03.005>
- Wiewiora, A., Smidt, M., & Chang, A. (2019). The “how” of multilevel learning dynamics: A systematic literature review exploring how mechanisms bridge learning between individuals, teams/projects and the organization. *European Management Review*, 16(1), 93-115. <https://doi.org/10.1111/emre.12179>
- Winch, G. M., Geels, F., Locatelli, G., & Sergeeva, N. (2023). Projecting for sustainability transitions. *International Journal of Project Management*, 41(3), 102456. <https://doi.org/10.1016/j.ijproman.2023.102456>
- Winch, G. M., & Maytorena-Sanchez, E. (2020). Institutional projects and contradictory logics: Responding to complexity in institutional field change. *International Journal of Project Management*, 38(6), 368-378. <https://doi.org/10.1016/j.ijproman.2020.08.004>
- Xu, X., & Liu, Y. (2023). The association between managerial short-termism and green innovation: The moderating role of firms’ digital transformation. *Asia Pacific Journal of Innovation and Entrepreneurship*, 17(3/4), 195-214. <https://doi.org/10.1108/apjie-07-2023-0147>
- Zheng, X., Lu, Y., Ma, C., Yuan, J., Stenseth, N. C., Hessen, D. O., Tian, H., Chen, D., Chen, Y., & Zhang, S. (2023). Greenhouse gas emissions from extractive industries in a globalized era. *Journal of Environmental Management*, 343, 118172.
- Zou, X., Yang, Q., Wang, Q., & Jiang, B. (2024). Measuring the system resilience of project portfolio network considering risk propagation. *Annals of Operations Research*, 340(1), 693-721. <https://doi.org/10.1007/s10479-022-05100-9>

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Appendix: List of Publications and Presentations

Presentations

Aghajani, M., Kiani Mavi, R., Ruge, G., & Jugdev, K. (2024). *Integrating sustainability in project portfolios: An investigation of barriers and drivers in extractive companies* [PowerPoint Presentation], International Research Network on Organizing by Projects (IRNOP) Conference, Stockholm, Sweden, 11–14 June 2024.

Aghajani, M., Kiani Mavi, R., Ruge, G., & Jugdev, K. (2024). *Integrating sustainability in project portfolios: An investigation of barriers and drivers in extractive companies* [PowerPoint Presentation], 2024 Society of Interdisciplinary Business Research (SIBR2024) Conference, Osaka, Japan, 4–6 July 2024.

Aghajani, M., Kiani Mavi, R., Ruge, G., & Jugdev, K. (2024). *Embedding sustainability in project portfolio management: Insights from extractive industries* [PowerPoint Presentation], 2024 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2024), Bangkok, Thailand, 15–18 December 2024.



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