Sustainable Project Portfolio Management – A Design Science Research Approach

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Sustainable Project Portfolio Management – A Design Science Research Approach

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Abstract

This paper follows the Design Science Research (DSR) approach to address the integration of sustainability into Project Portfolio Management (PPM). The current research identifies the key challenges in sustainable project management and how DSR methodology guides the iterative design, development, and evaluation of an artefact that integrates sustainability within the PPM context. The proposed Sustainable Project Portfolio Management (SPPM) framework builds on the Triple Bottom Line (TBL) sustainability principles, incorporating Project Materiality Assessments and data-driven decision-making tools to ensure that the three sustainability dimensions (economic, social, and environmental) are fully embedded in project selection and management processes. The research paper presents the design and development of the artefact, followed by its rigorous evaluation to assess effectiveness in achieving sustainability-driven project outcomes. The findings show that integrating sustainability within PPM through the SPPM framework provides a strategic alignment, better decision-making, and greater adherence to sustainability goals. The knowledge derived from this research, along with the identified limitations, is discussed, laying the groundwork for further refinement of the SPPM artefact. The paper outlines the contributions of the SPPM artefact to sustainable project management practices.

Keywords: sustainable project portfolio management, design science research, project materiality, sustainability disclosure standards, analytics

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1. INTRODUCTION

In recent years, sustainability has evolved from a peripheral concern to a mainstream and strategic imperative, influencing industries, government policies, and individual behaviour (Silvius & Marnewick, 2022). This shift is more than a mere trend and reflects an urgent response to global challenges like climate change, resource scarcity, and social inequality (van Tulder et al., 2014). Sustainability has become a complex paradigm that shapes the balance between environmental, social and economic considerations (Holling, 2001). It demands a rethinking of how we produce, consume, and manage the resources at our disposal.

Despite growing recognition, there is a notable gap in translating sustainability principles into practical, standardised methodologies for managing environmental, social, and economic outcomes throughout the project lifecycle (Blak Bernat et al., 2023). Existing research offers limited empirical guidance on integrating sustainability into project decision-making, risk assessment, and governance. Much of the existing literature focuses on embedding sustainability within individual projects; however, sustainability as a paradigm extends beyond the project lifecycle. This requires practitioners to move beyond project-specific timeframes and adopt a more holistic, long-term approach to delivering sustainable value. This gap is further widened by a lack of insight into leadership commitment, stakeholder engagement, and digital tools that enable the operationalisation and evaluation of sustainability at the project level (Silvius, 2021). Consequently, business leaders as well as practitioners lack clear, evidence-based frameworks and tools to embed sustainability consistently in project management methodology (Risso, 2022; Yu et al., 2018).

Three key challenges are addressed in this paper: *Firstly*, integrating and aligning sustainability principles into organisational project management practices to meet sustainability objectives. *Secondly,* the application of analytics to enhance decision-making processes, bridging the gap between qualitative and quantitative metrics within sustainability and Project Portfolio Management (PPM). This would help to develop advanced prediction models, data-driven decision-making (Hanafizadeh & Ashhari, 2025), and the delivery of sustainable project outcomes. *Finally*, organisations need to restructure existing PPM practices (Silvius & Marnewick, 2022) with as little disruption as possible and seamless integration of sustainability principles to accommodate emerging regulatory requirements. This is an area that is barely discussed in the literature, which will mandate organisational commitment towards sustainable activities.

This research utilises Design Science Research (DSR) (Baskerville et al., 2015; Gregor & Hevner, 2013; Schoormann et al., 2022; V. K. Vaishnavi & Kuechler, 2015; vom Brocke et al., 2020) to develop an artefact for sustainable project portfolio management and derive relevant knowledge from the process. DSR is essentially a structured problem-solving paradigm (vom Brocke et al., 2020) that aims to advance human knowledge through the development of innovative and purposeful artefacts and the creation of design knowledge (DK) by finding creative solutions to real-world issues (Hevner et al., 2004). Keeping with the fundamentals of DSR, the sustainable project portfolio management framework in this research has been designed to be iterative, cyclical, and non-linear, allowing for continuous refinement through cycles of theory and application.

After the introduction, the paper reviews sustainability as a guiding paradigm in project portfolio management before identifying the research gap in Section 3. Section 4 then explains the design science research methodology and approach used to create the SPPM artefact, followed by Sections 5 and 6, which provide a description of the framework's design and development. Finally, we discuss how DSR enriches our understanding, we acknowledge the study's limitations, and we wrap up with a concise conclusion.

2. LITERATURE REVIEW

2.1. Sustainability

The complexity inherent in understanding sustainability presents both a challenge and an opportunity due to the vast number of possible definitions (Cadenasso & Pickett, 2018). The Brundtland Report by the World Commission on Environment and Development (WCED) laid the foundation by defining sustainability as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). This broad-based definition has given rise to numerous interpretations across diverse domains, including ethics, corporate strategy, philosophy, environmental management and society (Cadenasso & Pickett, 2018). John Elkington's seminal work on the Triple Bottom Line (TBL) provided an instrument through which sustainability could be operationalised across three interconnected pillars: economic performance, environmental protection, and social equity (Elkington, 1997, 1999). In contrast to conventional approaches, both traditional and those currently in practice, which tend to treat the economic, social, and environmental dimensions of sustainability as separate and often disconnected domains, a sustainability-driven framework necessitates an integrated approach. It is key to recognise the complex interdependencies and trade-offs between them. This holistic integration ensures that decisions made in one domain do not undermine progress in another (Al-Marri & Pinnington, 2022; Høgevold et al., 2015; Padin et al., 2016). Thus, the integrating of sustainability within processes and practices should be seen as a strategic activity and not piecemeal or tactical.

The disruptive influence of sustainability redefines our value systems and success (Sardianou et al., 2021). Despite the advances in defining and understanding sustainability, there remains a significant challenge in effectively integrating these principles into organisational practices, particularly in project management (PM). Project management serves as a core function in turning organisational strategy into reality (Silvius & Marnewick, 2022). Integrating sustainability within its practices requires more than a technical shopping list; it demands a behavioural, cultural and strategic transformation (Silvius, 2017). This involves revisiting key elements such as project selection criteria, and material assessments (To & Chau, 2022; Wu et al., 2018) of industry-specific indicators (Kuzemko & Britton, 2020) and the use of both qualitative and quantitative insights to guide decision-making. The journey towards this integration is complex, requiring innovation in both practice and mindset. This paper explores how sustainability, when viewed as an integrated element of strategic project management, can become a driving force for long-term value creation across economic, social, and environmental domains.

2.2. Sustainability in Project Portfolio Management

To set the scene, it is essential to examine the two main domains of project activities, i.e., project management (PM) and project portfolio management (PPM), to ensure that sustainability is embedded not only at the level of individual projects but also across the broader strategic landscape of an organisation's portfolio. This creates alignment between the operational execution of projects and the overall strategic intent of the organisation, allowing sustainability to be considered right from the outset, i.e., an organisational strategy for project selection, implementation and delivery (Kaiser et al., 2015; Martinsuo & Geraldi, 2020; Moustafaev, 2017c, 2017a). The examination also enables the development of structured methodologies and relevant frameworks that produce tangible as well as measurable sustainability outcomes. Furthermore, the process as well as the outputs of project activities can be systematically evaluated against environmental, social, and economic criteria, ensuring that the organisation's sustainability commitments are achieved through its project practices.

Project management (PM), as defined by the Project Management Institute (Project Management Institute, 2021), refers to a temporary initiative involving the application of specialised knowledge, skills, tools, and techniques to fulfil project requirements. Project requirements have predefined limitations of time, cost, and scope or quality (Martinsuo & Geraldi, 2020; Martinsuo & Lehtonen, 2007). Essentially, PM focuses mainly on the outcome or deliverables of the project (Artto et al., 2008; Doorasamy, 2017; Pensenstadler & Femmer, 2013). This approach implies that a project's primary purpose is fulfilled once its immediate objectives are met, at which point it ceases to have further value from a PM perspective.

Project Portfolio Management (PPM), as described by Project Management (Project Management Institute, 2021), involves the coordination and organisation of projects and programmes to achieve strategic business objectives (Clegg et al., 2018). Unlike traditional PM, which focuses on individual project outcomes, PPM is about managing an entire suite of projects in a way that maximises their collective contribution to the organisation's goals. According to Cooper et al. (2001), PPM plays a vital functional role in selecting, prioritising, controlling, and monitoring projects. This ensures that resources are allocated effectively, and risks are managed strategically to create a competitive edge for the organisation (Moustafaev, 2017b). A key distinction is that PM is time-bound, while PPM is a continuous process. Given sustainability's long-term, ongoing nature, it may be argued that PPM offers a more suitable and enduring platform for its integration.

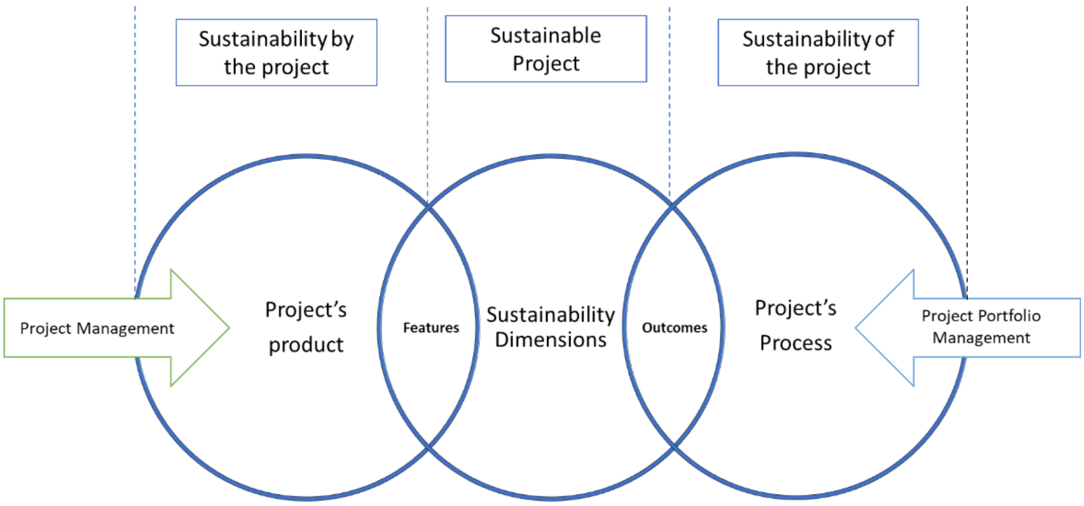
PPM, therefore, provides a strategic platform through which sustainability can be operationalised across the organisational landscape. While much of the literature has traditionally focused on embedding sustainability within individual projects (Huemann & Silvius, 2017), this approach often confines sustainability to the limited timeframe and scope of project execution. In contrast, PPM enables a long-term, integrated perspective that aligns project selection, prioritisation, and governance with enduring sustainability objectives (Wagner et al., 2021). This distinction is crucial, as sustainability extends well beyond the lifecycle of individual projects and requires systemic thinking, strategic alignment, and ongoing evaluation. As such, PPM is better positioned to translate sustainability ambitions into tangible, organisation-wide outcomes. Furthermore, it is a more suitable mechanism for embedding sustainability into strategic project decision-making.

The strategic orientation of PPM allows for a more holistic view of projects (Moustafaev, 2017b), considering their alignment with organisational values and sustainable practices (Meredith et al., 2016). This perspective transcends the limited lifecycle of individual projects and positions PPM as a vital component for achieving broader strategic objectives, including sustainability, risk management, and resource efficiency (Craddock et al., 2017). By adopting this wider perspective, PPM ensures that projects are not isolated tasks but interconnected efforts that collectively work towards fulfilling the organisation's strategic vision.

Furthermore, there remains a significant gap in research concerning the use of PPM as a mechanism that can be systematically applied across the entire product lifecycle, from concept to retirement. Exploring PPM in this broader context could provide valuable insights into how to maintain strategic alignment and sustainability throughout a product's life, beyond just the execution of individual projects. This research gap highlights the potential for PPM to evolve further, expanding its application to include not only the management of projects but also the management of products and services throughout their entire lifecycle (Craddock et al., 2017). A comprehensive approach would ensure that all projects contribute meaningfully to sustainable, long-term organisational success, fostering innovation while maintaining alignment with strategic objectives. (Huemann & Silvius, 2017; Silvius, 2021; Silvius & Marnewick, 2022).

The Association of Project Management (APM) emphasises that tactical projects should only be executed if they contribute to the broader strategic objectives of the organisation (APM Portfolio Management SIG, 2019). This alignment ensures that each project undertaken has a meaningful role and is aligned with the broader organisational goals. However, when we shift the focus to sustainability, the perspective broadens significantly. Sustainability considerations often include more far-reaching and long-term questions about the responsible use of resources, social equity, and the ethical behaviour of organisations. These considerations are often peripheral to the immediate goals of a project, which are typically time-bound and target-oriented. It can, therefore, be inferred that sustainability integrated into PM will be "sustainability by the project" (Huemann and Silvius, 2017) with a narrow focus on the product or deliverable, as depicted in Figure 1 (*Product versus Process sustainability in project environment*).

Figure 1: Product versus process sustainability in the project environment



The integration of sustainability into project management practices requires a shift beyond the confines of traditional PM. While conventional PM approaches are effective in achieving short-term project goals, the integration of sustainability is best facilitated through PPM, which provides a more strategic context for sustainability without being held back by the pre-defined limitations of PM. PPM necessitates moving into the more strategic domain, where projects are seen as components of a broader strategic initiative rather than isolated activities. PPM enables organisations to align individual projects with long-term strategic goals, including sustainability objectives. It provides the framework for assessing projects not just in terms of cost, quality, and time, but also their contribution to overarching goals like organisational goals, sustainability, ethical responsibility, and value creation for all stakeholders (Singh Dara Singh et al., 2021). This strategic approach encourages project practitioners to consider the impact of projects not only during the project lifecycle but also in terms of their lasting effects on the project deliverables and subsequently the triple bottom line (TBL).

How do we then square the circle of integrating a phenomenon into projects that exist beyond the lifecycle of projects? The research methodology employed in this paper uses Design Science Research (DSR), which aims to create and evaluate artefacts intended to solve the problems identified.

3. METHODOLOGY

The research methodology employed in this study is Design Science Research (DSR), which aims to create and evaluate artefacts intended to solve identified problems. Vaishnavi & Kuechler (2015) define Design Science Research (DSR) as a research paradigm where knowledge is expressed through constructs, techniques, methods, and models, as well as thoroughly developed theories (Vaishnavi & Kuechler, 2015). This knowledge base equips practitioners with the essential expertise to design and create artefacts, social innovations or new social, technical and informational properties (Peffers et al., 2007) that fulfil predefined functional requirements efficiently to solve a problem. vom Brocke et al. (2020) have considered DSR primarily as a problem-solving framework that focuses on enhancing human understanding and capability. It achieves this through the development of innovative artefacts and the generation of design knowledge (DK) (Gregor & Zwikael, 2024). By creating novel solutions to practical, real-world challenges, DSR not only contributes to the theoretical foundations of various disciplines but also provides tangible, effective tools and methods that address these issues directly. This approach integrates both theoretical research and practical application, bridging the gap between knowledge creation and its practical deployment. DSR has demonstrated substantial economic and social value within information systems (IS), and it serves as a core methodological approach in disciplines such as engineering, architecture, business, economics, and information technology for addressing practical design challenges (Gregor & Hevner, 2013; Hevner et al., 2004). The authors view DSR as a constructivist approach for finding solutions to complex research problems (Avenier, 2010) primarily because it purposefully constructs knowledge by building and refining solutions grounded in both theory and practice (Gregor & Hevner, 2013).

To begin with, there is a notable lack of literature on design science research (DSR) within the project management field. Much of what can be found focuses on information systems (IS). In the IS discipline, design knowledge (DK) encompasses knowledge about designing databases, modelling business processes, aligning IS with organisational strategies and leveraging data analytics (Baskerville et al., 2015; Moutinho et al., 2024; vom Brocke et al., 2020). Fundamentally, DSR for IS has many similarities that can be applied for building an artefact that supports sustainable project portfolio management as a business process. Both domains share a focus on developing artefacts that address complex organisational problems. IS provides data-driven insights and tools that enhance project management decision-making (vom Brocke et al., 2020). Project management (PM) is itself better understood through existing artefacts which organise and construct processes and exhibit greater clarity through the visual presentation of its processes, whether in PM or PPM. These may otherwise be complex and difficult to comprehend.

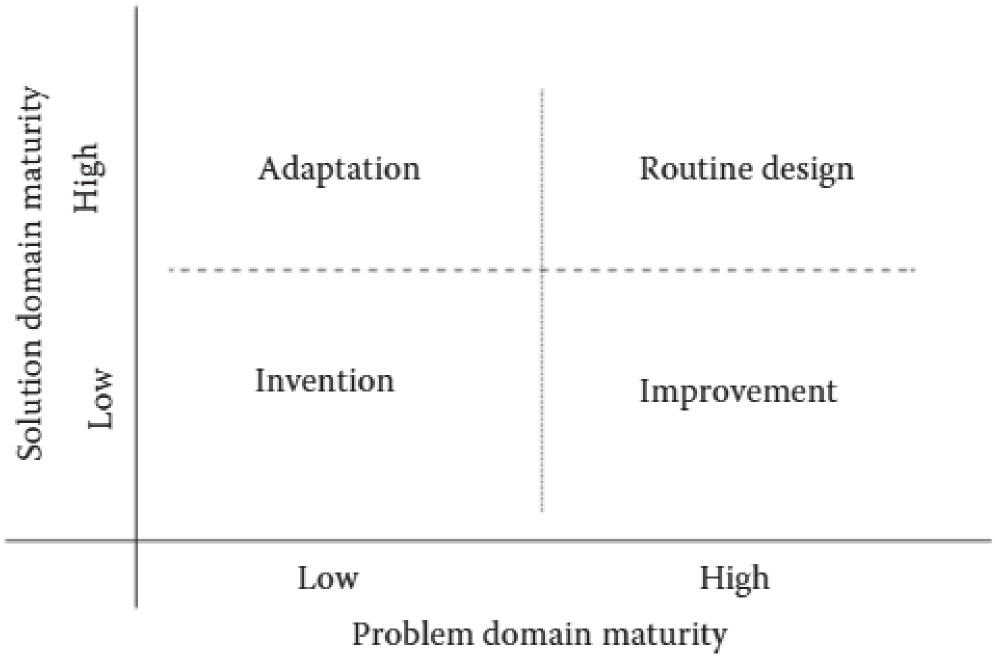
Design researchers frequently adopt conceptual frameworks from various disciplines, examining their relevance and application in different and multiple design contexts. Common concepts widely embraced within the design community include functionality or usability, context, and the situation of the context (Stolterman, 2008). These borrowed theories or concepts are typically employed to both stimulate the creation of new designs and to describe existing ones more effectively in a new environment. This study adopts a similar approach by assembling various recognised and tested frameworks and standards like a jigsaw puzzle to form a comprehensive solution to a real-world problem. Given the conceptual and artefactual nature of this research, the artefact is justified through analytical evaluation, existing literature-based grounding, and internal logical coherence, creating a solution for a real-world problem. The framework components are derived from established standards such as the Global Reporting Initiative (GRI) (Global Sustainability Standards Board, 2020) and PPM, ensuring external validity through alignment with recognised sustainability criteria. Analytical walkthroughs of hypothetical use scenarios demonstrate the artefact’s functional utility and replicability, while internal consistency checks confirm the soundness of the design. As such, this study adheres to DSR principles without relying on primary empirical data, consistent with the positioning and presentation of the DSR approach laid out by Gregor & Hevner, 2013.

4. DSR OUTPUTS

The primary outcome of a Design Science Research (DSR) project is the creation of design science knowledge (V. K. Vaishnavi & Kuechler, 2015). To fully understand the potential contributions this knowledge can make, it is important to explore the different types of contributions that DSR can offer. As illustrated in the framework by Gregor & Hevner, 2013 in Figure 2, DSR contributions can be categorised into four distinct types:

1. **Invention**: This involves the generation of entirely new knowledge or solutions for problems that have not been previously addressed. It represents a pioneering effort to create innovative approaches or artefacts that solve emerging challenges.
2. **Improvement:** This refers to the development of new knowledge or solutions aimed at enhancing existing methods or addressing known problems more effectively. Improvement builds upon current understanding to refine and optimise solutions.
3. **Adaptation**: This entails the non-trivial or innovative modification of existing knowledge or solutions to tackle new or different problems. Adaptation involves taking established concepts and creatively applying or adjusting them to fit new contexts.
4. **Routine design:** This involves applying established knowledge or solutions to known problems, but typically does not constitute a significant research contribution. For a contribution to be deemed substantial, it has to advance the current state of knowledge in the field and be deemed interesting.

Figure 2. DSR contributions framework (Gregor & Hevner, 2013)



It is important to note that a single DSR project can contribute in more than one of these ways, providing a multifaceted impact. March & Smith (1995) explain the potential outputs of design science knowledge, which can be represented by the following:

1. **Artefacts:** These can include constructs (theoretical concepts), models (representations of relationships), frameworks (structured approaches), architectures (design structures), design principles (guidelines for creating solutions), methods (procedural approaches), and instantiations (concrete implementations of solutions). These have been described further and associated with sustainable project management in Table 1, below:
2. **Design Theories (DTs):** Design theories generally encompass abstract artefacts and may also include instantiations. They provide a comprehensive framework for understanding and applying design science knowledge, integrating theoretical and practical elements.

Table 1. DSR and mapping to Sustainable Project Portfolio Management

Types of Artefacts	Description of DSR Perspective	Mapping to Sustainable Project portfolio management (SPPM)
Constructs	Constructs are the fundamental building blocks of a theory, representing key concepts used to describe and understand the problem domain.	These represent key concepts such as sustainability indicators, project materiality, and Triple Bottom Line (TBL) criteria. In SPPM, constructs help define and categorise what sustainability means within the portfolio management context, providing a common vocabulary for evaluating project alignment with sustainability objectives.
Models	Models are abstract representations that depict the relationships between constructs, helping to visualise and understand interactions within the problem or solution.	Models can depict relationships between projects, sustainability factors, and portfolio outcomes, helping to visualise how sustainability is integrated and evaluated across the portfolio.
Frameworks	Frameworks provide a systematic approach to addressing a problem or developing a solution, organising constructs, models, methods, and principles into a coherent structure.	The SPPM framework itself is a key DSR output that provides the structural approach for integrating sustainability into PPM. It defines the overarching structure, including governance, criteria, and processes, needed to effectively align project portfolios with sustainability goals.
Architectures	Architectures describe the design structure of the artefact, outlining the organisation of components and their interactions to achieve the desired functionality.	This includes the design of systems for capturing sustainability data, project categorisation, and communication channels that enable sustainability considerations to be factored into all portfolio decisions.
Design Principles	Design principles are prescriptive guidelines that inform the creation and refinement of artefacts, offering actionable advice for achieving specific goals.	For SPPM, design principles ensure that projects are assessed not only for financial value but also for their contribution to economic, social, and environmental impacts.
Methods	Methods are the procedural approaches used in the design and development of artefacts, ensuring systematic research and rigorous standards.	Methods may include procedures for conducting materiality assessments, evaluating sustainability metrics, or prioritising projects based on their environmental and social contributions.
Instantiations	Instantiations are the concrete implementations of the artefact, demonstrating the practical application of theoretical concepts, models, and principles.	Instantiations could involve a functioning software tool or a set of practices used to assess project sustainability within an organisation. These instantiations ensure that the theoretical components of SPPM are operationalised effectively.

To gain a deeper understanding of the different forms of contribution to knowledge within DSR, we will now examine the various types of design science knowledge in detail, culminating in an in-depth discussion of design theories and their role in advancing the field.

4.1 Phases of Design Science Research

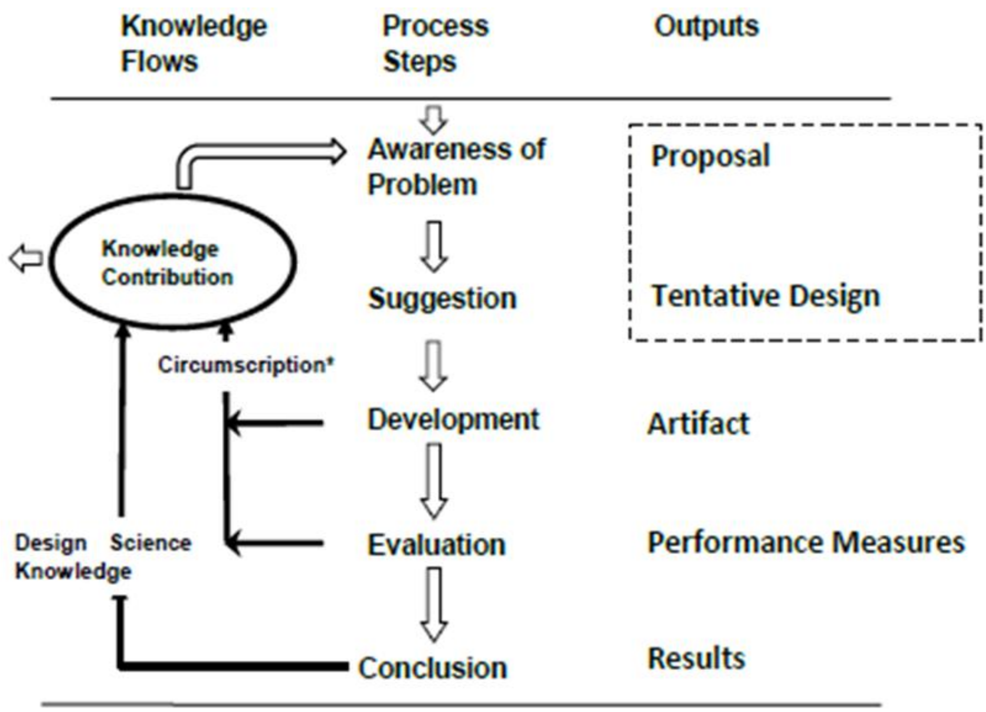
The Design Science Research (DSR) methodology progresses through a series of iterative phases, each designed to systematically address a real-world problem by developing and evaluating innovative artefacts that contribute both to practical solutions and theoretical knowledge.

Awareness of the Problem: This phase involves identifying and understanding the issue that needs addressing, establishing its significance (vom Brocke et al., 2020). It provides the foundation for credible goal setting, bridging gaps in existing research, and enables clear communication of the solution through an innovative artefact (V. K. Vaishnavi & Kuechler, 2015). The outcome is a formal or informal proposal to support the research.

Suggestion: This phase focuses on generating potential ideas or configurations for solutions (Aldin, 2010). The aim is to reach a tentative design for the artefact, often involving exploratory and inferential approaches (Peffers et al., 2007; vom Brocke et al., 2020). While inherently creative, this stage relies heavily on human intuition, which is critiqued for its unpredictability (Tuunanen et al., 2024; vom Brocke et al., 2020). A gap analysis is suggested to understand the current versus desired outcomes for the artefact.

Development and Design: This phase is dedicated to constructing the artefact, defining its desired functions and structure (V. K. Vaishnavi & Kuechler, 2015; vom Brocke et al., 2020). The artefact can be any designed object that incorporates research contributions.

Figure 3: Phases of DSR (V. K. Vaishnavi & Kuechler, 2015)



Evaluation: Evaluation involves assessing whether the artefact effectively addresses the problem, matching the intended objectives with actual outcomes (Hevner et al., 2004). Researchers may revisit the development phase to improve the artefact or proceed to communicating the findings (Gregor & Hevner, 2013; Moutinho et al., 2024; Tuunanen et al., 2024). Evaluation can be conducted using various techniques, including observational, experimental, and analytical methods (Baskerville et al., 2015; Hevner et al., 2004; Venable et al., 2016). The process may follow a positivist approach or incorporate interpretive techniques for a more thorough analysis (Baskerville et al., 2015).

Conclusion Phase: This phase represents the end of a research cycle, consolidating the results and categorising the findings into verified facts and unresolved issues (Hevner et al., 2004). Effective communication is essential here, as it helps to articulate the research's contribution clearly (Gregor & Hevner, 2013). The conclusion phase involves documenting outcomes and positioning the research appropriately within the broader knowledge landscape.

A thorough understanding of the DSR phases ensures that the Sustainable Project Portfolio Management (SPPM) framework is rigorously developed, assessed, and refined, providing a tool to effectively integrate sustainability into portfolio decision-making processes.

5. DESIGN & DEVELOPMENT OF THE ARTEFACT - SPPM FRAMEWORK

5.1 Underpinning Considerations

Organisations today are increasingly subject to rigorous assessments concerning the impacts of their activities on sustainability. These assessments are mandated through disclosures using recognised standards (Courtnell, 2019; Global Sustainability Standards Board, 2020; Global Reporting Initiative, 2021). This research highlights the value of using sustainability criteria derived from well-known disclosure standards such as the GRI (Global Reporting Initiative, 2021), CDP (Carbon Disclosure Project, 2023), and SASB (Sustainability Accounting Standards Board, 2023). These standards have been adopted globally for the purpose of sustainability reporting. Furthermore, the evolving nature and continuous development of these standards reflects a proactive stance towards governance and sustainability benchmarks, helping organisations stay ahead of compliance risks while supporting innovation in sustainable practice (Lai & Stacchezzini, 2021). For project professionals, this means that project and portfolio-level materiality assessments remain current, standardised, and consistent with best practices globally. It empowers them to make informed, evidence-based decisions while demonstrating commitment to sustainable development objectives and reinforcing organisational reputation and trust.

5.2 Employing Sustainability Disclosure Criteria in PPM

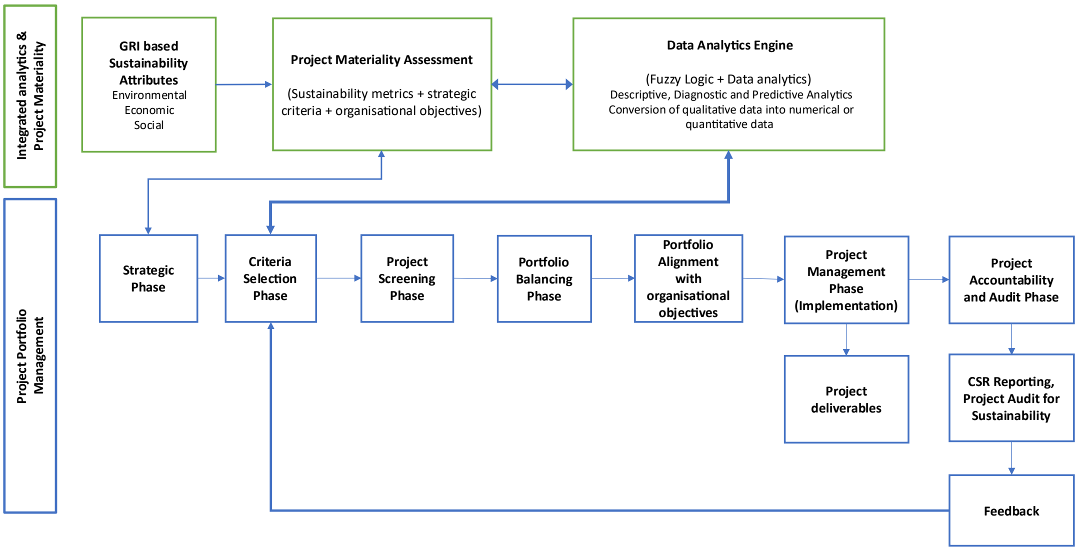
Sustainability disclosure standards are mainly designed to enable organisations to report sustainability performance and are, therefore, descriptive in nature and context. These standards do not tackle the specific challenges of managing sustainability within projects, which requires a more prescriptive approach. Nevertheless, there is a wealth of detail in the form of sustainability related attributes that can be employed as key performance indicators (KPIs) (Lai & Stacchezzini, 2021) as well as building the criteria within project portfolio management (PPM) processes for the screening and selection of new projects within the portfolio. This research paper uses the Global Reporting Initiative (GRI), a recognised standard to help develop sustainability criteria for PPM. GRI offers structured guidelines through industry-specific reporting standards which can be further mapped to the more universal and globally recognised United Nation's Sustainability Development Goals (UN SDGs) (Tsalis et al., 2020; United Nations, 2015). GRI also supports continuous improvement by promoting regular reviews and updates. It is important to point out that although GRI has global applicability, ensuring relevance across a number of sectors and organisational sizes, it remains a work in progress. New industries are brought into its purview after regular consultative rounds with industry experts.

6. THE SPPM FRAMEWORK

The aim is to design a composite sustainable project portfolio management (SPPM) framework that derives project criteria from established sustainability disclosure standards and applies analytics for decision-making in a manner that creates minimal disruption to existing PPM practices. DSR is applied not in the abstract but to create a sustainable project portfolio management (SPPM) framework that addresses the real-world problem of integrating sustainability into project portfolio management. Furthermore, the DSR artefact should be grounded in the literature and established models, and it needs to address the integration of sustainability in PPM, and the design process has to be logical and replicable (Schoormann et al., 2022; V. K. Vaishnavi & Kuechler, 2015). The PPM framework itself is based on tested and accepted frameworks derived from the works of Moustafaev (2017b), Risso (2022), (Patanakul, 2022), which ensures; a structured method to screen and select the right projects; strategic alignment with the organisation's objectives; balancing the portfolio; and a feedback loop that allows for accountability and improvement of the process. Figure 4 (*The Sustainable Project Portfolio Management (SPPM) Framework)* illustrates a framework that integrates project materiality assessment and data analytics to ensure alignment with organisational sustainability objectives.

The process begins with the incorporation of sustainability attributes i.e. environmental, economic, and social features derived from the established Global Reporting Initiative (GRI) standards (Global Reporting Initiative, 2021). These feed into a project materiality assessment that combines sustainability attributes, a strategy defined by the leadership, and organisational goals to determine the most relevant project considerations. This assessment is supported by a data analytics engine, which uses fuzzy logic analytics to convert qualitative sustainability data into measurable, quantitative indicators. Stakeholder intervention may be required before finalising the project criteria. These insights are then applied throughout the project portfolio lifecycle, beginning with the strategic phase, followed by criteria selection and project selection and screening. Once screened, projects move into a balancing phase, where the portfolio is optimised and then aligned with broader organisational objectives (Moustafaev, 2017b). This is followed by the implementation of the project management phase, leading to the delivery of project outcomes. The final stages involve accountability and audit processes, including sustainability audits and corporate social responsibility (CSR) reporting (Christensen et al., 2019, 2021; Delbard, 2008). Feedback from these activities loops back into the system, ensuring continuous improvement in all areas of the PPM process. This approach underpins sustainability integration throughout the portfolio of projects, enabling organisations to meet both strategic and regulatory demands effectively.

Figure 4: The Sustainable Project Portfolio Management (SPPM) Framework



6.1 Defining Project materiality for PPM

The concept of 'materiality' in sustainability was originally borrowed from financial reporting, where it refers to the significant economic, environmental, and social effects of a company, or how these effects shape stakeholders' evaluations and decisions (Ferraro & Reid, 2013; Jørgensen et al., 2022; To & Chau, 2022; Wu et al., 2018). This paper applies the concept of materiality to project portfolio management (PPM) by using the Global Reporting Initiative (GRI) guidelines to systematically identify the most significant sustainability issues relevant to the organisation, its portfolio, and individual projects. GRI provides a wealth of materiality-related topics, which can be very helpful in formulating a sustainability-driven project strategy (Courtnell, 2019; Dumay et al., 2010; Global Sustainability Standards Board, 2020).

In evaluating project portfolio materiality, a wide range of strategic, economic, environmental, and social criteria must be considered. Strategically, projects should align with organisational goals, leverage core competencies, and account for market conditions, technical feasibility, and associated risks. Economic assessments should include direct financial metrics such as ROI, NPV, IRR, cost efficiency, and broader indicators like local employment impact, infrastructure development, and procurement practices. Environmental considerations encompass resource use (materials, energy, and water), emissions, waste, biodiversity impacts, and legal compliance. Socially, projects should uphold labour standards, human rights, diversity, community engagement, and customer wellbeing, while also ensuring ethical practices such as anti-corruption and compliance with regulations (Ferraro & Reid, 2013; Moustafaev, 2017c; Rifkin, 2019; To & Chau, 2022). A robust materiality assessment incorporates these diverse attributes to ensure that projects contribute meaningfully to sustainable and responsible growth.

In addition to setting up the criteria, ongoing review and refinement of these selection standards should be encouraged. As market conditions, regulatory environments, and organisational priorities evolve, so too should the criteria used to evaluate and prioritise projects within the portfolio. This dynamic approach allows the organisation to remain agile, responsive to changes and focused on delivering value through its project portfolio management practices.

To effectively implement a materiality assessment for sustainability integration, organisations should begin by identifying relevant PPM attributes that align with their industry, operations, and stakeholder interests, noting that these indicators are comprehensive and evolving, covering economic, environmental, and social topics. Next, stakeholder engagement is essential to understand the concerns, expectations, and priorities of stakeholders, which can be accomplished through surveys, interviews, or focus groups. The insights gathered should then be used to prioritise the sustainability topics that are most important to stakeholders. Following this, the organisation should assess the impact and significance of each prioritised topic, considering factors like potential risks, opportunities, reputational impact, regulatory requirements, and financial implications. Once assessed, materiality topics should be prioritised based on their significance to both the organisation and stakeholders, utilising tools like materiality matrices to manage expectations from the outset. It is crucial to validate the assessment with key stakeholders, ensuring alignment with their expectations, and to document the materiality assessment process, detailing criteria, stakeholder input, and the rationale behind prioritisation. Finally, organisations need to regularly review and update the materiality assessment to reflect changes in stakeholder priorities, industry trends, and organisational developments.

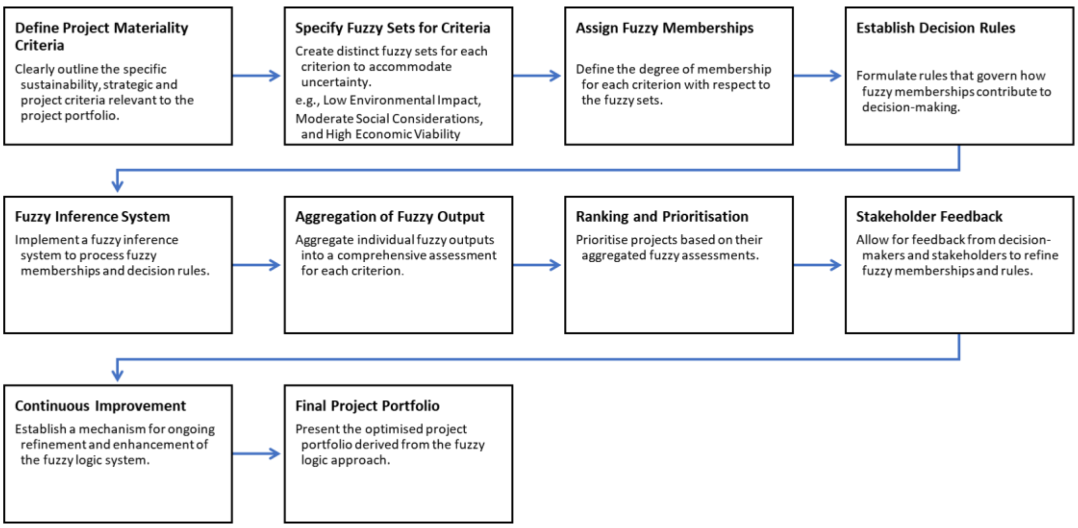
6.2 Applying Analytics in Project Portfolio Management

Project failures often stem from human bias, unrealistic goals, changing expectations, unclear requirements, a lack of executive support, cost overruns, and schedule delays, among other factors (Peddada & Sharma, 2020). Data-driven analytics or Business Intelligence (BI) can introduce objectivity into decision-making processes (Aldea et al., 2019; Marques et al., 2011).

The absence of data insights in project environments can lead to poor decision-making and project failures (Sharda, 2018). Data-based risk management, driven by statistical probabilities, can be challenging to estimate but it is crucial for successful project outcomes. As Niederman (2021) highlighted, analytics can revolutionise project management by providing incremental and disruptive advancements. Sharda (2018) emphasises the importance of data-based risk management, allowing for quick and economic scenario building and impact assessment (Barghi & Shadrokh Sikari, 2020; Gachie, 2019; Hartwig & Mathews, 2020; Peddada & Sharma, 2020).

Sustainability, especially the social elements, often subjective, should be assessed as a risk within the Sustainable PPM artefact. Analytical techniques like Fuzzy logic (Dursun et al., 2022) can translate qualitative sustainability data into quantitative formats, enabling measurable data, empirical evidence, and objective assessments alongside other data (Papadopoulos & Balta, 2022). Figure 5 (*The Sustainable PPM Analytics Decision Engine using Fuzzy Logic)* depicts the decision process using the criteria for project materiality, i.e. the strategic criteria based on an organisation's objectives and sustainability-related criteria derived from GRI (Global Reporting Initiative) guidelines to include environmental, social and economic criteria.

Figure 5: The Sustainable PPM Analytics Decision Engine using Fuzzy Logic



Applying a mathematical approach like Fuzzy Logic can assist with approximate reasoning and decision-making under uncertainty. This allows values to range between true and false rather than adhering to strict binary logic. Such a method can be hugely beneficial when considering the social criteria of sustainability, which can have unclear or 'Fuzzy' boundaries. Analytics integrated into project management, as highlighted by Nayebi et al. (2015), encompass domains, data access, validation, and result reuse. The three key types of analytics - descriptive, predictive, and prescriptive - enable data-driven decision-making and forecasting in project management. These analytics tools can uncover hidden risks and gaps in project assumptions, ultimately improving project success (Hartwig & Mathews, 2020; Luk et al., 2021). Other data analytics tools like Microsoft Power BI and IBM-SPSS can aid practitioners when analysing, describing, and predicting project outcomes, enhancing project management practices.

6.3 DSR Evaluation of the Artefact

Evaluating a sustainable project portfolio artefact involves several methods that ensure that the artefact effectively integrates sustainability principles into project portfolio management (PPM) and delivers the outcomes desired. One of the key considerations in designing the artefact has been to bring together existing frameworks and methods such that these can be integrated into project portfolio management processes seamlessly, causing the least amount of disruption to projects in the pipeline.

The evaluation of the artefact in Sustainable Project Portfolio Management (SPPM) involves multiple methods to assess its performance and applicability. *Experimental evaluation* tests the artefact in controlled environments to observe sustainability impacts, such as carbon reduction (Venable et al., 2016). *Case studies* offer detailed insights into how the artefact affects projects in real-world settings, assessing alignment with sustainability goals (Narazaki et al., 2020). *Simulation models* project portfolios to predict potential outcomes without real-world risks. *Expert review and peer evaluation* provide theoretical and practical feedback, ensuring alignment with industry standards. *Surveys and feedback* gather practitioner insights into user experience and effectiveness (Avdiji & Winter, 2019; Hevner et al., 2004). *Comparative analysis* contrasts projects managed with and without the artefact to measure added value (Owen, 1997). *A longitudinal study* evaluates the artefact's long-term impact on sustainability (Moutinho et al., 2024), while *benchmarking* assesses performance against industry standards like GRI and SDGs. *Usability testing* examines the ease of the implementation of the artefact and user experience, and *cost-benefit analysis* determines its economic feasibility by comparing costs with sustainability and financial benefits, highlighting improved resource efficiency and reduced waste.

This research evaluates the SPPM artefact through analytical and conceptual methods, focusing on internal consistency, design logic, and alignment with recognised sustainability standards such as GRI and CDP. Rather than using empirical or simulated project data, the framework's utility is demonstrated through design reasoning and literature-based benchmarking. This ensures methodological rigour while maintaining alignment with DSR principles and sets a foundation for future empirical validation through expert reviews or case applications.

7. CONTRIBUTION TO KNOWLEDGE AND LIMITATIONS

7.1 Theoretical Contributions

The SPPM framework augments existing PPM theory by moving beyond conventional portfolio selection, governance and implementation mechanisms (Cooper et al., 2001; Moustafaev, 2017b), which traditionally emphasise cost, scope, and time as the dominant criteria. Prior studies have largely focused on sustainability integration at the level of individual projects (Huemann & Silvius, 2017; Silvius, 2021), thereby limiting sustainability's influence to the bounded lifecycle of a single initiative. By contrast, the proposed framework incorporates sustainability as a core construct at the portfolio level through the operationalisation of project materiality and the systematic use of analytics such as fuzzy logic. This addresses the gap identified in the literature on how to consistently translate sustainability from normative principles into prescriptive, actionable decision criteria across the entire portfolio (Blak Bernat et al., 2023).

Furthermore, this research demonstrates how Design Science Research (DSR) can generate new design knowledge within project management, specifically by embedding sustainability attributes into artefacts that can be iteratively designed, tested, and refined (Gregor & Hevner, 2013; V. Vaishnavi & Kuechler, 2015). The framework, therefore, not only enriches PPM theory by expanding its scope to include environmental and social dimensions but also provides a methodological blueprint for how such extensions can be achieved in practice. In line with the sustainability roadmap of any organisation, it contributes to the theoretical debate on business and systems integration (Arena & Chiaroni, 2014) by presenting a sustainability-driven portfolio framework that directly addresses gaps in existing theory.

7.2 Practical Contributions

From a practitioner perspective, the framework provides a structured pathway to embed sustainability into decision-making across all stages of project portfolio management. At the *initiation and strategic alignment stage*, business leaders can apply the materiality-based screening process to ensure that proposed projects are evaluated not only on financial viability but also on sustainability criteria derived from GRI and aligned with SDGs. By employing project materiality mapping and analytics-driven evaluation, the framework provides transparent, evidence-based justification for project selection, enhancing organisational accountability and credibility. This transparency enables stronger stakeholder buy-in, as decision rationales become shared sustainability goals. Moreover, the participatory nature of the project materiality assessment encourages stakeholder involvement right from the outset, promoting collective ownership of project outcomes and reinforcing the organisation's focus on sustainability. During the *portfolio balancing stage*, decision-makers can employ the fuzzy logic analytics engine to manage trade-offs between projects, enabling portfolios to achieve a balanced mix of financial return, social impact, and environmental benefit.

At the *implementation stage*, project managers and sponsors can integrate sustainability audits into regular reporting cycles, ensuring accountability for social and environmental outcomes alongside traditional performance indicators. Finally, in the *closure and learning stage*, the framework requires the sustainability lessons learned to be captured systematically, creating a repository of knowledge that strengthens future decision-making. For smaller organisations, a simplified KPI-based version of the framework can be adopted with minimal resource implications (Agostino et al., 2012), while larger organisations can leverage advanced tools such as Power BI or SPSS for data-driven portfolio optimisation. In this way, the framework provides actionable guidance that can be tailored to different organisational sizes and levels of maturity, supporting firms as they align sustainability strategies with portfolio governance.

7.3 Limitations

The integration of sustainability into project portfolio management (PPM) through Design Science Research (DSR) presents several limitations. One of the primary challenges is the complexity of balancing sustainability with traditional project objectives, such as time, cost, and scope. Sustainability often introduces competing priorities that are not easily aligned with conventional success metrics, making it difficult to methodically incorporate sustainability criteria without disrupting the existing project management processes. Additionally, the absence of universally accepted criteria, metrics, or standards for assessing sustainability within project portfolios poses a significant challenge. Without standardised benchmarks, it becomes difficult to evaluate and compare sustainability aspects consistently and objectively across different projects and organisations, which can undermine the credibility and effectiveness of sustainability initiatives. Furthermore, integrating sustainability into PPM requires aligning the interests of diverse stakeholders, which is often challenging due to conflicting priorities and differing views on sustainability. This can delay the adoption of sustainability practices or lead to compromises that dilute their impact. Addressing these limitations requires the ongoing refinement of sustainability frameworks, the development of more robust standards, and effective stakeholder engagement strategies to ensure that sustainability is meaningfully embedded in PPM and contributes to organisational and societal goals.

8. CONCLUSION

Evaluating a sustainable project portfolio artefact is a critical step in ensuring that it effectively integrates sustainability principles into project portfolio management (PPM) and delivers the desired outcomes. Several methods can be employed to assess the artefact's performance, including experimental evaluation, case study analysis, simulation, expert review, and peer evaluation. These methods allow for the artefact to be tested in controlled environments, real-world scenarios, and through virtual models to predict its impact on sustainability metrics.

Additionally, gathering feedback from practitioners through surveys, conducting comparative analyses with traditional project management methods, and performing longitudinal studies provide valuable insights into the artefact's practicality, user-friendliness, and long-term effectiveness. Benchmarking against industry standards and conducting usability testing ensure that the artefact meets established benchmarks and is easy to implement. Finally, a cost-benefit analysis assesses the economic feasibility of the artefact by weighing its financial and sustainability benefits against the costs of adoption and operation. The artefact is designed to allow for seamless integration across different industries and business models. However, the framework can be tailored to accommodate diversity in industrial sectors.

The evaluation of a sustainable project portfolio artefact using a combination of these methods provides a comprehensive understanding of its effectiveness, practicality, and impact on sustainability. By systematically applying these evaluation techniques, organisations can ensure that the artefact is aligned with strategic sustainability goals and that it enhances decision-making processes within project portfolio management. This thorough evaluation process helps refine and optimise the artefact, ensuring that it drives meaningful and measurable improvements in sustainability, ultimately contributing to the long-term success of both the projects and the organisation.

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