Strategic Project Leadership: The Case for Integrating Systems Thinking and Artificial Intelligence

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Abstract

This paper positions itself at the intersection of systems thinking and Artificial Intelligence (AI) within the context of strategic project leadership, responding to the escalating complexity and interdependence inherent in modern project environments. Traditional project management methods often fall short in addressing the manifold challenges of today's large-scale projects, where leaders must navigate complex dependencies, rapid technological transitions, and a spectrum of competing priorities. In order to bridge these gaps, this paper presents an Integrated Intelligence Framework, which unites the epistemological depth of systems thinking with the analytical precision of AI. Through this dual approach, project leaders gain a sophisticated toolkit to manage complexity, anticipate challenges, optimise resource allocation, and align project outcomes with broader organisational objectives. Key contributions include emphasising the importance of data governance and quality, which are foundational to credible AI insights, and establishing ethical and transparent practices to mitigate risks associated with AI's expanding role in decision-making. Additionally, we highlight the significance of cross-functional collaboration and adaptive team training, which collectively support a systems-thinking mindset and enable the effective application of AI tools. Practical guidance on agile and hybrid methodologies is also offered, illustrating how iterative approaches facilitate real-time adaptation to shifting project conditions. The framework also further underscores the need for alignment with organisational goals, ensuring that AI and systems thinking are not only tactical tools but strategic assets. We thus argue that the implications of this work extend beyond operational efficiencies, reshaping our understanding of project leadership in complex environments.

Keywords: Strategic Project Leadership, Systems Thinking, Artificial Intelligence, AI, Complexity Management, Integrated Intelligence Framework, Cross-functional Collaboration, Data Governance, Agile Methodologies, Proactive Risk Management, Organisational Alignment.

1. Introduction

As projects increasingly escalate in complexity and scope, traditional management paradigms often prove insufficient in navigating the intricate dependencies and summary technological transformations characteristic of contemporary project environments (Maylor & Turner, 2017). Effective strategic project leadership, therefore, imposes a dual approach through the application of systems thinking to delineate and manage complex interdependencies, and the integration of Artificial Intelligence (AI) to harness predictive insights and data-driven decision-making (Anantatmula & Rad, 2018; Brookes et al., 2020; Dacre & Kockum, 2022; Dacre et al., 2020). In this vein, these modalities furnish project leaders with a sophisticated set of tools to anticipate potential challenges, optimise resources, and strategically align project outcomes with overarching organisational imperatives (Hsu et al., 2021a; Winter et al., 2006).

Within this dual framework, strategic project leadership represents the capacity to guide projects towards successful outcomes by combining a systemic perspective with advanced technological tools (Dacre, Eggleton, Cantone, et al., 2021; Shenhar, 2004). Systems thinking affords a structured framework to contextualise the dynamics of projects, transcending the limitations inherent in linear, siloed approaches (Sheffield et al., 2012). Within crisis environments where different layers of complexity blend, systems thinking empowers leaders to infer potential bottlenecks, extrapolate risks, and allocate resources across tiered organisational structures (Barber et al., 2021).

Conversely, AI technologies engender a layer of data-driven acuity and predictive capability, which significantly enhances strategic positioning and decision-making processes (Davenport & Kalakota, 2019; Hsu et al., 2021b; Kockum & Dacre, 2021). Current research underscores AI's transformative potential in complex projects, particularly in predictive forecasting, heuristic problem-solving, and real-time operational planning (Dacre & Kockum, 2022; Dacre et al., 2019; Duan et al., 2019). However, there persists a considerable gap in AI adoption, with a substantial portion of project professionals yet to leverage the advantages it offers in optimising project performance (Brookes et al., 2020; Kar et al., 2021).

Exploring the strategic advantages of synthesising systems thinking with AI, this paper posits that leaders who actively engage with both methodologies are inherently better equipped to address the complexities of contemporary projects (Elia & Margherita, 2018). Drawing on research into dynamic success conditions in projects and AI's predictive modalities, this paper proposes a practical

framework for instantiating a dual approach that underpins resilience and adaptability in project management (Dwivedi et al., 2021; Eggleton et al., 2021; Hsu et al., 2021b). The arguments support the view that merging systems thinking with AI positions strategic project leaders to tackle evolving challenges within complex environments (Elia & Margherita, 2018). The combined approach, therefore, ensures that decisions are both data-informed and aligned with a holistic understanding of project ecosystems. This integration allows leaders to achieve sustainable, adaptable, and strategically successful outcomes, all of which align with long-term organisational project objectives (Dacre, Eggleton, Gkogkidis, et al., 2021; Dong et al., 2021b; Gong et al., 2022; Williams et al., 2019).

2. The Role of Systems Thinking in Project Leadership

Systems thinking engenders a critical and sophisticated modality for navigating the mutuality endemic to contemporary project leadership (Yeo, 1993). This paradigm enables leaders to conceptualise the linked elements within projects, thereby fostering insights into emergent behaviours and unforeseen interactions that may arise from these interdependencies (Hobbs & Midgley, 2020). Rather than constituting projects as simple aggregations of tasks, systems thinking underscores a holistic view wherein leaders ascertain patterns, delineate feedback loops, and highlight points of potential synergy or failure across project components (Kopczyński & Brzozowski, 2015). Such a paradigm enhances the project leader's cognitive capacity to anticipate and pre-emptively address challenges with strategic foresight (Hobbs & Midgley, 2020; Yeo, 1993). The systems thinking perspective is particularly relevant in large-scale projects, which frequently embody complex, non-linear interactions that can precipitate failures if unmanaged (Sterman, 1994).

Within project management, systems thinking has demonstrably enhanced both internal project dynamics and overall performance (Kopczyński & Brzozowski, 2015). Research illustrates that familiarity with system dynamics, including feedback loops and temporal delays, engenders improved communication and cultivates a setting of psychological safety among team members (Bendoly, 2014). This understanding affords leaders the impetus to navigate complex interdependencies and fosters a collective engagement in managing the distinctions of project dynamics to optimise outcomes (Lyneis & Ford, 2007). Moreover, a shared understanding of systemic dependencies within a team mitigates the risk of process fragmentation and enables more cohesive decision-making (Senge, 1990).

In order to reinforce the practical application of systems thinking, recent studies reinforce the relevance of systems thinking frameworks in managing complex projects. For instance, structured models such as the Project Management Canvas instantiate a systems view by mapping project elements across dimensions and subsystems, thereby facilitating a comprehensive contextualisation of relationships among components (Elia et al., 2020). Systemic frameworks such as these underpin adaptive project planning, supporting leaders in adjusting project dimensions that may propagate effects through others, enabling leaders to leverage strategically aligned decisions (Checkland, 1981).

In crisis contexts, systems thinking plays a crucial role in reducing the risk of procedural stagnation and enabling effective management of multi-tiered project structures (Armenia et al., 2022; Sonjit et al., 2021b). The efficacy of a multi-dimension systems approach, such as within the UK Fire Service, highlights that a reductionist view often neglects key organisational dynamics impacting project outcomes (Barber et al., 2021). Findings indicate that addressing incidents in isolation, for instance without considering the wider organisational context, can lead to reactive and ultimately suboptimal solutions. This perspective resonates with empirical findings across high-risk industries, which show that understanding complex causal relationships is essential for fostering resilient outcomes (Hollnagel, 2018; Leveson, 2004).

The inherent dynamism within projects further underscores the value of a systems thinking approach (Dacre et al., 2014; Gkogkidis & Dacre, 2020a; Kopczyński & Brzozowski, 2015). There is growing recognition of the importance of managing factors such as team ethos, sustainability, and agility as part of an interdependent system rather than as separate entities (Dacre, Eggleton, Cantone, et al., 2021; Dong et al., 2021a; Dong et al., 2022; Eggleton et al., 2021; Ivory & Brooks, 2018). The situating of these conditions fosters a reinforcing cycle that contributes to long-term project success (Dacre, Eggleton, Gkogkidis, et al., 2021). For instance, team ethos, encompassing a shared sense of purpose and motivation (Dacre et al., 2015), enhances adaptability and resilience, particularly when coupled with agile and sustainable practices (Dacre, Eggleton, Cantone, et al., 2021; Hartwig et al., 2020; Sonjit et al., 2021c). Integrating sustainability into project goals also often requires agility to accommodate evolving regulatory or environmental considerations, which in turn can strengthen team ethos by reinforcing a commitment to responsible project delivery (Armenia et al., 2019; Tite et al., 2021a, 2021b). Such mutually reinforcing relationships reflect the self-sustaining dynamics that systems thinking brings to project management, thereby optimising

project outcomes (Emes & Griffiths, 2018). This approach supports the concept of complex adaptive systems, which posits that project components must function as interdependent entities that dynamically adjust in concert (Holland, 2006).

The flexibility intrinsic to systems thinking, particularly its adaptability to evolving project environments, stands in stark juxtaposition to reductionist methodologies that frequently overlook critical interactions (Sheffield et al., 2012). Studies of innovation projects illustrate that the flexibility afforded by systems thinking enhances leaders' capacity to manage uncertainty and adapt to shifting demands (Kapsali, 2011). Furthermore, the systems approach's emphasis on continuous feedback and heuristic adaptation fosters an iterative refinement of project strategies, thereby extending project resilience in response to evolving conditions (Argyris & Schön, 1997).

3. AI as a Strategic Tool in Project Leadership

AI is emerging as an influential component of data analytics, predictive modelling, and decision support, especially in project management, where uncertainty and risk are common (Bento et al., 2022; Brookes et al., 2020; Fridgeirsson et al., 2021; Hsu et al., 2021b). Through systematic analysis of historical project data and pattern recognition, AI provides project leaders with insights that can strengthen strategic decision-making (Ruiz et al., 2021). For example, AI can contribute to cost, schedule, and risk management, with the potential to further improve project outcomes by enhancing the accuracy of estimation and planning where historical data is available (Fridgeirsson et al., 2021).

The predictive capabilities that AI brings represent a promising shift in the tools available to project leaders. It has proven especially effective in managing innovation projects marked by Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) (Hsu et al., 2021a; Mesa Fernández et al., 2022). Research shows that AI is emerging across industries such as construction, software, and product development, which represent areas where adapting to real-time data is critical (Dacre & Kockum, 2022; Dacre et al., 2019; Mesa Fernández et al., 2022; Vărzaru, 2022). Furthermore, a Delphi study with project management experts highlights AI's transformative potential across a range of project management contexts, suggesting that its influence will continue to expand across a number of areas (Holzmann et al., 2022).

Integrating AI into project management frameworks extends beyond achieving operational efficiencies, enhancing both cognitive and strategic processes (Afzal et al., 2021; Davenport & Kalakota, 2019; Duan et al., 2019). Advanced hybrid AI systems, which combine various learning approaches, are being developed to support comprehensive project management frameworks, generating insights that align with wider organisational goals (Ruiz et al., 2021). This integration signals a shift from basic automation to complex analysis, reinforcing leaders' strategic decision-making abilities (Mesa Fernández et al., 2022).

Recent global events have accelerated the evolution of AI within project leadership (Dacre, Eggleton, Cantone, et al., 2021; Shenhar, 2004). The COVID-19 pandemic, in particular, catalysed AI adoption across diverse project environments, prompting a shift towards more technologically advanced project management methodologies (Eggleton et al., 2021; Najdawi & Shaheen, 2021; Sonjit et al., 2021a, 2021c). This shift is reflected in project management education (Dacre et al., 2018; Gkogkidis & Dacre, 2020b, 2021), where Explainable AI has started appearing in curricula to enhance time, cost, and risk management (Radhakrishnan et al., 2021). These developments indicate a progression from early AI applications towards a trajectory that could reshape project management practices (Ong & Uddin, 2020).

Despite these advances, challenges remain in fully realising AI's potential within project leadership. For instance, according to Dacre and Kockum (2022), AI's effectiveness is fundamentally dependent on the quality and accessibility of project data, making data management essential. Challenges in ensuring data is "fit for purpose" and adaptable across various project contexts continue to hinder AI deployment. Without high-quality, relevant data, AI tools risk producing inaccurate or misleading insights, reinforcing the adage, "garbage in, garbage out" (Dacre & Kockum, 2022). This principle underscores that even advanced AI systems are only as effective as the data they process; poor data quality not only reduces AI's value but can also lead to costly errors in decision-making (Brookes et al., 2020). Consequently, adoption rates vary widely across sectors, often hindered by uncertainty regarding practical implementation (Bento et al., 2022).

The gap between AI's theoretical potential and practical limitations highlights the importance of aligning AI implementation with project leadership objectives (Najdawi & Shaheen, 2021) (Table 1).

Table 1: Comparative Analysis of AI and Systems Thinking Benefits in Project Leadership

Benefit Area	Systems Thinking Contribution	AI Contribution	Integrated Benefit
Risk Management	Encourages a holistic view to identify and mitigate risks by understanding interdependencies and feedback loops.	Provides predictive analytics to foresee potential risks based on historical and real-time data.	Enables proactive risk mitigation by combining systemic foresight with data-driven prediction.
Adaptability	Supports flexible thinking, allowing teams to adjust strategies as project dynamics change.	Allows for real-time data analysis, helping teams make timely adjustments based on current insights.	Enhances agility, enabling project leaders to adjust in response to both systemic feedback and real-time data insights.
Predictive Accuracy	Provides qualitative insights into potential future states by understanding system behaviours.	Offers quantitative forecasts through machine learning and predictive models based on historical data.	Increases accuracy by blending systems thinking foresight with AI's quantitative predictions, leading to more reliable outcomes.
Decision-Making	Facilitates informed decision-making by considering the broader organisational impact of project choices.	Supplies data-driven insights to inform decisions on resource allocation and timing.	Enables well-rounded decision-making that incorporates both systemic impact and precise, data-backed insights.
Resource Optimisation	Supports the optimal allocation of resources by understanding systemic needs and dependencies.	Assists in identifying resource needs through data on usage patterns and project demands.	Combines systemic and data-driven approaches to resource allocation, ensuring resources are efficiently and strategically employed.
Team Collaboration	Fosters a shared understanding of project goals and interdependencies among team members.	Provides collaborative tools and shared data platforms to support team alignment.	Encourages unified team efforts, merging a common systemic perspective with shared data insights for seamless collaboration.

Anticipated future developments in adaptive and collaborative AI technologies suggest a transition in AI's role from a supportive tool to a more integrated project partner, with the potential to shape strategic project pathways while maintaining alignment with human-led objectives (Ong & Uddin, 2020). Recognising these constraints and opportunities is essential to exploring diffusion characteristics with new technologies and frameworks (Antonopoulou & Dacre, 2021), and effectively leveraging AI within project management (Ruiz et al., 2021).

4. Integrating Systems Thinking and AI in Strategic Project Leadership

Whilst systems thinking furnishes the epistemological framework to interpret interdependencies, emergent behaviours, and intricate project dynamics, AI affords the technological modality necessary to process extensive datasets, generate predictive insights, and automate responsive actions (Dacre & Kockum, 2022; Dam et al., 2019). In this vein, systems thinking and AI constitute an interactive paradigm that enables project leaders to leverage data in ways that inform, enhance, and contextualise decision-making within this dynamic framework (Bellamy et al., 2022; Kockum & Dacre, 2021).

Building upon this interactive foundation, the application of AI in project management has become especially pertinent with the rise of Big Data, often characterised by its Volume, Velocity, and Variety, the 3Vs describing the vastness and diversity of data, along with the speed of data production (Brookes et al., 2020; Kockum & Dacre, 2021; Wamba et al., 2015). This complexity aligns closely with a systems thinking approach, wherein project leaders are impelled to engage not only with isolated data points but also with the dialectical interconnections among them (Senge, 1990). Through machine learning algorithms and predictive analytics, AI enables leaders to extrapolate patterns and anticipate potential project challenges. Such predictive capabilities are particularly relevant in high-risk domains such as infrastructure and construction, where real-time modifications afforded by AI mitigate the risk of project disruptions in response to dynamic conditions(Chapman, 2016; Hsu et al., 2021b; Jaber et al., 2021).

Expanding on this, the construction and engineering sectors (Dacre et al., 2019; Reynolds & Dacre, 2019; Tite et al., 2021b) illustrate how AI-driven digital transformation serves as a strategic force for managing uncertainty and interdependencies (Afzal et al., 2021). In particular, Attencia and Mattos (2022) describe AI's role in facilitating smart asset management, thereby supporting project leaders through real-time data on asset performance within a systems-oriented framework. This strategic alignment between asset management and project objectives engenders adaptability, thus enhancing the overall resilience of project plans (Choi & Bae, 2009). Likewise, Dacre et al. (2020) underscore AI's role in complex engineering endeavours, highlighting how AI-enhanced insights foster agile decision-making and optimise project execution. Through automation, real-time monitoring, and actionable insights, AI reinforces leaders' capacity for interventions, underpinning the strategic agility engendered by systems thinking (Vărzaru, 2022).

The value of AI's data-processing capabilities takes on additional significance in the context of risk and uncertainty management for large-scale projects (Boussabaine, 2013). Within construction, for instance, fluctuating material costs, changing environmental conditions, and variable workforce availability introduce substantial risks that demand proactive approaches (Hwang et al., 2014). Here, AI's predictive analytics facilitate pre-emptive mitigation strategies, allowing project leaders to anticipate and counteract potential disruptions (Dam et al., 2019). This proactive modality not only addresses immediate project needs but also supports broader organisational imperatives, aligning with systems thinking's comprehensive, forward-looking perspective (Killen & Kjaer, 2012).

Moreover, the integration of AI within a systems thinking framework has the potential to foster continuous learning and iterative improvement, essential for managing complex adaptive systems (Dacre et al., 2022; Eggleton et al., 2021). Through synchronous access to real-time data, AI enables a heuristic process of ongoing adaptation, whereby strategies are refined in response to emerging insights (Argyris & Schön, 1997; Dacre & Kockum, 2022; Mitrovic et al., 2020). AI's capability to simulate scenarios based on historical and real-time data further enhances contingency planning (Brookes et al., 2020).

In high-complexity project environments, AI transcends simple automation, empowering leaders with a proactive and anticipatory management approach (Dam et al., 2019). Studies illustrate that in large, dynamic projects, AI's data-driven insights foster enhanced systems integration by streamlining data exchange and analysis across project domains (Whyte et al., 2022). This capacity to synthesise diverse data streams is indispensable in sectors demanding strategic alignment, such as rail infrastructure and telecommunications, where project interdependencies dictate comprehensive, data-informed decision-making (Bellamy et al., 2022; Choi & Bae, 2009).

The confluence of systems thinking and AI engenders, a paradigm shift from reactive problem-solving to a model prioritising strategic foresight and resilience. Such a shift enhances leaders' ability to proactively address risks, optimise resource allocation, and ensure congruence between project objectives and organisational aspirations (Chapman, 2016; Jaber et al., 2021). In project landscapes where technological innovations and external pressures demand adaptive strategies, the integrated application of AI and systems thinking equips project leaders with a framework that engenders resilient, adaptable, and

strategically aligned outcomes across industries (Dacre & Kockum, 2022; Dacre et al., 2020; Dam et al., 2019; Sonjit et al., 2021a).

5. Strategic Recommendations for Effective Integration

Integrating systems thinking and AI within project leadership requires not only strategic alignment but also practical, tactical approaches to address challenges and optimise outcomes (Table 2). When harmonised within a project framework, systems thinking and AI present valuable opportunities to navigate complex project dynamics, anticipate disruptions, and align project goals with broader organisational objectives. In order to fully leverage this potential, project leaders are encouraged to adopt specific, focused recommendations that drive the framework's effective implementation, fostering resilience, adaptability, and strategic alignment across project activities (Attencia & Mattos, 2022; Bellamy et al., 2022).

Table 2: Strategic Recommendations for Integrating Systems Thinking and AI in Project Leadership

Strategic Recommendation	Benefits	Example Application
Data Governance and Quality	Ensures high-quality data for reliable AI-driven insights; mitigates risks associated with poor data quality.	Implementing a data governance framework to standardise data quality and accessibility across departments.
Cross-Functional Collaboration	Promotes a holistic view by engaging diverse perspectives; improves adaptability and prevents isolated decision-making.	Establishing interdepartmental teams to collaborate on project strategies and share accountability.
Training and Capacity Building	Builds technical skills in AI and systems thinking; enhances team capability to manage complexity and VUCA environments.	Conducting training workshops on AI ethics, explainability, and systems thinking for project team members.
Continuous Learning and Feedback Loops	Supports iterative improvement; adapts strategies based on past outcomes, fostering resilience and continuous improvement.	Documenting lessons learned in each project phase to refine AI models and improve decision-making.
Agile and Hybrid Methodologies	Allows for real-time adaptation to project changes; integrates AI insights with flexible project planning.	Employing agile sprints to respond quickly to project changes informed by AI predictions.
Strategic Alignment with Organisational Goals	Ensures project outcomes align with organisational vision; prioritises AI investments that contribute to strategic goals.	Developing KPIs that align project outputs with organisational mission and long-term objectives.

A key aspect of successful integration lies in establishing cohesive, aligned data governance and quality standards. AI's predictive and analytical strengths fundamentally depend on the quality, accessibility, and integrity of project data.

Leaders must ensure data is not only accurate but also relevant, as the "garbage in, garbage out" principle illustrates AI's reliance on high-quality inputs (Brookes et al., 2020; Dacre & Kockum, 2022). Implementing data governance frameworks within project management promotes consistency across teams and departments, allowing AI to operate on a reliable data foundation. This alignment between data integrity and AI insights is crucial for generating actionable intelligence that informs decision-making throughout each project phase (Mesa Fernández et al., 2022; Najdawi & Shaheen, 2021) (Table 3).

Table 3: Data Quality and Governance in Enhancing AI Effectiveness

Step in Data Processing	Importance of Data Quality	Impact of Poor Data Quality	Role of Data Governance
Data Collection	Ensures relevant and accurate data is gathered from reliable sources.	Inaccurate data collection leads to unreliable AI insights.	Establishes standards for data sources and collection methods.
Data Storage	Provides organised, accessible data for efficient processing.	Disorganised storage can result in data loss and access issues.	Sets protocols for secure, structured data storage.
Data Cleaning	Removes errors and inconsistencies, improving data accuracy.	Uncleaned data introduces noise, leading to flawed AI predictions.	Implements processes to standardise and validate data.
Data Integration	Ensures data from multiple sources is harmonised and consistent.	Inconsistent integration leads to conflicting insights and errors.	Defines methods for merging diverse data sources reliably.
Data Analysis	High-quality data enhances the reliability of AI-driven insights.	Poor-quality data produces inaccurate and misleading AI outputs.	Ensures only validated data is used for analysis.
Data Reporting	Accurate reporting aids in making informed project decisions.	Errors in reports can lead to strategic missteps and resource waste.	Enforces quality checks before data is finalised for reporting.
Data Feedback and Iteration	Supports continuous improvement by learning from past data insights.	Low-quality feedback loops reduce AI's adaptability and precision.	Establishes feedback mechanisms for ongoing data refinement.

Equally important is cultivating a culture of cross-functional collaboration that supports a systems thinking approach. Systems thinking engenders a holistic view, best achieved when diverse stakeholders are actively engaged, aligned, and collaborative. Project leaders can enhance interdepartmental cooperation by establishing common objectives, fostering open communication, and setting shared metrics of success. This cohesion helps project leaders understand the cascading impacts of project decisions across the organisation, improving adaptability and reinforcing a systems perspective in daily project operations (Bellamy et al., 2022; Senge, 1990).

Investing in training is also critical to ensuring project teams are not only technically skilled with AI tools but also equipped to apply systems thinking principles. Foundational training in AI, including concepts such as Explainable AI, can deepen team members' understanding of AI's role and ethical implications within projects. Pairing this with systems thinking training builds the team's capacity to manage complex, adaptive systems, enhancing their ability to address VUCA in project environments (Bento et al., 2022; Holzmann et al., 2022; Radhakrishnan et al., 2021). Such training also boosts teams' cognitive flexibility, helping them adapt to evolving project requirements and external conditions with agility and insight (Jaber et al., 2021). As projects progress, real-time feedback loops and lessons learned should be systematically documented and analysed. This iterative improvement process allows teams to fine-tune AI models and adapt systems thinking practices based on past experiences, fostering a culture of continuous learning and resilience (Argyris & Schön, 1997; Dacre et al., 2022; Mitrovic et al., 2020). Such feedback mechanisms support a heuristic approach, where strategies are refined in response to emerging conditions (Elia et al., 2020; Gong et al., 2022).

Adapting project methodologies may also be necessary to leverage the combined benefits of AI and systems thinking. Agile and hybrid project management approaches, which allow for iterative adjustments, are particularly suited to environments where real-time data and complex interdependencies require continuous management. These methodologies provide the flexibility to integrate real-time AI insights with systems thinking, enhancing leaders' capacity to respond dynamically to evolving project needs and to apply insights strategically (Mesa Fernández et al., 2022; Najdawi & Shaheen, 2021). Agile methods align well with systems thinking's principle of continuous learning, supporting adaptive planning cycles that incorporate real-time feedback (Killen & Kjaer, 2012).

For long-term success, organisations must align AI applications with overarching organisational goals. AI should be implemented as part of an integrated strategy that complements organisational objectives, ensuring it contributes meaningfully to the vision and mission (Dacre & Kockum, 2022; Ong & Uddin, 2020). This strategic alignment helps prioritise AI investments that deliver sustained value, positioning AI as a key partner in achieving organisational success (Alshaikhi & Khayyat, 2021; Mesa Fernández et al., 2022).

Ultimately, these recommendations emphasise a balanced approach to integrating AI and systems thinking in project leadership. Through data governance, cross-

functional collaboration, adaptive training, continuous learning, ethical considerations, agile methodologies, proactive risk management, and strategic alignment, organisations can unlock the combined potential of AI and systems thinking. Together, they enable project leaders to navigate complexities with resilience and foresight, producing adaptable outcomes that align with organisational goals. These recommendations lay the foundation for a future-ready approach to project leadership that harnesses the depth of systems thinking and the power of AI, positioning organisations to thrive in today's complex project landscapes (Sutrisna & Barrett, 2007; Whyte et al., 2022).

6. Conclusion

In this paper, we sought to advocate for the integration of AI and systems thinking within project leadership by proposing a structured approach to address the demands of increasingly complex project environments. This integration, as conceptualised in the Integrated Intelligence Framework for Project Leadership (Figure 1), centres on Systems Thinking and Artificial Intelligence as foundational methodologies that interconnect and reinforce each other (Dacre & Kockum, 2022; Hobbs & Midgley, 2020).

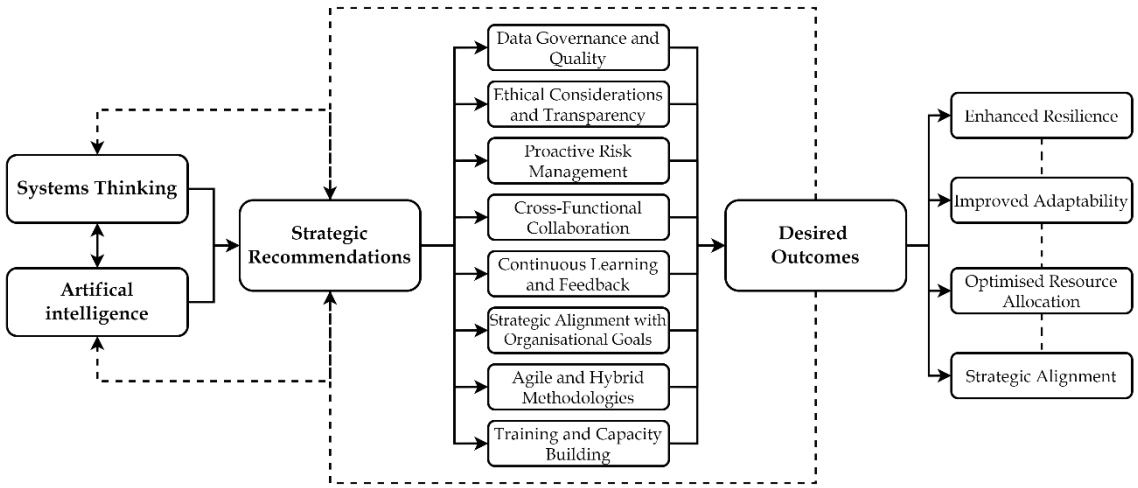

Figure 1: Integrated Intelligence Framework for Project Leadership

Systems thinking enables project leaders to view projects as complex, interconnected systems, while AI equips them with tools to handle large datasets, predict outcomes, and automate responses, meeting the needs of data-heavy projects (Elia et al., 2020; Mesa Fernández et al., 2022). From this synergy, the framework suggests Strategic Recommendations for practical application. Data Governance and Quality is key, ensuring data accuracy and reliability, which is essential for credible AI-driven insights and decision-making (Brookes et al., 2020; Dacre & Kockum, 2022). Ethical Considerations and Transparency promote the

responsible use of AI, maintaining clear and accountable data practices that mitigate ethical risks, particularly in high-stakes projects (Holzmann et al., 2022; Ruiz et al., 2021). Proactive Risk Management harnesses AI's predictive power to identify and address potential risks early, supported by a systems approach that considers the ripple effects across interlinked project components (Jaber et al., 2021; Whyte et al., 2022).

Additionally, Cross-Functional Collaboration fosters unity among diverse teams, which is vital for a systems-oriented approach that integrates various perspectives and prevents isolated thinking (Bellamy et al., 2022; Senge, 1990). Continuous Learning and Feedback Loops encourage adaptability, helping teams refine AI models and systems thinking practices, thus building resilience through continuous improvement (Argyris & Schön, 1997; Dacre et al., 2022). Strategic Alignment with Organisational Goals ensures that project efforts contribute to broader objectives, supporting coherence with the organisation's mission (Dacre & Kockum, 2022; Ong & Uddin, 2020).

Adopting Agile and Hybrid Approaches allows project leaders to respond flexibly to changing requirements, adapting AI insights and systems thinking in real time (Killen & Kjaer, 2012; Mesa Fernández et al., 2022). Training and Capacity Building enhances the team's ability to apply both AI tools and systems thinking, ensuring they have the skills to manage today's evolving project landscapes (Bento et al., 2022; Radhakrishnan et al., 2021).

Collectively, these Strategic Recommendations aim to produce Desired Outcomes including enhanced resilience, improved adaptability, optimised resource allocation, and strategic alignment with organisational goals. The continuous feedback loops embedded within the framework support an iterative approach to project leadership, allowing for resilience and agility in response to changing conditions (Gong et al., 2022; Najdawi & Shaheen, 2021).

In conclusion, as we confront the challenges of increasingly complex project landscapes, the integration of systems thinking and AI emerges not merely as an operational enhancement but as a transformational shift in project leadership. This combined approach enables project leaders to anticipate disruptions, respond with agility, and achieve strategic alignment with organisational goals. This synergy fosters resilience, adaptability, and a forward-looking vision, enabling project teams to operate effectively within technologically advanced, data-rich environments.

References

Afzal, F., Yunfei, S., Nazir, M., & Bhatti, S. M. (2021). A review of artificial intelligence based risk assessment methods for capturing complexity-risk interdependencies: Cost overrun in construction projects. *International Journal of Managing Projects in Business*, *14*(2), 300-328.

Alshaikhi, A., & Khayyat, M. (2021). An investigation into the impact of artificial intelligence on the future of project management. 2021 International Conference of Women in Data Science at Taif University, WiDSTaif 2021,

Anantatmula, V. S., & Rad, P. F. (2018). Role of organizational project management maturity factors on project success. *Engineering Management Journal*, *30*(3), 165-178.

Antonopoulou, K., & Dacre, N. (2021). Exploring Diffusion Characteristics that Influence Serious Games Adoption Decisions. *Innovation in Information Infrastructures*, 10. https://doi.org/10.48550/arXiv.2105.01745

Argyris, C., & Schön, D. A. (1997). Organizational learning: A theory of action perspective. *Reis*(77/78), 345-348.

Armenia, S., Dangelico, R. M., Nonino, F., & Pompei, A. (2019). Sustainable project management: A conceptualization-oriented review and a framework proposal for future studies. *Sustainability*, *11*(9), 2664.

Armenia, S., Tsaples, G., & Franco, E. (2022). A Systems Thinking Archetype to Understand, Analyze, and Evaluate the Evolution of International Political Crises. *Systems*, *10*(1), 18.

Attencia, G., & Mattos, C. (2022). Adoption of Digital Technologies for Asset Management in Construction Projects. *Journal of Information Technology in Construction*, *27*, 619-629. https://doi.org/10.36680/j.itcon.2022.030

Barber, C., Dacre, N., & Dong, H. (2021). Reframing Project Management Process Paralysis: An Autoethnographic Study of the UK Fire Service. *Advanced Project Management*, *21*(6), 4. https://doi.org/10.31235/osf.io/hxm68

Bellamy, L. A., Henning, T. F. P., Amor, R., Jones, D., Pancholy, P., Preston, G., & Zyl, J. E. V. (2022). Data strategies for improving infrastructure value and performance in New Zealand. *Proceedings of the Institution of Civil Engineers: Smart Infrastructure and Construction*, *176*(3), 98-107. https://doi.org/10.1680/jsmic.22.00008

Bendoly, E. (2014). System dynamics understanding in projects: Information sharing, psychological safety, and performance effects. *Production and Operations Management*, *23*(8), 1352-1369.

Bento, S., Pereira, L., Gonçalves, R., Dias, Á., & da Costa, R. L. (2022). Artificial intelligence in project management: systematic literature review. *International Journal of Technology Intelligence and Planning*, *13*(2), 143-163. https://doi.org/10.1504/ijtip.2022.126841

Boussabaine, A. (2013). *Risk pricing strategies for public-private partnership projects* (Vol. 4). John Wiley & Sons.

Brookes, N., Lattuf Flores, L., Dyer, R., Stewart, I., Wang, K., & Dacre, N. (2020). *Project Data Analytics: The State of the Art and Science*. Association for Project Management. https://www.apm.org.uk/media/46977/pathfinder-report-web-final.pdf

Chapman, R. J. (2016). A framework for examining the dimensions and characteristics of complexity inherent within rail megaprojects. *International Journal of Project Management*, *34*(6), 937-956. https://doi.org/10.1016/j.ijproman.2016.05.001

Checkland, P. (1981). Systems thinking, systems practice.

Choi, K., & Bae, D. H. (2009). Dynamic project performance estimation by combining static estimation models with system dynamics. *Information and Software Technology*, *51*(1), 162-172. https://doi.org/10.1016/j.infsof.2008.03.001

Dacre, N., Constantinides, P., & Nandhakumar, J. (2014). Instantiation of Organisational Routines in Cross-Expertise Collaborative Enterprise Systems. *Process Organization Studies*, 5. https://doi.org/10.31235/osf.io/ky8s7

Dacre, N., Constantinides, P., & Nandhakumar, J. (2015). How to Motivate and Engage Generation Clash of Clans at Work? Emergent Properties of Business Gamification Elements in the Digital Economy. *International Gamification for Business*, 11. https://doi.org/arXiv.2103.12832

Dacre, N., Dong, H., Gkogkidis, V., & Kockum, F. (2022). Innovative Strategies for Distance Learning: Gamification, Serious Play, and Miro in the Development of Project Management Competencies *Operational Research Society*, 22. https://doi.org/10.2139/ssrn.4997288

Dacre, N., Eggleton, D., Cantone, B., & Gkogkidis, V. (2021). Why People Skills Lead to Project Success: Towards Dynamic Conditions for People Skills and Leadership in Project Management *Project*, *307*, 14. https://doi.org/10.2139/ssrn.4998962

Dacre, N., Eggleton, D., Gkogkidis, V., & Cantone, B. (2021). Expanding the Paradigm of Project Success: A Review of Diversity as a Critical Success Condition in Project Management *SSRN Electronic Journal*, 23. https://doi.org/10.2139/ssrn.5001594

Dacre, N., Gkogkidis, V., & Jenkins, P. (2018). Co-Creation of Innovative Gamification Based Learning: A Case of Synchronous Partnership. *Society for Research into Higher Education*, 6. https://doi.org/10.48550/arXiv.2103.13273

Dacre, N., & Kockum, F. (2022). *Artificial Intelligence in Project Management: A review of AI's usefulness and future considerations for the project profession*. Association for Project Management. https://doi.org/10.61175/DOGX9829

Dacre, N., Kockum, F., & Senyo, P. (2020). Transient Information Adaptation of Artificial Intelligence: Towards Sustainable Data Processes in Complex Projects. *British Academy of Management*, *2*(63), 9. https://doi.org/10.48550/arXiv.2104.04067

Dacre, N., Senyo, P., & Reynolds, D. (2019). Is an Engineering Project Management Degree Worth it? Developing Agile Digital Skills for Future Practice. *Engineering Education Research Network*, 8. https://doi.org/10.31235/osf.io/4b2gs

Dam, H. K., Tran, T., Grundy, J., Ghose, A., & Kamei, Y. (2019). Towards effective AI-powered agile project management. 2019 IEEE/ACM 41st international

conference on software engineering: new ideas and emerging results (ICSE-NIER),
Davenport, T., & Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future healthcare journal*, *6*(2), 94-98.
Dong, H., Dacre, N., & Bailey, A. (2021a). Sustainability in Complex Agriculture Projects: A Study of Agile Agricultural Co-operative Institutions. *British Academy of Management*, 10. https://doi.org/10.2139/ssrn.3879454
Dong, H., Dacre, N., & Bailey, A. (2021b). Sustainable Agile Project Management in Complex Agriculture Projects: An Institutional Theory Perspective. *Advanced Project Management*, *21*(3), 7. https://doi.org/10.31235/osf.io/v4je2
Dong, H., Dacre, N., Baxter, D., & Ceylan, S. (2022). *Understanding Agile in Project Management*. Association for Project Management. https://doi.org/10.61175/PUSU1455
Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International journal of information management*, *48*, 63-71.
Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., & Eirug, A. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International journal of information management*, *57*, 101994.
Eggleton, D., Dacre, N., Cantone, B., & Gkogkidis, V. (2021). *Dynamic conditions for project success*. Association for Project Management. https://doi.org/10.61175/FXCU4654
Elia, G., & Margherita, A. (2018). Can we solve wicked problems? A conceptual framework and a collective intelligence system to support problem analysis and solution design for complex social issues. *Technological Forecasting and Social Change*, *133*, 279-286.
Elia, G., Margherita, A., & Secundo, G. (2020). Project management canvas: a systems thinking framework to address project complexity. *International Journal of Managing Projects in Business*, *14*(4), 809-835. https://doi.org/10.1108/IJMPB-04-2020-0128
Emes, M., & Griffiths, W. (2018). *Systems thinking: How is it used in project management? Association for Project Management*. https://doi.org/10.61175/GJMZ4716
Fridgeirsson, T. V., Ingason, H. T., Jonasson, H. I., & Jonsdottir, H. (2021). An authoritative study on the near future effect of artificial intelligence on project management knowledge areas. *Sustainability (Switzerland)*, *13*(4), 1-20, Article 2345. https://doi.org/10.3390/su13042345
Gkogkidis, V., & Dacre, N. (2020a). Co-Creating Educational Project Management Board Games to Enhance Student Engagement. *Game Based Learning*, 15. https://doi.org/10.48550/arXiv.2104.04063
Gkogkidis, V., & Dacre, N. (2020b). Exploratory Learning Environments for Responsible Management Education Using Lego Serious Play. *ArXiv Computers and Society* 13. https://doi.org/10.48550/arXiv.2104.12539

Gkogkidis, V., & Dacre, N. (2021). How to use Lego Serious Play as a Gamification Teaching and Learning Framework? A Responsible Management Approach. *SocArxiv*, 13. https://doi.org/10.31235/osf.io/vdzsu

Gong, Z., Dacre, N., & Dong, H. (2022). Fostering digital transformation through project integration management. *British Academy of Management*, 19. https://doi.org/10.2139/ssrn.5003601

Hartwig, A., Clarke, S., Johnson, S., & Willis, S. (2020). Workplace team resilience: A systematic review and conceptual development. *Organizational Psychology Review*, *10*(3-4), 169-200.

Hobbs, C., & Midgley, G. (2020). How systems thinking enhances systems leadership.

Holland, J. H. (2006). Studying complex adaptive systems. *Journal of systems science and complexity*, *19*, 1-8.

Hollnagel, E. (2018). *Safety-I and safety-II: the past and future of safety management*. CRC press.

Holzmann, V., Zitter, D., & Peshkess, S. (2022). The Expectations of Project Managers from Artificial Intelligence: A Delphi Study. *Project Management Journal*, *53*(5), 438-455. https://doi.org/10.1177/87569728211061779

Hsu, M.-w., Dacre, N., & Senyo, P. (2021a). Identifying Inter-Project Relationships with Recurrent Neural Networks: Towards an AI Framework of Project Success Prediction. *British Academy of Management*, 8. https://doi.org/10.2139/ssrn.3880328

Hsu, M.-w., Dacre, N., & Senyo, P. K. (2021b). Applied Algorithmic Machine Learning for Intelligent Project Prediction: Towards an AI Framework of Project Success. *Advanced Project Management*, *21*, 6. https://doi.org/10.31235/osf.io/6hfje

Hwang, B.-G., Zhao, X., & Toh, L. P. (2014). Risk management in small construction projects in Singapore: Status, barriers and impact. *International Journal of Project Management*, *32*(1), 116-124.

Ivory, S. B., & Brooks, S. B. (2018). Managing corporate sustainability with a paradoxical lens: Lessons from strategic agility. *Journal of business ethics*, *148*, 347-361.

Jaber, H., Marle, F., Vidal, L. A., Sarigol, I., & Didiez, L. (2021). A framework to evaluate project complexity using the fuzzy topsis method. *Sustainability (Switzerland)*, *13*(6), Article 3020. https://doi.org/10.3390/su13063020

Kapsali, M. (2011). Systems thinking in innovation project management: A match that works. *International Journal of Project Management*, *29*(4), 396-407. https://doi.org/10.1016/j.ijproman.2011.01.003

Kar, S., Kar, A. K., & Gupta, M. P. (2021). Modeling drivers and barriers of artificial intelligence adoption: Insights from a strategic management perspective. *Intelligent Systems in Accounting, Finance and Management*, *28*(4), 217-238.

Killen, C. P., & Kjaer, C. (2012). Understanding project interdependencies: The role of visual representation, culture and process. *International Journal of Project Management*, *30*(5), 554-566. https://doi.org/10.1016/j.ijproman.2012.01.018

Kockum, F., & Dacre, N. (2021). Project Management Volume, Velocity, Variety: A Big Data Dynamics Approach. *Advanced Project Management*, *21*, 6. https://doi.org/10.31235/osf.io/k3h9r

Kopczyński, T., & Brzozowski, M. (2015). Systems thinking in project management: theoretical framework and empirical evidence from Polish companies. *AdministracjaiZarządzanie,(34)*, *105*, 79-88.

Leveson, N. (2004). A new accident model for engineering safer systems. *Safety science*, *42*(4), 237-270.

Lyneis, J. M., & Ford, D. N. (2007). System dynamics applied to project management: a survey, assessment, and directions for future research. *System Dynamics Review: The Journal of the System Dynamics Society*, *23*(2-3), 157-189.

Maylor, H., & Turner, N. (2017). Understand, reduce, respond: project complexity management theory and practice. *International journal of operations & production management*, *37*(8), 1076-1093.

Mesa Fernández, J. M., González Moreno, J. J., Vergara-González, E. P., & Alonso Iglesias, G. (2022). Bibliometric Analysis of the Application of Artificial Intelligence Techniques to the Management of Innovation Projects. *Applied Sciences (Switzerland)*, *12*(22), Article 11743. https://doi.org/10.3390/app122211743

Mitrovic, Z. M., Rakicevic, A. M., Petrovic, D. C., Mihic, M. M., Rakicevic, J. D., & Jelisic, E. T. (2020). Systems Thinking in Software Projects-an Artificial Neural Network Approach. *IEEE Access*, *8*, 213619-213635, Article 9268157. https://doi.org/10.1109/ACCESS.2020.3040169

Najdawi, A., & Shaheen, A. (2021). Which project management methodology is better for ai-transformation and innovation projects? Proceedings of International Conference on Innovative Practices in Technology and Management, ICIPTM 2021,

Ong, S., & Uddin, S. (2020). Data science and artificial intelligence in project management: The past, present and future. *Journal of Modern Project Management*, *7*(4), 26-33. https://doi.org/10.19255/JMPM02202

Radhakrishnan, B. D., Jaurez, J. J., & Altamirano, N. (2021). Explainable Artificial Intelligence (XAI) in Project Management Curriculum: Exploration and Application to Time, Cost, and Risk. ASEE Annual Conference and Exposition, Conference Proceedings,

Reynolds, D., & Dacre, N. (2019). Interdisciplinary Research Methodologies in Engineering Education Research. *Engineering Education Research Network*, 7. https://doi.org/10.48550/arXiv.2104.04062

Ruiz, J. G., Torres, J. M., & Crespo, R. G. (2021). The application of artificial intelligence in project management research: A review. *International Journal of Interactive Multimedia and Artificial Intelligence*, *6*(6), 54-66. https://doi.org/10.9781/ijimai.2020.12.003

Senge, P. (1990). Peter Senge and the learning organization. *Dimension*, *14*.

Sheffield, J., Sankaran, S., & Haslett, T. (2012). Systems thinking: Taming complexity in project management. *On the Horizon*, *20*(2), 126-136.

Shenhar, A. J. (2004). Strategic Project Leadership® Toward a strategic approach to project management. *R&d Management*, *34*(5), 569-578.

Sonjit, P., Dacre, N., & Baxter, D. (2021a). *Covid-19 & Homeworking Project Management Agility as the New Normal* British Academy of Management, Online, UK.

Sonjit, P., Dacre, N., & Baxter, D. (2021b). Disruption and Agility Dynamics in Project Management Processes: An Institutional Theory Approach. *Advanced Project Management*, *21*(7), 4. https://doi.org/10.2139/ssrn.3830762

Sonjit, P., Dacre, N., & Baxter, D. (2021c). Homeworking Project Management & Agility as the New Normal in a Covid-19 World. *Advanced Project Management*, *21*(5), 5. https://doi.org/10.2139/ssrn.3823901

Sutrisna, M., & Barrett, P. (2007). Applying rich picture diagrams to model case studies of construction projects. *Engineering, Construction and Architectural Management*, *14*(2), 164-179. https://doi.org/10.1108/09699980710731281

Tite, C. N. J., Pontin, D., & Dacre, N. (2021a). Embedding Sustainability in Complex Projects: A Pedagogic Practice Simulation Approach. *Advanced Project Management*, *21*, 7. https://doi.org/10.48550/arXiv.2104.04068

Tite, C. N. J., Pontin, D., & Dacre, N. (2021b). Inspiring the Next Generation of Project Managers: Embedding Sustainability in Engineering Projects through Project Management Teaching and Learning. *Ingenium*, 9. https://doi.org/10.2139/ssrn.3880499

Vărzaru, A. A. (2022). An Empirical Framework for Assessing the Digital Technologies Users' Acceptance in Project Management. *Electronics (Switzerland)*, *11*(23), Article 3872. https://doi.org/10.3390/electronics11233872

Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data'can make big impact: Findings from a systematic review and a longitudinal case study. *International journal of production economics*, *165*, 234-246.

Whyte, J., Davies, A., & Sexton, C. (2022). Systems integration in infrastructure projects: seven lessons from Crossrail. *Proceedings of Institution of Civil Engineers: Management, Procurement and Law*, *175*(3), 103-109. https://doi.org/10.1680/jmapl.21.00014

Williams, T., Vo, H., Samset, K., & Edkins, A. (2019). The front-end of projects: a systematic literature review and structuring. *Production Planning & Control*, *30*(14), 1137-1169.

Winter, M., Smith, C., Morris, P., & Cicmil, S. (2006). Directions for future research in project management: The main findings of a UK government-funded research network. *International Journal of Project Management*, *24*(8), 638-649.

Yeo, K. (1993). Systems thinking and project management—time to reunite. *International Journal of Project Management*, *11*(2), 111-117.