Enhancing Project Management with Systems Thinking: A Framework for Complex Challenges

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ARTICLE INFO

Article details
Presented at the 35th annual conference of the Southern African Institute for Industrial Engineering, held from 20 to 22 October 2025 in Cape Town, South Africa

Available online 8 Dec 2025

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DOI
http://dx.doi.org//10.7166/36-3-3323

ABSTRACT

Delivering projects within prescribed budgets and timelines amid uncertainty in modern project management grows progressively difficult in keeping with increasing complexity. This article demonstrates how conventional project management approaches fall short for complex projects, thus calling for a necessary evolution through integrating systems thinking in project management. A broader understanding of the dynamics and interdependencies of projects and systems thinking could contribute to leadership effectiveness and societal impact. It is suggested that systems thinking be incorporated into project initiation and planning phases for enhanced control, adaptability, and predictability. Therefore, the study aimed to develop and validate a practical framework for integrating systems thinking into project management and so make teams better equipped to respond to complexity more effectively. With systems thinking, project leaders could achieve more successful outcomes in varied and complex organisational and community settings, since it puts into play the complex interactions among people involved, processes, and other environments.

OPSOMMING

Dit word toenemend moeilik om projekte binne voorgeskrewe begrotings en tydlyne te lewer te midde van onsekerheid in moderne projekbestuur, in ooreenstemming met toenemende kompleksiteit. Hierdie artikel demonstreer hoe konvensionele projekbestuursbenaderings tekort skiet vir komplekse projekte, wat dus 'n noodsaaklike evolusie vereis deur die integrasie van stelseldenke in projekbestuur. 'n Breër begrip van die dinamika en interafhanklikhede van projekte en stelseldenke kan bydra tot leierskapseffektiwiteit en maatskaplike impak. Daar word voorgestel dat stelseldenke in projekinisiasie- en beplanningsfases opgeneem word vir verbeterde beheer, aanpasbaarheid en voorspelbaarheid. Daarom het die studie ten doel gehad om 'n praktiese raamwerk te ontwikkel en te valideer vir die integrasie van stelseldenke in projekbestuur en sodoende spanne beter toegerus te maak om meer effektief op kompleksiteit te reageer. Met stelseldenke kan projekleiers meer suksesvolle uitkomste behaal in uiteenlopende en komplekse organisatoriese en gemeenskapsomgewings, aangesien dit die komplekse interaksies tussen betrokke mense, prosesse en ander omgewings in werking stel.

1. INTRODUCTION

Over the past two decades, it has become a significant concern in the evolving field of project management to recognise and manage complexity [1]. Besides, with increasingly ambitious projects being undertaken worldwide, particularly in Africa, such as South Africa's hosting of the 2010 FIFA World Cup, the Medupi power station, and Gautrain, the need for suitable frameworks to manage project complexities has grown. These kinds of project generally tend to be significantly delayed and to overspend budgets, proving that classical project management methodologies have difficulty with handling the uncertainties posed by complex and dynamic environments. Gautrain was delayed by two years and was over budget by R14 billion, while the 2010 FIFA World Cup was reported to be about R6 billion over budget. Similarly, construction of the Medupi power station was delayed by about 2.5 years, and reportedly exceeded the estimated completion cost by R56 billion [2].

The Project Management Institute (PMI) defines a project as a temporary endeavour to create a unique product, service, or result [3]. While effective for linear projects with low uncertainty and complexity, traditional project management tools tend to falter with non-linear and multifaceted projects. These are becoming the norm in our interconnected world [4]. This is particularly true in complex projects, where the outcome predictability and control over processes are reduced owing to the number and variability of interacting elements. Managing complex projects in the same way you would manage linear projects may not yield desirable results [5], [6]. However, researchers have found no single definition of project complexity to explain the whole concept of complexity in projects [5], [7].

Recent studies also suggest a growing acknowledgement in the project management community that new, more adaptive approaches are becoming necessary. This sentiment is echoed by Sterman [8] and supported by San Cristobal *et al.* [5], who argue that the inherent non-linearity of complex projects makes traditional methods unsuitable. There has been a burgeoning interest in systems thinking as a potential paradigm to address these challenges. Systems thinking offers a holistic approach that recognises and strategises around the interdependencies inherent in complex projects [1], [9].

Parsons-Hann and Liu [10] highlight how complexity contributes to failing organisational projects. In this sense, knowing how complex projects function and how to control them is essential in mastering such projects. Complexity becomes increasingly common in complex projects and, with that, concern arises about the complexity and its implications for the project management process [5]. Complex projects are challenging because they are so unpredictable under conditions of high uncertainty [10].

Nevertheless, there has been very little research on including systems thinking in project management in an African context. There is also a lack of frameworks specific to the African project environment, with its unique socio-economic and political dynamics [10], [11]. Therefore, this work suggests an approach based on systems thinking to improve project management practices in complex projects in Africa. This is an area that has been severely neglected in the review of the literature. The methodology section details the data collection, emphasising qualitative insights from the responding professionals to validate the applicability of the proposed framework. The findings are then discussed to link the theoretical underpinning with practical implications, thereby providing an in-depth understanding of the strategic integration of systems thinking into project management practices to tackle effectively the complexities of large-scale African projects. The framework of the theory proposed in this research is based on the latest studies that have suggested a systems thinking approach to managing complex projects. This approach is not just theoretical, but is derived from an empirical study of project management experiences in Africa, where complexity has arisen from the internal dynamics of projects and external environmental factors [10], [12], [13].

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Project complexity

The increasing scale and intricacy of global and especially of African projects have heightened the need for more effective management approaches [12]. Traditional project management methodologies are progressively proving insufficient because of their inability to handle the unpredictability and high uncertainty inherent in complex modern projects, leading to significant project risks. However, scholars highlight the absence of a consensus on the definition of project complexity, which complicates the development of strategies to manage it effectively [5]. Supporting this, Zhu *et al.* [7] emphasise the various

interpretations of complexity in the literature. These are examples of complexity definitions by different scholars:

- Complexity is a system property that makes it challenging to plan its overall conduct even if information about its atomic constituents and their interrelations is made available [14].
- Complexity is a project's property, making understanding, predicting, and controlling its overall conduct difficult [13].
- Complexity is having insufficient information when too many variables interact [15].

Project complexity is often used as a concept, but it is hardly ever understood [16]. A common theme in these definitions is the multiplicity of interrelated components and the unpredictable nature of complex project outcomes [16], [17]. In response to these challenges, this paper proposes a nuanced definition of a complex project, one that is particularly relevant for the African context, where socio-economic and environmental factors add layers of complexity that are not commonly encountered in more developed regions.

A multi-complex project, therefore, is said to comprise many interrelated parts in an equally complex system, which makes it difficult to predict, comprehend, and control; this is conpounded by the peculiar socio-economic and environmental dynamics surrounding it. This definition fits within the framework of Vidal and Marle [13], which categorised project complexity into four dimensions: size, variety, interdependence, and context. These categories seem to be pertinent in the African project environment, where limitations in resources, inconsistencies in regulatory frameworks, and cultural diversities affect the execution of projects [12], [13], [14], [18].

Complex projects have greater prominence in scale and a non-linear interrelationship between elements that is incompatible with traditional forms of linear management [6]. This is fundamental from an African perspective, where projects often bring together conflicting and contradictory interests and objectives. Applying traditional project management techniques to these complex projects can lead to erroneous assumptions and wrong iterations, thus leading to delays and even the failure of the project [9], [11].

Marle and Vidal [12] elaborate on the implications of complexity, including ambiguity in project objectives and the cascading effects of small changes on the project system. "Project ambiguity" refers to a lack of awareness of elements, events, features, and interactions owing to a lack of comprehension of the project system. "Project uncertainty" refers to the project manager's inability to anticipate project objectives, element characteristics, and the consequences of actions and decisions. Every change in any aspect of a project may affect other elements in an unforeseen way. The more complex that projects become, the greater the concern about the project management process [5], [10]:

- Complexity obstructs the clear identification of the goals and objectives of major projects.
- Complexity affects the selection of an appropriate project organisational form and suitable project management arrangements.
- Complexity affects project outcomes (time, cost, quality, safety, etc.).
- Understanding project complexity helps to determine the planning, coordination, and control requirements.

This study aims to integrate systems thinking into project management as a strategic way to deal with these complexities. The systems thinking approach permits a holistic view of project elements and their interactions, and it can be used to anticipate and manage the complexities more effectively. This approach is particularly interesting in African project management, as the structures are resilient and adaptable amid constant changes and uncertainties [17].

2.2. Systems thinking

Systems thinking became a decisive discipline in project management when tackling the many problems that are attributed mainly to the complexity of projects. Merriam-Webster states that a system is "an interacting or interdependent group of items forming a unified whole" [19]. In this context, systems thinking is used in project management to understand and manage the dynamic interdependencies that constitute a project environment, allowing the manager to take a holistic view of a project rather than a linear cause-and-effect approach.

San Cristobal [5] describes systems thinking as the study of complex systems, focusing on predicting behaviour and making strategic modifications to achieve desirable outcomes. This view is important in complex projects, where traditional linear project management does not apply. Systems thinking offers a set of synergistic analytical abilities that have a positive impact on the understanding of complex interrelationships that shape complex projects [19].

Elia *et al*. [20] state that systems thinking tries to view wholes rather than parts in isolation, and patterns of change rather than static snapshots. This is essential to understanding the interrelationships that characterise complex projects with their own sets of characteristics and challenges [20]. Given that, in the context of African project management, projects happen to be set in quite diverse and dynamic environments, systems thinking offers a way to manage uncertainty and complexity.

Applying systems thinking in project management is not only a different methodology: it also provides an added approach to conventional methods in project management. This is usually seen in managing highly complex projects, which are becoming more common in African settings where the socio-economic conditions, legal frameworks, and stakeholder landscapes differ [1]. Systems thinking would also bring all-important elements into the strategic, tactical, and operational processes of the project management process, thereby ensuring effective management of the projects in situations of unexpected changes and difficulties [5].

2.3. Applying systems thinking in complex project management

In project management, systems thinking provides an analytical framework that serves as a great asset in dealing with complex projects that do not lend themselves to the application of classical management approaches. Systems thinking relies on the holistic view of projects as systems in organisational and environmental contexts. Systems thinking in project management brings clarity and an sense of how different system elements affect general performance [1]. This general perspective is needed to predict the behaviour of scenarios to formulate strategic changes that benefit projects, especially in uncertainty and interdependence [19].

Elia *et al*. [20] define systems thinking as looking at wholes rather than at parts, and understanding the dynamic patterns of change rather than frozen snapshots. An awareness of systems thinking is critical in managing projects characterised by complex interactions that give the systems their unique properties [20]. This complexity is often related to the changing needs of stakeholders, unpredictable project scopes, and varieties of technologies and socio-elements, which substantially affect projects in African settings [22].

Incorporating systems thinking into project management involves an in-depth understanding of the problem-solving process while identifying the core problems of the project beyond superficial symptoms. Kopczyński [1] states that project decision-makers must understand and single out the nature of project problems, which are often neglected by conventional approaches. The Association for Project Management (APM) lists specific reasons why systems thinking is most relevant for project management [22]:

- **Non-deterministic nature of projects:** Projects often undergo changes that require dynamic scope, cost, and schedule adjustments. Systems thinking provides a framework for anticipating these changes through a comprehensive analysis of component interactions.
- **Evolving stakeholder needs:** As projects progress, the initial needs of stakeholders can evolve. Systems thinking encourages broader, more adaptive thinking continually to align project outputs with stakeholder expectations.
- **Integration and interdependencies:** Projects often entail integrating various components that must function cohesively. Systems thinking facilitates understanding of these interactions and managing the resultant complexities effectively.

The APM also emphasises that systems thinking recognises the emergence of properties and behaviours from interconnected, hierarchically organised units, which traditional analytical approaches may not adequately predict [22]. This emergent behaviour underscores the significance of understanding the relationships and feedback loops in project systems, which can be mapped using tools such as causal loop diagrams and system archetypes [23]. The “iceberg model” provides a generic framework to guide the implementation of systems thinking in support of project management [24]:

- The first level of the iceberg model recognises facts and events. Most acquired knowledge is based on this level, although it is superficial [1], [25].
- The next level, hidden from view, involves the pattern that links discrete events [25]. This level is less visible and perceptible in the thinking process [1].
- The third and deeper level consists of systemic structures explaining the observed patterns.
- At the deepest level are mental models, instinctive and habitual reactions to a complex and uncertain project environment.

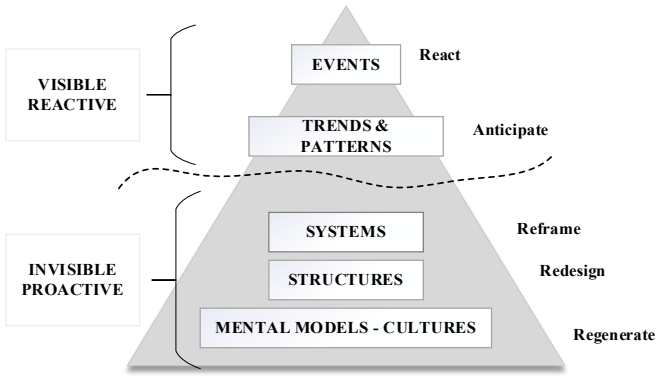

Figure 1: Systems thinking iceberg model (adapted from [24]**)**

The effectiveness of a holistic approach to problem-solving is based on understanding the structure of the problem, the phases, and the application of all levels of systems thinking [1]. It is also important to note that levels of thinking are applied to the concept phase [25]. However, despite all the available tools and methods, the staff still manage and support the completion of the project. Any new approach, such as systems thinking tools, requires the staff to implement the changes. This requirement could be summarised as four essential areas in which to provide for systems thinking [1]:

- **Holistic approach to problem-solving**. A holistic approach to problem-solving considers multiple elements: the nature of the project problem, diverse stakeholder perspectives, organisational conditions, and the available technological support [1], [25]. This comprehensive view is crucial to effectively addressing the underlying issues of complex projects.
- **Building a network of interactions**. Understanding the cause-and-effect relationships in project management is essential to developing effective strategies [26]. Causal loops may assist in understanding the variables that influence and drive observed events and patterns of mutual interactions between factors and their possible influence on potential delays. Systems thinking facilitates this by helping to identify and map causal loops, which reveal the interdependencies and potential impacts of different project variables [1], [25].
- **Role-play scenarios in dynamic and complex systems**. Scenario planning and role-playing are vital when exploring various project outcomes and preparing for future challenges. This approach is instrumental in complex environments, where it helps stakeholders to understand and adapt to evolving project dynamics. This method creates and assesses scenarios in a dynamic and complex setting [27]. Scenario planning and action strategy modelling can be used to look ahead to determine the system concept and to look back to assess the deployed system. Various scenarios that are selected on the basis of their relevance to the project would depend on the relationships between the causes and the effects. Periodic planning for the scenarios would allow major project stakeholders to adapt actively to the changing project environment [28].
- **Adaptive project team approach**. Project teams are subject to dynamic and highly complex environments; thus, they depend on activities of constant learning and growth through project practice. The systems approach demands flexibility and creativity from project teams. This promotes a continual learning and innovation culture, which is extremely important in dynamic project environments where conditions and requirements can shift rapidly [1]. Action learning, creativity, and fostering innovation include the activities above and so are seen to be essential enablers.

2.4. Conclusion to literature review

Traditional project management methodologies may be presumed to be adequate for the linear projects; but they are inadequate in scenarios of extreme complexity, such as one characterised by high uncertainty. A systems-thinking-induced intervention remedies those deficiencies while boosting the ability to manage complex projects. Therefore, by using the systems thinking approach in project management practice, project managers could increase the success of their projects by completing them within scope, time, and budget while managing the complexity associated with modern-day project environments. Despite its promise, adopting systems thinking into project management has not been embraced [28]. This research should help to narrow this gap by proposing a systems-thinking-based framework that is relevant to the peculiarities and complexities of African project environments. The framework and approach emerging from the findings of this study create an opportunity to strengthen the systems thinking literature and project management practices.

3. PROPOSED CONCEPTUAL MODEL

The outcomes of this research are discussed in relation to the literature in order to provide an original insight into the adoption of systems thinking in an African project management context, where local constraints are often particularly complex. This discourse aims to develop a bridge between theory and practice so that project leaders in Africa and similar areas may gain some practical strategies to manage complex projects more successfully.

This study provides a conceptual framework based on systems thinking to tackle complex project management challenges in the African context. The framework is based on Kopczyński [1] and on the recent project management literature to ground this study in applying systems thinking to the management of complex projects. The study's outcome should inform the framework or model with a strong construct, which could guide project practitioners on how systems thinking could be applied to manage complex projects effectively.

This framework responds to the particularities of African project environments' complexity and encourages new prospects for adapting systems thinking to this end. The relevant project leadership is also provided with actionable strategies for managing African projects' complexities to achieve project success and stakeholder satisfaction. The data collection took place with project practitioners, using this model. Figure 2 presents the research model that guided the empirical data collection from project practitioners [1].

- **Holistic approach to problem-solving**. This dimension of the frame studies how project managers find, treat, and maintain issues linked to projects. Its service includes evaluating whether practitioners have a holistic view, incorporating multiple stakeholder perspectives and multifaceted project objectives. This approach is pertinent in managing the uncertainties and complexities of African project environments, which involve many socio-economic welfare dimensions.
- **Network of Interactions**. It investigates and maps the cause-and-effect relationship among the components within the project systems. It studies how practitioners realistically analyse and use the intersectional linkages in predicting or guiding anticipated future project disruptions. Proof of the causal loops and scenario planning reflects the non-linear and interrelated dynamic quality of highly complex projects, where action taken in one particular area often has extremely lengthy-reaching effects.
- **Role-Play Scenarios**. This area looks at the preparedness of project teams to deal with unanticipated challenges by setting concrete strategies in place. It assesses how project managers prepare for possible problems by designing extensive, anticipatory responses against predictable issues, making project execution more reliable and flexible.
- **Project Team Approach**. This aspect of team dynamics examines how teams respond to changes and challenges during implementation. It assesses team creativity, adaptability, and learning orientation, essential attributes in strategising and figuring out ways of navigating complexities in the dynamic environment, often unpredictable, of projects in Africa.

This paper will bridge the gap by introducing a systems-thinking-based framework that addresses the specific complexity of African project environments. It also adds to the knowledge of systems thinking by advocating for its theoretical adoption and demonstrating its practical application using empirical data from project managers involved in highly complex African projects. The model will measure the extent to

which systems thinking is applied in project management. The findings of such a study will inform a framework or model for guiding practitioners in using systems thinking while managing complex projects.

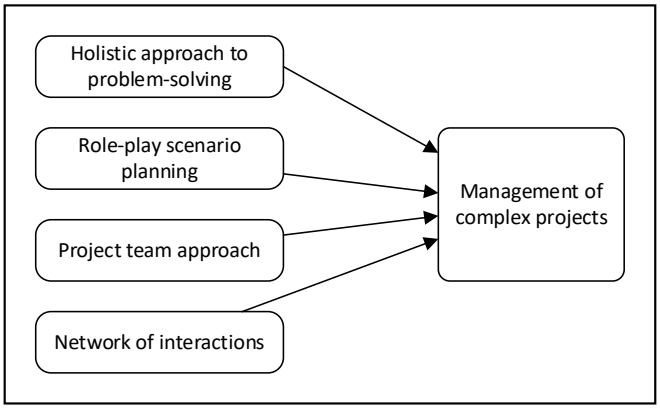

Figure 2: Proposed research model

4. RESEARCH METHOD

4.1. Literature review and conceptual framework

The purpose of the literature review was to consolidate knowledge of project complexity and theories of project complexity management. An area of thematic interest, especially in Africa, was to identify the gaps in applying systems thinking to managing complex projects. This literature review provided the current academic basis for the study, and helped to develop a conceptual framework purposely designed for project environments in Africa, characterised as they are by their specific difficulties [29]. The dichotomous framework informed the methodology and design of the data collection instruments to ensure that they captured relevant information from the research questions and the investigated contexts.

4.2. Research instrument

This research relied mainly on cross-sectional questionnaire data that targeted project practitioners, using a snowball sampling method, and distributed via Qualtrics. The questionnaire was so designed that immediate responses would directly address the research questions without specifying any hypotheses; the questions were more concerned with the practitioners' ways of applying systems thinking in project management processes. This quantitative analysis was supplemented by qualitative perspectives from open-ended questions that attempted to elicit practitioners' perceptions of applying systems thinking to improve project management productivity in a more complex environment. The questionnaire focused on the following main areas:

- Holistic approach to problem-solving: This focus assessed how comprehensively project issues are understood and addressed, considering various stakeholder perspectives and objectives.
- Network of interactions: This focus explored how to recognise and manage causal relationships in project systems and the development of alternative scenarios to manage potential changes.
- Role-play scenarios: This focus investigated the preparation and adaptability of project teams by developing action strategies for potential project disruptions through role-playing.
- Project team approach: This focused on how teams adapt to changes, on their creativity and development, and on the dynamics of team interactions.

4.3. Data analysis

The responses were collected online, with a total of 62 participants providing both partial and complete answers. The collected data were analysed for mean and standard deviations (SD) using the analytical tools provided by Qualtrics. The data collection focused on assessing the level of systems thinking integration in current practices using a five-point Likert scale, as seen in Table 1 [30]. This scale helped to quantify the extent to which systems thinking is embedded in the daily management of complex projects. The mean

score interpretation is shown in the third column. The responses to the qualitative open-ended questions were critically evaluated for common themes.

Table 1: Likert scale and mean score interpretation

Likert scale	Coded value	Mean ranges
Always	5	4.21 – 5.00
Most of the time	4	3.41 – 4.20
About half the time	3	2.61 – 3.40
Sometimes	2	1.81 – 2.60
Never	1	1.00 – 1.80

5. RESULTS

5.1. Conceptual model testing

The conceptual model was tested using the collected data to identify gaps in the current systems thinking application and to suggest areas for improvement. The data gathered indicated that all the respondents had some level of training in systems thinking. However, only 67% of them indicated that they applied systems thinking to a high degree in their projects.

5.1.1. A holistic approach to problem-solving

This first question set determined whether the practitioners used a holistic approach to problem-solving when managing their projects, as seen in Table 2.

Table 2: Respondents' responses to a holistic approach to problem-solving

	Mean	SD
How often do you take a comprehensive and holistic approach when solving problems?	4.26	0.82
How often do you take different points of view into consideration when defining a project problem?	4.26	0.85
How often do you map out different objectives for different aspects of the project?	3.88	1.02
Average values	4.13	0.897

Practitioners generally adopted a holistic approach to problem-solving (mean = 4.13), indicating a strong tendency to consider multiple aspects and viewpoints when addressing project difficulties. The average SD is 0.897, which shows that the data is clustered around the mean and not spread out. The respondents claimed that they took a comprehensive and holistic approach when solving problems (mean = 4.26). They also considered different points of view when defining the project problem (mean = 4.26). However, mapping out different objectives for various project aspects emerged as a potential area for improvement (mean = 3.88).

5.1.2. A network of interaction

The second question set determined whether the practitioners paid attention to causal relationships to analyse a network of interaction between elements in the project, as seen in Table 3. The average mean (3.62) indicates a moderate engagement with systems thinking principles, despite a higher SD (1.083). However, the higher SD (1.22) for cause-and-effect relationships indicates an inconsistent application of these principles in projects. This suggests that some practitioners might not fully use systems thinking to manage dependencies and interactions in projects.

Table 3: Respondents' responses to a network of interaction

	Mean	SD
How often do you analyse the interaction between different elements in the project?	3.85	0.97
How often do you consider cause-and-effect relationships between different factors in the project?	3.47	1.22
How often do you develop possible alternative scenarios when handling projects?	3.65	0.97
How often do you develop a plan to manage possible project changes?	3.50	1.17
Average values	3.62	1.083

5.1.3. Role-play scenarios in dynamic and complex systems

Table 4 shows the results of determining whether the project practitioners used role-play scenarios to develop action strategies with all the information. The practitioners engaged in such strategic planning less frequently (mean = 2.97), which is an area of concern that indicates a significant gap in preparedness and adaptability.

Table 4: Respondents' responses to a scenarios in dynamic and complex systems

	Mean	SD
How often do you develop different action strategies with relevant information to allow the project team to act swiftly should you encounter problems in the project during its lifecycle?	2.97	1.15
Average values	2.97	1.15

5.1.4. A project team approach

The final section determined how project teams responded to changes during execution, as shown in Table 5. The average mean for a project team approach is 3.57, indicating a project team approach. The data suggest that, while regular team meetings were common (mean = 4.26; SD is the lowest at 0.7), discussions of cause-and-effect relationships were less frequent (mean = 3.32; SD is the highest at 1.16). The mean for teams implementing creative thinking techniques in project management is lowest at 3.06, meaning that most respondents did not implement creative thinking in projects.

Table 5: Respondents' responses to a project team approach

	Mean	SD
Do you and your team learn project problems from different perspectives?	3.65	0.90
How often do you have team meetings to discuss cause-and-effect in situations that appear problematic?	3.32	1.16
How often does your team implement creative thinking techniques in project management?	3.06	1.11
How often do you have regular meetings with the project team?	4.26	0.70
Average values	3.57	0.968

5.2. Open question on the application of systems thinking

Responses to the open-ended question about applying systems thinking underscored its importance in the project initiation and planning phases. The practitioners emphasised that understanding interdependencies early on could significantly enhance project outcomes by aligning project objectives with the realities of the project environment and stakeholders' needs. The listed advantages of systems thinking in project management are as follows:

- Enhanced clarity in defining project objectives from the perspective of multiple stakeholders and designing for benefit.
- Increased adaptability and flexibility in management practices. As the project environment evolves, project managers can adjust strategies and tactics, based on the changing dynamics, rather than sticking rigidly to a predefined plan.
- Improved understanding of project dynamics and interdependencies, leading to improved decision-making and problem-solving capabilities.
- Reduced uncertainties through proactively identifying and mitigating risks.
- Better alignment of project outcomes with broader organisational goals. The outcome must fit the bigger picture to ensure affordability, supportability, and the effective use of available resources.

5.3. Discussion of results

Figure 3 summarises the conceptual model's results, highlighting the respondents' agreement about the framework's relevance in addressing project complexity. A holistic approach emerged as the most prominent parameter, probably because of the respondents' exposure to systems thinking and systems engineering in their work environment. However, role-playing scenarios could also enhance systems thinking in complex project management.

High levels of uncertainty, interrelated elements, and difficult predictability and control characterise project complexity. This study defines a complex project as "composed of highly complex, interrelated systems that challenge understanding, prediction, and control". Managing such projects successfully requires recognising complexity's impact on schedule, cost, and quality, so that tailored management approaches are enabled. Practitioners tend to rely on traditional project management methods, which inadequately address complexity, often leading to project delays and budget overruns.'

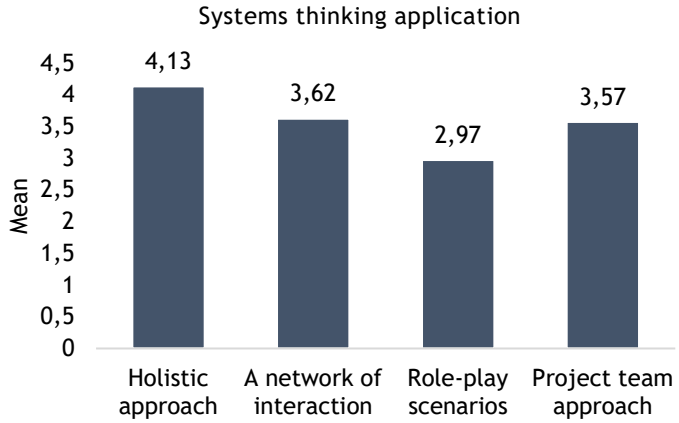

Figure 3: Four areas to apply systems thinking

While most of the respondents had some systems thinking training, only 67% applied it in their projects. Critical components such as cause-and-effect analysis, multiple action strategies, and interaction mapping were inconsistently applied even among those claiming to use systems thinking. This suggests a lack of clear guidelines or insufficient training in systems thinking for project management.

Although a holistic approach is widely used, mapping different objectives and analysing interdependencies remains underdeveloped. This immaturity in applying systems thinking limits its effectiveness in managing complexity. Also, action strategies are only intermittently developed, reducing agility in executing projects. Although project teams hold regular meetings, they seldom discuss cause-and-effect relationships; this raises concerns about their focus on proactive complexity management. This study underscores the need to integrate systems thinking systematically into project management; and so it proposes a refined framework that emphasises:

- Continual engagement with systems thinking throughout the project lifecycle.
- Regular training and development sessions to strengthen the application of systems thinking.
- Institutionalising systems thinking as a core element of project culture.

This research fills a critical gap by providing empirical evidence and a structured framework for embedding systems thinking in complex project environments, particularly in Africa. Systems thinking should not be viewed as a tool but as an organisational approach that enhances efficiency, cost-effectiveness, and project success.

5.4. Proposed framework for applying systems thinking in project management

Developed from the research results, Figure 4 outlines the refined guideline for applying systems thinking in project management, which addresses the intricacies and challenges that are unique to managing complex projects, particularly in African contexts. The expanded framework components include the following:

- **Emphasise the big picture**. Encourage project managers and team members to adopt a holistic view of projects. This broader perspective makes it easier to identify potential risks and bottlenecks and the improvement opportunities that are crucial when managing projects in diverse and dynamic environments.
- **Identify and address root causes**. Systems thinking shifts the focus from symptomatic solutions to addressing the underlying causes of project issues. This approach helps to prevent recurrence and promotes sustainable outcomes – a critical aspect in regions that face socio-economic instability.
- **Analyse interdependencies**. Understand the intricate web of dependencies in project elements for improved risk management and mitigation strategies.
- **Feedback loops and learning**. Systems thinking encourages learning from experience and adapting the project accordingly. Implement continual feedback mechanisms to adapt project strategies that are based on real-time insights.
- **Consider internal factors**. A structured decision-making process is critical to navigating the complex decision landscapes of large-scale projects in developing regions.
- **Consider external factors**. Projects do not exist in isolation. Acknowledge the impact of external influences such as economic conditions, market trends, and regulatory changes.
- **Collaborative decision-making**. Foster a culture of collaboration among stakeholders from different departments and backgrounds who have a shared commitment to project goals, thus enhancing cohesion and alignment.
- **Develop a systems mindset**. Cultivate a project culture that prioritises systems thinking, so encouraging open communication, embracing failure as a learning opportunity, and being flexible in response to unforeseen changes.
- **Use appropriate tools and techniques**. Leverage systems-thinking tools such as causal loop diagrams, system dynamics modelling, and influence diagrams to visualise and analyse project complexities.
- **Continual improvement**. Position each project as a learning opportunity. Post-project reviews are crucial for identifying successes and areas needing improvement, fostering a culture of constant development.

The proposed framework aims to enhance project management in African settings by embedding systems thinking at all organisational levels. Synthesising insights from the systems thinking literature and modern project management methodologies, it addresses the gaps in existing models, particularly the underrepresentation of African contexts. It advocates an embedded systems thinking approach on every organisational level, ensuring that this methodology is not just an add-on tool but a fundamental aspect of project management. By complementing traditional approaches, this framework adapts project management to complex environments, fostering adaptability, foresight, and resilience in project execution.

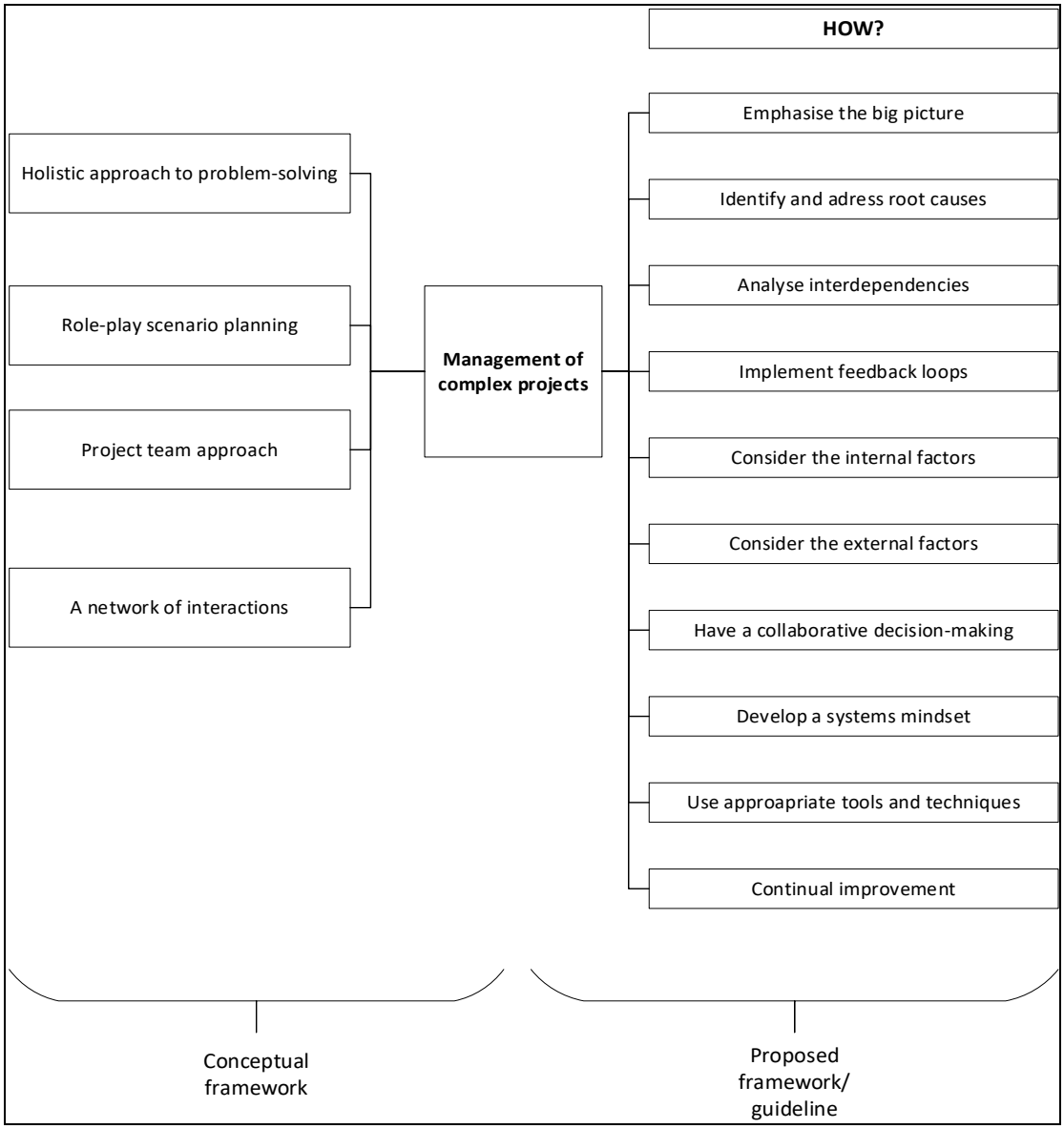

Figure 4: Proposed framework for applying systems thinking in project management

6. CONCLUSIONS AND RECOMMENDATIONS

With systems thinking in focus, this study has systematically evaluated how to enhance project management for complex project management in different African sub-sectors. Traditional project management is popular at present; however, because of its inherent rigidity, it is often considered ineffective in dynamic settings. The literature shows that most practitioners apply the conventional route, regardless of project complexity, which strengthens the argument for some variation.

Derived from empirical data, the framework provides some strategies for applying systems thinking to project management in practice. Systems thinking applied throughout the project lifecycle should enhance the project's initiation and planning phases, enabling managers to identify interdependencies and to draw upon them to mitigate the effects of risks. The theory–practice gap remains, underscoring the need for facilitators and for tailor-made approaches to implementation. Systems thinking knowledge should be cultivated by project teams at the level of people, teams, processes, and workflows for an enhanced impact.

This study contributes to the steady flow of literature on systems thinking and project management, and insists that such systems thinking should not remain external but be an internalised practice. The results of this study should encourage its use in all forms of project, not just complex ones, thereby promoting a more proactive stance towards the dynamics of project work. Key recommendations are the following:

- **Integration of systems thinking**. Organisations should institutionalise systems thinking in project methodologies and provide targeted training to enhance practitioners' competence.
- **Policy and strategy development**. Policymakers and leadership should allocate resources and adapt policies to support a systems-thinking approach.
- **Cultural change**. Encourage a project culture of continual learning, flexibility, and collaboration to strengthen resilience in complex environments.

However, the study's focus on practitioners who were already familiar with systems thinking may have introduced bias. Future research should be expanded to include a broader participant base, including those without formal training, to validate its findings. Action research could be conducted in various industries to refine and improve the framework's practical applicability.

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