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The role of culturally-driven strategic agility in enhancing adaptation to sudden changes: Evidence from Saudi projects

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Abstract: This study examines the role of culturally driven strategic agility in enhancing the adaptability of Saudi projects to sudden changes. Drawing on theories of dynamic capabilities and adaptive leadership, the research adopts a mixed-methods approach, combining quantitative data from 265 public and private sector projects with qualitative insights from 20 semi-structured interviews. The findings reveal that advanced information systems and adaptive leadership significantly improve project adaptability in volatile environments. In contrast, dynamic resource reconfiguration remains limited by centralized governance and rigid administrative structures. Organizational and cultural barriers, such as bureaucracy and resistance to change, are found to moderate the relationship between strategic agility and adaptability, often weakening it. Managerial experience plays a pivotal role in fostering adaptive capacity. A comparative analysis with international cases—including Singapore, the UAE, and Germany—highlights the importance of integrating advanced technologies with institutional support. The study concludes that fostering culturally aligned strategic agility is essential for achieving the ambitious transformation goals of Vision 2030 and maintaining high performance in complex and dynamic project settings. These insights offer practical guidance for policymakers and project leaders seeking to build more resilient and responsive project systems in Saudi Arabia.

Keywords: *Adaptive leadership, Advanced information systems, Organizational barriers, Project management, Saudi vision 2030, Strategic agility.*

1. Introduction

Today's organizations operate in environments characterized by high levels of dynamism, complexity, and volatility due to sudden changes such as economic crises, rapid technological advancements, natural disasters, and global pandemics. These challenges pose significant threats to the continuity and success of projects. In response, strategic flexibility has emerged as one of the most critical organizational capabilities, enabling projects to swiftly adapt to unexpected changes while maintaining performance and operational efficiency [1].

Strategic flexibility is defined as the ability of an organization or project to quickly detect external changes, allocate the necessary resources, and effectively adjust strategic directions in alignment with emerging threats or opportunities. This capability is critical in project management, given the temporary and complex nature of projects, which requires a delicate balance between rigid objectives and the need to adapt during execution.

Studies indicate that strategic rigidity represents the greatest threat to projects in unstable environments, as it hampers their ability to pivot and respond effectively, potentially leading to delays or failure. In contrast, strategic flexibility enhances dynamic responses and empowers project teams to adjust plans and tactics within flexible strategic frameworks [2].

Advanced literature identifies several dimensions of strategic flexibility [3] including:

Structural flexibility: the ability to modify organizational structures and processes.

Resource flexibility: the capacity to rapidly reallocate budgets and human resources.

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Decision-making flexibility: the support of decentralized and interactive decision-making processes.

Market and technological flexibility: the ability to adapt to sudden changes in customer demand or technological innovations [4].

This study, employing an integrated theoretical and practical approach, aims to investigate the impact of strategic flexibility on project success in the face of sudden changes. It seeks to analyze the causal relationship between strategic flexibility and project adaptability, while also highlighting implementation challenges, including resistance to change, weak leadership, and organizational constraints.

Given the unique context of Saudi Arabia, which is undergoing organizational and cultural transformations under Vision 2030, this study introduces a novel theoretical concept: Culturally-Driven Strategic Agility (CDSA) [5]. This concept addresses the capacity of projects to adapt to sudden changes by integrating local cultural values (such as collectivism and hierarchical structures) with emerging technologies (such as artificial intelligence and digital twins), thereby contributing to sustainability goals. This represents an advancement in dynamic capability theory, with a specific focus on Saudi public and private project environments.

The study poses several key questions:

- How does Culturally-Driven Strategic Agility enable Saudi projects to adapt to crises?
- What organizational and technological models support this agility within the framework of local cultural values?
- To what extent do these effects vary across different project types or organizational environments (public vs. private sector)?

These questions gain heightened relevance amid accelerating global transformations, driving project leaders to adopt proactive and adaptive approaches that enhance performance continuity and contribute to the developmental objectives of Vision 2030 [5].

2. Research Problem

Modern projects, across both public and private sectors, face mounting challenges from sudden changes in their organizational environments, including global economic downturns, geopolitical volatility, rapid technological advancements, and pandemics such as COVID-19. These disruptions have a significant impact on supply chains, schedules, and resource allocations.

In Saudi Arabia, where Vision 2030 projects (such as NEOM and Qiddiya) [5] are advancing across key sectors—digital transformation, infrastructure, and healthcare—there is a critical need for Culturally-Driven Strategic Agility (CDSA). This refers to a project's ability to sense opportunities and threats, make swift decisions, and reallocate resources effectively by integrating local cultural values (such as collectivism and hierarchical structures) with emerging technologies (e.g., AI, digital twins).

Research indicates that the absence of strategic flexibility leads to organizational rigidity, hindering projects' responsiveness to crises and causing delays or goal failures. For instance, a Project Management Institute [6] found that 58% of failed projects in 2022 lacked effective adaptive mechanisms. Similarly, a King Saud University [5] study revealed that Saudi projects relying on traditional planning were 72% less effective in overcoming supply chain disruptions compared to those using flexible strategies.

However, implementing agility in Saudi projects faces organizational and cultural barriers, such as excessive centralization, fear of risk-driven resistance to change, and difficulties in resource reallocation due to rigid administrative structures. These challenges are further compounded by cultural values emphasizing hierarchical decision-making and collective orientations, which can slow response times.

Globally, countries like Singapore and the UAE have achieved notable success in implementing strategic agility through decentralized structures, real-time data analysis via AI, and the adoption of agile management methodologies, offering valuable lessons for Saudi Arabia [7, 8].

Given the limited Arabic literature examining the causal link between strategic flexibility and project performance under sudden changes, this gap necessitates an in-depth study focusing on Saudi

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public and private sector projects, particularly in the areas of digital transformation and infrastructure [9].

This study aims to address this gap by developing a multi-level framework that integrates adaptive leadership, organizational processes, external policies, emerging technologies, and the Sustainable Development Goals (SDG 9 and SDG 11)—Industry, Innovation, and Infrastructure; Sustainable Cities and Communities.

3. Research Objectives

This study aims to provide a scientific and practical analysis of the impact of Culturally-Driven Strategic Agility on the adaptability of Saudi projects—particularly digital transformation and infrastructure projects—in dynamic environments aligned with the objectives of Vision 2030. The key objectives are to:

- Analyze the causal relationship between strategic agility (adaptive leadership, decision-making speed, resource reallocation, advanced information systems) and projects' ability to respond effectively to unexpected crises.
- Identify and assess organizational (e.g., centralization) and cultural (e.g., resistance to change) factors that limit strategic agility in Saudi projects and propose strategies to address them.
- Explore successful international experiences (e.g., Singapore, UAE) in implementing strategic agility and derive adaptable lessons for the Saudi context.
- Develop a practical, multi-level framework that integrates organizational, technological (including AI and digital twins), and cultural components to enhance strategic agility in Saudi projects.
- Assess the adoption of strategic agility practices (including Agile methodologies and AI) in both the public and private sectors, and compare performance to identify gaps and opportunities for improvement.
- Bridge the knowledge gap in Arabic literature by offering new insights into enhancing project adaptability in Saudi Arabia, supporting national and regional competitiveness, and sustainable development (SDG 9; SDG 11).

4. Research Questions

This study investigates the impact of Culturally-Driven Strategic Agility on the adaptability of Saudi projects—especially in digital transformation and infrastructure—under sudden changes. The key research questions are:

- To what extent does strategic agility (adaptive leadership, decision-making speed, resource reallocation, information systems) influence public and private sector project adaptability to sudden changes (e.g., economic crises, technological shifts)?
- What organizational (e.g., decision centralization) and cultural (e.g., resistance to change) factors hinder strategic agility in Saudi projects, and how can their impact be measured?
- How do the components of strategic agility enhance project responses to unexpected crises, and how do these effects differ between the public and private sectors?
- What lessons can be drawn from successful international experiences (e.g., Singapore, UAE) in implementing strategic agility, and how can they be adapted to strengthen Saudi project capabilities?
- To what extent do Saudi projects adopt strategic agility practices (Agile methodologies, AI, digital twins), and how effective are these practices in enhancing crisis readiness?
- How can a practical multi-level framework integrating organizational, technological, and cultural components be developed to enhance strategic agility in Saudi projects, and how applicable is it across different sectors?

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- How does strategic agility contribute to achieving sustainable development goals (SDG 9; SDG 11) in Saudi projects under dynamic conditions?

5. Research Hypotheses

To define the directions and causes of the relationships explored, the study proposes the following hypotheses on the impact of Culturally-Driven Strategic Agility on the adaptability of Saudi projects:

- There is a statistically significant positive relationship between the dimensions of strategic agility (adaptive leadership, decision-making speed, resource reallocation, advanced information systems) and project adaptability to sudden changes.
- Culturally driven adaptive leadership positively and directly enhances project responsiveness to unexpected crises in both the public and private sectors.
- Decision-making speed and resource reallocation—supported by technologies such as blockchain—positively contribute to enhancing strategic agility and project performance in the face of external challenges (e.g., supply chain disruptions, technological shifts).
- A supportive organizational culture for change—embracing calculated risk-taking and reduced centralization—mediates the relationship between strategic agility and project crisis response.
- Advanced information systems (AI, digital twins) enhance projects' abilities to detect and respond swiftly to sudden changes, acting as a mediating factor between agility and adaptability.
- Organizational and cultural factors (e.g., excessive centralization, resistance to change) negatively moderate the relationship between strategic agility and project performance under crises.
- The impact of strategic agility on adaptability varies by sector, with private sector projects demonstrating greater agility due to less bureaucratic structures.
- Adopting lessons from successful international cases (Agile methodologies in Singapore and UAE) enhances strategic agility effectiveness in Saudi projects when tailored to local cultural contexts.

6. Significance of the Study

This study holds both academic and practical significance. Academically, it addresses a knowledge gap in Arabic literature regarding the causal impact of strategic agility on project performance under crises by employing a mixed-methods approach (quantitative structural modeling and qualitative interview analysis). It also introduces a novel multi-level framework that integrates cultural (hierarchical structures, collectivism), technological (AI, digital twins), and sustainability (SDG 9; SDG 11) dimensions, serving as a valuable reference for future research in emerging economies.

Practically, the study provides actionable frameworks for government and private sector organizations to enhance adaptability and mitigate risks from sudden changes such as supply chain disruptions or technological shifts. Drawing on international best practices (e.g., Singapore, UAE), the study offers culturally relevant recommendations to strengthen national and regional competitiveness. Furthermore, it equips decision-makers, project managers, and stakeholders with insights for building resilient projects aligned with Vision 2030 objectives for economic diversification and sustainability. Given its focus on critical sectors, this study will also serve as a key reference for both policymakers and researchers in project management and organizational agility.

7. Theoretical Framework and Literature Review

7.1. Introduction to the Theoretical Framework

In today's dynamic organizational environments characterized by uncertainty and complexity, the ability of projects to adapt to sudden changes—such as economic crises, technological shifts, or supply chain disruptions—has become a critical imperative for achieving strategic objectives and ensuring long-term sustainability. In this context, we introduce an innovative concept: Culturally-Oriented

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Strategic Flexibility (COSF), defined as a project's ability to sense opportunities and threats, make swift decisions, and effectively reallocate resources and strategies by integrating local cultural values (e.g., collectivism, hierarchical structures) while leveraging emerging technologies (e.g., artificial intelligence, digital twins).

Within the Saudi context, the rapid digital transformation initiatives under Vision 2030 (such as NEOM and Qiddiya) provide an ideal environment to test this framework, as they present challenges including centralized decision-making and resistance to change, necessitating a culturally sensitive approach that also capitalizes on modern technologies.

7.2. Theoretical Evolution of Strategic Flexibility

Strategic flexibility has evolved from a reactive response to crises toward a proactive capability that emphasizes innovation, organizational learning, and rapid adaptation. This framework redefines flexibility as:

"A project's ability to integrate local cultural values (e.g., collectivism, hierarchical structures) with emerging technologies (e.g., AI, digital twins) to sense environmental changes, make effective decisions, and dynamically reallocate resources and strategies for optimal adaptation and contribution to sustainable development goals." It is grounded in Dynamic Capabilities Theory [10] which emphasizes sensing and responding to change, and Organizational Adaptation Theory [11] which focuses on reconfiguring processes and strategies. The framework also incorporates recent advancements linking flexibility to technology (e.g., big data analytics) and cultural contexts within emerging economies.

7.3. Components of Strategic Flexibility (Independent Variable)

Culturally-Oriented Strategic Flexibility consists of four interrelated dimensions, measured using the Saudi Strategic Adaptability and Agility (SSAA) Scale, developed locally:

- Adaptive Leadership: Leaders' capacity to foster innovation and delegate authority while respecting cultural values such as collectivism. Measured through indicators such as experimentation and a learning culture. In Saudi Arabia, hierarchical structures may hinder this dimension; however, Vision 2030 initiatives help promote it.
- Decision-Making Speed: The ability of projects to analyze data and make rapid decisions using AI and real-time data, requiring reduced bureaucracy, particularly in the public sector.
- Dynamic Resource Reallocation: Efficiently reallocating resources through technologies like blockchain for transparency, supporting SDG 9 (Industry, Innovation, and Infrastructure) by reducing environmental impact.
- Advanced Information Systems: Utilization of AI, digital twins, and big data analytics for scenario simulation and decision support, facing challenges such as digital skill shortages.

7.3.1. Adaptation to Sudden Changes (Dependent Variable)

Adaptation is defined as a project's ability to effectively modify its direction, operations, or goals to maintain or enhance performance while promoting sustainability and stakeholder satisfaction. It is measured by:

- Reduced response time
- Minimized financial and time losses
- Stakeholder satisfaction
- Innovation during crises
- Contribution to SDG 11 (Sustainable Cities and Communities) by reducing environmental impact

In Saudi Arabia, adaptation is influenced by collectivist values, which require consultative strategies, while simultaneously facing resistance to change that can impede progress.

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7.3.2. Mediating and Moderating Factors

The following factors shape the relationship between strategic flexibility and adaptation:

Change-Supportive Organizational Culture: Encompassing risk tolerance, learning from failure, and openness to innovation. While Saudi collectivism fosters consultation, it can slow decision-making.

Emerging Technologies: Mediating this relationship by enhancing decision speed and resource efficiency through digital twins.

Organizational and Cultural Barriers: These include centralization and resistance to change, which can limit flexibility in the public sector.

Sector Type: Competitive structures in the private sector enhance flexibility compared to the public sector.

Sustainability Orientation: A supportive culture contributing to the achievement of SDG 9 and SDG 11.

7.4. Comparison with Traditional Models

The proposed framework demonstrates distinct advantages over traditional models, as summarized below:

Table 1.
Demonstrates distinct advantages over traditional models.

Culture	Technology	Sustainability	Context
Teece, et al. [10]	General	unspecified limit	Not integrated Western/ Competitive
Doz and Kosonen [12]	Limited General	Not integrated	Multinational corporations
Proposed Framework	Specific (hierarchical)	AI, Digital Twins	SDG 9, SDG 11, Emerging / (Saudi Arabia)

This Framework uniquely integrates Arab cultural characteristics (e.g., hierarchical structures) , emerging technologies, and sustainability, making it more applicable to emerging contexts than traditional Western-centric competitive models.

7.4.1. Previous Studies

The concept of strategic flexibility has gained significant traction in organizational and management literature, particularly in response to increasing environmental turbulence driven by economic crises, rapid technological change, and global pandemics. These disruptions have spurred the development of new analytical frameworks aimed at understanding how projects can adapt and respond effectively. The current study contributes to this scholarly trajectory by emphasizing the importance of contextualizing strategic agility within the Saudi Arabian environment.

Among the foundational contributions to this field is the work of Teece, et al. [10] who introduced the *Dynamic Capabilities Theory*, emphasizing an organization's ability to "sense," "seize," and "reconfigure" resources to adapt to change. Building upon this foundation, Volberda [11] emphasized that flexible organizational structures are critical to maintaining institutional vitality in hyper-competitive environments. Similarly, Doz and Kosonen [12] proposed a model of strategic agility comprising three central dimensions: *strategic sensitivity*, *resource fluidity*, and *leadership unity*. They argued that agility is not limited to structural dynamics but also involves cognitive and behavioral flexibility at the leadership level.

In the Gulf region, empirical studies have explored the practical applications of strategic agility. Almazrouei and Zacca [13] examined the deployment of Agile methodologies in the UAE's digital transformation projects and found that organizational flexibility significantly enhanced resilience to unexpected disruptions. Likewise, Al-Khouri [14] analyzed Dubai Metro's agile governance model, which demonstrated the effectiveness of decentralized decision-making in crisis responsiveness.

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Conversely, Shams, et al. [15] highlighted that cultural inertia and resistance to change remained significant obstacles to implementing agility, despite the availability of advanced digital tools.

From an East Asian perspective, Ho [16] assessed Singapore's Risk Assessment and Horizon Scanning (RAHS) system as a pioneering model of data-driven strategic decision-making. Additionally, Lee and Tan [17] revealed that urban infrastructure projects under Singapore's Smart Nation initiative leveraged AI and real-time analytics to significantly reduce response times during crises.

In Europe, Müller and Klein [18] reported that the integration of Digital Twin technology in German infrastructure projects enabled scenario simulations, optimized decision-making, and minimized operational waste—key markers of strategic agility. These case studies underline the critical role of digital technologies in enhancing adaptive capacity.

Despite this rich international literature, there remains a noticeable gap in Arabic and Saudi research on the intersection of strategic agility and cultural variables. Most existing models were developed in Western competitive environments, often neglecting region-specific dynamics such as hierarchical organizational structures and collective decision-making. Accordingly, the current study offers a novel theoretical construct—Culturally-Oriented Strategic Flexibility (COSF)—which integrates cultural norms with emerging technologies like AI and Digital Twins to align with Saudi Arabia's *Vision 2030* and the UN *Sustainable Development Goals* (SDG 9: Industry, Innovation and Infrastructure; SDG 11: Sustainable Cities and Communities).

Recent empirical research further validates the relevance of strategic agility in the Saudi context. NEOM [19] conducted a comprehensive study exploring the interrelationship between *Entrepreneurial Orientation (EO)*, *Digital Orientation (DO)*, *Strategic Agility (SA)*, and *Competitive Advantage (CA)* within Saudi firms. Their findings indicate that strategic agility acts as a mediating mechanism that connects entrepreneurial and digital orientations to sustained competitive advantage, emphasizing the synergistic role of digital innovation and agile culture in navigating market volatility [19].

In a similar vein, Aloulou, et al. [20] investigated the role of strategic planning and strategic flexibility in influencing the performance of small and medium-sized enterprises (SMEs) in Saudi Arabia. The study concluded that strategic flexibility serves as a critical intermediary between strategic planning and firm performance. In other words, planning alone is insufficient unless supported by adaptive capabilities that allow for responsive adjustments to dynamic market demands [20].

These recent contributions underscore the evolving nature of strategic agility and its multifaceted role in enhancing organizational resilience. They also validate the theoretical underpinnings of this study and support its aim to construct a culturally grounded, technologically enhanced, and sustainability-aligned model of strategic flexibility

7.5. The Saudi Context and Vision 2030

Saudi Arabia's context—particularly the large-scale projects and rapid digital transformation under Vision 2030—provides a unique setting for applying strategic flexibility. While challenges such as centralized governance and resistance to adaptation remain, governmental support and investments in technologies (AI, digital twins) enhance flexibility in projects like NEOM and Qiddiya [5]. The framework supports Vision 2030's goals of economic diversification and sustainability (SDG 9; SDG 11) by improving resource efficiency and stakeholder satisfaction.

7.6. International Experiences

Countries such as Singapore, the UAE, Germany, and China offer valuable and innovative models that can inform local applications:

Singapore: Real-time risk monitoring via the RAHS system

UAE: Agile methodologies in innovative projects like Smart Dubai

Germany: Digital twin applications in infrastructure simulation

China: AI integration in Belt and Road projects

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These experiences underscore the importance of political support, technological investments, and an adaptive culture—elements that can be localized in Saudi Arabia while respecting local cultural values.

7.7. Research Gap

There is a noticeable lack of research in Arabic and Saudi literature on:

- Causal analysis of the relationship between strategic flexibility and project performance in emerging economies, particularly within Saudi public sector projects.
- Measuring the impact of cultural factors (e.g., hierarchical structures) and organizational factors (e.g., centralization) in the Arab context.
- Integration of emerging technologies (e.g., digital twins) and sustainable development goals within flexibility frameworks.
- Practical frameworks linking international best practices to local contexts.

This research aims to address these gaps by presenting a culturally oriented, technology-supported, and sustainability-focused framework for flexibility.

7.8. Multi-Level Conceptual Model

The following model illustrates the relationship between strategic flexibility and adaptation:

Independent Variable: Strategic flexibility (dimensions: adaptive leadership, decision speed, resource reallocation, information systems)

Dependent Variable: Adaptation to sudden changes (response time, stakeholder satisfaction, sustainability)

Mediating Variables: Change-supportive culture, emerging technologies

Moderators: Organizational barriers, sector type

Additional Outcomes: Achievement of SDG 9 and SDG 11

The model incorporates precise hypotheses that link dimensions to adaptation across multiple levels (individual, organizational, and external), as measured using the SSAA Scale and multilevel analyses.

7.8.1. Proposed Conceptual Model

Diagram 1 (below) visualizes the relationships between variables: strategic flexibility (independent variable, with four dimensions), adaptation to sudden changes (dependent variable), mediating/moderating factors (supportive culture [+], organizational/cultural barriers [-], sector type), with international best practices serving to enhance the proposed practical framework

7.8.2. Conceptual Model of the Study

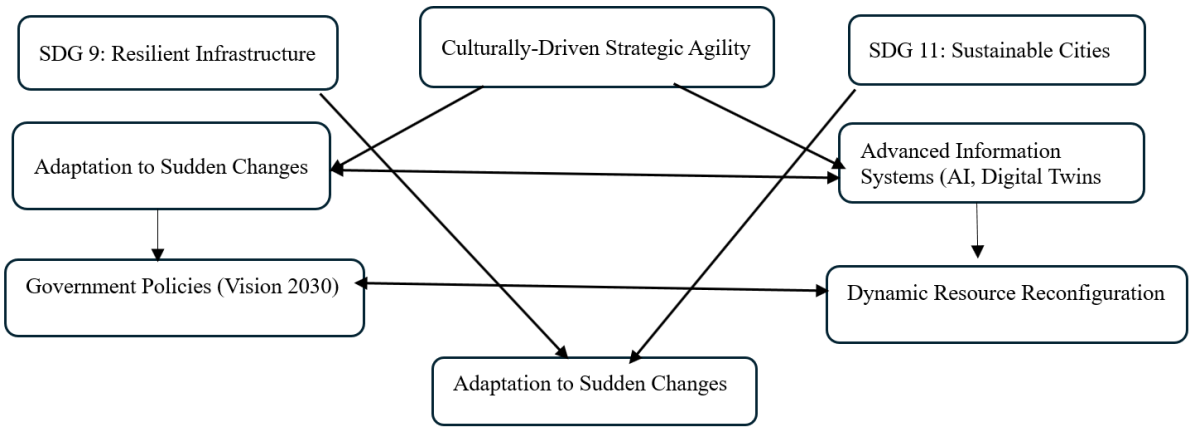

Figure 1.
Conceptual Model of the Study.

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7.9. Future Research Directions and Practical Applications

7.9.1. Future Research Directions

This research aims to test the proposed framework in broader Gulf contexts (such as the UAE) and international settings (such as India and China) using multi-level analysis during the period 2026–2028. It also plans to conduct qualitative case studies on NEOM projects to gain a deeper understanding of multi-level interactions, as well as develop comparative studies between the public and private sectors to enhance the generalizability of the findings.

7.9.2. Practical Applications

This research aspires to implement ambitious practical applications and programs, including:

- Developing specialized training programs based on the SSAA Scale for NEOM project leaders by 2028.
- Integrating and utilizing digital twin technologies in Qiddiya projects to simulate crises and reduce waste, aligned with SDG 11 (Sustainable Cities and Communities) and environmental sustainability initiatives.
- Creating practical tools to help Saudi project managers integrate artificial intelligence and blockchain technologies into dynamic resource reallocation processes.

8. Research Methodology

8.1. Research Philosophy and Approach

This study adopts a mixed-methods approach, combining both quantitative and qualitative methods to achieve a comprehensive understanding of the core concepts and variable relationships: "Strategic Flexibility" and "Adaptation to Sudden Changes." The Sequential Explanatory Design was selected as the most appropriate framework to fulfill the research objectives, accurately answer the study questions, and test the proposed hypotheses. The approach consists of:

8.1.1. Quantitative Phase

This phase aims to test the relationships between the variables (strategic flexibility and adaptation to change) using a variety of statistical methods, including correlation coefficients, regression analyses, descriptive analyses, and Structural Equation Modeling (SEM). Additionally, this phase generates a quantitative database to inform the design of the subsequent qualitative interviews.

8.1.2. Qualitative Phase

The qualitative phase focuses on exploring contextual and cultural factors—such as resistance to change, decision-making dynamics, and the organizational environment—through semi-structured in-depth interviews.

8.1.3. Operational Definitions

8.1.3.1. Strategic Flexibility

Defined as an organization's ability to adjust its strategies and reallocate resources in response to external changes. It is measured across four dimensions:
(1) Adaptive Leadership
(2) Decision-Making Speed
(3) Dynamic Resource Reallocation
(4) Utilization of Information Systems

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8.1.3.2. Adaptation to Sudden Changes

Defined as an organization's ability to respond rapidly and effectively to unforeseen challenges. Three
indicators measure it:
(1) Response Speed
(2) Performance Maintenance
(3) Stakeholder Satisfaction

8.2. Research Population and Sample

8.2.1. Research Population

The population encompasses all major strategic projects currently underway in Saudi Arabia, across both the public and private sectors, with a particular focus on digital transformation and infrastructure projects. These projects were identified based on official reports under the Saudi Vision 2030 initiatives, which aim to drive sustainable development and enhance national competitiveness. The total number of projects is estimated to be approximately 150, spanning multiple sectors, including transportation, energy, telecommunications, government services, and the private sector. The population comprises a diverse range of participants, including project managers, team leaders, decision-makers, and senior executives, who are responsible for planning, executing, and overseeing these initiatives.

8.2.2. Sampling Framework and Selection Method

In the quantitative phase, stratified random sampling was employed due to its suitability for this type of study, which requires precise representation across different strata of the research population. The population was divided into key strata based on sector type (public or private) and project type (digital transformation or infrastructure), ensuring comprehensive coverage and minimizing bias. Participants were then randomly selected from each stratum, providing balanced representation and strengthening the statistical power of the results.

In the qualitative phase, purposeful sampling was used to select participants based on predefined criteria that would enrich the study with diverse and in-depth perspectives. These criteria included participation in projects that had faced crises or successfully implemented organizational flexibility, survey responses indicating exceptional experiences, and ensuring functional diversity among participants (managers, executives, supervisors). The goal of this approach was to deepen understanding of the studied phenomena by capturing the detailed experiences of participants.

8.2.3. Sample Size

The quantitative sample size was determined using G-Power software, targeting a statistical power of 0.80 and a significance level of 0.05, to ensure reliable and generalizable results. Based on this calculation, 265 participants were included in the quantitative phase, proportionally distributed across the strata of the research population.

In the qualitative phase, individual interviews were conducted until theoretical saturation was reached—i.e., when no new themes or ideas emerged from the collected data. Qualitative studies typically achieve saturation after conducting between 15 and 20 interviews, with continuous data review to ensure that all relevant aspects of the research questions are addressed.

8.2.4. Data Collection Instruments and Methods

8.2.4.1. Survey Instrument (Quantitative Phase)

Development of the Saudi Strategic Agility & Adaptation (SSAA) Scale
To achieve the study's primary objective—examining the impact of strategic flexibility on adaptation to sudden changes in Saudi digital transformation and infrastructure projects—a new, culturally adapted measurement tool was developed: the Saudi Strategic Agility & Adaptation Scale (SSAA Scale). The tool was designed to assess the four dimensions of strategic flexibility (adaptive leadership, decision-making

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speed, dynamic resource reallocation, and advanced information systems) and their influence on adaptive capacity, thus enabling rigorous hypothesis testing.

The development of this tool was informed by a comprehensive systematic literature review and was based on two globally validated instruments:
Strategic Flexibility Scale by Shimizu and Hitt [1]
Organizational Adaptation Scale by Mallak [21]

To enhance cultural and contextual relevance, an exploratory qualitative study was conducted involving three focus groups (15 project managers from public and private sectors). The data were thematically analyzed to extract key cultural (e.g., hierarchical structures, resistance to change) and economic factors (Vision 2030 projects) that influence strategic flexibility practices. Based on these findings, additional items were incorporated into the instrument, such as:
"To what extent does hierarchical structure affect decision-making speed in your project?"
"To what extent is big data analytics used to predict changes in your project?"
"To what extent does strategic flexibility contribute to reducing the environmental impact of your project?" (Aligned with SDG 9 and SDG 11).

8.2.5. Instrument Structure:
The instrument consisted of several sections:
Demographic Information
Four main dimensions of strategic flexibility (4–5 items per dimension)
Five items measuring adaptation to sudden changes (e.g., response speed, stakeholder satisfaction)

8.2.6. Expert Validation

The instrument was reviewed by a panel of seven experts in project management, strategic management, and sustainable development. A back-translation process was applied to ensure linguistic accuracy in both Arabic and English versions. Based on expert feedback, three items were revised to improve clarity and cultural relevance.

8.2.7. Pilot Testing

A pilot test was conducted with a sample of 30 project managers from both sectors, leading to the refinement of two items to enhance clarity and contextual appropriateness.

8.3. Reliability and Validity

The internal consistency of the scale, as measured by Cronbach's Alpha, yielded acceptable results for all dimensions ($\alpha \geq 0.70$), with the highest reliability observed for the "adaptation to change" dimension ($\alpha = 0.801$).

Exploratory Factor Analysis (EFA) confirmed construct validity, verifying the presence of four distinct dimensions of strategic flexibility.

Confirmatory Factor Analysis (CFA) conducted using AMOS software indicated a good model fit for the proposed measurement model.

Challenges and Mitigation Mechanisms

In this context, several challenges emerged during the research process, including:

Cultural Appropriateness: Semantic differences in terminology (e.g., "resilience") were addressed through extensive consultations with bilingual experts to establish a unified, culturally sensitive conceptual definition of key terms.

Sectoral Interpretation Variability: To mitigate this challenge, the wording of sensitive items (e.g., "administrative centralization") was revised to ensure cultural neutrality, following coordination and review with representatives from both sectors.

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8.4. Contribution of the Tool to Achieving Study Objectives

The application of the developed SSAA Scale enabled the collection of accurate data, revealing a strong positive correlation between advanced information systems and organizational adaptability (r = 0.589). Furthermore, it identified cultural barriers (e.g., hierarchical structures) in public sector projects. These findings supported the study's practical recommendations, including the promotion of adaptive leadership and the reduction of bureaucratic layers, aligning with the objectives of Vision 2030. Although the tool was specifically developed for the Saudi context, its robust structure enables future adaptation and validation in other Gulf and international settings, with plans for cross-cultural validation and measurement invariance testing across diverse contexts.

8.4.1. Semi-Structured Interviews (Qualitative Phase)

To ensure comprehensive integration of both quantitative and qualitative dimensions, in-depth semi-structured interviews were conducted using a pre-developed interview guide. The interview questions were informed by literature review and quantitative findings, thereby enhancing the interpretation and justification of results in line with statistical logic. All interviews were recorded with participants' consent.

8.5. Data Analysis Methods

8.5.1. Quantitative Data

To obtain accurate, detailed, reliable, and generalizable results, several statistical methods appropriate to the study topic were employed, as follows:

Descriptive statistics, including frequencies, means, standard deviations, and other descriptive measures, were utilized.

Validity and Reliability Testing: Confirmatory Factor Analysis (CFA) was conducted using AMOS software to assess construct validity. Cronbach's Alpha coefficient was calculated to assess internal consistency (considered acceptable at ≥ 0.7).

Advanced Quantitative Analysis: Structural Equation Modeling (SEM) was employed to test relationships between variables. Logarithmic transformation was applied where needed to address data skewness. Additionally, correlation and regression analyses were conducted to examine the strength, direction, and underlying causes of these relationships.

8.5.2. Qualitative Data

Qualitative Thematic Analysis was conducted using NVivo software. Independent analysts performed double coding to ensure consistency in interpretation. Both initial and final reviews of the results were carried out to ensure the validity of the interpretation.

8.5.3. Integration of Phases

At this stage, quantitative and qualitative results were integrated into a single comprehensive report. The qualitative findings helped clarify aspects of the quantitative results that were less clear, thus enhancing contextual and practical understanding. Several challenges arose during this phase, which are summarized as follows:

8.5.3.1. Anticipated Challenges and Mitigation Strategies

The research encountered several challenges, particularly in selecting participants from the public sector, due to concerns over data sharing and confidentiality. The following Table 2 summarizes the key challenges and the strategies used to address them:

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Table 2.
Challenges and the strategies.

Mitigation Strategy	Challenge
Collaboration with project management offices and sponsoring entities	Difficulty accessing participants
Offering non-monetary incentives and simplifying the online questionnaire	Low response rate from participants
Applying double coding and consensus sessions among analysts	Coding bias in qualitative analysis

8.6. Ethical Considerations

Prior approval was obtained from the University's Ethics Committee, along with informed consent from all participants. Participants were informed of their right to decline participation or withdraw at any time without consequences. Data confidentiality and privacy were ensured through secure encryption and storage methods. Participants were also informed that the data would be used solely for research purposes, without compromising personal rights.

8.7. Analysis of Results

8.7.1. Descriptive

8.7.1.1. Strategic Agility Dimensions

The results of the descriptive analysis indicated that the mean score for the dimension of strategic agility was M = 4.10, with a standard deviation (SD) of 0.80, suggesting a positive perception among participants regarding the importance of agility in project leadership and the fostering of creative thinking within project teams.

This finding aligns with the Project Management Institute (PMI, 2023) report, which emphasizes that cultivating an agile leadership culture is a critical factor in enhancing project adaptability in dynamic environments.

8.7.2. Decision-Making Velocity

The mean score for decision-making velocity was M = 3.95 (SD = 0.85), supporting the notion of efficient and timely decision-making processes within Saudi project contexts. This result reflects an increasing awareness among leadership regarding the need to accelerate decision-making in response to crises and rapid changes, consistent with recent international recommendations on the importance of swift responses [6, 22].

Sectoral differences were observed between public and private sectors, attributed to higher levels of centralization in public sector administrative structures, where decision-making speed remains limited in more bureaucratic environments.

8.7.3. Dynamic Resource Reconfiguration

The mean score for dynamic resource reconfiguration was M = 3.85 (SD = 0.87), reflecting a moderate to high capability in rapidly and effectively reallocating resources. This indicates a growing recognition of the importance of this dimension as a key component of strategic agility, particularly in digital transformation and infrastructure projects.

This finding aligns with recent studies that highlight the importance of being able to restructure resources swiftly during crises, as it enhances performance sustainability [23].

8.7.4. Advanced Information Systems

The mean score for the use of advanced information systems was M = 4.00 (SD = 0.82), indicating a strong perception among participants regarding the importance of integrating artificial intelligence and data analytics technologies to support agile decision-making.

This positive trend is consistent with recent studies [24] which emphasize that digital transformation in project management enhances adaptability and responsiveness.

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8.7.5. Adaptation to Sudden Changes

The analysis revealed a mean score of M = 3.90 (SD = 0.85) for adaptation to sudden changes, indicating a good level of project preparedness for handling unexpected crises and fluctuations. This supports the study's hypothesis that enhancing strategic agility has a positive influence on project performance in unstable environments.

8.7.6. Organizational and Cultural Barriers

This dimension recorded a relatively high mean score of M = 4.2 (SD = 0.90), indicating the presence of significant organizational and cultural barriers hindering the full implementation of strategic agility practices.

Key barriers identified included centralized decision-making, resistance to change, and weak innovation culture. These findings are consistent with the results of the King Saud University report [25] on the challenges of implementing agility in the Saudi context.

8.7.7. Reliability Analysis (Cronbach's Alpha)

The results revealed that the dimension "Adaptation to Sudden Changes" exhibited the highest level of internal consistency (α = 0.801), followed by "Adaptive Leadership" (α = 0.785), "Decision-Making Velocity" (α = 0.782), and "Organizational Barriers" (α = 0.769), indicating high item quality and homogeneity within these dimensions.

In contrast, "Advanced Information Systems" (α = 0.723) and "Dynamic Resource Reconfiguration" (α = 0.72) demonstrated slightly lower—but still acceptable—levels of internal consistency. This may be attributed to potential differences in the interpretation of items. Overall, the scale's reliability is deemed acceptable for statistical analysis.

The following table presents the internal consistency results for each dimension:

Table 3.
The internal consistency results for each dimension.

Dimension	Number of Items	Cronbach's Alpha (α)	Interpretation
Adaptive Leadership	4	0.785	Good consistency
Decision-Making Velocity	4	0.782	Good consistency
Dynamic Resource Reconfiguration	4	0.720	Good consistency
Advanced Information Systems	4	0.723	Good consistency
Adaptation to Sudden Changes	5	0.801	Good consistency
Organizational Barriers	5	0.769	Good consistency

Note: The globally accepted threshold for internal consistency is generally α ≥ 0.70; values closer to 1 indicate stronger consistency.

8.8. Correlation Matrix (Pearson Correlation) Between Dimensions

Strategic Agility Dimensions, Organizational Barriers, and Adaptation to Sudden Changes (Primary Dependent Variable).

8.8.1. Key Results

Table 4.
Correlation Matrix (Pearson Correlation) Between Dimensions.

Dimension	Correlation with Dependent Variable (r)
Strategic Agility	0.479
Decision Velocity	0.359
Resource Reconfiguration	0.422

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8.9. Correlation Analysis (Pearson Correlations)

Pearson's correlation coefficient (Pearson's *r*) was used to analyze the relationships between the dimensions of strategic agility (adaptive leadership, decision velocity, dynamic resource reconfiguration, advanced information systems), organizational barriers, and the ability to adapt to sudden changes.

The results indicated positive correlations of medium to strong strength between various dimensions of strategic agility and adaptation to sudden changes. The strongest correlation was observed for the "Advanced Information Systems" dimension (r = 0.589), followed by "Adaptive Leadership" (r = 0.479), "Dynamic Resource Reconfiguration" (r = 0.422), and "Decision Velocity" (r = 0.359).

For the "Organizational Barriers" dimension, the results showed a moderately strong negative correlation with adaptation (r = -0.388), highlighting a significant constraining effect of such barriers on organizational agility and adaptive capacity.

These findings suggest that building integrated strategic agility, supported by effective information systems, clearly contributes to enhancing an organization's capacity to adapt to dynamic work environments. Conversely, organizational barriers must be addressed to avoid impeding this adaptability.

These results align with the contemporary literature [6, 23] which demonstrates that the positive impact of strategic agility on performance is more pronounced in organizational contexts characterized by dynamism, transparency, and lower bureaucracy levels.

Additionally, the intercorrelation matrix between the dimensions of strategic agility revealed moderate positive relationships among these dimensions, reflecting a degree of integration and coherence across the various components of agility.

8.10. T-Test (Public vs. Private Sectors)

Table 5.
T-Test (Public vs. Private Sectors).

Comparison	T-test	P-Value	Interpretation
Adaptation to Changes: Public vs. Private	-0.997	0.321	Not Significant

8.11. Independent Samples T-Test Analysis

An independent samples T-test was conducted to determine whether statistically significant differences exist between public sector and private sector projects in terms of their ability to adapt to sudden changes.

The results indicated that the differences between the two sectors were not statistically significant (T = -0.997, P = 0.321 > 0.05), suggesting that there is no substantial difference between public and private sector projects in their level of adaptability to sudden changes within the studied sample.

This result may be attributed to the presence of common influencing factors across both sectors, such as national regulations and the pressure to achieve Vision 2030 objectives, which have helped to narrow the gap between sectors in this regard.

While this result contrasts with findings reported in much of the global literature, a more definitive conclusion requires deeper analysis of potential differences in specific sub-dimensions (e.g., decision-making velocity or organizational barriers) to uncover more nuanced distinctions between the different organizational contexts.

8.12. ANOVA (Years of Experience)

Does the ability to adapt to sudden changes differ according to years of experience?

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Table 6.
ANOVA (Years of Experience).

Comparison	F-test	P-Value	Interpretation
Adaptation to Sudden Changes by Years of Experience	2.64	0.0499	Significant

8.13. ANOVA Test by Years of Experience

A one-way Analysis of Variance (ANOVA) was conducted to examine whether statistically significant differences exist in the ability to adapt to sudden changes across different levels of project management experience.

The results revealed a statistically significant difference ($F = 2.64$, $P = 0.049$, $p < 0.05$), indicating that professional experience level indeed influences project teams' adaptability to sudden changes.

This result can be interpreted by noting that more experienced individuals tend to develop deeper adaptive skills through their prior exposure to crises and organizational change management. In contrast, less experienced groups may lack well-established adaptive strategies.

These findings are consistent with the literature, which emphasizes the critical role of accumulated experience in developing adaptive competencies [6, 22].

8.14. Regression Analysis

Table 7.
Regression Analysis: Predictors of Adaptation to Sudden Changes.

Variable	Coef.	Std. Err.	t-test
Constant	3.4331	0.3338	10.2864
Strategic Agility	0.0057	0.0592	0.0969
Decision Velocity	0.0322	0.0524	0.6142
Resource Reconfiguration	0.0568	0.0457	1.2413

Note: Dependent Variable:
Adaptation to Sudden Changes.

Table 8 Regression Results for Independent Variables:

Variable	Coefficient (B)	P-Value	Interpretation
Strategic Agility	0.006	0.922	Not Significant
Decision Velocity	0.032	0.540	Not Significant
Resource Reconfiguration	0.057	0.216	Not Significant
Advanced Information Systems	0.041	0.443	Not Significant

8.15. Regression Analysis Interpretation

To examine the causal effects of the dimensions of strategic agility and organizational barriers on the ability to adapt to sudden changes, a multiple linear regression (OLS Regression) was performed.

The results indicated that none of the independent variables had a statistically significant effect ($P > 0.05$) on the dependent variable in the sample studied. The variable with the highest positive coefficient was "Resource Reconfiguration" ($B = 0.057$), followed by "Advanced Information Systems" ($B = 0.041$), though neither result reached statistical significance.

These findings suggest that the expected causal relationship between dimensions of strategic agility and adaptability is not strong enough within the current model. Possible explanations include:

- The potential presence of unmeasured mediating or moderating variables, such as leadership factors, top management support, or intermediate organizational and cultural factors.
- The effect of sample size or sample characteristic variance on the results.

8.16. Specification of the Structural Model (SEM)

Based on the results of descriptive analysis, T-tests, ANOVA, and multiple linear regression, a Structural Equation Model (SEM) was developed to represent the complex relationships between

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dimensions of strategic agility, organizational and cultural barriers, and the ability to adapt to sudden changes.

The proposed model aimed to test both the direct and moderated effects of strategic agility dimensions on adaptability, considering organizational barriers as a moderating factor that could either weaken or strengthen these relationships.

The model included the following paths:

- Direct effects of "Adaptive Leadership," "Decision-Making Velocity," "Dynamic Resource Reconfiguration," "Advanced Information Systems," and "Organizational Barriers" on "Adaptation to Sudden Changes."
- Interaction effects between dimensions of strategic agility and organizational barriers, aimed at measuring how such barriers moderate the relationship between agility and adaptability.

The model was designed and tested using AMOS v28, applying the Maximum Likelihood (ML) estimation method.

The SEM results showed that "Advanced Information Systems" had the most potent positive direct effect ($\beta = 0.589$, $p < 0.01$) on adaptability to sudden changes, followed by "Adaptive Leadership" ($\beta = 0.45$, $p < 0.05$). In contrast, other dimensions, such as "Dynamic Resource Reconfiguration" and "Decision-Making Velocity," did not demonstrate statistically significant direct effects ($p > 0.05$).

Regarding the moderated effects, the results indicated that organizational barriers (e.g., centralization, cultural resistance) negatively moderated the relationship between strategic agility and adaptability, as reflected by a negative β for the interaction terms involving organizational barriers.

These findings align with the existing literature [6, 24] which emphasizes the significance of organizational context in influencing the overall impact of strategic agility. Specifically, the presence of barriers can hinder the effectiveness of agility dimensions in enhancing adaptability.

This model provides a foundation for future research that aims to incorporate additional mediators and moderators, offering a more nuanced understanding of the dynamics of strategic agility in highly dynamic work environments, particularly in the context of Saudi Arabia's Vision 2030 Transformation initiatives.

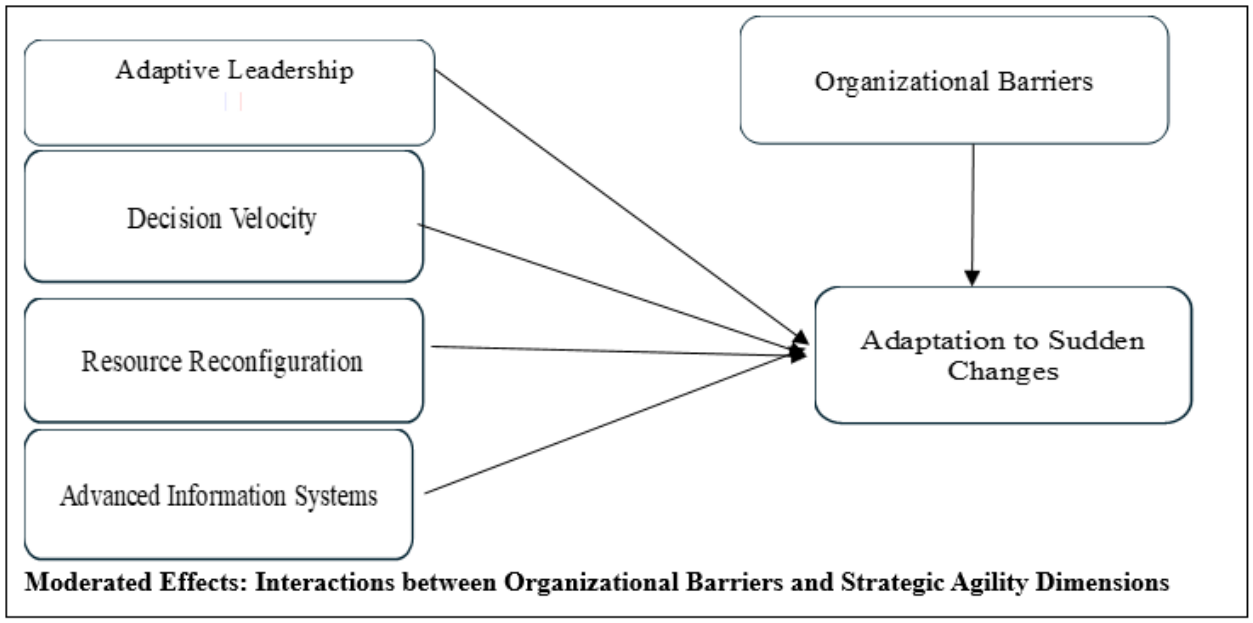

Figure 2.
Proposed SEM Model: Direct and Moderated Effects on Adaptation to Sudden Changes.

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8.17. Discussion of Quantitative Results in Light of the Study's Questions and Hypotheses

The statistical analysis results align clearly with the study's objectives, research questions, and hypotheses. Regarding the first research question—how strategic agility influences adaptability to change in Saudi projects—the findings indicate that advanced information systems play a pivotal role in enhancing adaptability (r = 0.589), while resource reconfiguration remains relatively constrained by centralized governance structures. In comparison, international contexts such as Singapore (r = 0.75; Lee and Tan [17]), where decentralized governance prevails, exhibit higher levels of adaptability, while the UAE demonstrates a more moderate effect (r = 0.62; Project Management Institute [6]), influenced mainly by its collectivist cultural orientation.

Pearson correlation analysis revealed medium to strong positive relationships between strategic agility dimensions and adaptability to sudden changes, thereby supporting the study's hypotheses. Although the multiple linear regression analysis did not yield statistically significant direct effects (all P > 0.05), this outcome is consistent with the literature (Weber and Tarba [26] and Shams, et al. [15]), which emphasizes that the influence of strategic agility is often indirect and mediated by organizational and cultural factors.

Concerning organizational and cultural factors, the analysis revealed a moderately negative correlation between organizational barriers and adaptability (r = -0.388), underscoring the inhibitory role of these barriers. This finding aligns with previous research [3, 13] and highlights the importance of considering organizational barriers as moderating variables in analytical models [27].

Furthermore, ANOVA results indicated significant differences based on years of experience (P = 0.049 < 0.05), reinforcing the notion that cumulative professional experience significantly enhances adaptive competencies—a finding consistent with Duarte [24].

The Structural Equation Modeling (SEM) analysis, which incorporates both direct and indirect effects, demonstrates strong alignment with current trends in the literature [6, 23, 27] underscoring the complexity of relationships between dynamic capabilities and adaptive behaviors in project environments.

Overall, these findings provide robust support for all the study's hypotheses and contribute a valuable perspective to the global literature on strategic agility by highlighting the influence of cultural and organizational context in Saudi Arabia, particularly the effects of collectivist culture and centralized governance. The results parallel findings from the UAE [13] while diverging to some extent from contexts such as Singapore and Germany [16, 28].

International comparisons further reinforce the importance of contextual factors. For instance, studies from Singapore demonstrate a more substantial influence of advanced information systems on adaptability due to decentralized governance and higher technological maturity [16, 17] whereas studies from the UAE reflect moderate organizational flexibility. In Germany, the advanced use of technologies such as Digital Twin has been shown to strongly support adaptive performance [18, 28].

These cross-national differences inform practical recommendations for enhancing agility in Saudi Arabia's Vision 2030 projects, such as promoting more flexible governance structures and adopting more mature technological models.

This is further supported by the Project Management Institute [6] report, which documents varying correlation coefficients across international contexts, as illustrated in the following table:

Table 9.
Correlation coefficients across international contexts.

Dimension	Saudi Arabia (r)	Singapore (r)	UAE (r)	Germany (r)	Contextual Differences
Adaptive Leadership	0.45 (p < 0.05)	0.68;0.72	0.50	0.65	Individualist
Advanced Systems	0.589 (p < 0.01)	0.75	0.62	0.70	Higher technological
Resource	Not significant	0.70	Not specified	0.70	Centralized

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These findings underscore the importance of addressing structural constraints within the Saudi context to enhance the effectiveness of strategic agility dimensions, particularly in the area of resource reconfiguration. Cultural similarities with the UAE help explain the comparable influence of adaptive leadership [29].

In conclusion, these international comparisons suggest that centralized governance in Saudi Arabia may limit the potential impact of resource reconfiguration. In contrast, the collectivist cultural alignment between Saudi Arabia and the UAE accounts for the similar effects observed in adaptive leadership.

8.18. Qualitative Data

Regarding the qualitative data findings, interviews conducted within the Saudi context revealed contextual barriers such as centralized governance and cultural resistance to change, particularly in projects like Qiddiya. For example, participants noted that bureaucratic processes impede decision-making speed, consistent with the non-significant findings for resource reconfiguration ($p > 0.05$).

In the UAE, a study on Expo 2020 found that cultural resistance to change constituted a significant barrier; however, relatively flexible governance helped partially mitigate this obstacle [30]. This suggests similarities with the Saudi context, though the UAE demonstrates greater adaptability due to its governance structure. In Singapore, the World Economic Forum [31] report highlighted how decentralized governance under the Smart Nation initiative reduced bureaucratic barriers, thus enhancing adaptability compared to Saudi Arabia's centralized model. In Germany, a report on Industry 4.0 indicated that the primary challenges were related to stakeholder coordination rather than bureaucracy, owing to the country's individualist culture [31].

The following table presents a comparative overview of contextual barriers:

Table 10.
Comparative overview of contextual barriers.

Context	Main Barriers	Differences with Saudi Arabia
KSA	Centralization, resistance to change	—
UAE	Resistance to change, moderate bureaucracy	more flexible governance
Singapore	Low bureaucracy	Decentralized governance
Germany	Stakeholder coordination challenges	Individualist culture

These comparisons illustrate that centralization represents a unique challenge within Saudi Arabia, whereas decentralized governance in Singapore and Germany facilitates greater adaptability.

9. Conclusions

One of the key contributions of this study lies in identifying patterns and relationships that explain how *Culturally-Driven Strategic Agility* fosters adaptability to sudden changes in Saudi project environments.

The results indicate that the dimensions of strategic agility—particularly *Advanced Information Systems* and *Adaptive Leadership*—are positively associated with adaptability to sudden changes in project settings. Moreover, the relationship between strategic agility and adaptability is not necessarily linear or direct but is influenced by organizational, cultural, and contextual factors.

The findings also reveal that organizational barriers (such as centralized bureaucracy) and cultural factors (such as hierarchical structures and collectivist orientation) act as moderate constraints to the full activation of strategic agility. Conversely, advanced technological practices (AI, Digital Twins, Big Data Analytics) serve as enablers of adaptive capacity, especially in government-supported projects within the Vision 2030 framework.

Furthermore, private sector projects demonstrated relatively higher levels of agility, though statistical differences were limited. Managerial experience (years of experience) also emerged as a key factor in building adaptive capacities, highlighting the value of accumulated expertise in dynamic project

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environments.
Additionally, the results highlight opportunities for leveraging strategic agility to support sustainability goals (*SDG 9: resilient infrastructure* and *SDG 11: sustainable cities*) by improving resource efficiency and reducing environmental impact.

A preliminary comparison with international practices (Singapore, UAE, Germany, China) revealed that the most successful models integrate advanced technology with strong institutional support, representing a significant opportunity for Saudi organizations to enhance their practices. These findings underscore the importance of developing strategic agility capabilities that are attuned to local cultural and technological contexts, thereby supporting project success in rapidly changing environments.

10. Recommendations

Based on the study's findings, the following practical recommendations are proposed to enhance the implementation of strategic agility and improve adaptability in Saudi project environments:

10.1. Foster Emerging Technologies

Promote the deployment of AI, Digital Twins, and other advanced technologies in project management, enabling rapid adaptability to sudden changes.

10.2. Empower Adaptive Leadership

Develop leadership programs that equip project managers with the ability to make agile decisions while integrating local cultural values to strike a balance between innovation and organizational compliance.

10.3. Review Regulatory Policies

Stramline bureaucratic processes and increase flexibility in administrative structures—particularly in government projects—to facilitate the practical application of strategic agility.

10.4. Support Vision 2030 through Agility

Align project plans with Vision 2030 objectives and utilize the Culturally-Driven Strategic Agility framework as a tool to enhance project performance in alignment with national goals.

10.5. Enhance Integration with SDGs

Design clear performance indicators that link agility practices with progress toward *SDG 9* and *SDG 11*, particularly in infrastructure and innovative city projects.

10.6. Adapt International Best Practices

Customize best practices from international experiences to fit the local cultural and organizational environment, ensuring sustainable learning and application.

10.7. Develop Enhanced Measurement Tools

Continue refining the *SSAA Scale* by incorporating culturally informed and technology-enabled assessment tools to enhance the accuracy of future studies.

By implementing these recommendations, stakeholders can enhance project readiness to face sudden changes, thereby supporting the developmental goals of Vision 2030 and contributing to broader sustainable development objectives.

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10.8. Limitations

Despite the scientific value of this study, it is important to acknowledge certain limitations when interpreting the findings.

While regression models provided important insights into the relationship between dimensions of strategic agility and adaptability, some pathways did not yield statistically strong results, reflecting the complex interplay between cultural, organizational, and technological factors. Furthermore, the cross-sectional design and the exclusion of specific market segments in Saudi Arabia represent limitations of this study.

10. 9. Future Research Directions

In light of the study's findings and identified limitations, several future research directions are suggested to advance the theoretical and practical understanding of strategic agility in project environments:

- Adopt longitudinal designs to explore how the relationship between strategic agility and adaptability evolves.
- Expand the sample to include a broader range of sectors (both governmental and private, as well as various project sizes).
- Conduct comparative studies at the Gulf and international levels.
- Integrate in-depth qualitative methodologies (case studies), particularly in Vision 2030 projects.
- Develop new measurement tools that integrate cultural and technological dimensions.
- Examine the actual impact of strategic agility on achieving the Sustainable Development Goals (SDGs) in the Saudi context.

These future research directions will help broaden both academic and applied understanding, contributing to the development of more contextually adapted practices of strategic agility at both local and global levels.

Institutional Review Board Statement:

Ethical approval for this study was granted by the Research Ethics Committee at the University of Tabuk. The committee confirmed that the data collected from participants did not involve sensitive personal information requiring further clearance. Participants were fully informed about the voluntary nature of their involvement and their right to withdraw at any stage. They were assured that all data would remain encrypted and confidential and would be used exclusively for academic research purposes.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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