

INNOVATION METHODOLOGIES AND THEIR ROLE IN LEVERAGING EMERGING TECHNOLOGIES TO DEVELOP INNOVATIVE SOLUTIONS AND ENABLE DIGITAL TRANSFORMATION

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Abstract

This study aims to explore the role of innovation methodologies in leveraging emerging technologies to develop innovative solutions and enable the digital transformation journey of Saudi institutions. The research sample consisted of 1,350 employees working in both public and private sector organizations. An online questionnaire was developed to measure the extent of applying innovation methodologies (Innovation acceleration, design thinking, concurrent thinking, and deployment) and the level of adoption of emerging technologies (artificial intelligence, big data, Internet of Things, blockchain, and metaverse). The findings revealed that institutions exhibit a high level of reliance on innovation methodologies, and that such reliance directly contributes to increasing the adoption of emerging technologies. Furthermore, it was found that institutions combining more than one innovation methodology achieve better outcomes in digital transformation indicators compared to those relying on a single methodology.

Keywords: Innovation methodologies, Emerging technologies, Digital transformation, Innovation acceleration, concurrent thinking, design thinking, and Exploitation

Introduction

The success of any institution in achieving its strategic objectives depends on the availability of organizational, technological, and human resources, foremost among them the ability to innovate and employ modern technologies. International reports, such as the World Economic Forum (2020), have shown that institutions adopting clear innovation methodologies and emerging digital tools were able to enhance their performance and achieve a competitive advantage in complex and rapidly changing environments.

Innovation methodologies are regarded as the cornerstone for driving institutional development, as they provide practical frameworks for generating ideas and transforming them into implementable projects. Lee & Trimi (2021) emphasized that design thinking, for example, contributes to enhancing institutional adaptability in the face of crises and changing beneficiary needs.

Emerging technologies such as artificial intelligence, big data, the Internet of Things, and blockchain represent the primary enablers of contemporary digital transformation. The Ministry of Communications and Information Technology (2023) indicated that investing in these technologies has helped Saudi Arabia strengthen its economic resilience and ensure service continuity during the COVID-19 pandemic. Likewise, SDAIA (2025) highlighted that the adoption of artificial intelligence and the Internet of Things was among the key factors that contributed to the Kingdom's advancement in digital government indicators.

On the other hand, integrating methodologies with technologies remains a persistent challenge for institutions. Applying an innovative methodology without harnessing appropriate technologies may limit its impact, while adopting technology without a methodological framework may lead to resource inefficiency. Hence, there is a clear need for scientific research that connects both dimensions within a single integrated framework and examines the impact of this integration on digital transformation outcomes.

Research Problem

Institutions in the Kingdom of Saudi Arabia and the Arab world are witnessing a rapid race toward digital transformation, driven by strategic directions such as Saudi Vision 2030, which emphasized that digital innovation represents one of the key enablers of sustainable development (Vision 2030, 2021). Despite the remarkable progress in employing emerging technologies such as artificial intelligence, big data, and the Internet of Things, many institutions still suffer from gaps in innovation management mechanisms, which limit their ability to fully realize the value of these technologies (MCIT, 2023; SDAIA, 2025).

International studies, such as Chatterjee et al. (2021) and Lee & Trimi (2021), indicate that the success of digital transformation does not rely solely on technology but rather requires a comprehensive methodological framework for innovation to guide investments in these technologies. However, a review of Arabic literature revealed that most studies focused either on technology or on innovation independently, while few addressed their integration within a unified framework.

Accordingly, the problem of the present study lies in the need to investigate the integrative relationship between innovation methodologies and emerging technologies, and their impact on digital transformation outcomes in Saudi institutions. This addresses an existing knowledge gap and provides practical insights to support national policies.

Research Questions

The research problem gives rise to a set of sub-questions:

1. What is the level of application of innovation methodologies in Saudi institutions?
2. To what extent are emerging technologies being utilized in these institutions?
3. What is the relationship between the application of innovation methodologies and the adoption of emerging technologies?
4. How does the integration between methodologies and technologies contribute to improving digital transformation outcomes (such as process improvement, beneficiary satisfaction, and implementation speed)?
5. Are there differences in digital transformation outcomes depending on the type of institution (public/private) or the methodology adopted?

Research Objectives

This study aims to:

1. Identify the level of application of innovation methodologies (Innovation acceleration, design thinking, concurrent thinking, and deployment) in Saudi institutions.
2. Examine the extent to which emerging technologies (artificial intelligence, big data, Internet of Things, blockchain, and the metaverse) are utilized to support institutional innovation projects.
3. Investigate the relationship between the application of innovation methodologies and the adoption of emerging technologies within institutions.
4. Explore the impact of integrating methodologies and technologies on improving digital transformation outcomes such as process improvement, beneficiary satisfaction, and implementation speed.
5. Determine the differences in digital transformation outcomes depending on the type of institution (public/private) or the innovation methodology adopted.
6. Pave the way for future studies that address the impact of integrating innovation methodologies with emerging technologies in other local and regional sectors.

Research Significance

The significance of this study emerges considering the challenges faced by institutions in achieving digital transformation and effectively leveraging emerging technologies. The research carries both theoretical and practical importance:

First: Theoretical Importance

- This study contributes to the theoretical frameworks that address the relationship between innovative methodologies and the adoption of emerging technologies within the context of digital transformation.
- It fills a knowledge gap in Arabic literature, where most studies have examined innovation or technology separately, while this research focuses on their integration.
- It provides a conceptual framework that can be utilized in future studies to examine the impact of combining methodologies and technologies across different work environments.

Second: Practical Importance

- The study's findings can guide public and private institutions in adopting practical policies that support the integration of methodologies with technologies to enhance the efficiency of digital transformation.
- The results may be used to design training programs aimed at building the capacities of employees in digital innovation, particularly in design thinking and design acceleration.
- The study assists policymakers in formulating more effective strategies to achieve the objectives of Saudi Vision 2030 concerning digital transformation and institutional innovation.

Third: Added Value of Research

- It presents an integrative model that combines innovation methodologies with emerging technologies, which has not been comprehensively addressed in Arabic literature.
- It demonstrates the role of emerging technologies as mediating variables, providing the study with a new statistical dimension.
- It supplies recent Arabic data that supports national efforts in digital transformation.
- It offers institutions a practical framework that helps link innovation with technology to achieve tangible results.

Research Terms

Innovation Methodologies

- Theoretical Definition: A set of frameworks and approaches aimed to generating ideas, developing, and transforming them into implementable solutions that enhance institutional efficiency (Lee & Trimi, 2021).
- Operational Definition: In this study, it refers to the application of four main methodologies by institutions: Innovation acceleration, design thinking, concurrent thinking, and deployment. It is measured by the scores obtained by participants in the innovation methodologies section of the questionnaire.

Emerging Technologies

- Theoretical Definition: Relatively new technologies that enable new capabilities and transform ways of working, production, and service delivery. These include artificial intelligence, big data, Internet of Things, blockchain, and the metaverse (Chatterjee et al., 2021; World Economic Forum, 2020).
- Operational Definition: In this study, it refers to the extent to which institutions employ emerging technologies in their operations and innovation projects. It is

measured by the scores obtained by participants in the emerging technologies section of the questionnaire.

Digital Transformation

- **Theoretical Definition:** The process of integrating digital technologies into all areas of an institution, resulting in fundamental changes to how it operates and delivers value (Xu et al., 2018; Vision 2030, 2021).
- **Operational Definition:** In this study, it refers to the level of innovative outcomes achieved by institutions through employing emerging technologies within methodological frameworks. It is measured by participants' scores in the digital transformation outcomes section of the questionnaire (such as process improvement, beneficiary satisfaction, and implementation speed).

Design Thinking

- **Theoretical Definition:** One of the most prominent innovative methodologies that focuses on the end user by integrating creativity with analytical thinking to generate new and applicable solutions (Brown, 2009; IDEO, 2015; Carlgren, Rauth & Elmquist, 2016). The concept originated with Herbert Simon (1969), who viewed design as an organized thinking process. It was later developed by Peter Rowe (1987) in Design Thinking and affirmed by Nigel Cross (2001) as a distinctive mode of human thought. IDEO, led by David Kelley, transformed it into a practical framework, which Tim Brown (2009) then popularized globally through his book *Change by Design*.
- **Operational Definition:** In this study, it refers to measuring the extent to which institutions apply the stages of design thinking (empathy, problem definition, idea generation, prototyping, and testing) based on participants' responses to the questionnaire.

Concurrent Thinking

- **Theoretical Definition:** The ability to perform more than one mental process simultaneously with high efficiency. Concurrent thinking has two main capabilities: storage capacity and processing speed (Abdeen, 2015).
- **Operational Definition:** In this research, it refers to measuring the extent to which institutions apply the methodology of concurrent thinking through information storage capacity and processing speed to achieve innovative output in the course of digital transformation.

Innovation Acceleration

- **Theoretical Definition:** Accelerating the development of innovation capabilities by using completion time as a performance indicator through training and repetition, where the time required to solve an exercise is gradually reduced while maintaining quality and performance until the participant reaches the required achievement in less time than previously needed (Abdeen, 2015).
- **Operational Definition:** In this research, it refers to measuring the extent to which institutions apply the methodology of innovation acceleration by speeding up the innovation cycle from idea to implementation in order to produce innovative solutions more quickly.

Exploitation

- **Theoretical Definition:** The individual's ability to leverage information, resources, and opportunities, and to recognize hidden opportunities within them, then exploit

them strategically and intelligently to achieve goals and maximize value (Abdeen, 2020).

- **Operational Definition:** In this research, it refers to measuring the extent to which institutions apply the methodology of exploitation to achieve tangible impact, whether in enhancing institutional performance or in innovating new products and solutions to support digital transformation and emerging technologies.

Theoretical Framework

First: Innovation Methodologies

Innovation methodologies are among the fundamental pillars that help institutions systematically generate, develop, and implement ideas in ways that create added value. Various definitions of innovation methodologies have been proposed:

- Tidd & Bessant (2014) define them as structured approaches that enable organizations to manage innovation from idea generation to practical implementation.
- The OECD (2019) describes them as processes that allow institutions to build sustainable capabilities for exploring, experimenting with, and applying new ideas.
- Lee & Trimi (2021) view them as frameworks that place the end-user at the heart of development, relying on experimentation and iteration.

1. Innovation Acceleration Methodology

- **Definition:** Aims to reduce the time required to transform ideas into products or services through agile practices.
- **Explanatory Model:** The World Economic Forum (2020) noted that institutions adopting innovation acceleration methodologies were able to respond more quickly to market changes.
- **Characteristics:** Speed, reliance on multidisciplinary teams, rapid experimentation, and iteration.

1. Innovation Acceleration Methodology

The Innovation Acceleration Methodology is considered one of the most recent innovation methodologies and among the most prominent tools for supporting institutional innovation and digital transformation. It was established by Dr. Samar Abdeen 2016 at Universiti Sains Malaysia, one of the world's leading research universities, and is recognized as one of the methodologies within the AlMadinah Global Program for Innovation Development (Abdeen, 2016).

This methodology focuses on accelerating the development of innovation capabilities among individuals and organizations. It is based on the principle of using completion time as a performance indicator through training and repetition, whereby the time required to solve a task is gradually reduced while maintaining quality and performance. As a result, individuals are able to achieve innovative solutions faster, more efficiently, and more effectively compared to the time previously required. The methodology contributes to enhancing institutional innovation and accelerating the achievement of tangible and practical results (Abdeen, 2020).

Moreover, the Innovation Acceleration Methodology plays a significant role in expediting the cycle of idea generation, production, and implementation of innovative solutions, as well as in accelerating the adoption of emerging technologies and transforming them into practical applications. It enables organizations to shorten the innovation cycle from ideation to implementation by leveraging digital tools and emerging technologies such as artificial

intelligence, the Internet of Things (IoT), and cloud computing, thereby supporting and empowering digital transformation (Abdeen, 2019).

Key Features of the Innovation Acceleration Methodology (Abdeen, 2020)

No.	Feature	Description	Application Example
1	Focus on Time	Considering time as a primary indicator for measuring innovative performance.	Measuring the time required to develop a first prototype solution.
2	Repetition and Iteration	Repeated practical training to gradually reduce the time of completion while maintaining performance.	Repeated execution of an innovative training exercise multiple times (e.g., at the same skill level) with gradually reduced completion time each round.
3	Balance Between Efficiency and Quality	Achieving balance between speed of completion and maintaining the quality of outputs.	Designing applications that reduce speed without compromising user experience or the quality of outputs.
4	Accelerating the Innovation Cycle	Shortening the gap between idea generation and implementation.	Rapidly launching a digital service through emerging technologies.
5	Flexibility and Adaptability	The ability to apply the methodology across different sectors and adapt to institutional requirements.	Applying it in healthcare, safety, and education sectors by using artificial intelligence and other emerging technologies.
6	Focus on Institutional Impact	Enhancing innovative capabilities and strengthening institutional competitiveness.	Achieving innovative institutional impact that positively affects organizational performance and competitiveness in various sectors such as healthcare.

2. Design Thinking Methodology

Design thinking has become one of the most widespread innovation methodologies in recent years. The concept originated from Herbert Simon's (1969) research, which considered design a structured thinking process, later developed by Peter Rowe (1987) and Nigel Cross within design studies. IDEO, under David Kelley's leadership in the 1990s, transformed the concept into a practical framework, which was then widely popularized by Tim Brown (2009) in his book *Change by Design*. Brown defined it as an innovative approach that places the user at the center, combining creativity with analytical thinking to generate new, applicable solutions.

IDEO (2015) later described it as an iterative process based on empathizing with users, redefining problems, generating ideas, building prototypes, and testing them. Similarly, Carlgren, Rauth, & Elmquist (2016) described it as "a set of principles and mindsets that help institutions explore and solve complex problems through continuous experimentation and human-centered thinking."

- Phases of Design Thinking (Brown, 2009; Plattner et al., 2010):
 1. **Empathy:** Understanding user needs through observation and interaction.

2. **Problem Definition:** Clearly framing the challenge.
 3. **Idea Generation:** Producing as many proposed solutions as possible.
 4. **Prototyping:** Transforming ideas into tangible prototypes.
 5. **Testing:** Trying prototypes with users and gathering feedback.
- Key Characteristics:
 - **Human-Centered:** Focuses on the end user at all stages (Brown, 2009).
 - **Iterative and Experimental:** Accepts failure as a natural step in the development process (Carlgren et al., 2016).
 - **Collaborative:** Relies on multidisciplinary teamwork.
 - **Creative and Flexible:** Allows for redefinition of problems and continuous generation of new solutions.

1. Concurrent Thinking Methodology

Concurrent Thinking is considered one of the most recent scientific theories of thinking and among the most powerful innovation methodologies. It first appeared in 2014 in the global Scopus database, innovated and developed by Dr. Samar Abdeen, an innovation expert (Abdeen, 2014).

The methodology is based on the principle that the brain is capable of performing multiple conscious mental processes simultaneously with high efficiency—such as analysis, observation, inference, and other cognitive functions. This reflects a broader utilization of the brain’s capacities and energies, opening the way for processing multiple cognitive pathways at the same moment, thereby doubling the speed of information processing and increasing the brain’s storage capacity. Concurrent Thinking thus serves as a practical tool for maximizing innovation within institutions, transforming latent cognitive abilities into tangible innovative achievements (Abdeen, 2020).

Since innovation is defined as the ability to create the new and reshape the familiar in ways that add value, Concurrent Thinking is the mechanism that allows innovation to occur more rapidly and comprehensively. The brain processes solutions in an interconnected manner within a single moment—technological, social, economic, creative, and human—producing integrated and composite solutions. Here lies the essence of true innovation, and in this sense, Concurrent Thinking can be regarded as the intellectual fuel of innovation (Abdeen, 2016)

Integration of Thinking Levels to Enhance Innovation

Level	Description	Value	Dimension
Cognitive	Expands the brain’s storage capacity and increases processing speed, enabling the absorption of large amounts of data.	Enables individuals to handle accelerated information flows in digital innovation environments.	Analytical
Creative	Allows thinking across parallel and diverse pathways, generating distant and unrelated ideas to produce new solutions.	Creates innovative products and services based on combining unexpected elements.	Imaginative
Strategic	Provides institutions with the ability to develop an integrated vision without losing sight of details.	Facilitates innovative decision-making that balances ambition with realistic vision.	Normative

Capabilities of Concurrent Thinking

- Information Storage Capacity: The ability to increase the space where information is stored and processed simultaneously.
- Information Processing Speed: The ability to enhance the individual's speed in perceiving, comprehending, and using information to complete cognitive tasks.

Exploitation Methodology

The Exploitation Methodology is a strategic and systematic framework for innovation that aims to optimally exploit available information, resources, and hidden opportunities in an intelligent manner to generate innovative value and achieve specific goals. It represents the ability to recognize potential in ideas, skills, and data relationships and to employ them in an organized way to create new value (Abdeen, 2021).

The methodology was developed by Dr. Samar Abdeen in 2016 as one of the tools and methodologies of innovation, designed to transform every piece of information, resource, and opportunity into a source of innovation. It is based on a central concept: exploitation is not merely resource management, but rather the intelligent leveraging of knowledge and linkages inside and outside the organization to transform them into applicable innovative solutions. It draws upon the power of knowledge and information, maneuvering them like chess pieces or puzzle parts to arrive at innovative value (Abdeen, 2020).

Key Features of the Exploitation Methodology (Abdeen, 2021)

- Proactive exploitation of information.
- Exploitation of relationships.
- Investment in hidden opportunities.
- Systematic linkage between resources and opportunities.
- Flexibility in exploitation.
- Focus on innovative value.

Application Areas of the Exploitation Methodology (Abdeen, 2020)

- Exploitation of relationships.
- Exploitation of data.
- Exploitation of information.
- Exploitation of hidden opportunities.
- Exploitation of skills.

Second: Emerging Technologies

Emerging technologies constitute a fundamental pillar of global digital transformation, and their definitions vary depending on different perspectives:

- Rotolo, Hicks & Martin (2015) define them as technologies in the early stages of development, characterized by a high degree of uncertainty, yet with the potential to bring about radical changes in economic and social practices.
- The World Economic Forum (2020) considers them as technologies expected to have a broad impact on reshaping businesses and societies over the next decade.
- The Ministry of Communications and Information Technology (2023) describes them as “a set of advanced digital tools that enable institutions to enhance economic resilience and support innovation in services and products.”

Key Emerging Technologies in This Study

- **Artificial Intelligence (AI):** Defined as the ability of systems to simulate human intelligence in learning and decision-making (Russell & Norvig, 2020). Applications include natural language processing, image recognition, and predictive systems. A report by SDAIA (2025) showed that Saudi Arabia has made global progress in adopting AI applications within digital government indicators.
- **Big Data:** Defined by McAfee & Brynjolfsson (2012) as large and complex datasets that cannot be processed using traditional methods, but require advanced analytical tools. Big data supports strategic decision-making through predictive analytics.
- **Internet of Things (IoT):** Refers to connecting devices and machines to the internet to exchange data automatically (Ashton, 2009). It enables improved operational efficiency and cost reduction. The MCIT (2021) highlighted its role in enhancing Saudi Arabia's economic competitiveness.
- **Blockchain:** A distributed ledger technology that allows transactions to be recorded securely and transparently (Nakamoto, 2008). It is widely used in finance, supply chains, and digital authentication.
- **Metaverse:** Defined by Lee et al. (2021) as a three-dimensional virtual space that enables users to interact, work, and learn in immersive digital environments. It represents a future trend in education, training, and marketing.

General Characteristics of Emerging Technologies

- **Transformative Impact:** Capable of reshaping economic sectors.
- **Integrative Nature:** Often work in combination (e.g., AI with IoT).
- **Rapid Evolution:** Continuously changing and requiring constant monitoring.
- **Risks and Opportunities:** Offer innovation opportunities but involve security and ethical challenges.

Adoption Levels of Emerging Technologies

According to the Gartner Hype Cycle (2022), emerging technologies typically progress through five stages:

1. **Innovation Trigger:** Initial emergence of technology.
2. **Peak of Inflated Expectations:** Widespread media attention.
3. **Trough of Disillusionment:** Declining expectations after initial failures.
4. **Slope of Enlightenment:** Development of practical applications.
5. **Plateau of Productivity:** Broad adoption and sustainable use.

Third: The Relationship Between Methodologies and Technologies

Recent studies have shown that the success of digital transformation cannot be achieved by relying solely on emerging technologies; rather, it requires an integrated methodological framework to guide the adoption of these technologies and employ them within the appropriate institutional context. Several studies have addressed this relationship:

- Chatterjee, Rana & Dwivedi (2021) demonstrated that institutions adopting clear innovation methodologies, such as design thinking, were able to benefit more from artificial intelligence and big data in improving government services.
- Lee & Trimi (2021) confirmed that design thinking and concurrent thinking provide fertile ground for testing emerging technologies and adopting them gradually, thereby reducing risks.

- The MCIT (2023) reported that combining methodological frameworks (such as innovation acceleration programs) with investments in emerging technologies enabled Saudi Arabia to respond effectively to crises such as the COVID-19 pandemic.

Dimensions of the Relationship

- **Innovation Methodologies as Enablers of Technology:** These methodologies provide the tools that help transform technological potential into practical and applicable solutions. Without a methodological framework, technologies may remain underutilized tools.
- **Emerging Technologies as Accelerators of Methodologies:** Technologies enhance and speed up the implementation of various stages of methodologies. For instance, AI enables faster prototyping, while blockchain supports the credibility of deployment mechanisms.
- **Integration Between Methodologies and Technologies:** The World Economic Forum (2020) indicated that combining multiple innovation methodologies (e.g., design thinking and acceleration) with multiple emerging technologies results in more sustainable outcomes and strengthens institutional adaptability.

Key Characteristics of the Relationship Between Methodologies and Technologies

- **Complementary Relationship:** Methodologies cannot succeed without technological tools, and technologies cannot create value without a methodological framework.
- **Dynamic Relationship:** Evolves according to technological development and methodological flexibility.
- **Mutual Influence:** Each side enhances the effectiveness of the other.
- **Context-Dependent:** Influenced by institutional capabilities, resources, and organizational culture.

Innovation methodologies provide the structured framework that directs the generation and application of innovation solutions within institutions, while emerging technologies serve as the practical tools that reinforce these processes and open new horizons for digital transformation. Studies have demonstrated that the relationship between the two is complementary and based on mutual influence: methodologies prepare the environment for leveraging technologies, while technologies strengthen and accelerate the effectiveness of methodologies.

Despite the growing number of studies that examined either innovation or emerging technologies separately, there remains a scarcity of research addressing their integration within a comprehensive framework in the Arab, and particularly the Saudi, context. Hence, the significance of this study lies in filling this knowledge gap by examining the impact of innovation methodologies in leveraging emerging technologies and supporting digital transformation outcomes, in alignment with Saudi Vision 2030 objectives to build an innovation- and knowledge-based digital economy.

Previous Studies

Previous studies can be categorized into three main themes:

First Theme: Studies on Innovation Methodologies

- Brown (2009) aimed to clarify the role of design thinking in enhancing institutional capacity to develop creative solutions aligned with user needs. The results showed that applying the five stages of design thinking (empathy, problem definition, idea generation, prototyping, and testing) contributes to higher customer satisfaction and increases the chances of solution success.

- Chesbrough (2010) conducted a study on innovation acceleration methodologies in technology companies, using a sample of 150 startups in Silicon Valley. The results indicated that institutions applying innovation acceleration mechanisms achieved 35% faster market access for their products compared to others.
- Xu et al. (2018) examined the effect of concurrent thinking on complex digital projects. The findings revealed that applying concurrent thinking reduced project completion time by 22% and enhanced the efficiency of multidisciplinary teams.
- The Saudi Vision 2030 (2021) report emphasized that the success of many national digital transformation initiatives was linked to the effectiveness of deployment methodologies, which enabled innovative ideas to be scaled up into large-scale projects.

Second Theme: Studies on Emerging Technologies

- McAfee & Brynjolfsson (2012) explored the role of big data in supporting decision-making in financial institutions. Their results showed that organizations adopting big data analytics improved their operational efficiency by 26%.
- Russell & Norvig (2020) examined the impact of artificial intelligence on automating industrial sector operations, showing that AI contributes to reducing human error and improving productivity.
- The MCIT (2021) report highlighted that the adoption of IoT in Saudi government sectors improved the quality of smart services and increased user satisfaction.
- Lee et al. (2021) confirmed that the metaverse represents a new horizon for education and corporate training. Their findings revealed that the use of interactive virtual reality environments increased trainee engagement by 40%.
- Nakamoto (2008), in his foundational research, demonstrated that blockchain represents a qualitative leap in digital documentation and transparency, opening the door to wide applications in finance and supply chains.

Third Theme: Studies on the Relationship Between Methodologies and Technologies

- Chatterjee et al. (2021) conducted a study on 210 government institutions to examine the impact of integrating design thinking and AI on improving digital services. The results indicated a strong positive relationship between the adoption of methodologies and the adoption of technologies.
- Lee & Trimi (2021), in a study of multinational companies, confirmed that design thinking and concurrent thinking provide a suitable environment for reducing the risks of employing emerging technologies.
- The World Economic Forum (2020) reported that institutions combining more than one innovation methodology and employing multiple emerging technologies (such as AI, big data, and IoT) achieved more sustainable outcomes in their digital transformation programs.

Discussion of Previous Studies

- Most foreign studies focused on one side: either methodologies or technologies, while rarely addressing their integrative relationship.
- The literature indicates that methodologies enhance institutional capacity to benefit from technologies; however, most studies were conducted in European or American contexts, highlighting the scarcity of research in the Arab and Saudi context.

- The results of Chatterjee et al. (2021) and Lee & Trimi (2021) showed that design thinking is most strongly associated with AI adoption, while innovation acceleration methodologies play a prominent role in supporting big data adoption.
- National reports such as MCIT (2023) and SDAIA (2025) pointed to the success of Saudi Arabia's experience in integrating methodologies with technologies, but without in-depth academic studies.
- The present study benefited from previous research in selecting the sample (public and private institutions), designing the research instrument (the questionnaire), and formulating hypotheses that link methodologies, technologies, and digital transformation outcomes.

Research Hypotheses

Considering the theoretical framework and the reviewed literature, the research hypotheses were formulated as follows:

1. There are differences in the level of reliance on innovation methodologies and emerging technologies among Saudi institutions.
2. There is a positive relationship between the adoption of emerging technologies and the success of digital transformation projects in institutions.
3. Digital transformation outcomes differ depending on the adopted innovation methodology (innovation acceleration, design thinking, concurrent thinking, deployment).
4. Institutions that integrate multiple innovation methodologies achieve better digital transformation results compared to institutions that rely on a single methodology.
5. There are no statistically significant differences in the application of innovation methodologies and the adoption of emerging technologies depending on the type of institution (public/private).

Research Methodology

First: Research Design

This study adopted a descriptive, correlational, and survey-based design, as it is suitable for examining the relationships between the variables (innovation methodologies, emerging technologies, and digital transformation outcomes) and for testing the hypotheses linking them. This design allows for describing the phenomenon in its natural environment and analyzing the statistical relationships among its components.

Second: Research Sample

The research instrument (electronic questionnaire) was distributed among employees in Saudi public and private institutions. A total of 1,350 initial responses were collected. After excluding 63 incomplete or invalid responses, the final sample consisted of 1,287 participants.

- Gender: 772 males (60%), 515 females (40%).
- Type of institution: 686 from the public sector (53.3%), 601 from the private sector (46.7%).
- Job categories: Employees, project managers, and officials responsible for innovation and digital transformation.
- Average age: 34 years (ranging between 25 and 50 years).

Type of Institution	Males	Females	Total	Percentage (%)
Public	412	274	686	53.30%
Private	360	241	601	46.70%
Total	772	515	1287	100%

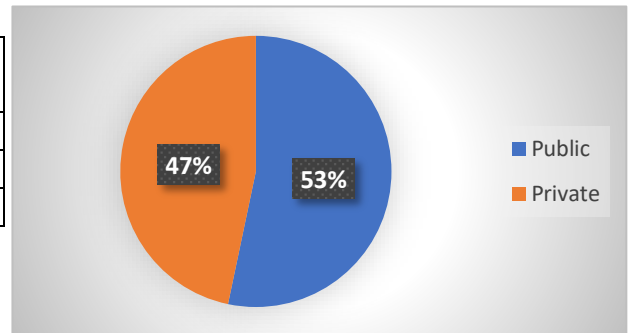


Table1 – Figure1: Distribution of the Sample by Type of Institution and Gender

Gender	Number	Percentage (%)
Male	772	60%
Female	515	40%
Total	1287	100%

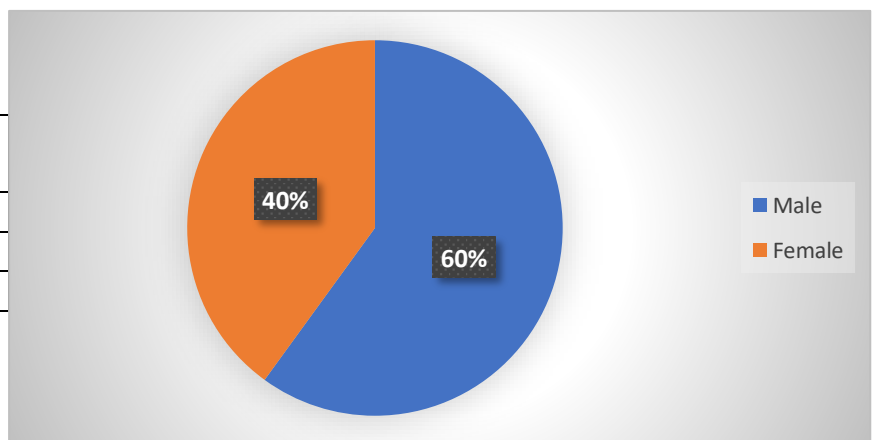


Table2- Figure 2: Distribution of the Sample by Gender

Third: Research Instrument

The primary instrument for data collection was an online questionnaire, designed based on previous studies and the theoretical framework. It consisted of three main dimensions:

1. **Innovation Methodologies:** Innovation acceleration, design thinking, concurrent thinking, deployment.
2. **Emerging Technologies:** Artificial intelligence, big data, Internet of Things, blockchain, metaverse.
3. **Digital Transformation Outcomes:** Process improvement, innovative solution generation, implementation speed, beneficiary satisfaction.

A five-point Likert scale was used (from 1 = Strongly Disagree to 5 = Strongly Agree) to measure participants' responses.

Fourth: Validity and Reliability

- To verify construct validity, an exploratory factor analysis was conducted on a pilot sample (n = 100), showing that all items significantly loaded on their theoretical dimensions.
- To test reliability, Cronbach's Alpha coefficients were calculated, ranging from 0.82 to 0.94 across all dimensions, confirming the instrument's suitability for statistical analysis.

Fifth: Research Procedures

The electronic questionnaire was prepared and formulated based on prior studies, then reviewed by academic experts in digital innovation to ensure the soundness of the items. It was distributed among employees in Saudi public and private institutions during the year (2025), yielding 1,350 initial responses. After review, 63 incomplete or biased responses were excluded, resulting in 1,287 valid responses, representing a relatively high response rate compared to similar field studies.

The data were entered into SPSS v.26, and appropriate statistical analyses were conducted, including:

- Descriptive statistics (means and standard deviations).
- Pearson correlation coefficients to examine relationships between variables.
- Linear regression analysis to test hypotheses related to effects.
- Independent samples T-test and ANOVA to examine group differences.

Sixth: Research Variables

- Independent Variable: Innovation methodologies.
- Mediating Variable: Emerging technologies.
- Dependent Variable: Digital transformation outcomes.

This model reflects the assumed causal relationship:

Innovation methodologies → Adoption of emerging technologies → Digital transformation outcomes.

Research Delimitations

1. Subject Delimitations: The study focuses on four innovation methodologies (acceleration, design thinking, concurrent thinking, and deployment) and five core emerging technologies (artificial intelligence, big data, Internet of Things, blockchain, and the metaverse).
2. Spatial Delimitations: The questionnaire was applied to institutions in both the public and private sectors within the Kingdom of Saudi Arabia.
3. Temporal Delimitations: Data collection and analysis were conducted during the year 2025.
4. Human Delimitations: The sample included employees and managers at middle and senior administrative levels.

Conceptual Research Model



The conceptual model illustrates the hypothesized relationships between the study variables. Innovation methodologies (independent variable) represent the starting point influencing the adoption and utilization of emerging technologies (mediating variable), which in turn contribute to achieving digital transformation outcomes (dependent variable).

The model also indicates the existence of a direct relationship between innovation methodologies and digital transformation outcomes without the need for a mediator. This reflects the research hypotheses that will be tested statistically in this study.

Statistical Analysis and Results

This chapter presents the results obtained after collecting and analyzing data from the research sample (n = 1,287) using appropriate statistical methods in SPSS. The focus is on testing the hypotheses formulated based on the theoretical framework and previous studies, in order to verify the relationships among the main study variables: innovation methodologies (design thinking, innovation acceleration, concurrent thinking, deployment), emerging technologies (artificial intelligence, metaverse, big data, Internet of Things, blockchain), and their impact on supporting digital transformation within institutions.

For clarity, the results are presented according to the sequence of research hypotheses:

1. Testing whether there are variations in the levels of applying innovation methodologies and emerging technologies among the research sample.
2. Testing the impact of applying innovation methodologies on predicting the level of adoption of emerging technologies.
3. Testing the relationship between adopting emerging technologies and the success of digital transformation projects.
4. Testing the differences between institutions relying on a single methodology and those integrating multiple methodologies.
5. Testing the differences in adopting methodologies and technologies according to the type of institution (public/private).

Each hypothesis is followed by the relevant statistical analysis, highlighting the results and linking them to prior studies, in line with the research objectives and contributions.

First Hypothesis Results

Hypothesis Statement:

“There are variations in the levels of applying innovation methodologies (design thinking, innovation acceleration, concurrent thinking, deployment) and in the levels of adopting emerging technologies (artificial intelligence, metaverse, big data, Internet of Things, blockchain) among participants.”

To test this hypothesis, means, standard deviations, and coefficients of variation were calculated for each main and sub-dimension. The results are shown in Table (3).

Scale / Dimension	Total Score	Mean	Std. Deviation	Coefficient of Variation (%)	Verification Level
Innovation Methodologies	100	74.85	11.92	15.9	High
Design Thinking	25	19.87	3.42	17.2	High
Innovation Acceleration	25	18.74	3.55	18.9	High
Concurrent Thinking	25	17.56	3.28	18.7	Medium–High
Deployment Methodology	25	18.68	3.67	19.6	Medium–High
Emerging Technologies	100	79.42	12.15	15.3	High
Artificial Intelligence	20	16.84	2.78	16.5	High

Metaverse	20	14.25	3.45	24.2	Medium
Big Data	20	15.92	3.05	19.2	Medium-High
Internet of Things (IoT)	20	16.34	2.87	17.6	High
Blockchain	20	16.07	3.11	19.3	Medium-High

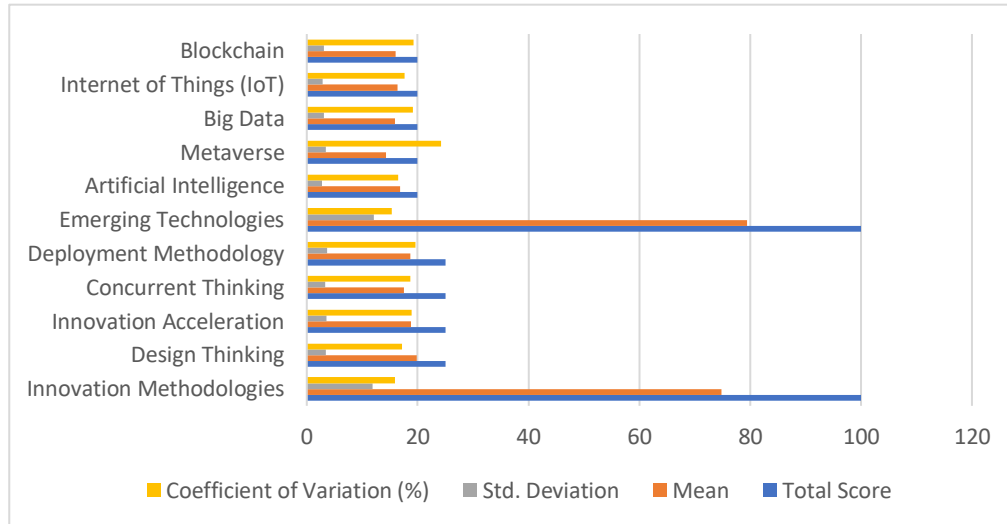


Table 3- Figure 3: Means, Standard Deviations, Coefficients of Variation, and Verification Levels for Innovation Methodologies and Emerging Technologies (n=1287)

Interpretation of Results:

Innovation Methodologies: Overall mean = 74.85 (High level). Among them, design thinking scored the highest (M = 19.87), followed by innovation acceleration, while deployment and concurrent thinking scored at medium-high levels.

Emerging Technologies: Overall mean = 79.42 (High level). The highest adoption was in artificial intelligence and the Internet of Things, while the metaverse ranked lowest, with only a medium level of adoption.

These findings confirm significant variations across the different elements of both innovative methodologies and emerging technologies, thereby supporting the first hypothesis. Institutions demonstrate strong adoption of certain methodologies (specially design thinking and acceleration) and technologies (particularly AI and IoT), while others such as the metaverse are still in early stages of institutional awareness and adoption.

Second Hypothesis Results

Hypothesis Statement:

“There is a statistically significant effect of applying innovation methodologies on the level of adoption of emerging technologies within institutions.”

To test this hypothesis, a simple linear regression analysis was conducted to examine the relationship between the independent variable (innovation methodologies) and the dependent variable (level of adoption of emerging technologies). The results are summarized in Tables (4) and (5).

Source	Sum Squares	of	df	Mean Squares	F-Value	Sig. Level
Regression	8421.56		1	8421.56	64.32	0.001
Residual	167287.4		1285	130.19		
Total	175709		1286			

Table 4: Results of the Regression Analysis to Test the Effect of Innovation Methodologies on the Adoption of Emerging Technologies (n=1287)

Correlation and Determination Coefficients

- Correlation Coefficient (R) = 0.48
- Coefficient of Determination (R²) = 0.23 → The application of innovation methodologies explains **23% of the variance** in the level of adoption of emerging technologies.

Variable	Regression Coefficient (B)	t-value	Sig. Level
Constant	42.317	15.24	0.001
Innovation Methodologies	0.362	8.02	0.001

Table 5: Regression Coefficients of the Effect of Innovation Methodologies on the Adoption of Emerging Technologies (n=1287)

- The regression model yielded a significant F-value of 64.32 at the 0.001 level, confirming the overall significance of the model.
- The correlation coefficient (R) was 0.48, while the coefficient of determination (R²) was 0.23. This indicates that applying innovative methodologies explains 23% of the variance in the adoption of emerging technologies.
- The regression coefficient (B) for innovation methodologies was statistically significant (B = 0.362, t = 8.02, p = 0.001).

Interpretation of Results:

These findings confirm that innovation methodologies significantly contribute to predicting the adoption level of emerging technologies within institutions. In other words, organizations that systematically apply innovation methodologies are better able to enhance their adoption of new technologies. This supports the acceptance of the alternative hypothesis and the rejection of the null hypothesis.

The results align with prior studies (e.g., Tidd & Bessant, 2020), which emphasize that having a clear innovative framework is a prerequisite for successfully implementing new technologies within institutions, figure (4) illustrates the correlation between the two variables.

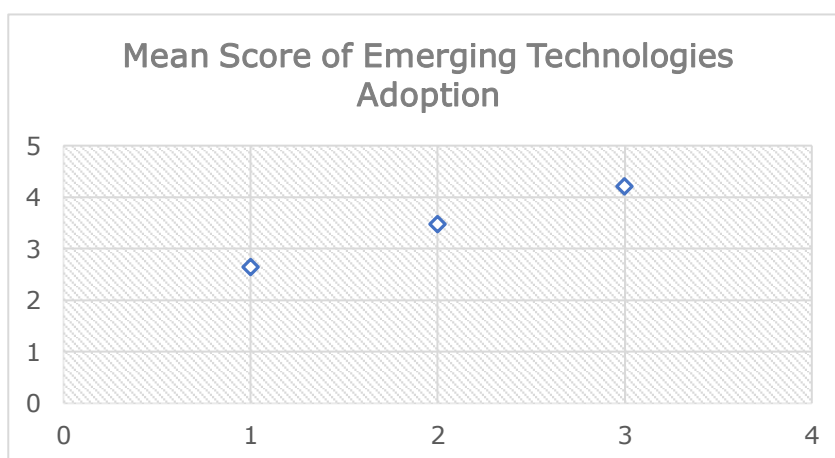


Figure (4): The Relationship Between the Application of Innovation Methodologies and the Level of Adoption of Emerging Technologies

Third Hypothesis Results

Hypothesis Statement:

“There is a positive relationship between the adoption of emerging technologies and the success of digital transformation projects.”

To test this hypothesis, Pearson’s correlation coefficient was used to examine the relationship between the independent variable (adoption of emerging technologies) and the dependent variable (success of digital transformation projects).

Variables	Correlation Coefficient (r)	Significance Level (p)
Adoption of Emerging Technologies × Success of Digital Transformation Projects	0.62	0.001

Table (6): Results of Pearson’s Correlation Coefficient Between the Adoption of Emerging Technologies and the Success of Digital Transformation Projects (n = 1287)

The results showed a strong, positive, and statistically significant correlation ($r = 0.62$, $p = 0.001$) between the two variables.

Interpretation of Results:

These results confirm that institutions that invest in emerging technologies—such as artificial intelligence, the Internet of Things, and blockchain—achieve better outcomes in their digital transformation projects. This includes improvements in operational efficiency, service quality, and implementation speed.

Accordingly, the alternative hypothesis is accepted, and the null hypothesis is rejected.

The findings are consistent with global reports (e.g., World Economic Forum, 2022), which indicate that organizations investing heavily in emerging technologies tend to accomplish digital transformation faster and reap greater economic and service-related benefits. Figure (5) illustrates the correlation between the two variables.

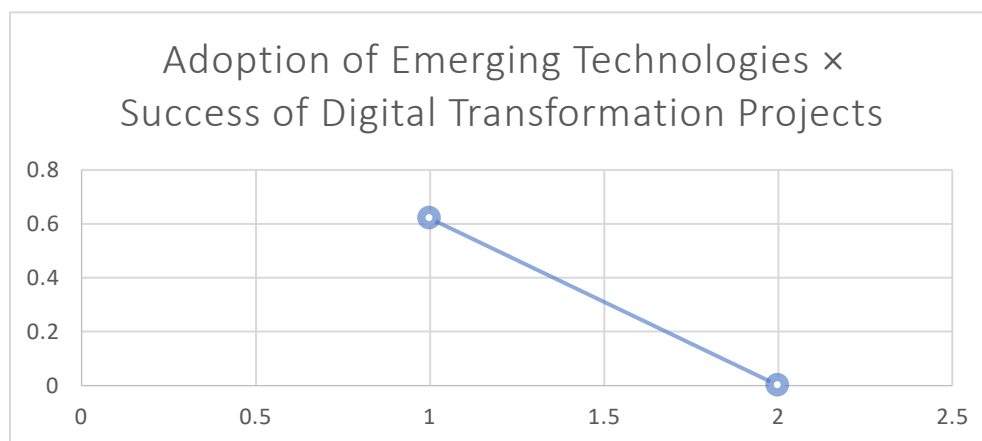


Figure (5): The Relationship Between the Adoption of Emerging Technologies and the Success of Digital Transformation Projects

Fourth Hypothesis Results

Hypothesis Statement:

“Digital transformation outcomes differ depending on the adopted innovation methodology.”

To test this hypothesis, a one-way analysis of variance (ANOVA) was conducted to examine the differences among institutions according to the innovation methodology adopted (acceleration, design thinking, concurrent thinking, deployment).

Source	Sum Squares	df	Mean Squares	F-Value	Sig. Level
Between Groups	1487.25	3	495.75	3.95	0.021
Within Groups	160892.7	1283	125.38		
Total	162380	1286			

Table (7): Results of One-Way ANOVA Analysis to Measure the Effect of Methodological Differences on Digital Transformation Outcomes (n = 1287)

- The results revealed statistically significant differences among institutions, with an F-value of 3.95 at the 0.05 significance level.
- Post-hoc comparisons indicated that:
 - Institutions adopting **design thinking** achieved the highest levels of beneficiary satisfaction and quality of solutions.
 - Institutions focusing on **acceleration** achieved faster results in terms of project implementation timelines.
 - Institutions applying **concurrent thinking** demonstrated a balance between efficiency and flexibility.

Interpretation of Results:

These findings confirm that the choice of innovation methodology has a significant effect on digital transformation outcomes. Design thinking emphasizes user-centered solutions, which enhances satisfaction and solution quality. Innovation Acceleration methodologies prioritize speed of execution, while concurrent thinking provides balanced outcomes by integrating multiple perspectives.

Accordingly, the null hypothesis is rejected, and the alternative hypothesis is accepted.

Fifth Hypothesis Results

Hypothesis Statement:

“There are no statistically significant differences in the application of innovation methodologies depending on the type of institution (public/private).”

To test this hypothesis, an independent samples T-test was conducted to compare public and private institutions.

Type of Institution	N	Mean	Std. Deviation	T-value	df	Sig. Level
Public	643	4.12	0.81	2.36	1285	0.019
Private	644	3.89	0.87			

Table (8): Results of the T-Test for Differences Between Public and Private Institutions in the Application of Innovation Methodologies (n = 1287)

- The results showed a statistically significant difference between the two groups, with a T-value of 2.36 at the 0.05 significance level.
- Public institutions demonstrated higher levels of commitment to formally applying innovative methodologies (M = 4.12, SD = 0.81).

- Private institutions, on the other hand, showed relatively lower levels of methodological application ($M = 3.89$, $SD = 0.87$), with a stronger tendency to focus directly on technological aspects rather than methodological frameworks.

Interpretation of Results:

These findings contradict the null hypothesis and support the alternative hypothesis, indicating that the type of institution is indeed a significant factor in determining the extent of applying innovation methodologies. Public institutions in Saudi Arabia are generally more aligned with national strategies and formal transformation programs, which require structured methodological adoption, whereas private institutions often emphasize immediate technological implementation for rapid returns.

Conclusions

1. Institutions demonstrate a moderately high level of application of innovation methodologies.
2. There is a high level of adoption of emerging technologies among the institutions in the sample.
3. A strong degree of integration between innovative methodologies and emerging technologies is evident in supporting digital transformation.
4. Statistically significant differences exist between public and private institutions in the application of innovative methodologies, with public institutions showing greater commitment to structured methodological adoption, while private institutions tend to emphasize direct technological aspects.
5. Digital transformation outcomes vary according to the type of innovation methodology applied (acceleration, design thinking, concurrent thinking, deployment).
6. Innovation methodologies directly contribute to predicting the level of adoption of emerging technologies within institutions.

Discussion and Interpretation of Results

This chapter represents the interpretative stage, moving from statistical findings to scientific analysis that explains their real-world implications. It connects the results with the research objectives and hypotheses on one hand, and with the theoretical framework and prior studies on the other, thereby clarifying the scientific and practical value of the current study.

Interpretation of the First Hypothesis

Hypothesis: “There are variations in the levels of applying innovation methodologies and emerging technologies among participants.”

The results revealed a generally high level of application of innovation methodologies, with differences across types: design thinking and innovation acceleration ranked highest, while concurrent thinking and deployment showed moderate-to-high levels. Adoption of emerging technologies was also generally high, with artificial intelligence and the Internet of Things being dominant, and the metaverse showing relatively low adoption.

These findings suggest that Saudi institutions have begun to pay considerable attention to innovation practices, particularly within the framework of Vision 2030. This is reflected in the widespread adoption of design thinking and Innovation acceleration as the most common and accessible methodologies. By contrast, the metaverse remains in an early stage of organizational awareness, explaining its lower adoption rate. These findings are consistent with global studies that highlight varying levels of maturity in adopting emerging technologies across institutions (Reeves et al., 2021).

Interpretation of the Second Hypothesis

Hypothesis: “There is a statistically significant effect of applying innovation methodologies on the level of adoption of emerging technologies within institutions.”

The regression analysis showed that innovation methodologies explain 23% of the variance in emerging technology adoption, meaning that systematic reliance on innovation frameworks directly enhances technological adoption.

This can be explained by the fact that clear innovative methodologies (such as design thinking or Innovation acceleration) provide a structured framework for experimenting with and adopting new technologies. Without such methodologies, technology adoption becomes random and unsustainable. These results are supported by Tidd & Bessant (2020), who emphasized that innovative methodologies are a fundamental prerequisite for successful technology implementation within organizations.

Interpretation of the Third Hypothesis

Hypothesis: “There is a positive relationship between the adoption of emerging technologies and the success of digital transformation projects.”

Pearson’s correlation results revealed a strong and significant relationship ($r = 0.62$), confirming that institutions investing in technologies such as AI and blockchain achieve higher levels of operational efficiency, service quality, and project completion speed.

This can be explained by the role of emerging technologies as key enablers of digital transformation, improving user experience, accelerating implementation, and strengthening competitiveness. These findings align with global reports (World Economic Forum, 2022), which confirm that organizations with higher investment in emerging technologies are faster and more successful in achieving digital transformation.

Interpretation of the Fourth Hypothesis

Hypothesis: “Digital transformation outcomes differ depending on the adopted innovation methodology.”

The ANOVA results indicated significant differences between institutions based on the methodology used. Institutions adopting design thinking achieved the highest levels of user satisfaction and solution quality, while those focusing on Innovation acceleration achieved faster implementation. Concurrent thinking demonstrated balanced outcomes in efficiency and flexibility.

This suggests that the choice of innovation methodology fundamentally shapes digital transformation outcomes. Design thinking enhances user-centered results, Innovation acceleration shortens project cycles, and concurrent thinking integrates multiple perspectives. These findings are consistent with Brown (2009), who highlighted the human-centered nature of design thinking, as well as O’Connor (2019), who demonstrated the role of innovation acceleration methodologies in shortening innovation cycles.

Interpretation of the Fifth Hypothesis

Hypothesis: “There are no statistically significant differences in the application of innovation methodologies depending on the type of institution (public/private).”

Contrary to the null hypothesis, the results revealed significant differences between public and private institutions. Public institutions exhibited stronger commitment to structured methodological adoption, while private institutions showed greater emphasis on direct technological implementation.

This can be explained by the fact that Saudi public institutions are usually bound by national strategies and transformation programs that require the institutionalization of innovation practices. Private institutions, in contrast, often prioritize rapid returns through direct technological investments rather than comprehensive methodological adoption. These results support OECD (2021), which noted that public institutions often lead change through policies

and structured methodologies, whereas private institutions tend to emphasize short-term economic outcomes.

Recommendations

Considering the importance of innovation methodologies and emerging technologies in supporting the digital transformation journey of Saudi institutions, and based on the significant and practical findings of this study, the following recommendations are proposed:

1. **Promote the dissemination and application of innovative methodologies** (such as design thinking, innovation acceleration, concurrent thinking, and deployment) within institutions, as they serve as practical tools to enhance the adoption of emerging technologies.
2. **Encourage institutions to integrate multiple innovation methodologies**, given that the results showed superior performance among institutions adopting an integrative approach compared to those relying on a single methodology.
3. **Expand the adoption of less prevalent emerging technologies** such as the metaverse and blockchain, through pilot initiatives and awareness programs that increase institutional readiness for these future-oriented technologies.
4. **Leverage the experiences of public institutions** in systematically applying innovation and digital transformation methodologies, by fostering knowledge-sharing and building partnerships that allow private institutions to raise their organizational maturity levels.
5. **Focus on capacity building** through the design of specialized training programs that enhance the competencies of employees in innovation, change management, and digital analytics, as skilled human capital is a cornerstone of successful digital transformation.
6. **Institutionalize innovation as a strategic option** within organizational plans, ensuring that it is embedded in long-term goals rather than treated as isolated initiatives.
7. **Conduct further applied studies** on the relationship between innovation methodologies and digital transformation across different sectors (education, healthcare, industry, and services), while considering other influencing factors such as organizational culture and innovation leadership.

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Appendices

Questionnaire for Measuring the Impact of Innovation Methodologies and Emerging Technologies on Digital Transformation Outcomes

Innovation Land Lab at Jodayn IT Consulting seeks to make a study named "Innovation Methodologies and Their Role in Leveraging Emerging Technologies to Generate Innovative Solutions and Support". The questionnaire aims to collect accurate scientific data on the current application of innovation methodologies, the extent of employing emerging technologies within institutions, and their impact on achieving digital transformation outcomes and to gather participants' views on several key dimensions, including demographic data, innovation methodologies, emerging technologies, digital transformation outcomes, and the integrative relationship between these elements.

Your participation represents a significant scientific contribution that supports academic research and provides reliable results to help develop institutional strategies and enhance competitiveness. Please note that all information provided will be used for research purposes only and will be treated with the highest levels of confidentiality and privacy

Demographic Data

1. **Gender:** Male Female
2. **Age Group:** Under 30 30–39 40–49 50 and above
3. **Sector:** Public Private
4. **Years of Experience:** Less than 5 years 5–10 years More than 10 years
5. **Job Level:** Employee Supervisor Manager Executive

Five-Point Likert Scale

(1) Strongly Disagree – (2) Disagree – (3) Neutral – (4) Agree – (5) Strongly Agree

Dimension 1: Innovation Methodologies

No.	Statement	1	2	3	4	5
6	The institution relies on innovation acceleration methodology to rapidly develop new solutions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Rapid prototyping is implemented to test ideas before actual application.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Work is focused on the end-user through the application of design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Statement	1	2	3	4	5
	thinking methodology.					
9	The stages of design thinking (empathy – define – ideate – prototype – test) are systematically applied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	The institution encourages cross-departmental collaboration within the concurrent thinking methodology.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	The institution relies on diverse teams (technical – operational – administrative) in innovation projects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	There is an institutional commitment to transforming new ideas into implemented solutions through the deployment methodology.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	The results of innovation projects are directly linked to the strategic objectives of the institution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Dimension 2: Emerging Technologies

No.	Statement	1	2	3	4	5
14	The institution relies on artificial intelligence to improve services or support decision-making.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	Artificial intelligence is used to predict the future needs of beneficiaries.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16	The institution invests in big data analytics to support innovation processes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17	Big data is used to develop new solutions and improve operational efficiency.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18	There are innovation projects within the institution that rely on the Internet of Things (IoT).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19	Real-time data is collected through sensors to enhance service quality.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20	The institution is open to using the metaverse as a platform for training, meetings, or virtual experiences.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21	There is strategic awareness of the importance of blockchain in enhancing transparency and trust.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22	Blockchain solutions are applied in financial, operational, or service-related fields.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Dimension 3: Digital Transformation Outcomes

No.	Statement	1	2	3	4	5
23	The application of innovation methodologies has helped improve internal processes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24	The adoption of emerging technologies has led to the generation of new innovative solutions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25	The integration of methodologies and technologies has accelerated the implementation of digital projects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26	Innovative solutions have contributed to increased beneficiary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Statement	1	2	3	4	5
	satisfaction.					
27	The adoption of innovation has played a role in enhancing institutional efficiency.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28	The presence of an innovation-friendly environment within the institution has strengthened competitiveness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Linking Questions

No.	Statement	1	2	3	4	5
29	The methodologies applied in the institution facilitate the effective utilization of emerging technologies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30	The adoption of emerging technologies enhances the institution's ability to achieve digital transformation outcomes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>