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AGILE METHODS EFFECTIVENESS IN DIGITAL TRANSFORMATION: AN EMPIRICAL SOFTWARE ENGINEERING APPROACH

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AN EMPIRICAL SOFTWARE ENGINEERING APPROACH

by

Beatriz Torres

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Agile Methods Effectiveness in Digital Transformation:
An Empirical Software Engineering Approach

BEATRIZ TORRES

ABSTRACT

This doctoral research investigates the effectiveness of Agile and DevOps methods in enabling successful digital transformation from an empirical Software Engineering perspective. Despite widespread adoption, there remains limited empirical understanding of how digital and IT strategies, mediated by Agile/DevOps practices and IT spending priorities, translate into measurable innovation and operational benefits in large-scale digital transformation initiatives. This study addresses this gap by examining the mediating role of Agile/DevOps practices between organizational strategies and performance outcomes.

Based on data collected between 2019 and 2022 from Canadian organizations engaged in large-scale digital transformation initiatives, the research develops and tests a structural model comprising six latent constructs: Digital Strategy, IT Strategy, IT Spending Priorities, Agile/DevOps Practices, Innovative Benefits, and Operational Benefits. Eight hypotheses are formulated to assess direct and mediating relationships among these constructs.

A quantitative survey methodology is employed, and the proposed model is evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM). Measurement validity and structural relationships are assessed through path coefficients, explained variance (R^2), effect sizes, and mediation analyses, including Sobel analysis.

The results provide empirical support for seven of the eight hypothesized relationships. The findings demonstrate that Agile/DevOps practices play a significant mediating role in translating strategic intent and investment priorities into both innovative and operational benefits. However, the direct relationship between digital strategy and performance outcomes is not statistically supported, suggesting limitations in how strategic initiatives are operationalized through Agile methods. Overall, this research contributes empirical evidence on Agile methods effectiveness in

digital transformation and clarifies the conditions under which Agile practices generate tangible organizational value.

Keywords: Digital transformation, Agile, DevOps, Partial Least Squares (PLS-SEM), Structural Equation Modeling (SEM), IT strategy, Software engineering, Analytics.

Efficacité des méthodes agiles dans la transformation numérique :
Une approche empirique de l'ingénierie logicielle

BEATRIZ TORRES

SOMMAIRE

Cette recherche doctorale examine l'efficacité des méthodes Agile et DevOps pour une transformation numérique réussie, selon une perspective empirique de génie logiciel. Malgré leur adoption généralisée, la compréhension empirique de la manière dont les stratégies numériques et informatiques, mises en œuvre par les pratiques Agile/DevOps et les priorités de dépenses informatiques, se traduisent par des avantages mesurables en matière d'innovation et d'efficacité opérationnelle dans le cadre d'initiatives de transformation numérique à grande échelle demeure limitée. Cette étude comble cette lacune en examinant le rôle médiateur des pratiques Agile/DevOps entre les stratégies organisationnelles et les résultats de performance.

À partir de données recueillies entre 2019 et 2022 auprès d'organisations canadiennes engagées dans des initiatives de transformation numérique à grande échelle, la recherche développe et teste un modèle structurel comprenant six construits latents : stratégie numérique, stratégie informatique, priorités de dépenses informatiques, pratiques Agile/DevOps, avantages en matière d'innovation et avantages opérationnels. Huit hypothèses sont formulées afin d'évaluer les relations directes et indirectes entre ces construits.

Une méthodologie d'enquête quantitative est employée et le modèle proposé est évalué à l'aide de la modélisation par équations structurelles aux moindres carrés partiels (PLS-SEM). La validité des mesures et les relations structurelles sont évaluées à l'aide des coefficients de cheminement, de la variance expliquée (R^2), des tailles d'effet et d'analyses de médiation, notamment l'analyse de Sobel.

Les résultats confirment empiriquement sept des huit relations hypothétiques. Ils démontrent que les pratiques Agile/DevOps jouent un rôle de médiation significatif dans la traduction des

intentions stratégiques et des priorités d'investissement en bénéfices à la fois innovants et opérationnels. Cependant, la relation directe entre la stratégie numérique et les résultats de performance n'est pas statistiquement significative, ce qui suggère des limites dans la mise en œuvre des initiatives stratégiques par les méthodes Agile. Globalement, cette recherche apporte des preuves empiriques de l'efficacité des méthodes Agile dans la transformation numérique et clarifie les conditions dans lesquelles les pratiques Agile génèrent une valeur organisationnelle tangible.

Mots-clés : Transformation numérique, Agile, DevOps, Moindres carrés partiels (PLS-SEM), Modélisation par équations structurelles (SEM), Stratégie informatique, Génie logiciel, Analyse de données.

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1 INTRODUCTION

Digital transformation has become a central strategic imperative for organizations striving to remain competitive in increasingly dynamic, technology-driven environments (Stol et al., 2016). Beyond technological adoption, digital transformation reshapes governance structures, leadership roles, and organizational culture, challenging executives to align strategic objectives with operational execution (Stol et al., 2016). Within this context, IT leadership functions particularly those of Chief Information Officers (CIOs) play a critical role in translating digital strategy into actionable initiatives while balancing innovation and operational performance (Pavlou, 2022).

Digital transformation is a complex organizational endeavor that requires the alignment of strategic objectives, technological capabilities, organizational resources, and expected business outcomes. Yucel (Yucel, 2018) emphasizes the importance of adopting a holistic approach to digital transformation strategy by considering its potential benefits, drawbacks, risks, and mitigation plans. This perspective highlights the need to examine digital transformation not only in terms of technology adoption but also in relation to strategic decision-making and the realization of organizational benefits. Building on this perspective, the present research investigates the relationships among digital strategy, IT strategy, spending priorities, Agile/DevOps practices, and digital transformation benefits.

The alignment between digital strategy (DSTR) and IT strategy (STRA) is essential for achieving successful digital transformation outcomes (Bharadwaj et al., 2013). However, alignment alone is insufficient. Organizations must make informed resource allocation decisions (SPEN), balancing investments in initiatives that drive innovation (BINN) with those that enhance operational performance (BOPR) under conditions of uncertainty and rapid technological change. The CIO is pivotal in orchestrating these decisions, ensuring that strategic priorities are effectively executed and that resource trade-offs align with organizational objectives.

To support strategic execution, organizations increasingly adopt Agile and DevOps(1) practices (AGIL) (Lindskog & Netz, 2021).

(1) DevOps (development and operations) is a set of collaborative practices that automate delivery of new software updates with the aim to reduce the development life cycle and produce quality software products.

Originating in software engineering, these approaches emphasize iterative development, continuous integration, collaboration across development and operations teams, and adaptability to changing requirements (Schön et al., 2020) (Sherer, 2014).

Agile and DevOps are conceptualized not merely as project-level methods but as organizational capabilities that may mediate the relationship between strategic intent and performance outcomes. Yet empirical evidence on how these practices contribute to organizational-level digital transformation, particularly in linking strategy, resource allocation, and innovation, remains limited (Gertzen et al., 2022)(Alipour et al., 2022).

Prior research has primarily examined Agile adoption from cultural or team-level perspectives, leaving a gap in understanding how Agile/DevOps practices function as mediating mechanisms at the strategic and organizational level. Few studies explore how these practices enable CIOs and other IT leaders to translate digital strategy and IT strategy into actionable outcomes, or how IT spending priorities influence the effectiveness of Agile adoption. A deeper understanding of these interdependencies is critical for both theory and practice, as it highlights the conditions under which Agile and DevOps practices can enhance innovation and operational performance in large-scale digital transformation initiatives.

We could formulate a research question motivating this study***:***

To what extent do Agile and DevOps practices relate to the effectiveness of large-scale digital transformation, and which factors influence this relationship?

This study addresses these gaps by adopting an empirical Software Engineering approach, using Partial Least Squares Structural Equation Modeling (PLS-SEM)[(2)] to examine the relationships among digital strategy, IT strategy, IT spending priorities, Agile/DevOps practices, and organizational outcomes. By analyzing data from Canadian organizations engaged in digital transformation initiatives, the research aims to provide robust evidence on the mediating role of Agile and DevOps practices in translating strategic intent into innovation and operational benefits, while highlighting the critical governance and decision-making role of the CIO.

(2) PLS-SEM: Partial Least Squares Structural Equation Modeling is used to analyze and predict complex relationships between latent constructs, especially when the research objective is explaining variance and assessing effectiveness rather than confirming a well-established theory (Hair et al., 2018).

The study is structured around three levels of analysis to evaluate the relationships among the main factors. First, it examines the relationships between digital transformation, IT strategy, Agile/DevOps practices, and organizational outcomes, including innovative and operational benefits. Second, it analyzes the relationships between digital strategy, IT strategy, and Agile/DevOps practices, focusing on how strategic alignment is associated with the adoption and use of Agile/DevOps. Third, it assesses the relationships among Agile/DevOps practices, IT strategy, IT spending priorities, and organizational outcomes (innovative and operational benefits), with particular attention to the role of Agile/DevOps as a mediating mechanism.

1.1 Research problem

Although digital transformation strategy is intended to support the achievement of organizational objectives and the realization of business benefits, translating strategic intentions into measurable outcomes involves multiple interdependent organizational and technological factors. Yucel (Yucel, 2018) argues that digital transformation strategies should be evaluated by considering objectives, expected benefits, costs, drawbacks, risks, and supporting corporate strategies. However, further empirical investigation is needed to understand how strategic orientations and implementation practices are associated with the realization of digital transformation benefits. Examining the relationships between digital strategy, IT strategy, spending priorities, and Agile/DevOps practices can provide additional insight into the mechanisms through which organizations pursue innovative and operational outcomes.

The problem addressed in this thesis lies in the persistent difficulty organizations face in translating digital and information technology (IT) strategies into measurable innovation and productivity outcomes, despite the widespread adoption of Agile and DevOps practices. In the context of large and complex Canadian organizations, the mediating mechanisms through which Agile/DevOps practices connect digital strategy, IT strategy, and IT spending priorities to organizational performance remain insufficiently theorized and empirically validated. This lack of empirical clarity constrains Chief Information Officers' ability to effectively govern Agile adoption and to systematically realize its intended strategic value.

1.2 Research objective and research questions

Drawing on Yucel's (Yucel, 2018) holistic perspective on digital transformation strategy and the importance of aligning strategic objectives with organizational outcomes, this research examines how digital strategy, IT strategy, spending priorities, and Agile/DevOps practices are related to the realization of digital transformation benefits. While Yucel (Yucel, 2018) provides a framework for characterizing the factors that may influence digital transformation success, the present study focuses on empirically examining the proposed relationships among these constructs. Accordingly, the research questions are formulated to guide the development of the conceptual model, the hypotheses, and the subsequent empirical analysis.

The objective of this research is to investigate how Agile/DevOps practices mediate the relationships between digital strategy, IT strategy, IT spending priorities, and organizational benefits, including innovation and operational outcomes, in large-scale digital transformation initiatives More specifically, the study examines whether IT Strategy, Spend Priorities, and Agile/DevOps practices play mediating roles within the proposed relationships among strategic factors and innovative and operational benefits.

Based on the research gaps identified in the literature, the study addresses three research questions:

RQ1. What is the role of IT Strategy in the relationships between Digital Strategy, Agile/DevOps practices, and digital transformation benefits?

RQ1 is operationalized through three hypotheses:

- H1: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Benefits-Innovative (BINN).
- H2: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Operational Benefits (BOPR).
- H3: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL).

RQ2. What is the role of Spend Priorities in the relationship between Digital Strategy and Agile/DevOps practices?

RQ2 is operationalized through:

- H4: Spend Priorities (SPEN) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL).

RQ3. What is the role of Agile/DevOps practices in the relationships between IT Strategy, Spend Priorities, and digital transformation benefits?

RQ3 is operationalized through four hypotheses:

- H5: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Innovative Benefits (BINN).
- H6: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Operational Benefits (BOPR).
- H7: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Innovative Benefits (BINN).
- H8: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Operational Benefits (BOPR).

The three research questions provide the organizing framework for the conceptual model. RQ1 examines the role of IT Strategy, RQ2 examines the role of Spend Priorities, and RQ3 examines the role of Agile/DevOps practices in relation to digital transformation benefits. The corresponding hypotheses operationalize these questions are empirically assessed using PLS-SEM and mediation analysis.

These research questions operationalize selected dimensions of the holistic digital transformation strategy perspective proposed by Yucel (Yucel, 2018), with particular attention to strategic alignment, organizational resource priorities, implementation practices, and the realization of digital transformation benefits. The questions guide the subsequent development of the conceptual model and the formulation of the hypotheses examined in this study.

1.2.1 Research Questions and Positioning

In sum, this thesis does not assume Agile as inherently effective but rather investigates its potential role in digital transformation through a critical, empirical lens. By combining quantitative and qualitative evidence, it aims to contribute to the scholarly discourse on Agile in software engineering and IT governance, while providing practical insights for leaders navigating digital transformation.

This study was attended as one of the requirements for a Ph.D. in Sciences and Information Technology program at Université du Québec en Outaouais (UQO). Key issues that are emerging in the application of agile practices to software development (Niederman et al., 2018), and

characteristics of the agile project management approach entails greater emphasis on select elements to adapt digital initiatives and focuses on agile methods (Kudyba & Cruz, 2023).

1.3 Research Design

This study adopts an empirical software engineering research design grounded primarily in a quantitative approach. A survey of Chief Information Officers and senior IT leaders is used to collect data on strategic decision-making, Agile/DevOps practices, and performance outcomes in large-scale digital transformation initiatives. The quantitative design enables the examination of complex interdependencies and mediating relationships among strategic and organizational constructs.

The research operationalizes six latent constructs—Digital Strategy (DSTR), IT Strategy (STR), IT Spending Priorities (SPEN), Agile/DevOps Practices (AGIL), Innovation Benefits (BINN), and Operational Benefits (BOPR)—and empirically tests their relationships using Partial Least Squares Structural Equation Modeling (PLS-SEM). This method is particularly suited to exploratory and explanatory research involving mediation effects and strategic variables in complex organizational contexts.

To complement the quantitative findings and enhance interpretive depth, a limited number of semi-structured interviews are managed with selected participants. These qualitative insights support the interpretation of statistical results by capturing practitioners' experiences with Agile adoption and governance challenges.

The study is situated within established theoretical foundations in digital transformation, IT governance, and project management, allowing for an integrated analysis of strategy, agility, and performance from a CIO-centric perspective.

1.4 Target Audience and Relevance

The significance of this research extends across multiple industries and professions. IT leaders, executives, healthcare managers, financial experts, engineers, educators, HR professionals, and entrepreneurs can all benefit from a deeper understanding of how Agile show a positive and statistically significant relationship to both operational efficiency and innovation capacity.

In the Canadian context, Agile's inclusivity and adaptability align well with multicultural and multidisciplinary workplace environments. As such, this research provides not only academic contributions to the literature on IT governance and digital transformation, but also practical guidance for organizations seeking to scale Agile practices in diverse, knowledge-intensive settings.

2 LITERATURE REVIEW

This literature review examines scholarly research related to Agile and DevOps practices within the context of enterprise digital transformation, with a particular focus on their strategic, organizational, and performance implications. Rather than providing a descriptive overview of Agile methodologies or practitioner-oriented frameworks, the review critically synthesizes academic work that informs the research problem concerning the role of Agile/DevOps as a mediating mechanism between digital strategy, IT strategy, and organizational outcomes.

The scope of the review is organized around four primary streams of literature. First, it examines research on digital transformation and digital strategy to establish how organizations articulate and govern technology-driven change. Second, it reviews studies on IT strategy and IT governance, including the role of CIOs in strategic alignment and resource allocation (Pavlou, 2022, p. 19) and how impact the benefits innovative and operational. Third, it analyzes empirical and conceptual research on Agile and DevOps practices beyond the software team level, with particular attention to scalability, hybrid forms of adoption, and enterprise-wide implementation challenges. Fourth, it reviews literature on innovation and operational performance to clarify how these outcomes have been measured and theorized in prior research.

This review deliberately excludes practitioner guides, industry frameworks, and prescriptive best-practice models (e.g., generalized Agile frameworks or PMBOK-based implementation manuals), except where such sources are referenced in peer-reviewed studies (Okoli, 2015) provide distinct categorizations of specific agile practices and software development techniques. The objective is to identify conceptual gaps, unresolved debates, and empirical limitations in the existing literature that justify the development and testing of the research model proposed in this thesis.

By structuring the literature review around these analytical dimensions, the study establishes a coherent theoretical foundation for examining how Agile/DevOps practices mediate strategic intent and performance outcomes in large-scale digital transformation initiatives.

2.1 The CIO's strategic role in enabling digital transformation

The strategic alignment perspective identified by Yucel (Yucel, 2018) also provides a basis for considering the organizational responsibilities involved in connecting digital transformation objectives with IT-related decisions. Complementary literature on the strategic role of CIOs and other digital leadership roles further informs the discussion of how organizations coordinate technology, business objectives, and transformation priorities.

Chief Information Officers (CIOs) play a central role in digital transformation by governing IT resources, aligning IT and digital strategies with organizational objectives, and guiding technology investments toward business value (Pavlou, 2022). As key components of organizational IT capability, CIOs influence strategic execution, investment prioritization, and governance, thereby shaping the conditions under which digital initiatives generate innovation and operational benefits (Pavlou, 2022) (Le Masson, 2011).

The evolution of digital leadership has also introduced Chief Digital Officers (CDOs), particularly in some European organizations, where they contribute to digitalization and organizational creativity (Veronica Scuotto , Domitilla Magni , Tzanidis Theofilos , and Manlio Del Giudice, 2022). However, the CIO remains an important actor in integrating digital and IT strategies, particularly in large enterprises. CIO effectiveness further depends on the ability to bridge technological and business capabilities, anticipate future digital requirements, and support organizational adaptation (Berman et al., 2012). At the team level, motivational factors, including intrinsic and hedonic motivation, can also support engagement and innovative behavior in digital work environments (Meske et al., 2019).

Although the literature establishes the strategic importance of CIO leadership, the mechanisms linking CIO-related strategic decisions, IT spending priorities, and Agile/DevOps practices to innovation and operational benefits remain insufficiently understood. This study addresses this gap by examining Agile/DevOps as a mediating mechanism between strategic orientations and

organizational outcomes in large-scale digital transformation initiatives, with particular attention to the Canadian context.

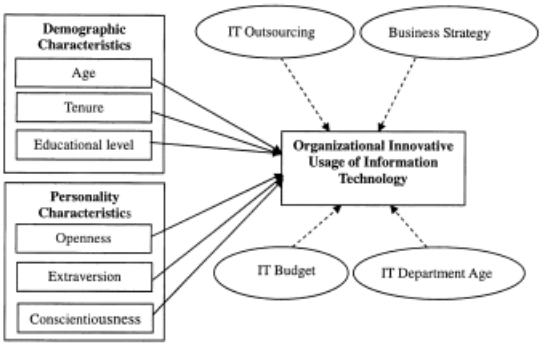


Fig. 1. Conceptual model.

2.2 Digital Strategy as a foundational driver of organizational change

Digital strategy is a central construct in this thesis, providing the foundation through which organizations implement digital transformation and leverage Agile methods to generate innovation and operational benefits. It refers to the formulation and execution of organizational strategy through the integration of digital technologies—such as cloud computing, data analytics, artificial intelligence (AI), Internet of Things (IoT), and automation—to create value, improve efficiency, and enhance customer experience.

Unlike traditional IT strategy, which focuses on aligning information systems with business needs, digital strategy extends across the organization and reshapes value creation mechanisms (Bharadwaj et al., 2013). It is inherently cross-functional, requiring coordination between business and IT units. In this context, Agile methods play a key role by enabling iterative development, faster delivery, and continuous integration of digital solutions, thereby supporting the implementation of digital strategies.

A key dimension of digital strategy involves the digitalization of business processes through software-intensive systems. Agile and DevOps practices facilitate this transformation by promoting iterative cycles, continuous feedback, and adaptive responses to technological and market changes. These practices enable rapid experimentation, incremental innovation, and

continuous deployment, contributing to both operational efficiency and the development of new digital products, services, and business models.

Despite its importance, digital transformation remains complex. Organizations often face challenges in aligning technological capabilities with strategic objectives, leading to fragmented initiatives or limited outcomes. Prior research highlights multiple interrelated dimensions influencing transformation success, including resources, activities, value propositions, and revenue models (Porkkovan Elangovan, 2021), emphasizing the need for systemic alignment.

Complementing this view, (Baslyman, 2022) conceptualizes digital transformation as a data-driven process leveraging disruptive technologies to optimize operations and enhance customer experience. The study proposes a model linking corporate strategy, business units, and operational capabilities with digital elements, and identifies three phases: discovery, planning, and implementation (Figure 1). This process highlights the importance of cross-functional collaboration and digital teams, aligning closely with Agile practices.

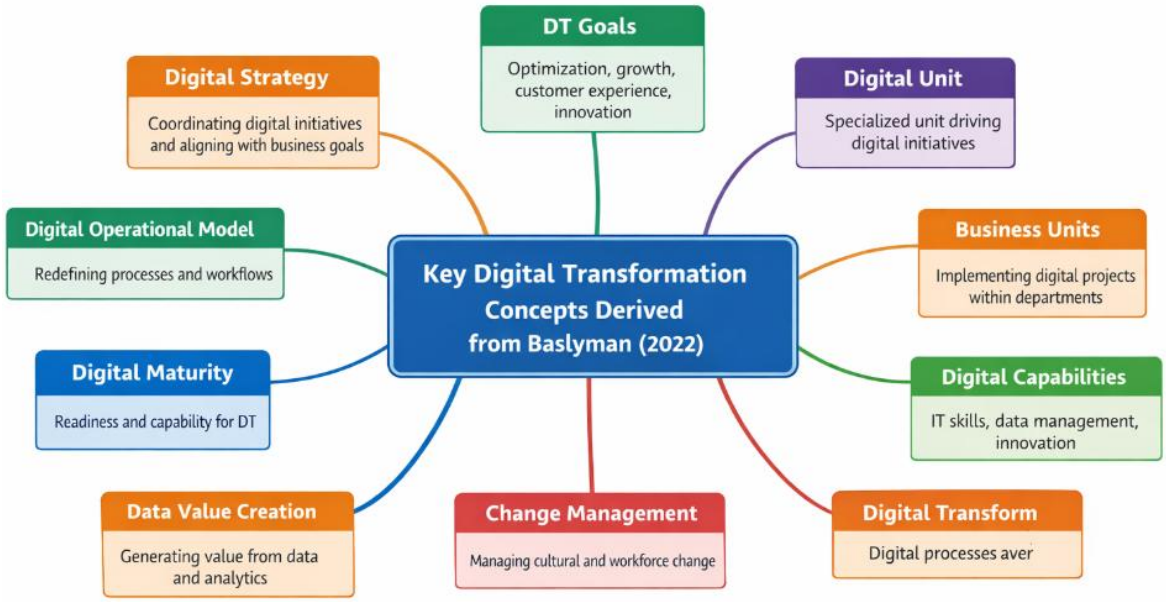


Figure 1: Key Digital Transformation from Baylyman (2022)

Consistent with the resource-based view (RBV), digital strategy can be understood as the deployment of digital resources and capabilities to achieve competitive advantage (Bharadwaj et al., 2013). Within this perspective, Agile methods represent a key organizational capability that

supports effective digital transformation by enhancing adaptability, accelerating delivery, and improving collaboration.

Finally, the effectiveness of digital transformation depends not only on technology adoption but also on implementation practices. Agile and DevOps facilitate continuous integration, rapid deployment, and iterative improvement of digital systems (Yucel, 2018). From an empirical software engineering perspective, examining how these practices relate to innovation and operational performance provides important insights into how digital strategy translates into measurable organizational outcomes.

2.3 Strategic alignment between digital strategy and IT strategy

In this thesis, IT strategy is conceptualized as the set of strategic choices through which organizations align IT capabilities, investments, and governance mechanisms with broader business objectives in the context of digital transformation. Rather than viewing IT as a purely operational function, this study adopts a strategic perspective in which IT acts as a key enabler of organizational performance and long-term growth.

Prior research highlights two main organizational contributions of IT: efficiency-oriented outcomes, such as cost reduction and process optimization, and growth-oriented outcomes, including innovation, revenue expansion, and competitive advantage (Chen et al., 2010). From this perspective, IT strategy plays a critical role in balancing operational efficiency with strategic transformation.

Effective IT strategy depends largely on the alignment between business objectives and IT initiatives. This alignment is achieved not only through formal planning processes but also through the integration of IT resources with complementary organizational capabilities (Queiroz et al., 2020). Consequently, the value generated by IT investments depends on how coherently they support organizational priorities.

In the context of digital transformation, IT strategy also involves governance and resource allocation decisions, including the prioritization of initiatives, allocation of financial and human resources, and management of technology-related risks (Monzelo & Nunes, 2019). As digital environments evolve rapidly, organizations increasingly require adaptive IT strategies capable of responding to uncertainty and supporting continuous transformation. Strategic-level IT

performance metrics, such as the ratio of business value generated relative to implementation speed or cost, are used to assess transformation outcomes (Porkkovan Elangovan, 2021).

Recent studies further emphasize that IT functions are no longer limited to supporting business operations but increasingly show a positive and statistically significant relationship with organizational innovation and change (Peppard, 2010). This evolution strengthens the interdependence between IT strategy and Agile/DevOps practices, as flexibility, speed, and responsiveness become critical strategic capabilities.

In this research model, IT strategy is therefore considered a key mechanism linking digital strategy and organizational outcomes, influencing how strategic priorities translate into innovative benefits (BINN) and operational benefits (BOPR). The assessment of IS strategic alignment relies on responses from top management team members, consistent with prior research (Karahanna & Preston, 2013).

2.4 The role of IT strategy in digital transformation outcomes

2.4.1 Digital strategy and benefits innovative

Digital strategy defines an organization's vision for leveraging digital technologies to transform business models, processes, and value creation. However, digital strategy alone does not directly generate innovative outcomes. Its impact materializes through the formulation and execution of a coherent IT strategy that operationalizes digital ambitions into actionable technological capabilities and investments.

IT strategy plays a critical mediating role by translating digital objectives into structured architectures, governance mechanisms, and implementation priorities that enable innovation. When aligned with digital strategy, IT strategy facilitates the development of new digital products, services, and processes, thereby contributing to innovation-related benefits. Prior research emphasizes that innovation outcomes are more likely to emerge when digital initiatives are supported by a well-defined and aligned IT strategy that connects strategic intent with execution mechanisms (Kunisch et al., 2022).

Accordingly, this study examines whether IT strategy serves as a mediating mechanism through which digital strategy is positively associated with innovative benefits.

We hypothesized:

Hypothesis H1*: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Benefits-Innovative (BINN).*

Table 1 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 1. The table highlights how IT strategy can serve as an important intermediary mechanism linking digital strategy to innovative benefits, emphasizing the role of IT strategic alignment in enabling organizations to transform digital initiatives into innovation outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Chief Digital Officer (CDO) organizational creativity, digital transformation (DT), dynamic capabilities (DCs), microfoundation.	Chief digital officers: An exploratory analysis of their emergence, nature, and determinants (Kunisch et al., 2022)	How dynamic capabilities (DCs) of Chief Digital Officers (CDOs) trigger digitalization and organizational creativity of 2124 small to medium enterprises (SMEs) across 39 different European countries.	Managerial literature 2124 CDOs operating in SMEs of 39 different European countries	Case study Collection data: SMEs via a structured survey by Eurostat to identify the dimensions that trigger the digitalization and organizational creativity in Europeans' SMEs Analyse date: SPSS 25.0 and PROCESS 3.5	Since CDOs are seen to be the spark of unique ideas and innovations in the organization, further insights are proposed to position the need for conceptualizing new paths for developing technologies toward organizational creativity and humanity.
Digital transformation (DT), Disruptive change (DC), Technological process innovation (TPI), Industry 4.0 (I4.0), The event of disruptive change (EDC	Organizational competencies toward digital transformation at the events of disruptive changes: an operational process innovation perspective (Al-Edenat, 2021)	This paper aims to examine the impact of different variables such as disruptive change, technological to identify the different capabilities needed for digitalization and digital maturity, identify the supporting methods for adopting different technologies and offer answers to overwhelmed those challenges and obstacles resulting in this environment.	450 participants have been surveyed from three major private mining organizations in the Jordanian context	Research paper Data Collection 212/450 questionnaires retrieved with around a 47% response rate Analyze data: Harman's single factor test with exploratory factor analysis (EFA)	The results of the analysis revealed that support the direct impact of the event of disruptive change, technological process innovation on digital transformation. In addition, the results showed that there is a positive direct impact of the event of disruptive change on technological process innovation.
Digital business strategy, Knowledge-based dynamic	How does a firm's digital business strategy affect its innovation	While previous research has demonstrated the positive effects of digital business strategies on	215 firms in China	Research paper	The empirical analysis reveals that a firm's digital business strategy has positive impacts on both product and process innovation performance. These

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
capability, Innovation performance, Entrepreneurial orientation, Market turbulence	performance? An investigation based on knowledge-based dynamic capability (Zheng, 2023)	operational efficiency, financial performance and value creation, little is known about how such strategies influence innovation performance. To address the gap, this paper aims to investigate the impact of a firm's digital business strategy on its innovation performance		Analyze Data : multiple regression and structural equation modeling	impacts are partially mediated by knowledge based dynamic capability. Additionally, a firm's digital business strategy interacts positively with its entrepreneurial orientation in facilitating knowledge-based dynamic capability.

*Table **1**: Comparison of research objectives, methodological approaches, and principal findings across studies for H1*

2.4.2 Digital strategy and benefits operational

Digital strategy articulates an organization's intent to leverage digital technologies to improve efficiency, resilience, and operational performance. However, operational benefits such as cost reduction, process optimization, reliability, and productivity are not achieved through digital vision alone. These outcomes depend on the extent to which digital priorities are translated into coherent IT architectures, governance mechanisms, and operational capabilities.

IT strategy plays a mediating role by converting digital objectives into concrete infrastructure investments, security controls, and process-enabled systems that support stable and efficient operations. In particular, information security management has become a critical operational concern, as high-profile security breaches have elevated cybersecurity to a top CIO priority (C. Q. Feng & Wang, 2019)). A well-aligned IT strategy ensures that digital initiatives are implemented in a secure, scalable, and operationally sustainable manner, thereby enabling measurable operational benefits.

Accordingly, this study examines whether IT strategy serves as a mediating mechanism through which digital strategy contributes to operational performance improvements.

Hypothesis H2*: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Operational Benefits (BOPR).*

Table 2 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 2. The table highlights how IT strategy can serve as an important intermediary mechanism linking digital strategy to operational benefits, emphasizing the role of IT strategic alignment in enabling organizations to transform digital initiatives into operational outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Digital transformation, Smart manufacturing, Supply chain structure, Relational arrangement, Servitization, Business performance	Is digital transformation equally attractive to all manufacturers? Contextualizing the operational and customer benefits of smart manufacturing (Opazo-Bas aez et al., 2023)	The implementation of Smart Manufacturing (SM) is deemed a key enabler in the enhancement of manufacturing competitiveness and performance. This study analyzes the effect of SM on operational and customer performance.	Surveys 351 Spanish manufacturing firms operating in an SM environment.	Research paper Data Collection: Questionnaire was issued to three different innovation managers prior to implementation in order to ensure that the questions/statements were clear and easy to understand. Analyze Data: e Generalized Structural Equation Modeling (GSEM) approach using the Stata package	This research clearly differentiates the benefits of SM depending on business context. In this regard, transnational production firms tend to gain in operational performance while service-oriented manufacturers gain in customer performance.
Power enterprises Digital transformation Operational fficiency	Does digital transformation improve the operational efficiency of Chinese power enterprises?	With the ongoing reform of the electric power system, more and more power enterprises are adopting digital transformation (DT) as a key strategy to stay competitive in the market. This study aims to examine the potential impact of DT on the operational efficiency (OE) of power enterprises, as well as to	A sample of Chinese-listed power generation companies from 2011 to 2020 is selected as the research subjects. 540 valid observations from	Research paper Data Collection A sample of Chinese-listed power generation companies from 2011 to 2020 is selected as the research subjects. Analyse Data : regression analysis	Our findings suggest that DT indirectly improves the OE of power enterprises by promoting innovation, enhancing capital utilization rates, and easing financial constraints. Additionally, DT plays a more significant role in improving OE in a fiercely competitive industry environment. Finally, large, state-owned, and growing power firms have benefited more from DT than other types of firms.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
		investigate the underlying mechanisms, which have received limited attention in prior research	54 power generation firms.		
Digital transformation, digital strategy, business mode, conceptual model, industry, digital transformation process, digital transformation goals.	Digital Transformation From the Industry Perspective: Definitions, Goals, Conceptual Model, and Processes (Baslyman, 2022)	In this study, I interviewed nine senior DT (Digital Transformation) leaders to provide a holistic and comprehensive understanding of DT in practice. The DT leaders provided definitions of DT, its core goals and motivations, its concepts and relationships, and its implementation processes. Through analyzing the leaders' responses, an empirically driven definition of DT and its goals are presented.	Nine individuals agreed to participate in this study. Seven of these individuals had, on average, five years of experience working in DT	Data Collection: Interviewing Analyze Data commercial tool was used to transform the data from voice to text	. In addition, the study provides a conceptual model that depicts the basic entities in the DT context and their relationships. Finally, it provides a comprehensive representation of phases and processes through which organizations, that have already implemented DT successfully in some of their business units, undergo.

*Table **2**: Comparison of research objectives, methodological approaches, and principal findings across studies for H2*

2.4.3 Digital strategy and Agile/DevOps

Digital strategy articulates an organization's ambition to leverage digital technologies to enhance responsiveness, customer experience, and innovation. Achieving these objectives typically requires faster delivery cycles, continuous integration, and close alignment between business and IT capabilities that are central to Agile and DevOps practices. However, the adoption of Agile/DevOps does not occur automatically because of digital intent alone.

IT strategy plays a critical mediating role by translating digital priorities into enabling technological architectures, governance models, and operational processes. It defines standards, toolchains, integration approaches, and resource allocation mechanisms that support iterative development, automation, and cross-functional collaboration. In this sense, IT strategy operationalizes digital strategy by creating the conditions under which Agile and DevOps practices can be effectively implemented (Niederman et al., 2018).

Accordingly, Agile and DevOps practices act as execution mechanisms through which digitally driven initiatives are delivered rapidly and reliably, while IT strategy ensures strategic coherence and technical feasibility. The alignment between digital strategy and IT strategy is therefore essential for enabling Agile/DevOps adoption and sustained agility.

Hypothesis H3*: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps(AGIL).*

Table 3 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 3. The table highlights how IT strategy can serve as an important intermediary mechanism linking digital strategy to Agile/DevOps, emphasizing the role of IT strategic alignment in enabling organizations to transform digital initiatives with Agile/DevOps.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Transformation, large-scale agile, normalisation process theory, case study	From transformation to normalisation: An exploratory study of a large-scale agile transformation (Carroll et al., 2023)	This study addresses the growing challenge of scaling Agile methods beyond the team level to support organization-wide transformation. Many organisations attempt to scale agile methods in an effort to scale success outcomes by introducing methods such as SAFe or Scrum-at-Scale, or some customised version of related methods.	Global financial service organisation (FinanceCo2) who employ approximately 1250 employees across the US, Ireland, India, and China	Case Study Collection Data: Interview Analyze data: 4 key constructs: coherence; cognitive participation; collective action; and reflective monitoring	This research indicated a lack of theoretically grounded studies of large-scale agile transformations and weak assumptions under pinning those that do exist. This research also indicates that practitioners often over-relied on adherence to agile methods rather than identifying approaches to successfully embed and sustain the transformation process.
program management, interteam coordination, agile software development, agile approaches, software engineering, method tailoring	Coordinating Knowledge Work in Multiteam Programs: Findings from a Large-Scale Agile Development Program (Dingsøyr et al., 2018)	This case study describes the coordination of knowledge work in a large-scale agile development program with 12 teams.	24 program participants	Case study Data Collection: Interview Analyze data: software package for qualitative analysis (QSR International, 2017) and used the framework established in the background section to identify expressions relating to coordination modes and changes in coordination mechanisms over time	The findings highlight coordination modes based on feedback, the use of several mechanisms, and how coordination practices change over time. The findings can improve the outcomes of large knowledge-based development programs by tailoring coordination practices to needs over time.

DevOps, best practices, fuzzy AHP analysis	Toward Successful DevOps: A Decision-Making Framework (Muhammad et al., 2022)	Software organizations face several barriers while adopting DevOps practices as the integration of development and operation teams requires merger of different processes, tools, and skill sets. This study aims to develop a prioritization-based framework of the DevOps best practices based on evidence collected from industry experts.	Systematic Literature review	Data collection: Selection of appropriate data sources is essential to identify literature related to the research objective of the study Analyze: Fussy AHP	DevOps is an approach which combines development and operations to enable agility during software development process. The implementation of DevOps practices is complex, and this motivates us to explore the best practices that are important for success of DevOps paradigm in software organizations.

*Table **3**: Comparison of research objectives, methodological approaches, and principal findings across studies for H3*

2.5 Strategic prioritization of digital investments and Agile/DevOps

In this thesis, spend priorities refer to the strategic allocation and prioritization of financial resources across IT and digital initiatives. Rather than reflecting absolute budget levels, this construct captures how investment decisions are oriented toward strategic objectives such as innovation, operational efficiency, and risk mitigation.

From a strategic perspective, spend priorities represent a critical mechanism through which digital and IT strategies are translated into actionable initiatives.

Spend priorities also affect organizational capabilities by shaping investments in digital tools, training, and collaborative environments. Prior research suggests that effective leadership of virtual teams requires specific skills and organizational support structures (Cripe & Burleigh, 2022), which depend on the strategic allocation of IT resources. In addition, risk management represents an important dimension of spend prioritization, particularly in enterprise environments where cybersecurity, regulatory compliance, and business continuity are essential to operational resilience. As noted in prior research, risk cannot be fully eliminated and must instead be managed through informed allocation of financial and managerial resources (Saddiqa et al., 2023).

Beyond risk mitigation, spend priorities also contribute to enabling innovation. Investments in emerging technologies, digital platforms, and modernization initiatives create the conditions under which Agile and DevOps practices can be effectively implemented. Agile/DevOps approaches require sustained investments in automation tools, skills development, cross-functional collaboration, and iterative delivery processes. Without appropriate prioritization of spending, organizations may struggle to support the structural and cultural changes required for agile implementation (Niederman et al., 2018).

Moreover, Agile practices emphasize continuous stakeholder engagement and adaptive planning, increasing the need for flexible and strategically aligned funding mechanisms. Effective spend prioritization ensures that resources are directed toward initiatives that support experimentation, customer involvement, and incremental value delivery. In this sense, spend priorities act as an execution bridge between digital strategy and Agile/DevOps practices, enabling organizations to translate strategic intent into operational capabilities.

Prior studies also highlight that IT spending is often characterized by limited transparency and budgetary reallocations across organizational units, which can obscure the true cost and strategic

intent of digital initiatives (D. Sharma et al., 2009). This reinforces the importance of analyzing spend priorities not merely as financial controls, but as strategic signals reflecting executive intent and governance choices.

Within the proposed research model, spend priorities are therefore conceptualized as a mediating strategic construct that links digital and IT strategies to organizational performance outcomes. The study empirically examines how these priorities, when aligned with Agile/DevOps practices, influence innovation benefits (BINN) and operational benefits (BOPR) in large Canadian organizations.

From a project-level perspective, Agile practices emphasize continuous stakeholder engagement and adaptive planning, which further increase the need for flexible and strategically aligned funding mechanisms. Effective spend prioritization ensures that resources are allocated to initiatives that support rapid experimentation, customer involvement, and incremental value delivery. In this way, spend priorities act as an execution bridge between digital strategy and Agile/DevOps practices.

Hypothesis H4: Spend Priorities (SPEN) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps (AGIL).

Table 4 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 4. The table highlights how Spend priorities can serve as an important intermediary mechanism linking digital strategy and Agile/DevOps, emphasizing the role of Spend priorities alignment in enabling organizations to transform digital initiatives with Agile/DevOps.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Software organisational structures, human aspects in software engineering, social software engineering, empirical software engineering, industrial mixed-methods research	On the Relationship Between Organizational Structure Patterns and Architecture in Agile Teams (Tamburri et al., 2023)	Is there a recurrent organisational structure pattern in agile software engineering teams? and if so, what does that pattern imply, in terms of software architecture quality?	In four years, involving 90 people in 9 different organizations and arranged in 30 different teams (with an average of three teams per organization) collected over a total period of 18 months	Case Study Data collection: (1) survey design and Delphi study [28]; (2) online survey; (3) confirmatory interviews; (4) data summary and observer reliability assessment; (5) content analysis. Analyse data: data was loaded into tables formatted to be analysed with the R data analytics toolkit in parallel	The study observes a negative correlation between a proposed organisational measure and architecture smells. The ROI-Tracking characteristic is the most frequent. This characteristic denotes the importance of Return-On-Investment (ROI) as a key-performance indicator for project teams, and it was reported 20+ times.
Digitalisation, digital ransformation, strategy, portfolio management, return on investment (ROI)	Navigating digital transformation in airports: A disciplined approach to project portfolio selection and execution (Strome, 2023)	This paper posits that a disciplined and analytical approach to evaluating both the likely effort required for successful execution and the potential impact and value generated can assist airports with the selection and timing of projects, with the aim of avoiding ‘digital isappointment’.	Airports Council International (ACI)	Research paper Cost–benefit analysis (CBA),	Adopting a disciplined approach to digital transformation, striving to achieve the potential benefits while being mindful of risks and issues associated with digital transformation is most likely to result in the achievement of critical airport business and operational objectives.
Computable General	Economic Impact of Information Industry	This paper seeks to address these questions: what is the	42 industry sectors into 11	Research paper	The results show the development will rapidly promote economic development and social welfare,

Equilibrium Model, Development, Economic, Impact, Information Industry, Investment Strategy	Development and Investment Strategy for Information Industry (Lin et al., 2021)	impact of the accelerated development of the information industry on GDP? What are the spillover effects on other industries? Which industries will benefit more?	sectors by keeping the major downstream of the information industry and the industry with a relatively large input in information technology	Data Collection: China Input-Output Table (CIOT) is used to construct Social Accounting Matrix (SAM), which is a basic data of CGE model (China Input-Output Association 2015) Analize data : CGE model (Computable General Equilibrium)	promote the reduction of commodity prices and the rise of output by providing higher social productivity. The development of the information industry can promote the decline of commodity prices and the rise of output by providing higher social productivity. The development of information industry mainly stimulates the development of the tertiary industry, followed by the secondary industry

*Table **4**: Comparison of research objectives, methodological approaches, and principal findings across studies for H4*

2.6 Agile methods as an organizational capability

Agile and DevOps practices are widely adopted in digital transformation to address uncertainty, rapid technological change, and evolving user needs. Agile promotes iterative delivery and adaptability, while DevOps enhances integration between development and operations, improving delivery speed and reliability (Lappi & Aaltonen, 2017).

However, their effectiveness depends on evolving from team-level practices to an organizational capability. Evidence shows that Agile adoption limited to practices and ceremonies, without integration into governance and decision-making, constrains transformation outcomes. Large-scale initiatives often fail when Agile is not aligned with organizational structures and value creation objectives. Research highlights that Agile effectiveness relies on its normalization across roles and management levels. For instance, (Carroll et al., 2023) show that digital transformation efforts weaken when Agile practices are not collectively understood, legitimized, and continuously evaluated.

Beyond the project level, agility is increasingly viewed as the organization's ability to reconfigure resources, processes, and technologies in response to environmental change (Niederman et al., 2018). However, empirical evidence remains mixed regarding whether team-level Agile adoption translates into enterprise-wide performance gains. This is partly due to tensions between Agile principles and traditional governance mechanisms based on predictive planning and rigid financial controls, leading many organizations to adopt hybrid approaches (Niederman et al., 2018).

These findings suggest that Agile should be understood as a contingent organizational capability, whose effectiveness depends on strategic alignment, governance, and leadership decisions. Its impact is shaped by its alignment with digital strategy (DSTR), IT strategy (STRA), and resource allocation decisions (SPEN).

Accordingly, this study conceptualizes Agile/DevOps (AGIL) as a mediating construct that is positively associated with how strategic intent is translated into innovation (BINN) and operational performance (BOPR), rather than assuming direct performance effects.

2.7 Organizational Performance: Innovative and operational benefits

2.7.1 Benefits Innovation

Benefits represent realized value derived from the effective use of project outputs by customers or stakeholders (Musawir et al., 2017). In digital transformation, innovation benefits reflect both tangible and intangible value created through IT capabilities, Agile practices, and organizational alignment.

Research highlights the critical role of IT leadership, particularly the CIO, in enabling innovation outcomes (C. Feng et al., 2021); (Barnes et al., 2021.

Innovation benefits are multidimensional. First, they support strategic differentiation by enabling new products, services, and processes, enhancing competitiveness and growth (Barnes et al., 2021; (Ramirez et al., 2018). Second, organizational agility(3), often enabled by Agile/DevOps, enhances the ability to sense and respond to environmental changes, and is a key success factor in advanced digital initiatives (Brock & von Wangenheim, 2019).

Third, innovation improves service quality and operational efficiency, through process optimization, automation, and better resource utilization (Lindström et al., 2006). Fourth, it enhances customer value and market expansion, including through marketing innovation such as new distribution channels and pricing strategies (Ramirez et al., 2018).

Finally, innovation contributes to risk mitigation and organizational resilience, as well as human capital development and ecosystem collaboration, supporting long-term competitiveness (Banker & Feng, 2019) (Tafti et al., 2017) Moreover, innovation is often accelerated through strategic partnerships and inter-organizational collaboration, including public–private partnerships, which facilitate knowledge sharing, access to new markets, and collective value creation (Gasco-Hernandez et al., 2022).

Overall, innovation benefits encompass strategic, operational, customer, and organizational dimensions, forming the BINN construct in this study.

(3) Organizational agility refers to a firm's ability to rapidly and flexibly respond to customers' needs, adapt production/service delivery to demand fluctuations, and implement decisions in the face of market changes. (Brock & von Wangenheim, 2019)

2.7.2 Benefits Operational

Operational benefits reflect the extent to which organizations improve efficiency, reliability, and scalability through digital transformation (Chen et al., 2010) (Barnes et al., 2021).

Innovation shows a positive and statistically significant relationship with operational performance by enabling process optimization, cost reduction, and productivity gains, allowing organizations to allocate resources more effectively. Digital transformation initiatives—such as AI and IoT-enabled systems—further enhance operational effectiveness by supporting data-driven decision-making and integrated process management (Brock & von Wangenheim, 2019).

At the same time, technological innovation introduces organizational challenges, including resistance to change and internal power dynamics, which may limit the realization of operational benefits if not properly managed (Taylor & Vithayathil, 2018) (C. Q. Feng & Wang, 2019).

In sum, operational benefits extend beyond efficiency gains to include resilience, security, and improved decision-making, forming the BOPR construct in this research model.

2.8 Agile/DevOps as a mechanism linking strategy and performance

Yucel (Yucel, 2018) conceptualizes digital transformation strategy as an organizational journey toward a desired future state of digital transformation. From this perspective, digital transformation requires more than the adoption of individual technologies; it involves the consideration of organizational objectives, corporate policies, technological adoption, risks, and expected benefits. This holistic perspective supports the examination of digital strategy as an important strategic dimension of enterprise-level digital transformation.

Figure 2 synthesizes the key dimensions of digital transformation strategy identified by (Yucel, 2018), including strategic drivers, expected benefits, potential drawbacks, and associated risks. Organizations pursue digital transformation to respond to digital disruption and evolving market conditions, with objectives such as improving customer experience, enhancing operational efficiency, fostering innovation, and enabling new business models. However, these strategies also involve significant complexity, costs, and risks, including resistance to change, security challenges, and integration issues.

(Yucel, 2018) emphasizes the need for holistic evaluation approaches, integrating system dynamics, economic, statistical, and machine learning techniques to model how benefits, risks,

and mitigation strategies evolve and interact over time. This perspective highlights that digital transformation outcomes are not linear but depend on multiple interrelated factors.

Building on this framework, Agile/DevOps practices can be understood as an organizational mechanism that supports the execution of digital transformation strategies. By enabling iterative development, continuous delivery, and closer collaboration between development and operations, Agile/DevOps facilitates the translation of strategic objectives into realized outcomes.

Accordingly, this study positions Agile/DevOps (AGIL) as a mediating construct linking digital and IT strategies (DSTR, STRA) and resource allocation decisions (SPEN) to innovation (BINN) and operational performance (BOPR).

Thus, (Figure 2) the visual representation provides a structured overview of the relationships among the main factors influencing digital transformation strategies as identified in the literature.

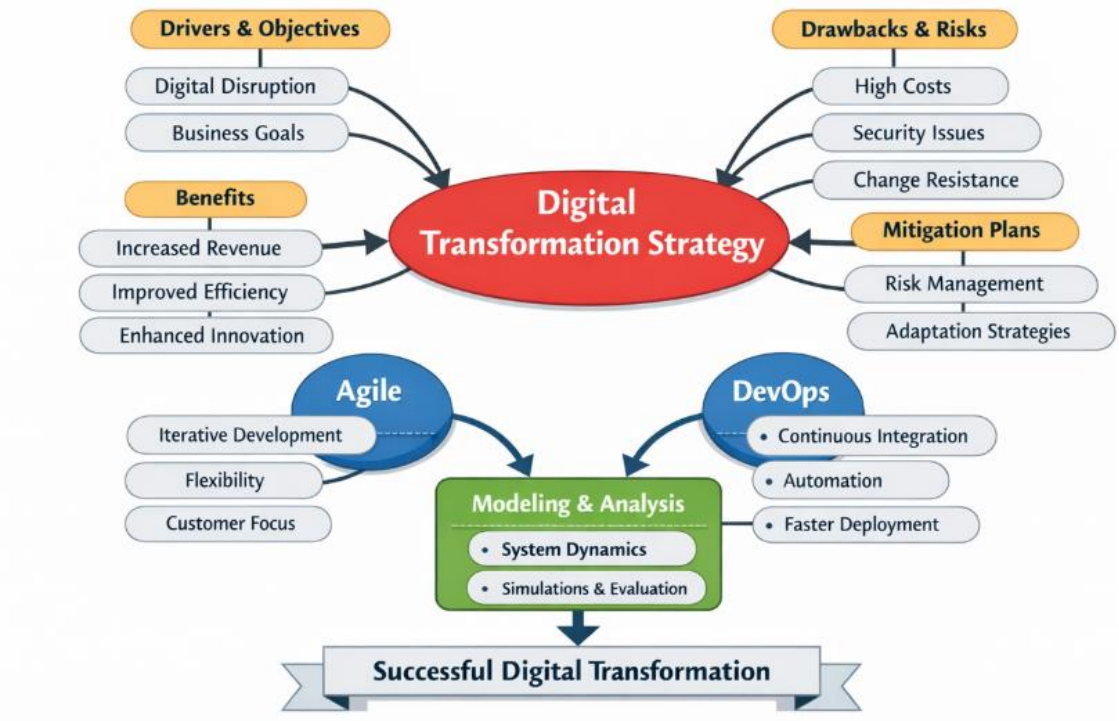


Figure 2: Key Successful Digital Transformation from Yucel (2018)

2.8.1 IT Strategy and Benefits Innovative

IT strategy establishes the technological capabilities, governance structures, and investment priorities that enable organizations to pursue innovation-oriented objectives. However, the

translation of IT strategy into innovative outcomes depends on the organization's capacity to experiment, learn, and rapidly transform ideas into viable digital solutions. Agile and DevOps practices support this capability by fostering iterative experimentation, continuous learning, and close collaboration between business and IT stakeholders.

Agile/DevOps is positively and significantly associated with innovation by shortening feedback cycles, encouraging incremental exploration, and supporting rapid prototyping and deployment of new digital services. Prior research shows that Agile practices enhance organizational learning and innovation performance by enabling flexibility, responsiveness, and cross-functional knowledge integration (Dyba & Dingsøyr, 2008). Prior research shows that innovation and first-to-market strategies can generate competitive advantage and superior returns (Tamayo-Torres et al., 2010). Similarly, Agile and DevOps practices facilitate continuous innovation by allowing organizations to adapt digital products and services in response to evolving market and customer needs (Forsgren et al., 2018).

In this context, Agile/DevOps acts as a mediating mechanism through which IT strategy is transformed into innovative benefits, such as faster time-to-market, enhanced digital capabilities, and improved innovation outcomes.

Hypothesis H5: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Innovative Benefits (BINN).

Table 5 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 5. The table highlights how Agile/DevOps can serve as an important intermediary mechanism linking IT Strategy and Innovative Benefits, emphasizing the role of Agile/DevOps alignment in enabling organizations to transform with IT Strategy into innovation outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Digital transformation strategy, success of digital transformation strategy, estimating benefits of digital transformation strategy	Estimating the Benefits, Drawbacks and Risk of Digital Transformation Strategy (Yucel, 2018)	The objective of this paper is to examine relevant dynamics in estimating the benefits of digital transformation strategy while taking into consideration the drawbacks, risks and mitigation plans and develop models for estimating its success under various conditions and scenarios.	Analyze a model proposed	Model-building (theoretical) research Data source: Secondary literature, prior frameworks, conceptual cases Analyse Data: Use simulations and sensitivity analysis	To measure the benefits, relevant dynamics should be identified and characterized. Relevant dynamics include the digital disruption characteristics in the market and in the industry of the corporation, objectives with the digital transformation, expected benefits and drawbacks, risks and mitigation plans due to the digital transformation and with the execution of the digital transformation strategy, characteristics of corporate policies and other supporting strategies, characteristics of corporate digital transformation initiatives, characteristics of digital technology adoption, characteristics of network effects on the digital platforms and ecosystems on which the corporation becomes a player.
DevOps Cloud Agile Integration Synergy	A systematic literature review on Agile, Cloud, and DevOps integration: Challenges, benefits (Aouni et al., 2024)	This study explores the integration of Agile, Cloud, and DevOps in today's software development landscape. It aims to analyze the challenges and benefits associated with merging these three approaches, focusing on their impact on software testing and the role of	31 articles highlights benefits	Research paper Data colletion : Systematic Literature Review(SLR)	Our study examines the advantages and challenges of this integration, focusing on its impact on software testing and the role of mindset in successful implementation and identifying the most suitable Agile methodologies. Mindset is crucial in navigating cultural shifts for successful integration, and addressing mindset challenges is pivotal for creating an environment conducive to seamless integration.

		mindset in successful implementation and identifying the most suitable Agile methodologies.			
DevOps, microservices, ethnographic study, participant observation, interview	A Cross-Company Ethnographic Study on Software Teams for DevOps and Microservices: Organization, Benefits, and Issues (Zhou et al., 2022)	This study aims to discover the organization, benefits and issues of software teams using DevOps & microservices from an immersive perspective.	January 2020 with a total of seven months of participant observations in the three companies at different scales	Study case Data Collection: participant observations and interviews Analyse Data were analyzed using Straussian Grounded Theory, employing open, axial, and selective coding to inductively generate theory from qualitative ethnographic data.	The adoption of DevOps and microservices brings benefits to rapid delivery, ability improvements and burden reduction, whilst the high cost and lack of practical guidance had emerged. Our findings contribute to the understanding of the organization, benefits and issues of adopting DevOps and microservices from an immersive perspective of software teams. It results from requirements that a single team has to be capable for almost full spectrum of responsibilities in the entire life cycle of DevOps. Individual's enthusiasm for learning might be stimulated.

*Table **5**: Comparison of research objectives, methodological approaches, and principal findings across studies for H5*

2.8.2 IT Strategy and Operational Benefits

IT strategy defines the structural foundations, governance mechanisms, and investment priorities required to support organizational objectives. However, the realization of operational benefits depends not only on strategic intent but also on the organization's ability to effectively execute that strategy. Agile and DevOps practices play a critical role in this execution by translating IT strategic objectives into operational capabilities through iterative delivery, continuous feedback, automation, and cross-functional collaboration.

Prior research emphasizes that Agile and DevOps improve operational performance by enhancing deployment frequency, system reliability, responsiveness to change, and coordination across IT and business units (Forsgren et al., 2018). These practices enable organizations to operationalize IT strategy by reducing lead times, improving service quality, and increasing adaptability in dynamic environments (Muhammad et al., 2022). As such, Agile/DevOps does not replace IT strategy but acts as a mediating mechanism that connects strategic planning with day-to-day operational execution.

Moreover, effective implementation of Agile/DevOps requires alignment with organizational culture, governance structures, and strategic objectives. When properly embedded within IT strategy execution, Agile/DevOps amplifies the operational impact of strategic investments and supports sustained performance improvements.

Hypothesis H6: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Operational Benefits (BOPR).

Table 6 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 6. The table highlights how Agile/DevOps can serve as an important intermediary mechanism linking IT Strategy and Operational Benefits, emphasizing the role of Agile/DevOps alignment in enabling organizations to transform with IT Strategy into operational outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Agile Methodologies, DevOps Practices, Cloud Computing, Software Development Efficiency, Operational Cost-Effectiveness, Digital Transformation, Continuous Learning	Efficiency and Cost-Effectiveness in Agile DevOps with Cloud Computing (Stoica & Nitu, 2024)	This article explores how Agile methodology, DevOps principles, and Cloud Computing fit into the software industry. The synergy study focuses on Axes Software, the oldest logistics software company in Romania.	One company — Axes Software	Case Study Data Collection Methods □ Operational Metrics Collection □ Financial Data Collection □ Observational & Experiential Data □ Documented System Evidence Analyze data descriptive, comparative, and evaluative, 1. Analysis 2. Descriptive KPI Analysis 3. Cost–Benefit and ROI Analysis 4. Qualitative Thematic Analysis	Operational & Technical Outcomes • Bug incidence reduced from 72 to an average of 4 • Release cycle improved from weekly bug-fix releases to one release every five months • Deployment time reduced from 11 days to 2 days • Development velocity and reliability increased • Enhanced traceability, transparency, and accountability through version control and CI/CD Financial Outcomes • 275% increase in customers preferring cloud-hosted solutions over on-premises • Annual financial benefit: approx. €46,050 • Initial investment: approx. €25,588 • First-year ROI: approx. 180% Organizational & Human Impact • Stronger collaboration between development, QA, and operations • Increased emphasis on continuous learning and certification • Leadership involvement (CTO-driven transformation) was critical to success
Automation, Automation Tool, DevOps, Hybrid Model, Software Development	Continuous Assessment and Improvement of Software Quality with DevOps-Based Hybrid Model of Automation Tools (Narang & Mittal, 2023)	The purpose of this study is to evaluate and compare the performance of a pre-selected, validated DevOps-based hybrid automation tool chain with a randomly selected	Three Java-based software projects: 1. Web-based application 2. Searching application	Experimental / Validation research Data Collection Experimental and quantitative data collection Analyze data Metric-Based Performance Evaluation • Defect Density (DD)	The study demonstrates that the pre-selected DevOps-based hybrid tool chain consistently outperforms the randomly selected tool chain across all evaluated metrics. • Main Results • Lower Defect Density (DD): The validated tool chain shows significantly fewer defects per KLOC. • Higher Deployment Frequency (DF): Faster and more frequent deployments, indicating better CI/CD efficiency.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
		DevOps tool chain, in order to determine which approach delivers higher software quality, productivity, and deployment efficiency.	3. Scientific calculator	• Deployment Frequency (DF) • Risk Identification (RI) • System Productivity (SP)	• Improved Risk Identification (RI): Greater coverage of identified and tested risk sets. • Higher System Productivity (SP): More user stories completed in less time. Overall, the findings confirm that carefully selected and integrated DevOps automation tools lead to superior quality, faster delivery, and higher productivity compared to random tool-chain selection.
Decision-making, Benchmarking, Banking sector, Data envelopment analysis, Multicriteria framework, Government-owned banks	Acknowledge-based directional multicriteria framework with defuzzied subset of preferences for sustainable banking strategy analysis. (Cavalcante Nepomuceno et al., 2023)	This article presents a methodological application of decision support with the purpose of identifying and better aligning sustainable banking strategies. Those strategies are based on best practices declared by employees and conducted during efficient periods affecting sustainable production, the health quality of clients, the	Brazilian Federal Savings Bank reports and systems regarding two bank operations executedinati meseriesof36 months, from July 2016 to June 2019: (1) business transactions and (2) social programs.	Research paper Data Collection Interviews Analyze data. Data envelopment analysis (DEA) to benchmark knowledge based on employee opinions	The outcomes yield a ranking of strategies, emphasizing the crucial role of technology in banking services while highlighting the need for more agile services to ensure customer satisfaction. These underscores the necessity of aligning with the market perspective, as fintech companies are reshaping the socio. technological-environmental landscape of financial services.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
		organization's profitability, and social impact on the local community across different sectors.			

*Table **6**: Comparison of research objectives, methodological approaches, and principal findings across studies for H6*

2.8.3 Spend Priorities and Benefits Innovative

Innovative benefits emerge when organizations effectively translate financial investments into capabilities that support experimentation, learning, and rapid value creation. Spend priorities determine how resources are allocated to digital initiatives, tools, and competencies that enable innovation. However, the realization of innovative outcomes depends on the organization's ability to operationalize these investments through appropriate execution mechanisms.

Agile and DevOps practices serve as such mechanisms by enabling iterative development, continuous integration, and rapid feedback loops. These practices allow organizations to transform prioritized investments into innovative products, services, and processes more efficiently. From a governance perspective, Agile/DevOps differs fundamentally from traditional project management by emphasizing team autonomy, adaptive planning, and leadership over rigid control structures. This people-oriented and organic organizational form supports creativity, responsiveness, and continuous improvement, which are essential for innovation (Lappi & Aaltonen, 2017).

Accordingly, spend priorities alone are insufficient to generate innovative benefits unless they are enacted through Agile/DevOps practices that facilitate experimentation and learning. Agile/DevOps therefore mediates the relationship between investment decisions and innovation outcomes.

Hypothesis H7*: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Innovative Benefits (BINN).*

Table 7 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 7. The table highlights how Agile/DevOps can serve as an important intermediary mechanism linking Spend Priorities and Innovative Benefits, emphasizing the role of Agile/DevOps alignment in enabling organizations to prioritize the spends into innovative outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Decision support, Project management, Agile, Dashboard, Analytics, Data engineering	Understanding project success involving analytic-based decision support in the digital era: a focus on IC and agile project management (Kudyba & Cruz, 2023)	Digital transformations of business processes are on the rise, and the result is a need for a better understanding of how the elements of intellectual capital (IC) play a role in achieving successful digital project outcomes. New structural capital in the form of digital technologies must be identified and understood.	This study focuses on a case analysis approach of a multinational commercial and consumer products company.	Case study Data Collection: Interviews, Surveys, Support tickets Analyze Data: ERPs into a centralized database	An examination at the case level illustrates that effective management and integration of IC has positive effects on project outcomes. While a balanced approach is evident as a requirement, the unique characteristics of the agile project management approach entails greater emphasis on select elements to adapt to a more dynamic development process.
Digital excellence, human capital development, educational policy, competence supply.	Defining Digital Excellence: Requisite Skills and Policy Implications for Digital Transformation (Wiggberg et al., 2022)	This paper discusses the issue of characterising these competencies, since a definition is needed to ensure an adequate supply of cutting-edge scholars and a highly educated and agile technological workforce.	Digitalisation Council of Sweden 119 articles 19 people were interviewed	Case study Data Collection mixed-methods research design Rapid Literature Review Interviews Expert Workshops Focus Groups	Digital excellence is different from digital competence Digital competence refers to the basic ability of citizens to use digital tools and services in everyday life. Digital excellence refers to advanced specialist expertise required to create, design, and lead digital innovations. Digital excellence is a bottleneck for innovation Even in highly digitalised countries like Sweden: the lack of highly specialized digital experts' limits innovation and economic growth. The paper proposes a framework and policy roadmap for developing digital excellence in national workforces.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
Agility, DevOps, Framework, IT Asset, IT Service, Maturity Assessment, Organization	A Practical Agile Framework for IT Service and Asset Management ITSM/ ITAM[3] Through a Case Study (Sahid et al., 2018)	The success of IT service and asset management depends on innovation, agility, and efficiency to support the transformation of an organization from a traditional vision to a digital vision. The purpose is to study IT service practices and assess the organization's ability to transform traditional IT support into a global and agile IT service center through the implementation of the proposed framework.	Leading port sector organization in Morocco Information System department has 40 employees with different profiles.	Case Study The questionnaire consists of 100 questions. Analyze Data Validate each answer through the developed maturity software. The treatment consists of calculating a weighted average of the scores obtained based on the selected responses and the coefficient of efficiency of each function in the organization.	The finding will help organizations to assess their capabilities and to address the procedural, technical, and human aspects of IT service and asset management.

Table 7: Comparison of research objectives, methodological approaches, and principal findings across studies for H7

(3) ITSM : IT Service Management
ITAM – IT Asset Management
ITSM/ITAM processes are structured practices used to manage IT services and the lifecycle of IT assets, ensuring that technology resources are effectively controlled, maintained, and aligned with organizational needs.

2.8.4 Spend Priorities and Benefits Operational

Operational benefits—such as increased productivity, system reliability, and cost efficiency—depend on how effectively organizations translate financial investments into operational capabilities. Spend priorities define where resources are allocated, including investments in automation, monitoring tools, and process standardization. However, financial allocation alone does not guarantee improved operational performance.

Agile and DevOps practices provide the execution mechanisms through which prioritized investments are converted into operational outcomes. By emphasizing continuous integration, automation, rapid feedback, and iterative delivery, Agile/DevOps is positively and significantly associated with organizations to reduce cycle times, minimize errors, and improve operational stability. Insights from lean and agile manufacturing further suggest that agility enhances operational performance by shortening delivery times and improving responsiveness to change, even though the precise mechanisms may vary across industries (Niederman et al., 2018).

Accordingly, Agile/DevOps adoption mediates the relationship between spend priorities and operational benefits by operationalizing investment decisions into improved execution and continuous improvement.

Hypothesis H8: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Operational Benefits (BOPR).

Table 8 provides a comparative overview of the objectives, methodologies, and key findings of the studies supporting Hypothesis 8. The table highlights how Agile/DevOps can serve as an important intermediary mechanism linking Spend Priorities and Operational Benefits, emphasizing the role of Agile/DevOps alignment in enabling organizations to prioritize the spends into operational outcomes.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
DevOps, culture, challenges, systematic literature review (SLR)	Critical Challenges to Adopt DevOps Culture in Software Organizations: A Systematic Review (M. S. Khan et al., 2022)	Explore and discuss challenges related to DevOps culture and practices. Moreover, it describes how DevOps works in an organization, provides a detailed explanation of DevOps, and investigates the cultural challenges that organizations face when implementing DevOps. - Develop the DevOps Culture Challenges Model (DC2M) to promote collaboration, understanding, and trust among development and operations teams and reduce barriers between them	380 research papers out of 11495 in five digital libraries as the primary choic Finallye: 66 research papers	Research paper Data Collection Research articles from the available literature. Analize data:	The proposed paper reveals ten critical challenges that need to be addressed in adopting the DevOps culture. The challenges are further analyzed based on the various continents. According to the findings, the following critical challenges are considered during the implementation of a DevOps culture: lack of collaboration and communication, Lack of skill and knowledge, complicated infrastructure, Lack of management, Lack of DevOps approach, and trust confidence problems.
Social and professional topics, Project and people management; Software management; Sustainability; • Software and its engineering → Agile software development; Agile, ethnography,	The Agile Success Model: A Mixed-methods Study of a Large-scale Agile Transformation (Russo, 2021)	This article presents an in-depth field study of a large-scale Agile transformation in a mission-critical environment, where stakeholders' commitment was a critical success factor. The goal of such a transformation was to implement mission-oriented features, reducing costs and time to operate in critical scenarios	Surveying 200 software engineers involved in similar projects	Case Study Data Collection: Survey Analize data: Partial Least Squares - Structural Equation Modelling	Leading a large-scale Agile transformation to success enables large-scale productivity gains, decreases time-to-market, and increases product quality. This study clarified the different professional roles and relations in a large-scale Agile project to achieve a project's success.

Keywords	*Research Paper*	*Purpose*	*Target Population*	*Method research*	*Key findings*
grounded theory, multivariate analysis, structural equation modeling, partial least squares, mixed methods research					
Systems-of-Systems, Cloud, Institution, IT Governance, IT Processes, DevSecOps	Major Challenges of Systems-of-Systems with Cloud and DevOps - a financial experience report (Gennari Caraturan & Hideko Goya, 2019)	This paper aims at describing the main actions, concerns and lessons learned, during planning and implementation phases, about IT Processes and I T Governance Model to transform an IT traditional environment into Systems-of-Systems environment, considering DevSecOps standards in a large Brazilian financial institution.	Financial institution in Brazil Internal study	Case Study Data Collection and Analyze Total of 18 months of project where 2 months to detail, plan and get approvals of the implantation plan, 1 month to mobilize the team and create cells with specific responsibilities and deliverables. The other months to execute the implementation with a clear sequence of projects, prioritization and deliverables. Every month, the project executive level reviewed the implementation plan and updated it	The project findings showed the added value in standardization and efficiency in processes, in integration and collaboration between teams, cultural changes, awareness of security issues and the importance of k knowledge transfer and the potential cost reduction in usage of infrastructure of cloud environment.

*Table **8**: Comparison of research objectives, methodological approaches, and principal findings across studies for H8*

2.9 Theoretical gaps and hypothesis development

Yucel (Yucel, 2018) provides a holistic framework for characterizing and evaluating digital transformation strategies, including their objectives, benefits, risks, and supporting organizational conditions. However, the present research adopts a different empirical focus by examining a specific set of relationships among Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and digital transformation benefits. In particular, the proposed mediation paths provide an empirical approach to investigating the relationships between strategic and resource-related factors, implementation practices, and selected organizational outcomes. The study therefore builds on the broader strategic perspective of Yucel (Yucel, 2018) while examining the proposed relationships through a cross-sectional PLS-SEM model. This literature review demonstrates that agile methods are not only compatible with digital transformation initiatives but are increasingly central to their successful implementation. However, existing studies suggest that agile practices cannot be examined in isolation. Their effectiveness depends on broader organizational, strategic, technological, and human factors, which justifies the need for a more comprehensive conceptualization. This observation motivates the development of an integrated research model suitable for empirical testing using Partial Least Squares Structural Equation Modeling (PLS-SEM).

By synthesizing findings across the domains of digital strategy, IT strategy, agile and DevOps practices, spend priorities, and innovation and operational benefits, this chapter establishes the theoretical foundations of the research. The review highlights that agility functions both as an enabler and an outcome of digital transformation, reinforcing its relevance as a central construct in the proposed model. Furthermore, the analysis underscores the critical role of CIO leadership and strategic decision-making in translating agile practices and IT investments into measurable organizational benefits.

To ensure methodological rigor and transparency, the outputs of the literature review were systematically structured into a series of research artefacts, summarized in (Table 9) and detailed in Appendices A to G. They link the review findings to a broader conceptual framework for agile methods. These appendices collectively document the literature selection process, concept extraction, categorization of success factors, and the alignment of agile concepts with PMBOK knowledge areas. Together, they form the analytical backbone supporting the construction of the research model.

APPENDIX	PURPOSE FOR THE RESEARCH	PURPOSE FOR THE STUDY
APPENDIX A *Guidelines for literature reviews and theorical contributions*	We present in a few tables the structuring the review, article x concept changes. The first table about how to perform a systematic review in Appendix A	The base of knowledge
APPENDIX B *Building blocks of agile methods*	Shows all the papers that have passed the quality assessment phase and had their data extracted. The data were extracted based on the relevance to the research goal and questions. • Agile component (when available) • Keys concepts to build a mode (when available) • How to include into the model • Article title, author(s), journal name, publication date, keywords, methodology	Resume the topics most important for our model from point of view agile
APPENDIX C *Concepts to measure success*	Based on Appendix B, we took only the concepts to measure the success of agile implementation.	Concepts to consider the implementation success
APPENDIX D *PMBOK knowledge areas linked to model concepts*	With this result we could see the main factors to have success in different category: Organisation, People, Process and technical. We took each factor of each category in Appendix D. Concepts to considerate for the model by category.	Factors categorization
APPENDIX E *PMBOK knowledge areas and count of concepts*	PMBOK knowledge areas versus concepts number for the model from the Appendix D.	PMBOK knowledge areas versus concepts number for the model
APPENDIX G *Mapping the pmbok knowledge areas with model concepts*	Mapping the PMBOK knowledge areas with the concepts into a model	Mapping of agile concepts in PMBOK methodology

*Table **9**: Appendices reporting review results: conceptual framework for agile methods.*

2.10 Theoretical Framework

Consistent with Yucel's (Yucel, 2018) emphasis on aligning digital transformation objectives with broader organizational considerations, the present research examines the relationship between Digital Strategy (DSTR) and IT Strategy (STRA). This relationship reflects the role of IT-related strategic orientation in supporting the implementation of digital transformation objectives. The study further investigates whether IT Strategy is associated with Agile/DevOps practices and digital transformation benefits.

This thesis proposes a Conceptual Research Model that examines how a firm's digital strategy is positively associated with the definition of its IT strategy and spending priorities, and how these, in turn, affect the implementation of Agile/DevOps practices, ultimately generating innovative and operational benefits. Evaluating the performance of a digital transformation process is essential to ensure its effective implementation and the realization of expected outcomes. This evaluation can

be conducted at two levels: measuring the success of the new business model and assessing the effectiveness of its implementation.

The impact of the proposed model is captured through a research model (Figure 3), the study has integrated several key hypotheses in a conceptual model, with eight hypotheses designed to explore the relationships among six key variables: Agile/DevOps implementation (AGIL), Spending priorities SPEN, Digital strategy (DSTR), IT strategy (STRA), Innovative benefits (BINN), Operational benefits (BOPR).

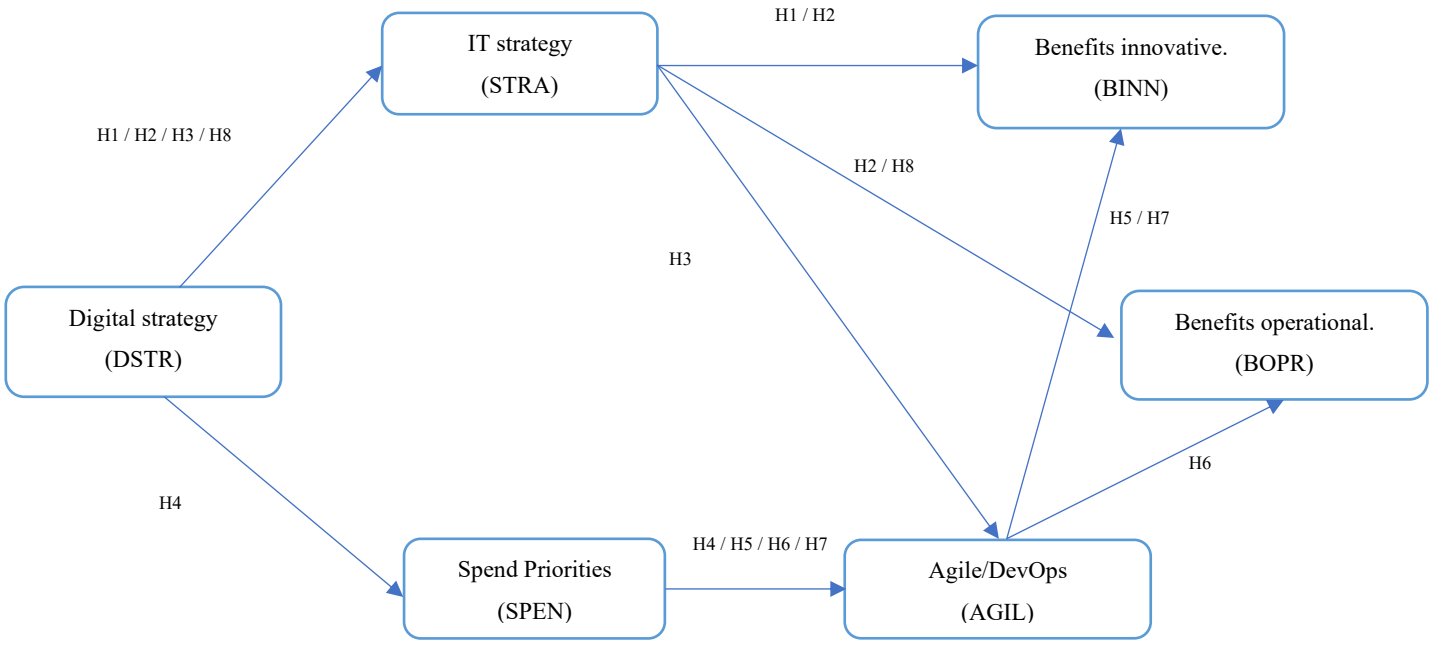


*Figure **3**: Research Model*

These hypotheses aim to test the pathways through which digital strategy and IT strategy influence organizational outcomes, mediated by spending priorities and Agile/DevOps practices, providing a comprehensive view of the mechanisms driving digital transformation success.

This model was designed to achieve three aspects of digital transformation: IT strategy, Spend Priorities and Agile/DevOps. This aspect will be covered by assessing the mediating effect IT Strategy in the relationship between Digital Strategy and Benefits innovative (H1). The mediating effect of IT Strategy in the relationship between Digital strategy and IT Benefits operational (H2). The mediating effect of IT Strategy in the relationship between Digital strategy and Agile/DevOps (H3). The mediating effect of Spend priorities in the relationship between Digital strategy and Agile/DevOps (H4). The mediating effect of Agile/DevOps in the relationship between IT Strategy

and Benefits innovative (H5). The mediating effect of Agile/DevOps in the relationship between IT Strategy and Benefits Operational (H6). The mediating effect of Agile/DevOps in the relationship between Spend Priorities and Benefits innovative (H7). The mediating effect of Agile/DevOps in the relationship between Spend priorities and Benefits Operational (H8).

In conclusion, this chapter provides a coherent conceptual and theoretical basis for the empirical phase of the study. The resulting framework bridges prior research and practice-oriented insights, enabling the examination of how digital and IT strategies, mediated by agile practices and spend priorities, influence innovation and operational outcomes. The next chapter builds on this foundation by presenting the methodology, and measurement approach used to empirically validate the proposed model.

3 METHODOLOGY

3.1 Quantitative Validation Using PLS-SEM

The empirical design of this study operationalizes selected dimensions of the digital transformation strategy perspective discussed by Yucel (Yucel, 2018). While Yucel proposes a holistic approach to characterizing and evaluating digital transformation strategies, the present research examines a defined set of relationships among strategic, resource-related, implementation, and outcome constructs. A cross-sectional survey design and Partial Least Squares Structural Equation Modeling (PLS-SEM) are used to assess the proposed relationships and mediation hypotheses. The findings are interpreted as evidence of statistical associations within the study's sample and research design.

To empirically test the Research model (Figure 3), this research employs Partial Least Squares Structural Equation Modeling (PLS-SEM), using a quantitative, hypothesis-driven survey approach. PLS-SEM allows for the evaluation of latent constructs, mediation effects, and complex model structures, providing predictive insights on Agile and DevOps effectiveness in digital transformation.

The target respondents include senior IT and digital transformation stakeholders involved in implementing digital initiatives (Kollmann et al., 2023). Cross-sectional data capture perceptions of digital strategy, IT investments, Agile/DevOps practices, and operational outcomes, forming the basis for structural model estimation.

Following Hair (Hair et al., 2018), the PLS-SEM procedure includes eight stages:

1. Define the structural model, specifying relationships among latent variables.
2. Develop the measurement models, distinguishing between reflective and formative constructs.
3. Collect and analyze data, ensuring quality and appropriateness for modeling.
4. Estimate the PLS path model, computing path coefficients and statistical results.
   4a. Validate reflective measurement models, assessing reliability and validity.
   4b. Validate formative measurement models, evaluating indicator significance.
5. Assess the structural model, examining path coefficients, R^2 values, and effect sizes.
6. Perform advanced analyses, including mediation, moderation, or multi-group comparisons.
7. Interpret findings, drawing conclusions and providing actionable insights.

This systematic approach integrates conceptual modeling with empirical testing, enabling a robust examination of how organizational, process, people, and technical factors influence Agile implementation and operational performance. In (Figure 4) shows the flow of the methodology used.

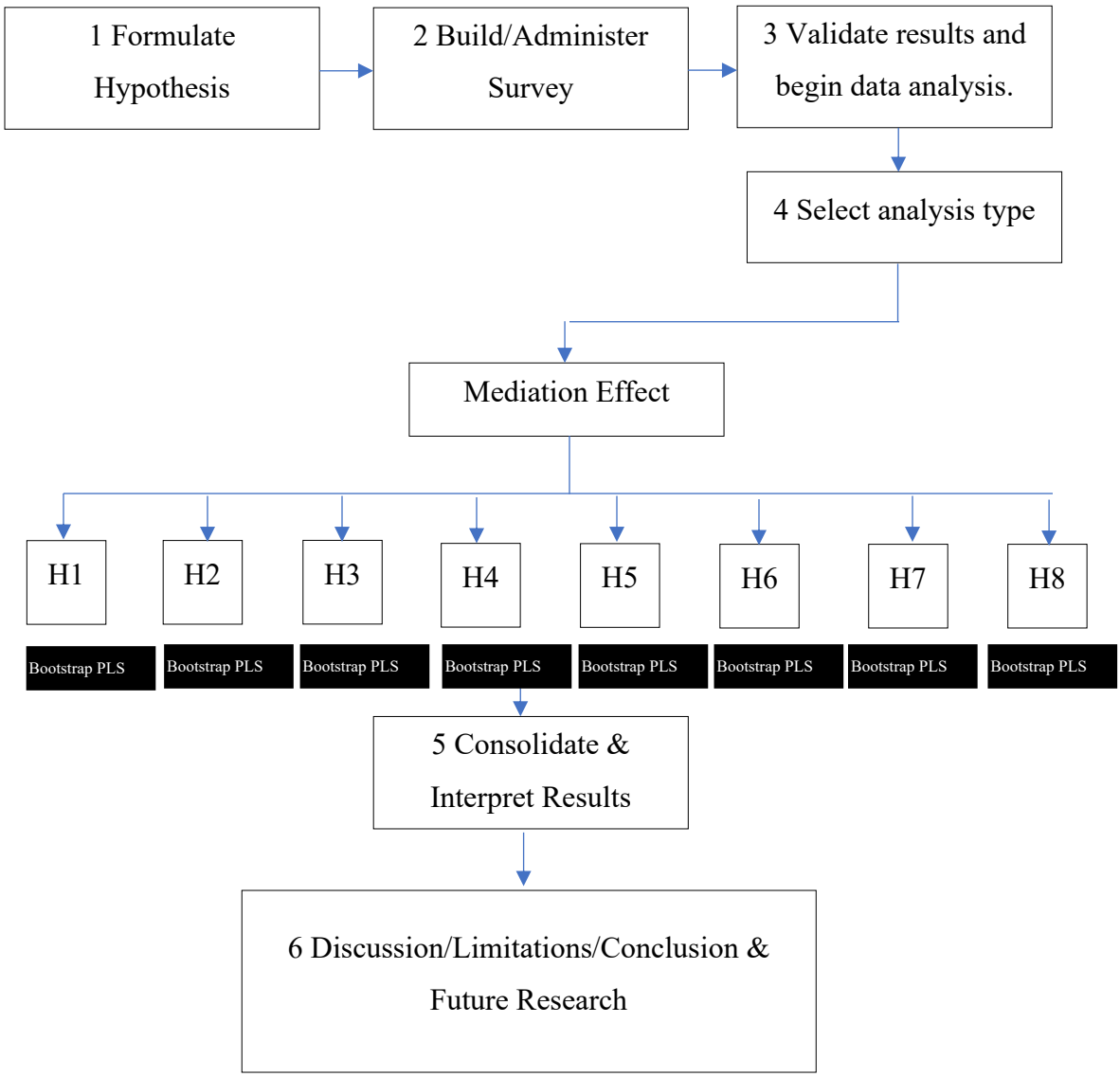


Figure 4: Research Approach

3.2 Measurement Instrument and Data Collection

This research adopts a quantitative, hypothesis-driven survey methodology to empirically test the proposed research model and examine the relationships among digital strategy, IT strategy, spend

priorities, Agile/DevOps practices, and organizational benefits. A survey-based approach is appropriate as it enables the standardized collection of data across multiple organizations and supports the measurement of latent constructs and the testing of complex conceptual and mediating relationships at scale.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was selected as the primary analytical technique due to its suitability for predictive research, its ability to handle complex models with multiple mediating constructs, and its robustness when theory is still evolving. In this study, PLS-SEM supports the simultaneous estimation of measurement and structural models and aligns with the research objective of assessing how Agile/DevOps practices operationalize digital and IT strategies to generate innovation and operational benefits.

3.2.1 Research Design and Hypotheses Testing

The research design is grounded in a theoretically informed conceptual model comprising eight hypotheses, including direct and mediating effects. Based on the conceptual framework, a structured questionnaire was developed to operationalize the constructs and collect cross-sectional data. Following data collection, responses were screened to remove incomplete submissions and questionnaires from respondents who did not meet the inclusion criteria. This process resulted in a final sample of 477 valid responses, which is considered sufficient for PLS-SEM analysis given the complexity of the model and the number of constructs involved.

The hypotheses were categorized into direct effects and mediation effects and were tested using the PLS algorithm following the systematic procedure proposed by Hair et al. (2018). Model estimation, measurement validation, and structural assessment were conducted sequentially and are reported in subsequent chapters.

In PLS-SEM, mediation analysis examines the indirect effects of an independent variable (X) on a dependent variable (Y) through a mediating variable (M), providing deeper insights into relationship between constructs mechanisms (Hair et al., 2018). The process involves estimating direct and indirect effects using bootstrapping, a non-parametric resampling technique that enhances statistical inference robustness. A mediation effect is established if the indirect path (X → M → Y) is statistically significant.

Full mediation occurs when the direct effect (X → Y) is non-significant after accounting for M, whereas partial mediation exists when both direct and indirect effects remain significant (ZHAO et al., 2010). Researchers must assess confidence intervals and p-values to validate mediation and

ensure that multicollinearity does not distort results (Hair et al., 2018). Furthermore, PLS-SEM allows for estimating models that researchers hypothesize as having (multiple) mediating effects, either in isolation, or in combination with moderators in mediated moderation, or moderated mediation models (Ringle et al., 2020).

To achieve the mediation, exist an equation to stablish it:

$$Y = i_1 + c\,X + e_1 \qquad (1)$$

$$Y = i_2 + c'\,X + b\,M + e_2 \qquad (2)$$

$$M = i_3 + a\,X + e_3 \qquad (3)$$

Where:

Y: The variable of result
X: Independent variable
M: Mediating variable
i_1, i_2, i_3: The interceptor variable
e_1, e_2, e_3: The residual variable

The coefficient “c” captures the total effect of X on Y. The parameter “c’” represents the direct effect of X on Y after accounting for M, while “b” reflects the impact of M on Y when controlling for X. Lastly, the coefficient “a” measures the relationship between X and M.

Mediating and moderating effects are analyzed using MacKinnon's regression models and corresponding equations for mediation and moderation (MacKinnon, 2011). A model of a simple mediation could be (Figure 5):

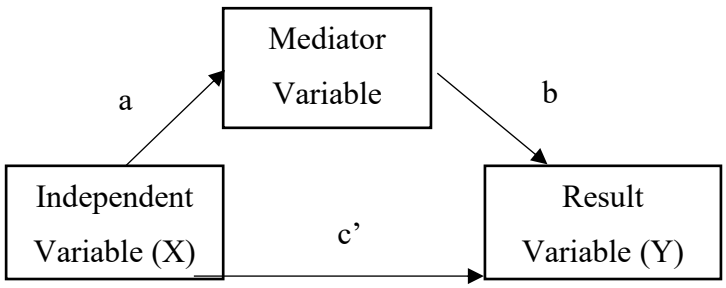


Figure 5: Example of a mediation model

3.2.2 Target Population and Sampling Strategy

A clearly defined sampling strategy is a prerequisite for rigorous empirical analysis (Miles & Huberman, 1994). The target population for this study consists of senior IT decisionmakers with direct involvement in IT strategy formulation, governance, and execution.

The empirical analysis is based on secondary data collected through a structured online survey administered by IT World Canada to its professional membership network between 2019 and 2022. IT World Canada provided the resulting dataset to the university for academic and research purposes. This secondary dataset was selected as the primary empirical source because it provides a substantially larger and broader sample of senior IT decisionmakers than the candidate's own survey, which resulted in 55 valid responses. The larger secondary dataset was considered more appropriate for the empirical objectives of this study and for estimating the proposed PLS-SEM model, given the number of constructs and structural relationships examined.

The IT World Canada survey channel was selected because of its strong representation of CIOs and senior IT leaders across Canada, ensuring relevance to the research objectives and appropriate respondent expertise. Participation was restricted to professionals operating in Canada and actively engaged in IT management and decision-making, who were directly involved in defining, implementing, or overseeing digital, IT, and Agile/DevOps initiatives (Kollmann et al., 2023)

The respondent profiles included:

- Architect/Sec/Other Direct Report - Enterprise Architects and senior security leaders
- IT/SE/Dev/Ops Manager - IT, Software Engineering, DevOps, and Operations Managers
- Director/CIO/CDO/CTO - Directors and executives, Chief Information Officers (CIOs)
- VP/CXO - Executives
- President/CEO - Presidents and Chief Executive Officers

This sampling approach is appropriate for examining strategic, governance, and execution-level constructs, as respondents possess the organizational visibility and decision authority required to assess IT strategy, digital initiatives, spend priorities, and Agile/DevOps adoption. After data cleaning and exclusion of incomplete or non-qualified responses, the final sample comprised **477 valid observations**, which satisfies the recommended sample size requirements for the proposed PLS-SEM model.

The minimum sample size was estimated using G*Power. Since the study examines relationships among multiple constructs, the parameters for multiple linear regression analysis were applied to estimate the required sample size: effect size $f^2 = 0.15$, significance level (α) = 0.05, statistical power ($1 - \beta$) = 0.80, and number of predictors (n) = 5. Based on these parameters, the analysis indicated that a minimum sample size of 55 responses was required. To account for potential non-responses and incomplete questionnaires, approximately 150 respondents were invited each year, with the objective of achieving a final usable sample exceeding the minimum threshold required for robust statistical analysis.

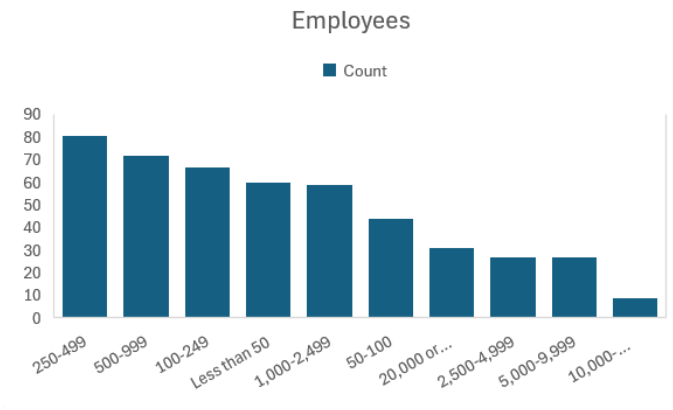
Regarding ethical considerations, the dataset was provided by IT World Canada to the university specifically for academic and research purposes. The present study therefore constitutes a secondary-data analysis conducted within the research-use framework under which the dataset was provided. The analysis did not seek to identify individual respondents, and the results are reported at an aggregate level. The use of the dataset was limited to the academic research objectives of this study, with appropriate attention to confidentiality and the protection of respondent information.

However, several limitations related to the sampling approach and data quality should be acknowledged. The study relied on a non-random sampling strategy, which may limit the generalizability of the findings beyond the surveyed population. In addition, the data were collected through self-reported questionnaires, which may introduce potential response biases. Respondents may also have interpreted certain key concepts such as digital strategy, Agile/DevOps practices, or digital transformation outcomes differently depending on their organizational context and professional background. To mitigate these risks, the survey instrument included standardized definitions and structured measurement scales; nevertheless, some degree of subjective interpretation cannot be entirely excluded.

3.2.3 Respondents' Profile

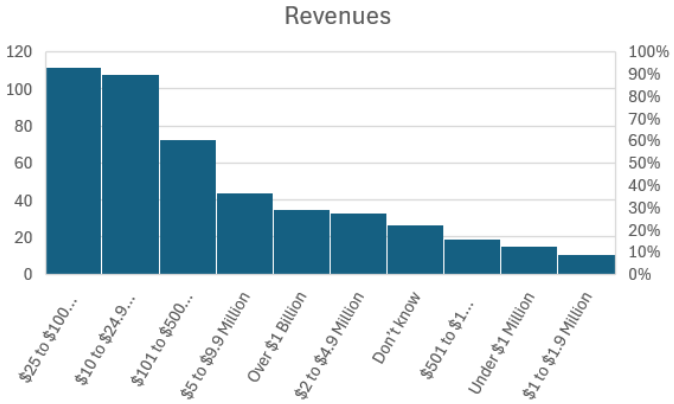
How many people are employed in your entire organization or enterprise?

Employees	Count	Percent
1,000-2,499	59	12%
10,000-19,999	9	2%
100-249	67	14%
2,500-4,999	27	6%
20,000 or more	31	6%
250-499	81	17%
5,000-9,999	27	6%
500-999	72	15%
50-100	44	9%
Less than 50	60	13%
Grand Total	**477**	**100%**



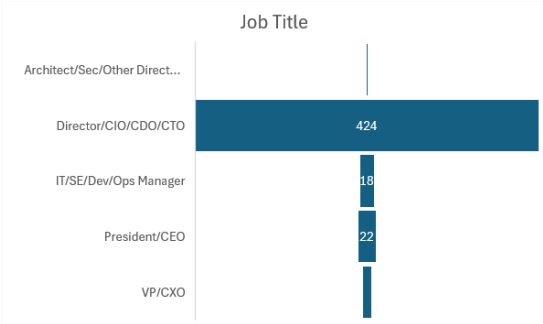
What is the estimated annual revenue for your entire organization or enterprise?

Revenues	Count	Percent
$1 to $1.9 Million	11	2%
$10 to $24.9 Million	108	23%
$101 to $500 Million	73	15%
$2 to $4.9 Million	33	7%
$25 to $100 Million	112	23%
$5 to $9.9 Million	44	9%
$501 to $1 Billion	19	4%
Don't know	27	6%
Over $1 Billion	35	7%
Under $1 Million	15	3%
Grand Total	**477**	**100%**



Which of the job titles below is closest to your own?

Job Title	Count	Percent
Architect/Sec/Other Direct Report	1	0%
Director/CIO/CDO/CTO	424	89%
IT/SE/Dev/Ops Manager	18	4%
President/CEO	22	5%
VP/CXO	12	3%
Grand Total	**477**	**100%**



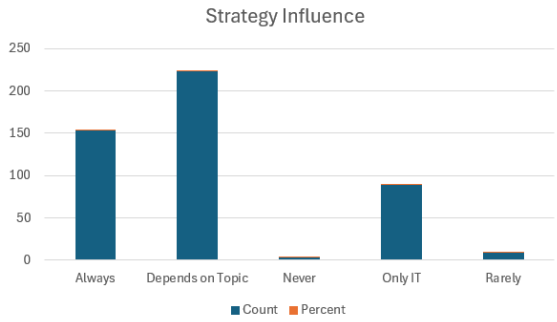
How many years have you held this role?

CIO Role	Count	Percent
11-15 Years	60	13%
1-5 Years	165	35%
15-25 Years	39	8%
6-10 Years	209	44%
More than 25 Years	4	1%
Grand Total	**477**	**100%**



How often, if ever, are you involved in executive decision-making meetings?

Strategy Influence	Count	Percent
Always	153	32%
Depends on Topic	223	47%
Never	3	1%
Only IT	89	19%
Rarely	9	2%
Grand Total	**477**	**100%**



No incentives were offered to complete this survey.

3.2.4 Survey instrument development and measurements

The measurement instrument was developed using established and validated scales from prior research to ensure content validity and reliability. Survey items were adapted to the context of large-scale digital transformation and Agile/DevOps implementation. Constructs were measured according to their theoretical nature, using either reflective or formative approaches as appropriate. The questionnaire consists of 64 items organized into 15 sections, covering strategic, organizational, technological, and performance-related dimensions. To enhance response quality and capture additional insights, items addressing IT skills gaps, leadership, implementation challenges, and transformation objectives were also included. A detailed mapping of constructs and their corresponding indicators is presented in (Table 10).

CONSTRUCT NAMES	MEASUREMENT ITEMS	SURVEY ITEM		INDICATOR	MESUREMENT SCALE	CONSTRUCT	RESOURCES
COMPANY SIZE	The number of employees employed in the entire organization or enterprise that classifies or separates small-, medium-, and large-organization.	SIZE1	How many people are employed in your entire organization or enterprise?	SIZE1 Number of employees Scale Type: Ordinal Range of Scale: 1-6	1 = Less than 50 (Small) 2 = 50 – 100 (Small) 3 = 100 – 249 (Medium) 4 = 250 – 499 (Medium) 5 = 500 – 999 (Large) 6 = 2,499 or more (Large)	Type: Control Variable	(Okoli, 2015)
		SIZE2	What is the estimated annual revenue for your entire organization or enterprise?	SIZE2 Annual revenue Scale Type: Ordinal Range of Scale:1 – 9	Don't know Under $1 Million $1 to $1.9 Million $2 to $4.9 Million $5 to $9.9 Million $10 to $24.9 Million $25 to $100 Million $101 to $500 Million $501 to $1 Billion Over $1 Billion		(Porkkovan Elangovan, 2021)
AGILE/DEVOPS	The extent to which Agile methodologies and DevOps practices are adopted and applied within the organization's software development and IT operations.	AGIL1	How are you progressing on your implementation of Agile/DevOps systems?	AGIL1 Implementation progress Scale Type: Ordinal Range of Scale: 1 – 6	It's not for us We're stalled We're still exploring our options Pushing ahead and making progress Accelerated aspects to manage remote work Fully implemented	Type: Reflective	(Brock & von Wangenheim, 2019)
		AGIL2	What are the biggest barriers to furthering your use of Agile/DevOps?	AGIL2 Adoption barriers Ordinal (categorical ranking) Range of Scale: 1 – 9	It requires a culture change on my team Management commitment Business users commitment Tightly coupled architectures The project management process is too complicated Availability and cost of talent Skills/ Team capability Security It's unproven		

CONSTRUCT NAMES	MEASUREMENT ITEMS	SURVEY ITEM		INDICATOR	MESUREMENT SCALE	CONSTRUCT	RESOURCES
CIO POSITION	The presence of a Chief Information Officer responsible for overseeing IT management and supporting digital transformation initiatives within the organization.	CPOS1	Which of the job titles below is closest to your own?	CPOS1 Job title Scale Type: Ordinal Range of Scale: 1 – 5	Architect/Sec/Other Direct Report IT/SE/Dev/Ops Manager Director/CIO/CDO/CTO VP/CXO President/CEO	Type: Reflective	(Pavlou, 2022)
		CPOS2	How many years have you held this role?	CPOS2 Years in role Scale Type: Ordinal Range of Scale: 1 – 5	1-5 Years 6-10 Years 11-15 Years 15-25 Years More than 25 Years		
		CPOS3	How often, if ever, are you involved in executive decision-making meetings?	CPOS3 Involvement in executive decision making Scale Type: Ordinal Range of Scale: 1 – 5	Never Rarely Only IT Depends on Topic Always		
		CPOS4	Who do you report into at your organization?	CPOS4 Reporting structure Scale Type: Ordinal Range of Scale: 1 – 5	Other Levels/Units Other Non-IT Director Director/CIO/CDO/CTO VP/CXO President/CEO		
		CPOS5	Do you have involvement in or influence over technology-related purchase decisions for your business?	CPOS5 Influence on technology purchases Scale Type: Ordinal Range of Scale: 1 – 5	Never Rarely Only IT Depends on Topic Always		
IT STRATEGY	The organization's strategic approach to managing information technology resources and initiatives in alignment	STRA1	Approximately what percentage of all your IT-related projects in the past 12 months were controlled by lines-of-business? By controlled, we mean	STRA1 % of projects controlled by business units Scale Type: Ordinal Range of Scale: 1 – 7	0 % 1-5 % 6-14 % 15-24 %	Type: Reflective	(Bharadwaj et al., 2013) (Chen et al., 2010)

CONSTRUCT NAMES	MEASUREMENT ITEMS	SURVEY ITEM		INDICATOR	MESUREMENT SCALE	CONSTRUCT	RESOURCES
	with business objectives and digital transformation goals.		they were conceived, purchased, managed and budgeted by lines-of-business.		25-49 % 50-74 % 75-100 %		
		STRA2	Organization's annual ICT spend per employee	STRA2 ICT spend per employee Scale Type: Ordinal Range of Scale: 1 – 5	Less than $2,000 $2,000 – $4,999 $5,000 – $6,999 $7,000 – $9,999 $10,000+		
		STRA3	How much has your organization's IT budget changed over last year's budget?	STRA3 Change in IT budget Scale Type: Ordinal Range of Scale: 1 – 7	Decreased 15%+ Decreased 5-14% Decreased 1-4% Unchanged Increased 1-4% Increased 5-14% Increased 15%+vvvv		
SPEND PRIORITIES	The prioritization and allocation of financial resources toward IT and digital initiatives that support organizational strategy and digital transformation.	SPEN1	Run the business (IT is focused on the continuing operation of the business)	SPEN1 Run the business Scale Type: Ratio Range of Scale: 0 – 100%	0 to 100 %	Type: Reflective	(Saddiqa et al., 2023)
		SPEN2	Grow the business (IT is enhancing business outcomes in existing markets)	SPEN2 Grow the business Scale Type: Ratio Range of Scale: 0 – 100%	0 to 100 %		
		SPEN3	Transform the business (IT is entering new markets, with new value propositions)	SPEN3 Transform the business Scale Type: Ratio Range of Scale: 0 – 100%	0 to 100 %		
BENEFITS OPERATIONAL	Improvements in organizational efficiency, productivity, and operational performance resulting from IT and digital transformation initiatives.	BOPR1	Outsourcing	BOPR1–BOPR6 Scale Type: Ordinal Range of Scale: 1 – 5	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	Type: Reflective	(Barnes et al., 2021)
		BOPR2	Enterprise Mobility				
		BOPR3	Cloud (Public, Private, Hybrid) "As-a-Service"				
		BOPR4	Enterprise Application Integration				
		BOPR5	Enterprise Collaboration				
		BOPR6	Security				

CONSTRUCT NAMES	MEASUREMENT ITEMS	SURVEY ITEM		INDICATOR	MESUREMENT SCALE	CONSTRUCT	RESOURCES
BENEFITS INNOVATIVE	Organizational benefits related to innovation, including the development of new products, services, processes, or digital capabilities enabled by IT and digital transformation initiatives.	BINN1	Social	BINN1–BINN5 Scale Type: Ordinal Range of Scale:1 – 5	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	Type: Reflective	(Ramirez et al., 2018)
		BINN2	Big Data/Analytics				
		BINN3	Internet of Things (IoT)				
		BINN4	Artificial Intelligence				
		BINN5	Blockchain				
IT SKILLS GAP	The gap between the technical competencies required for modern software development practices (such as Agile and DevOps) and those currently available in the organization.	SKIL1	Mobile development	SKIL1–SKIL9 Scale Type: Ordinal Range of Scale: 1 – 5	1 = Not a Priority 2 = Low Priority 3 = Medium Priority 4 = High Priority 5 = Very High Priority	Type: Reflective	(Muhammad Usman ShehzadJianhua ZhangSajjad AlamZiao Cao, 2017)
		SKIL2	Data analytics				
		SKIL3	Social media				
		SKIL4	Cloud services				
		SKIL5	Internet of Things				
		SKIL6	Artificial intelligence				
		SKIL7	Collaboration				
		SKIL8	Financial				
		SKIL9	Security				
DIGITAL STRATEGY	Research suggests digital transformation will impact every industry. How long will it be before your businesses is significantly affected?	DSTR1	Research suggests digital transformation will impact every industry. How long will it be before your businesses is significantly affected?	DSTR1 Digital transformation impact horizon Scale Type: Ordinal Range of Scale: 1 – 6	My industry won't be impacted Don't know 3-5 years 2-3 years 12 months We feel the change right now	Type: Reflective	(Bharadwaj et al., 2013)
		DSTR2	Where is your digital transformation leadership coming from?	DSTR2 Digital transformation leadership source Scale Type: Ordinal Range of Scale: 1 – 5	Business Marketing/Sales Other Senior Management CIO or senior IT leadership CEO		
				DSTR3 Expected benefit from digital transformation Scale Type: Ordinal	Increased retention of employees and ability to attract new employees Customer retention		

CONSTRUCT NAMES	MEASUREMENT ITEMS	SURVEY ITEM		INDICATOR	MESUREMENT SCALE	CONSTRUCT	RESOURCES
		DSTR3	What is the main benefit you expect to see from digital transformation?	Range of Scale: 1 – 9	Improve productivity for workers (remote and on-site) Lower operating costs Increased sales revenue Ability to rapidly change and adopt new technologies Ability to rapidly introduce new products or services Competitive parity; keeping up with others in our industry Competitive leadership; disrupting the industry as an early mover		

Table 10 Operationalization of Study Construct; Measures instruments

3.2.5 Constructs Model

The study includes the following types of latent variables:

- Exogenous variable:
  - Digital Strategy (DSTR)
- Mediating variables:
  - IT Strategy (STRA)
  - Spend Priorities (SPEN)
  - Agile/DevOps (AGIL)
- Endogenous variables:
  - Operational Benefits (BOPR)
  - Innovative Benefits (BINN)

All constructs were modeled as latent variables measured through multiple indicators. Reflective measurement models were applied to the primary constructs, consistent with prior research. The reliability and validity of reflective indicators were assessed using Cronbach's alpha, composite reliability (CR), the heterotrait–monotrait ratio (HTMT), the Fornell–Larcker criterion, and the average variance extracted (AVE). Where applicable, formative indicators were evaluated by examining outer weights and the statistical significance of each indicator. Descriptive statistics for all constructs are also reported.

3.2.6 Control Variables

Several control variables were incorporated to enhance the robustness and contextual relevance of the analysis. These include organizational size, annual revenue, respondent job title, tenure in the current position, and participation in executive decision-making forums. These variables were selected to account for organizational heterogeneity and leadership influence.

Consistent with Chen (Chen et al., 2010), CIO leadership and strategic involvement were emphasized, as organizational support for the IT function signals the strategic importance of IT and is positively associated with transformation outcomes. The inclusion of these control variables allows for more accurate estimation of the hypothesized relationships.

3.2.7 Data Quality and Final Dataset

To ensure data quality, responses were screened for completeness, consistency, and respondent qualification. Only fully completed questionnaires from eligible participants were retained. The final dataset of 477 observations satisfies methodological requirements for PLS-SEM and supports reliable estimation of both measurement and structural models.

The reliability and validity of the measurement models, as well as the assessment of the structural model, are presented in Chapter 4.

3.3 Data Collection and PLS-SEM Execution

This section describes the **procedural execution** of data collection and the application of Partial Least Squares Structural Equation Modeling (PLS-SEM).

3.3.1 Data Collection Procedure

Data were collected using a structured online questionnaire administered to senior IT and digital transformation stakeholders. The survey link was distributed through professional networks and industry contacts. Participation was voluntary, and respondents were required to meet predefined inclusion criteria related to strategic involvement in IT or digital initiatives.

A total of 477 valid responses were retained after excluding incomplete questionnaires and responses that did not meet eligibility requirements.

3.3.2 Data Preparation and Screening

Prior to analysis, the dataset was screened for missing values, outliers, and inconsistencies. All retained cases were complete and suitable for multivariate analysis. As PLS-SEM does not require multivariate normality, no data transformation was applied.

3.3.3 PLS-SEM Execution Using SmartPLS

The analysis was conducted using SmartPLS software. The PLS algorithm was applied to estimate both the measurement (outer) and structural (inner) models. Reflective and formative constructs were modeled according to their theoretical specifications.

The evaluation followed the systematic procedure recommended by Hair et al. (2018), consisting of measurement model assessment followed by structural model assessment.

The aspect to consider doing an analyse in PLS (Hair et al., 2019) is shown in the table below:

Aspect	*Description*
Research Design	Define the objective, variables, and relationships to be tested. PLS-SEM is often used for exploratory research or when theory is underdeveloped.
Data Collection	Ensure an adequate sample size and proper measurement of variables. PLS-SEM works well with smaller samples but requires reliability testing.
Latent Variables & Indicators	Identify constructs and their indicators. PLS-SEM uses reflective or formative indicators, requiring proper validation.
Measurement Model	Assess reliability and validity of indicators. This includes internal consistency (Cronbach's Alpha, Composite Reliability (CR)) and convergent/discriminant validity, use Average Variance Extracted (AVE) to confirm that constructs explain sufficient variance in their indicators.
Structural Model	Test relationships between constructs. Evaluate path coefficients, R^2 values, and predictive relevance (Q^2).
Bootstrapping & Significance Testing	Use bootstrapping to assess significance of paths and factor loadings. Report confidence intervals and t-values.
Multicollinearity & Model Fit	Check for variance inflation factors (VIF) to avoid multicollinearity issues. Goodness-of-fit indices in PLS-SEM differ from CB-SEM.
Ontology & Semantic Enrichment	If using textual or ontological data, consider feature extraction and enrichment to improve latent variable representation.
Interpretation & Reporting	Clearly report results, include effect sizes, and discuss theoretical contributions and practical implications.

Here is a comparison table highlighting the key differences between Covariance-Based Structural Equation Modeling (CB-SEM) and Partial Least Squares Structural Equation Modeling (PLS-SEM):

Aspect	*CB-SEM (Covariance-Based SEM)*	*PLS-SEM (Partial Least Squares SEM)*
Objective	Theory testing and confirmation	Prediction and exploratory research
Approach	Covariance-based estimation	Variance-based estimation
Data Requirements	Requires large sample sizes	Works with small to medium sample sizes
Assumptions	Requires multivariate normality	No strict distributional assumptions
Measurement Model	Primarily reflective constructs	Handles both reflective & formative constructs
Model Fit Assessment	Uses goodness-of-fit indices (e.g., CFI, RMSEA)	No global fit index, focuses on predictive relevance
Handling of Complexity	Best for simpler, well-established models	Suitable for complex models with many indicators
Latent Variable Estimation	Based on common factors (shared variance)	Based on weighted composites (component scores)
Use Cases	Theory-driven confirmatory research	Exploratory studies, prediction-oriented analysis
Software Examples	AMOS, LISREL, Mplus, EQS	SmartPLS, WarpPLS, ADANCO

*Table **11**: Comparation between CB-SEM and PLS-SEM*

PLS has been used both in other business disciplines, and in the strategic management area to examine risk–return outcomes, cooperative ventures, and global integration (Hulland, 1999). The analysis was conducted using Smart-PLS (Garson, G. D., 2016), which provides an integrated platform for estimating PLS models with enhanced capabilities for bootstrapping, predictive modeling, and multi-group analysis. The methodological approach adhered to a structured sequence of model evaluation stages, ensuring the robustness and interpretability of results.

Statistical techniques such as Structural Equation Modeling (SEM) will be utilized to examine relationships between Agile adoption and the constructs. This method is particularly suited for analyzing complex relationships between latent variables and is widely used in business and organizational research (Hair, 2014).

3.3.4 Model Evaluation Procedure

Measurement model evaluation included the assessment of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Structural model evaluation examined path coefficients, coefficients of determination (R^2), effect sizes (f^2), predictive relevance (Q^2), and Heterotrait-monotrait ratio (HTMT), Fornell-Larcker criterion.

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These procedures ensure the robustness and interpretability of the estimated relationships.

3.3.5 Bootstrapping and Significance Testing

Statistical significance was assessed using a bootstrapping procedure with 5,000 resamples, as recommended for PLS-SEM. Bootstrapping was used to evaluate the significance of path coefficients, indicator loadings, and indirect effects. Confidence intervals, t-values, and p-values were generated to support hypothesis testing.

Direct effects were evaluated using the standard PLS algorithm, while mediation effects were tested using bootstrapped indirect paths. Detailed mediation logic is presented in chapter 4.

3.4 Mediation Analysis

Mediation analysis examines whether the effect of an exogenous latent variable on an endogenous latent variable is transmitted through one or more intervening constructs within a PLS path model

(Hair et al., 2018). In this study, mediation is used to explain the underlying mechanisms through which strategic and organizational capabilities translate into operational and innovative benefits.

The research framework was operationalized through a structural (inner) model that specifies the hypothesized causal relationships among latent constructs and a measurement (outer) model that defines how observed indicators reflect these constructs (Figure 3). While the measurement model ensures the validity and reliability of constructs, mediation effects are assessed at the structural level and depend on the robustness of the estimated path relationships.

Prior to testing mediation effects, construct reliability and validity were confirmed to ensure unbiased estimation of indirect effects. Indicator loadings, composite reliability (CR), and average variance extracted (AVE) were examined to establish convergent validity, while discriminant validity was assessed using the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio (Henseler et al., 2015). These validation steps are necessary conditions for conducting mediation analysis in PLS-SEM.

Mediation effects were evaluated by estimating indirect paths between the independent variable and the dependent variables through the proposed mediators. Statistical significance of indirect effects was assessed using a non-parametric bootstrapping procedure with 5,000 resamples, which are associated with confidence intervals and p-values without imposing distributional assumptions (Hair et al., 2018). A mediation effect was considered present when the indirect effect was statistically significant.

Following (ZHAO et al., 2010), mediation was classified as full mediation when the indirect effect was significant and the corresponding direct effect was non-significant, and as partial mediation when both direct and indirect effects remained significant. This approach avoids the limitations of traditional relationship between constructs, step methods and provides a more accurate assessment of mediation in complex models.

By focusing on mediation mechanisms, this study advances understanding of how IT strategy, spend priorities, and Agile/DevOps practices function as transmission channels through which digital strategy is associated with operational and innovative benefits. This analytical approach strengthens the explanatory power of the proposed model and aligns with the predictive and theory-building orientation of PLS-SEM in contemporary information systems research.

To summarize the PLS analyse is shown in Appendix H.

4 RESULTS

This chapter presents the empirical results of the proposed research model, organized according to the research questions and hypotheses developed in the preceding chapters. The analysis examines the relationships among Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and innovative and operational digital transformation benefits. The results include the evaluation of the measurement model and structural model, followed by the assessment of the proposed mediation relationships. The interpretation of the findings in relation to the existing literature, including the perspective proposed by Yucel (Yucel, 2018), is presented in Chapter 2.

This section presents the empirical results obtained from the analysis of the survey data using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS. The results are reported following the established PLS-SEM evaluation procedure and are organized to reflect the assessment of the measurement model and the structural model, including the testing of direct and mediating effects corresponding to the proposed hypotheses.

Consistent with the research design outlined in Chapter 3, the analysis focuses on evaluating construct reliability and validity, examining the strength and significance of structural relationships, and assessing the presence and nature of mediation effects (Hair et al., 2018). The findings are reported objectively, without interpretation beyond statistical evidence, while their theoretical and practical implications are discussed in the subsequent chapter.

4.1 Evaluation of the global PLS model

The evaluation of the Partial Least Squares Structural Equation Model (PLS-SEM) followed the two-stage approach recommended by Joseph F. Hair Jr. et al. (2018) (Hair et al., 2018). In the first stage, the measurement model was assessed using a reflective measurement approach to evaluate the reliability and validity of the constructs. This assessment included the examination of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity.

In the second stage, the structural model was evaluated to examine the hypothesized relationships between constructs. This step involved analyzing path coefficients, the statistical significance of relationships using bootstrapping procedures, coefficients of determination (R^2), and effect sizes (f^2) to assess the explanatory power and predictive relevance of the model. This two-step evaluation procedure is consistent with prior studies applying PLS-SEM in information systems and innovation research, such as Network Embeddedness and Innovation Performance: A

Mediation–Moderation Analysis Using PLS-SEM (Tian et al., 2021) and An Empirical Investigation of the Factors Affecting Data Warehousing Success (Wixom & Watson, 2021). The overall PLS-SEM model illustrating the relationships among the constructs is presented in (Figure 6). Detailed results of the measurement and structural model assessments, including the mediation hypothesis testing, are presented later, where a summary table synthesizes the main findings of the analysis.

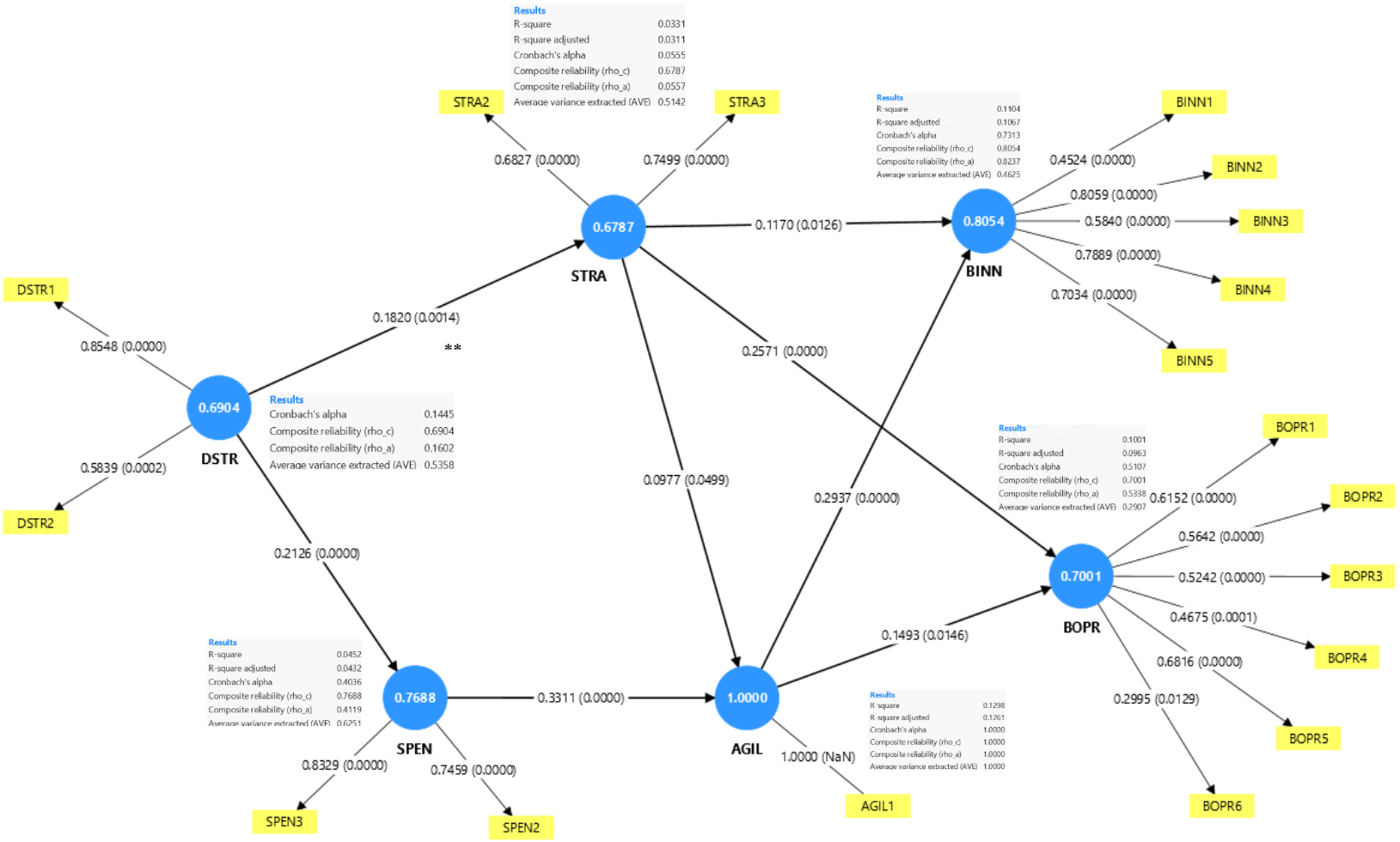


Figure 6: Global PLS Model

4.1.1 Measurement model

Benefits innovation (BINN): Selected to capture the perceived innovation-related outcomes associated with digital transformation initiatives.
REFLECTIVE : *Why The indicators reflect the perceived innovative benefits resulting from digital transformation*.

Fornell = 0.6801	Indicator	Range of Scale	Measurement scale	Std. Dev	Loading	Assessment	Justification
Social	BINN1	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.8918	0.4524	Evaluate/retain with justification	Retained based on its theoretical relevance to innovation-related benefits and its contribution to the content coverage of the construct, despite its relatively low loading.
Big Data/Analytics	BINN2	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.5920	0.8059	Supported	Loading exceeds the recommended threshold.
Internet of Things (IoT)	BINN3	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.8117	0.5840	Evaluate/retain with justification	Retained because IoT represents a theoretically relevant technology domain contributing to innovation-related benefits and complements the other digital technology indicators.
Artificial Intelligence	BINN4	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.6146	0.7889	Supported	Loading exceeds the recommended threshold.
Blockchain	BINN5	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.7107	0.7034	Supported	Retained because the loading is marginally below the recommended threshold and the indicator provides theoretically relevant coverage of digital innovation.

Benefits operational (BOPR): Selected to capture the perceived operational improvements resulting from digital transformation initiatives.
REFLECTIVE: *Why -The indicators reflect the perceived operational benefits resulting from digital transformation.*

Fornell = 0.5392	Indicator	Range of Scale	Measurement scale	Std. Dev	Loading	Assessment	Justification
Outsourcing	BOPR1	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.7884	0.6152	Evaluate/retain with justification	Captures operational benefits associated with outsourcing, particularly efficiency and organizational resource optimization.
Enterprise Mobility	BOPR2	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.8257	0.5642	Evaluate/retain with justification	Captures operational benefits associated with mobility, including improved accessibility, responsiveness, and employee productivity.

Cloud (Public, Private, Hybrid) "As-a-Service"	BOPR3	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.8516	0.5242	Evaluate/retain with justification	Captures operational benefits associated with cloud adoption, including scalability, flexibility, and operational efficiency.
Enterprise Application Integration	BOPR4	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.8840	0.4675	Evaluate/retain with justification	Captures operational benefits associated with application integration and improved process coordination and information flows.
Enterprise Collaboration	BOPR5	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.7317	0.6816	Evaluate/retain with justification	Provides a relevant measure of operational benefits related to collaboration, coordination, and organizational productivity.
Security	BOPR6	1 - 6	Not applicable/Not investing in this area Don't know/too early to tell Fallen below expectations Met expectations Exceeded expectations	0.9541	0.2995	Critical evaluation / retain with explicit limitation	Although substantially below the recommended threshold, Security is theoretically relevant to operational performance through secure and resilient IT operations. Its retention is therefore a theoretically motivated decision and represents a measurement limitation.
Digital strategy (DSTR) : Selected to examine how an organization's digital strategic orientation influences IT strategy, investment priorities, and digital transformation outcomes. **REFLECTIVE :** *Why - The indicators reflect different manifestations of the organization's digital strategic orientation.*							
Fornell = 0.7320	**Indicator**	**Range of Scale**	**Measurement scale**	**Std. Dev**	**Loading**	**Assessment**	**Justification**
Research suggests digital transformation will impact every industry. How long will it be before your businesses is significantly affected?	DSTR1	1 - 6	My industry won't be impacted Don't know 3-5 years 2-3 years 12 months We feel the change right now	0.5189	0.8548	Supported	Strongly represents the perceived urgency and expected timing of digital transformation within the industry.
Where is your digital transformation leadership coming from?	DSTR2	1 - 5	Business Marketing/Sales Other Senior Management CIO or senior IT leadership CEO	0.8118	0.5839	Evaluate/retain with justification	Although the loading is below the recommended threshold, the indicator captures a theoretically distinct aspect of Digital Strategy by identifying the organizational leadership responsible for driving digital transformation. It was retained to preserve the conceptual coverage of the construct.
Spend Priorities (SPEN) : Selected to examine how digital investment priorities relate to the adoption of Agile/DevOps practices and the realization of transformation benefits. **REFLECTIVE:** *Why - The indicators may reflect a common orientation toward digital investment priorities, provided they measure manifestations of the same underlying orientation.*							

Fornell = 0.7906	Indicator	Range of Scale	Measurement scale	Std. Dev	Loading	Assessment	Justification
Grow the business (IT is enhancing business outcomes in existing markets)	SPEN2	0 – 100%	0 to 100 %	0.6660	0.7459	Supported	Captures the allocation of IT resources to improve business outcomes within existing markets, representing an important dimension of IT spending priorities.
Transform the business (IT is entering new markets, with new value propositions)	SPEN3	0 – 100%	0 to 100 %	0.5534	0.8329	Supported	Captures the allocation of IT resources toward new markets and value propositions, representing the transformational dimension of IT spending priorities.
IT Strategy (STRA): Selected to assess the role of IT strategy in translating digital strategic objectives into technological initiatives and organizational benefits. **REFLECTIVE:** *Why - The indicators reflect the organization's IT strategic orientation and alignment.*							
Fornell = 0.7171	**Indicator**	**Range of Scale**	**Measurement scale**	**Std. Dev**	**Loading**	**Assessment**	**Justification**
Organization's annual ICT (Information and Communications Technology) spend per employee	STRA2	1 - 7	0 % 1-5 % 6-14 % 15-24 % 25-49 % 50-74 % 75-100 %	0.7307	0.6827	Evaluate/retain with justification	Slightly below 0.708; theoretically relevant measure of ICT resource allocation
How much has your organization's IT budget changed over last year's budget?	STRA3	1 - 7	Decreased 15%+ Decreased 5-14% Decreased 1-4% Unchanged Increased 1-4% Increased 5-14% Increased 15%	0.6616	0.7499	Supported	Above recommended threshold
AGILE (AGIL): Selected to investigate the role of Agile/DevOps adoption in supporting digital transformation and contributing to innovative and operational benefits. **Single-item** *Why - The indicators may reflect the adoption or implementation of Agile/DevOps practices. However, the use of a single adoption item requires specific consideration.*							
Fornell = 1.0000	**Indicator**	**Range of Scale**	**Measurement scale**	**Std. Dev**	**Loading**	**Assessment**	**Justification**
How are you progressing on your implementation of Agile/DevOps systems?	AGIL	1 - 6	It's not for us We're stalled We're still exploring our options Pushing ahead and making progress Accelerated aspects to manage remote work Fully implemented	0.7307	0.6827	Evaluate/retain with justification	Single-item adoption measure; limitation acknowledged

Table 12: Measurement model

The single-item measure (AGILE) provides a parsimonious operationalization of overall Agile/DevOps adoption, but its use limits the assessment of measurement reliability and construct dimensionality.

Agile/DevOps was operationalized using a single-item measure capturing the overall level of organizational adoption of Agile/DevOps practices. The use of a single item was intended to provide a parsimonious measure of adoption rather than to capture the multiple dimensions or specific practices associated with Agile and DevOps. Given this operationalization, internal consistency measures such as Cronbach's alpha and composite reliability are not applicable in the same manner as for multi-item constructs. The indicator was therefore assessed through its outer loading within the PLS-SEM measurement model.

Nevertheless, the use of a single item represents a methodological limitation of the study. It does not allow the construct to capture the multidimensional nature of Agile/DevOps or to assess internal consistency across multiple indicators. Consequently, the findings related to Agile/DevOps should be interpreted as reflecting an overall level of adoption rather than a comprehensive measurement of the construct. Future research should employ a validated multi-item scale covering the relevant dimensions of Agile/DevOps adoption.

4.1.2 Path coefficients

We examine the path coefficients (Table 13) of overall PLS model. They examine the relationships between the variables in the model. We can say that an estimate is **significant** when its p-value is less than 5% **(p < 0,05)** or T-Stat greater than 1.96 (Benitez et al., 2020). Among the 8 relationships in our model, 8 are under than the limit. What is still interesting is the fact that 8 of them concern the moderating.

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
AGIL -> BINN	*0.2932*	*0.2975*	*0.0425*	*6.8950*	*0.0000*
AGIL -> BOPR	*0.1486*	*0.1505*	*0.0614*	*2.4198*	*0.0156*
DSTR -> SPEN	*0.2171*	*0.2211*	*0.0431*	*5.0357*	*0.0000*
DSTR -> STRA	*0.1438*	*0.1473*	*0.0578*	*2.4865*	*0.0129*
SPEN -> AGIL	*0.3308*	*0.3309*	*0.0474*	*6.9781*	*0.0000*
STRA -> AGIL	*0.1005*	*0.1027*	*0.0495*	*2.0294*	*0.0425*
STRA -> BINN	*0.1187*	*0.1232*	*0.0466*	*2.5474*	*0.0109*
STRA -> BOPR	*0.2563*	*0.2689*	*0.0451*	*5.6774*	*0.0000*

Table 13: Path coefficients

If we see the **Table 13** coefficients paths, we show a positive and statistically significant relationship with the prediction of:

• The strongest relationships (coefficients > 0.25):

SPEN → AGIL (0.3308): Strategic performance is a key factor in agile.

AGIL → BINN (0.2932): Agility strongly stimulates innovation.

STRA → BOPR (0.2563): IT Strategy significantly improves operations.

• Moderate relationships (0.15 < coefficient < 0.25):

DSTR → SPEN (0.2171): Digital strategy is positively associated with strategic performance.

AGIL → BOPR (0.1486): Agility has a positive effect on operational efficiency.

DSTR → STRA (0.1438): Digital strategy promotes IT Stategy.

• Weaker but significant relationships (coefficient < 0.15):

STRA → BINN (0.1187): IT Strategy plays a role, but less dominant, in innovation.

STRA → AGIL (0.1005): IT Strategy slightly is positively associated with Agile.

4.1.3 Construct Reliability & Validity

	Construct	Loading	AVE	CR	√AVE
Agile/DevOps	AGIL1	1.0000	1.0000	1.0000	1.0000
Benefits innovative	BINN1	0.4524	0.4625	0.8054	0.6800
	BINN2	0.8059			
	BINN3	0.5840			
	BINN4	0.7889			
	BINN5	0.7034			
Benefits operational	BOPR1	0.6152	0.2907	0.7001	0.5392
	BOPR2	0.5642			
	BOPR3	0.5242			
	BOPR4	0.4675			
	BOPR5	0.6816			
	BOPR6	0.2995			
Digital strategy	DSTR1	0.8548	0.5358	0.6904	0.7320
	DSTR2	0.5839			
Spend Priorities	SPEN2	0.7459	0.6251	0.7688	0.7906
	SPEN3	0.8329			
IT strategy	STRA2	0.6827	0.5142	0.6787	0.7171
	STRA3	0.7499			

Table 14: Consolidated Standardized Factor Loadings, CR and AVE

Reference: AVE ≥ 0.50 y CR ≥ 0.70

		Agile/DevOps	Benefits innovative	Benefits operational	Digital strategy	Spend Priorities	IT strategy
1	Agile/DevOps						
2	Benefits innovative	0.2896					
3	Benefits operational	0.2744	0.9850				
4	Digital strategy	0.5213	0.2567	0.7040			
5	Spend Priorities	0.5395	0.2495	0.3258	0.8318		
6	IT strategy	0.6532	0.7937	1.5147	2.0486	1.1039	

Table 15 – Discriminant Validity – Heterotrait-Monotrait Ratio (HTMT)

		Agile/DevOps	Benefits innovative	Benefits operational	Digital strategy	Spend Priorities	IT strategy
1	Agile/DevOps	1.0000					
2	Benefits innovative	0.3115	0.6801				
3	Benefits operational	0.1884	0.5720	0.5392			
4	Digital strategy	0.2011	0.0051	0.1140	0.7320		
5	Spend Priorities	0.3471	0.1591	0.1112	0.2126	0.7906	
6	IT strategy	0.1519	0.1616	0.2798	0.1820	0.1637	0.7171

Table 16: Discriminant Validity – Fornell-Larcker Criterion

		R-square	R-square adjusted
1	Agile/DevOps	0.1298	0.1261
2	Benefits innovative	0.1104	0.1067
3	Benefits operational	0.1001	0.0963
4	Spend Priorities	0.0452	0.0432
5	IT strategy	0.0331	0.0311

Table 17: R-square

	f-square
AGIL -> BINN	0.0947
AGIL -> BOPR	0.0242
DSTR -> SPEN	0.0473
DSTR -> STRA	0.0342
SPEN -> AGIL	0.1226
STRA -> AGIL	0.0107
STRA -> BINN	0.0150
STRA -> BOPR	0.0717

Table 18: f-square

4.1.4 Mediation: Zhao Classification interpretation

Hypothesis		*Test Variable*	*A*B Is significant?*	*C Is significant?*	*A*B*C Is Positive?*	*p-value< 0.05*	*PLS Decision*	*Sobel Decision*	*Type of mediation*
H1	H1AB	DSTR> STRA> BINN	0.03162704 Significant	0.5022 Not significant	0.1459* 0.1679*-0.0389 = -0.0009565 Negative	0.03124132	Accepted	2.15398533 Accepted	Indirect-only (**Full mediation**)
H2	H2AB	DSTR> STRA> BOPR	0.01123319 Significant	0.2092 Not significant	0.1454* 0.2852*0.0300 Positive	0.01124102	Accepted	2.5351567 Accepted	Complementary (**Mediation**)
H3	H3AB	DSTR> STRA> AGIL	0.06074782 Not Significant	0.0000 Significant	0.1437*0.1302 *0.1652 Positive	0.06216268	Rejected	1.86513357 Rejected	Direct-only (**Non Mediation**)
H4	H4AB	DSTR > SPEN> AGIL	0.0000226 Significant	0.0000 Significant	0.2171* 0.3222* 0.1146 Positive	0.000001903	Accepted	4.27602252 Accepted	Complementary (**Mediation**)
H5	H5AB	STRA> AGIL> BINN	0.00190469 Significant	0.0000 Significant	0.1579* 0.2929* 0.1215 Positive	0.00201457	Accepted	3.08807556 Accepted	Complementary (**Mediation**)
H6	H6AB	STRA> AGIL> BOPR	0.00500328 Significant	0.0000 Significant	0.1541* 0.1486* 0.2563 Positive	0.00489906	Accepted	2.8135972 Accepted	Complementary (**Mediation**)
H7	H7AB	SPEN> AGIL> BINN	0.00000001 Significant	0.0000 Significant	0.3498* 0.2974* 0.0601 Positive	0.00000001	Accepted	5.80557999 Accepted	Complementary (**Mediation**)
H8	H8AB	SPEN> AGIL> BOPR	0.00001378 Significant	0.0035 Significant	0.3473* 0.1930* 0.0953 Positive	0.00001379	Accepted	4.35710555 Accepted	Complementary (**Mediation**)

Table 19: Zhao Classification interpretation table with values

4.2 Summary of hypothesis testing results of Mediation

All hypotheses were accepted except the hypothesis 3. In this study we can see the impact of implementing the agility methodology shows a significant positive relationship in the benefits as innovative than operational. The results highlighted that mediation was present in all cases except in hypothesis 3.

Given that the analysis relies on PLS-SEM, which is primarily a predictive statistical approach, the findings should be interpreted as associations within the studied sample rather than definitive causal relationships. Consequently, the results suggest potential mediation patterns that warrant further investigation through longitudinal or experimental research designs, summarize the results in (Table 20).

Question	***Hypotheses***	***Result***
Does it strategy mediate the relationship between digital strategy and innovative benefits?	H1: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Benefits-Innovative (BINN).	The PLS results suggest that IT Strategy (STRA) plays a mediating role in the relationship between Digital Strategy (DSTR) and Innovative Benefits (BINN). The findings indicate that organizations with more clearly articulated IT strategies tend to report higher levels of innovation-related benefits when pursuing digital strategies.
Does it strategy mediate the relationship between digital strategy and operational benefits?	H2: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Operational Benefits (BOPR).	The empirical results indicate a statistically significant mediation effect of IT Strategy (STRA) between Digital Strategy (DSTR) and Operational Benefits (BOPR). This suggests that the alignment and articulation of IT strategy may contribute to the translation of digital strategic initiatives into operational improvements.
Does it strategy mediate the relationship between digital strategy and agile/devops adoption?	H3: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL).	The results do not provide strong empirical support for the mediating role of IT Strategy (STRA) in the relationship between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL).
Do spend priorities mediate the relationship between digital strategy and agile/devops adoption?	H4: Spend Priorities (SPEN) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL).	The findings suggest that Spend Priorities (SPEN) may play a mediating role between Digital Strategy (DSTR) and Agile/DevOps adoption (AGIL). Organizations that prioritize digital investments appear more likely to adopt Agile/DevOps practices, highlighting the potential importance of resource allocation decisions in enabling digital transformation initiatives.
Does agile/devops adoption mediate the relationship between it strategy and innovative benefits?	H5: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Innovative Benefits (BINN).	The results indicate that Agile/DevOps adoption (AGIL) is associated with the relationship between IT Strategy (STRA) and Innovative Benefits (BINN). The mediation analysis suggests that organizations implementing Agile/DevOps practices tend to report stronger innovation-related outcomes in the presence of supportive IT strategies.

Question	*Hypotheses*	*Result*
Does agile/devops (agil) mediate the relationship Between IT strategy (stra) and operational benefits (bopr)?	H6: Agile/DevOps (AGIL) positively and significantly mediates the relationship between IT Strategy (STRA) and Operational Benefits (BOPR).	The findings provide evidence of a mediating association of Agile/DevOps (AGIL) in the relationship between IT Strategy (STRA) and Operational Benefits (BOPR). This suggests that Agile/DevOps practices may facilitate the operationalization of IT strategic objectives into observable operational improvements.
Does agile/devops adoption mediate the relationship between spend priorities and innovative benefits?	H7: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Innovative Benefits (BINN).	The results suggest that Agile/DevOps adoption (AGIL) is associated with the relationship between Spend Priorities (SPEN) and Innovative Benefits (BINN). Organizations allocating resources toward digital initiatives appear more likely to generate innovation-related benefits when Agile/DevOps practices are adopted.
Does agile/devops adoption mediate the relationship between spend priorities and operational benefits?	H8: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Operational Benefits (BOPR).	The empirical findings suggest that Agile/DevOps adoption (AGIL) may mediate the relationship between Spend Priorities (SPEN) and Operational Benefits (BOPR). This indicates that the allocation of digital investment resources may be associated with improved operational outcomes when Agile/DevOps practices are implemented.

Table 20: Results summary

The summary of results of mediation (Table 19) according to Sobel evaluation, shows the mediation analysis results indicate that seven of the eight hypotheses are supported, confirming the importance of strategic alignment, resource prioritization, and Agile/DevOps practices in digital transformation. IT strategy significantly mediates the relationship between digital strategy and both innovative and operational benefits, while spend priorities mediate the relationship between digital strategy and Agile/DevOps adoption. In addition, Agile/DevOps practices play a key mediating role in translating IT strategy and investment priorities into innovation and operational performance outcomes. The only unsupported hypothesis concerns the mediation of IT strategy between digital strategy and Agile/DevOps adoption, suggesting that agile implementation may depend more on operational or cultural factors than on formal strategic alignment.

4.3 Multi-Group Analysis: Summary Hypothesis 1 to Hypothesis 8

Across 2019–2022, the MGA results (*Appendix O : Multi-group for years*) reveal that Agile/DevOps (AGIL) consistently demonstrated strong measurement quality, while the other constructs (IT Strategy, Digital Strategy, Spend Priorities, Innovative Benefits, and Operational Benefits) showed fluctuating reliability and convergent validity over time. Overall, the structural relationships were not uniformly stable across the four years. The most consistent finding is that Spend Priorities significantly influence Agile/DevOps adoption, whereas mediation effects involving Agile/DevOps were generally partial, weak, or significant only in specific years (particularly 2020). Explanatory power (R^2) across models remained low to moderate, and effect sizes (f^2) were mostly small to moderate, indicating limited practical impact. In conclusion, the longitudinal MGA analysis suggests that while certain relationships—especially those involving spend priorities and Agile/DevOps—show recurring significance, most hypothesized mediation mechanisms lack strong temporal stability, highlighting the contextual and evolving nature of digital strategy implementation and its organizational benefits.

The longitudinal MGA findings reinforce the central argument of this thesis, Agile Methods Effectiveness in Digital Transformation: An Empirical Software Engineering Approach. Although Agile/DevOps adoption consistently demonstrates strong measurement stability and plays a recurrent mediating role, its impact on operational and innovative benefits is neither automatic nor uniformly stable over time. The results show that Agile effectiveness depends strongly on strategic alignment and investment priorities, and that its contribution to digital transformation outcomes is context-dependent and temporally dynamic. Thus, this empirical study confirms that agile methods constitute a significant lever in software engineering–driven digital transformation, but their effectiveness materializes primarily when supported by coherent strategic orientation and sustained organizational commitment.

ANALYTICAL DIMENSION	MAIN FINDINGS	INTERPRETATION
MEASUREMENT QUALITY	AGIL consistently demonstrated strong measurement quality, while other constructs showed fluctuations in reliability and convergent validity.	Measurement quality varied across constructs and years.
STRUCTURAL RELATIONSHIPS	The relationships among constructs were not uniformly stable across the four years.	The relationships between strategy, investment priorities, Agile/DevOps, and benefits varied over time.
SPEND PRIORITIES → AGILE/DEVOPS	This relationship showed recurring statistical significance across the years.	Spend Priorities were consistently associated with Agile/DevOps adoption.

MEDIATION THROUGH AGILE/DEVOPS	Indirect effects involving Agile/DevOps were generally weak, partial, or significant only in specific years, particularly 2020.	The mediating role of Agile/DevOps in linking strategic factors to organizational benefits was not consistently supported over time.
EXPLANATORY POWER (R^2)	R^2 values were generally low to moderate.	The models explained a limited to moderate proportion of variance in the endogenous constructs.
EFFECT SIZES (F^2)	Effect sizes were mostly small to moderate.	The individual structural relationships generally had limited to moderate explanatory contributions.
TEMPORAL STABILITY OF MEDIATION	Most hypothesized mediation relationships were not consistently significant across all four years.	The indirect pathways connecting strategic orientation, Agile/DevOps, and organizational benefits varied over time.
OVERALL CONTRIBUTION	Agile/DevOps adoption showed recurring relationships with strategic and investment factors, but its indirect relationships with innovative and operational benefits varied across years.	The contribution of Agile/DevOps to digital transformation benefits appears context-dependent and temporally dynamic.

This table summarizes the longitudinal findings reported in Appendix O. MGA was used to examine results across yearly groups, while mediation analysis evaluated indirect relationships. These analyses do not, by themselves, establish causality or confirm measurement invariance across years.

The longitudinal MGA findings indicate that the mediating role of Agile/DevOps in digital transformation varied between 2019 and 2022. Although Spend Priorities showed a recurring relationship with Agile/DevOps adoption, the indirect pathways connecting strategic factors to organizational benefits were not consistently supported across years. These findings suggest that Agile/DevOps adoption alone does not guarantee innovative or operational benefits; its contribution must be interpreted in relation to the strategic and organizational context.

The complete analyse for multi-group is in 7.15 Appendix O.

4.4 Additional Exploratory Analysis: Unified Benefits Construct

Following the measurement and structural model assessment presented in the previous sections 4.1, an additional exploratory analysis was conducted to examine an alternative specification of the benefits dimension. This analysis was motivated by the objective of investigating whether Innovative Benefits (BINN) and Operational Benefits (BOPR) could be represented through a more parsimonious and unified Benefits construct (BENE).

The original model specifications presented previously in the thesis were retained. The purpose of the additional analysis was not to replace the previous results retrospectively, but to provide a complementary exploratory specification and to assess whether a unified Benefits construct could provide a more parsimonious representation of the empirical relationships examined in the study.

In the exploratory specification, the Innovative Benefits and Operational Benefits dimensions were merged into a single construct labelled Benefits (BENE). The indicators were reassessed according to their empirical contribution within the exploratory specification and their conceptual relevance to the benefits dimension. The resulting model retained BINN2 (Big Data/Analytics) and BINN4 (Artificial Intelligence) as indicators of BENE. In addition, DSTR2 and STRA2 were excluded from this exploratory specification, resulting in single-indicator specifications for Digital Strategy (DSTR) and IT Strategy (STRA).

The resulting exploratory model therefore comprised five constructs: Digital Strategy (DSTR), IT Strategy (STRA), Spend Priorities (SPEN), Agile/DevOps (AGIL), and Benefits (BENE).

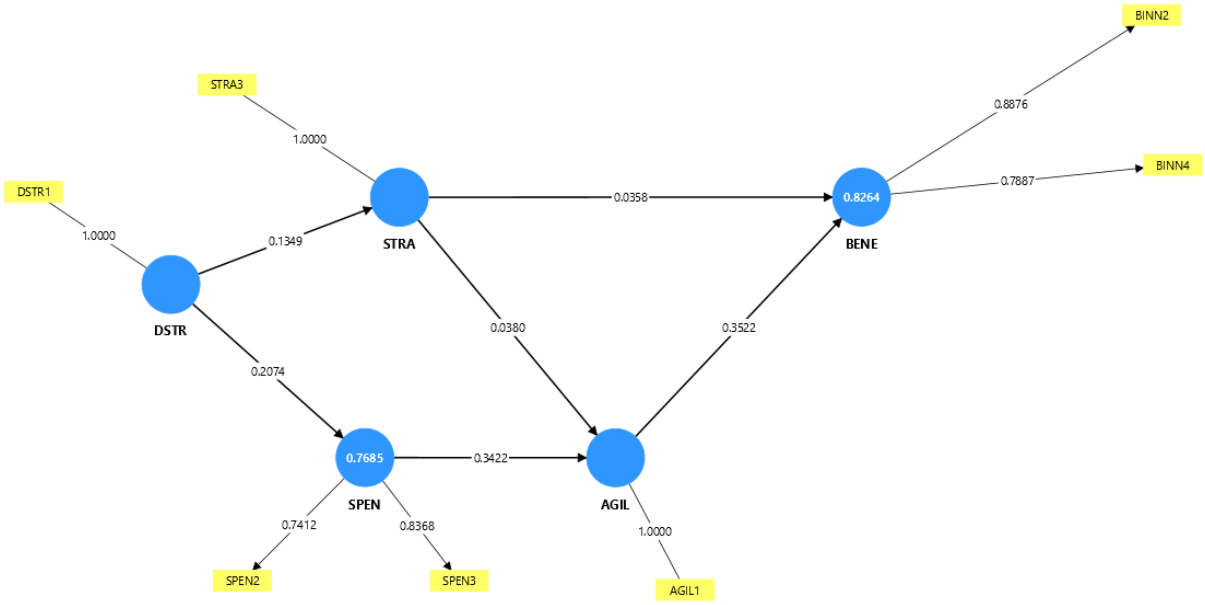


Figure 7: H8 – Boostrap Test Additional Exploratory Analysis.

Variable	Construct	Loading	AVE	CR
Agile/DevOps	AGIL1	1.0000	1.0000	1.0000
Benefits	BINN2	0.8876	0.7049	0.8264
	BINN4	0.7887		
Digital strategy	DSTR1	1.0000	1.0000	1.0000
Spend Priorities	SPEN2	0.7412	0.6248	0.7685
	SPEN3	0.8368		
IT strategy	STRA3	1.0000	1.0000	1.0000

Table 21: Standardized Factor Loadings, Composite Reliability, and AVE for the Exploratory BENE Model

CONSTRUCT	INDICATOR	LOADING	AVE	CR	DECISION
AGILE/DEVOPS (AGIL)	AGIL1	1.0000	1.0000*	1.0000*	Retained
BENEFITS (BENE)	BINN2	**0.8876**	**0.7049**	**0.8264**	Retained
	BINN4	**0.7887**	—	—	Retained
DIGITAL STRATEGY (DSTR)	DSTR1	1.0000	1.0000*	1.0000*	Retained
SPEND PRIORITIES (SPEN)	SPEN2	**0.7412**	**0.6248**	**0.7685**	Retained
	SPEN3	**0.8368**	—	—	Retained
IT STRATEGY (STRA)	STRA3	1.0000	1.0000*	1.0000*	Retained

Table 22: Measurement Model Assessment and Indicator Retention Decisions for the Exploratory BENE Model

The measurement results of the exploratory BENE specification are presented in Table 241. The two retained indicators of the Benefits construct exhibited outer loadings of **0.8876 for BINN2** and **0.7887 for BINN4**. The resulting AVE was **0.7049**, exceeding the conventional threshold of 0.50, while the composite reliability was **0.8264**, exceeding the conventional threshold of 0.70. The Spend Priorities construct also maintained satisfactory measurement values, with loadings of 0.7412 for SPEN2 and 0.8368 for SPEN3, an AVE of 0.6248, and a CR of 0.7685.

AGIL, DSTR, and STRA were represented by single indicators in this exploratory specification. Consequently, their reported loading values of 1.0000 reflect the single-indicator specification and should not be interpreted in the same manner as reliability evidence derived from multiple indicators.

4.4.1 Discriminant Validity – HTMT

To assess discriminant validity in the exploratory specification, the Heterotrait-Monotrait ratio (HTMT) was examined. The results are presented in Table 242.

	AGIL	BENE	DSTR	SPEN	STRA
AGIL					
BENE	0.4560				
DSTR	0.1690	0.0266			
SPEN	0.5395	0.3142	0.3301		
STRA	0.0854	0.0824	0.1349	0.2194	

Table 23: HTMT for Unified Benefits Construct

As shown in Table 23, all HTMT values in the exploratory BENE specification were below 0.85. The highest value was observed between AGIL and SPEN (HTMT = 0.5395), followed by AGIL and BENE (HTMT = 0.4560). The remaining construct pairs showed substantially lower values.

These results provide evidence supporting discriminant validity among the constructs in the exploratory specification. In particular, the unified Benefits construct showed relatively low HTMT values with the other constructs: 0.4560 with AGIL, 0.0266 with DSTR, 0.3142 with SPEN, and 0.0824 with STRA.

This result is considered in conjunction with the results of the measurement model and does not constitute evidence that the exploratory specification is theoretically superior to the model specifications previously reported in the thesis.

4.4.2 Comparison with the Previous Thesis Model

ORIGINAL MODEL	ADDITIONAL EXPLORATORY MODEL
H1 DSTR-STRA-BINN	**H1/H2** DSTR>STRA>BENE
H2 DSTR-STRA-BOPR	
H3 DSTR-STRA-AGIL	**H3** DSTR>STRA> AGIL
H4 DSTR-SPEN-AGIL	**H4** DSTR>SPEN>AGIL
H5 STRA-AGIL-BINN	**H5/H6** STRA>AGIL>BENE
H6 STRA-AGIL-BOPR	
H7 SPEN-AGIL-BOPR	**H7/H8** SPEN>AGIL>BENE
H8 SPEN-AGIL-BOPR	

Table 24: Summary of hypothesis in additional exploratory

ASPECT	MODIFIED THESIS MODEL	EXPLORATORY BENE MODEL
BENEFITS CONCEPTUALIZATION	Innovative Benefits (BINN) and Operational Benefits (BOPR) modeled separately	Innovative and Operational Benefits explored as a unified **Benefits (BENE)** construct
BENEFITS INDICATORS	BINN and BOPR indicators	**BINN2 and BINN4**
BENE / BINN AVE	BINN AVE = **0.4625**	BENE AVE = **0.7049**
BENE / BINN CR	BINN CR = **0.8054**	BENE CR = **0.8264**
OPERATIONAL BENEFITS AVE	BOPR AVE = **0.2907** in the original specification	Not separately modeled
MAXIMUM HTMT INVOLVING BENEFITS	BINN–BOPR = **0.9850** in the original specification	Maximum BENE-related HTMT = **0.4560**
DSTR SPECIFICATION	DSTR1 + DSTR2	**DSTR1**
STRA SPECIFICATION	STRA2 + STRA3	**STRA3**
SPEN SPECIFICATION	SPEN2 + SPEN3	SPEN2 + SPEN3
AGIL SPECIFICATION	AGIL1	AGIL1
ANALYTICAL ROLE	Main modified thesis analysis	Additional exploratory analysis
PURPOSE	Assessment of the originally proposed dimensions and subsequent modifications	Examination of a more parsimonious unified Benefits specification

Table 25: Comparison of the Modified Thesis Model and the Exploratory BENE Model

Table 25 summarizes the principal differences between the modified thesis model and the additional exploratory BENE specification. In the modified thesis model, Innovative Benefits and Operational Benefits were treated as separate dimensions. In the exploratory analysis, these dimensions were combined into a broader Benefits construct.

The original specification presented measurement challenges for the benefits dimensions. In particular, the original Operational Benefits construct presented an AVE of **0.2907**, while the Innovative Benefits construct presented an AVE of **0.4625**. Furthermore, the original HTMT matrix showed elevated values for several construct pairs, including **BINN–BOPR (0.9850)** and other relationships involving DSTR, BOPR, and STRA.

The exploratory BENE specification resulted in a more parsimonious measurement structure. The BENE construct retained two indicators, BINN2 and BINN4, with loadings of **0.8876 and 0.7887**, respectively. Its AVE was **0.7049** and its CR was **0.8264**. In addition, all HTMT values in the exploratory specification were below 0.85.

These results indicate that the exploratory specification provides a statistically coherent alternative representation of the benefits dimension. However, the results should be interpreted within the exploratory purpose of this additional analysis. The BENE specification does not retrospectively replace the modified model presented previously in the thesis.

4.4.3 Interpretation of the Exploratory Analysis

The additional exploratory analysis provides a complementary perspective on the measurement and structural model. The consolidation of Innovative Benefits and Operational Benefits into a unified Benefits construct resulted in a more parsimonious model with two retained indicators, BINN2 and BINN4. The resulting BENE construct demonstrated satisfactory AVE and composite reliability values, while the HTMT and Fornell–Larcker assessments provided evidence supporting discriminant validity within this exploratory specification.

Nevertheless, this result should be interpreted with caution. The reduction of the Benefits construct to two indicators also represents a more restricted operationalization of the broader benefits domain. Consequently, statistical improvement alone was not considered sufficient to establish that the exploratory specification should replace the conceptualization developed in the main thesis model.

Given the exploratory objective of the research, the BENE model is therefore reported as an additional model specification. The modified thesis model remains part of the main analysis, while the BENE model provides an additional empirical examination of whether a unified representation of benefits can be supported by the data.

We do the verification with the decisional tree of Zhao of all hypotheses.

Hypothesis		*Test Variable*	*A*B Is significant?*	*C Is significant?*	*A*B*C Is Positive?*	*PLS Decision*	*Sobel Decision*	*Type of mediation Zhao*
H1/H2	AB	DSTR> STRA> BENE	0.01358443 ≤ 0.05 Significant	0.5133 > 0.05 Not significant	Positive	Accepted	1.7054 Accepted	Indirect-only (**Full mediation**)
H3	H3AB	DSTR> STRA> AGIL	0.1349 *0.0854=0.0115 ≤ 0.05 Significant	0.0004 < 0.05 Significant	Positive	Accepted	1.5663 Accepted	Complementary (**Mediation**)
H4	H4AB	DSTR> SPEN> AGIL	=0.2074 *0.3474=0.0720 ≤ 0.05 Not Significant	0.0004 < 0.05 Significant	Positive	Rejected	4.09765 Rejected	Direct-only (**Non Mediation**)
H5/H6	AB	STRA> AGIL> BENE	0.04853576 ≤ 0.05 Significant	0.0004 ≤ 0.05 Significant	Positive	Accepted	3.2009 Accepted	Complementary (**Mediation**)
H7/H8	AB	SPEN> AGIL> BENE	0.1175 ≤ 0.05 Not Significant	0.0001 ≤ 0.05 Significant	Positive	Rejected	5.7216 Rejected	Direct-only (**Non Mediation**)

Table 26: Zhao Classification interpretation & Sobel table with values, exploratory model

ORIGINAL MODEL	ADDITIONAL EXPLORATORY MODEL
H1 DSTR-STRA-BINN	**H1/H2** DSTR>STRA>BENE
H2 DSTR-STRA-BOPR	
H3 DSTR-STRA-AGIL (REJECTED)	**H3** DSTR>STRA> AGIL
H4 DSTR-SPEN-AGIL	**H4** DSTR>SPEN>AGIL (REJECTED)
H5 STRA-AGIL-BINN	**H5/H6** STRA>AGIL>BENE
H6 STRA-AGIL-BOPR	
H7 SPEN-AGIL-BOPR	**H7/H8** SPEN>AGIL>BENE (REJECTED)
H8 SPEN-AGIL-BOPR	

Table 27: Summary result of hypothesis in additional exploratory

The exploratory model examined the structural relationships using a unified Benefits (BENE) construct combining innovative and operational benefits. The results provide complementary evidence regarding the roles of IT Strategy (STRA), Agile/DevOps (AGIL), and Spending Priorities (SPEN) in relation to digital transformation benefits.

The results support the mediating role of IT Strategy in the relationship between Digital Strategy (DSTR) and Benefits. They also support complementary mediation through Agile/DevOps in the relationship between IT Strategy and Benefits, suggesting that the latter relationship operates through both indirect and direct pathways. In contrast, the indirect relationships involving Spending Priorities through Agile/DevOps were not supported.

These findings complement the original model by examining whether the structural relationships remain meaningful under a unified conceptualization of benefits. Given its exploratory purpose, this alternative specification provides additional insight but does not replace the principal hypothesis tests or their interpretation.

5 DISCUSSION

This study aimed to examine the effectiveness of Agile and DevOps practices in enterprise digital transformation through an empirical software engineering perspective. The research investigated how digital strategy, IT strategy, and IT spending priorities interact to influence Agile/DevOps adoption and the realization of innovative and operational benefits. The discussion of the findings is structured according to the research objectives and research questions defined at the beginning of the thesis.

Relationship between digital strategy and IT strategy

The first objective of this study was to examine the relationship between digital strategy and IT strategy in enterprise digital transformation contexts, particularly whether IT strategy mediates the relationship between digital strategy and organizational outcomes.

The results indicate that digital strategy is positively associated with IT strategy, as demonstrated by the significant relationship DSTR → STRA ($\beta = 0.1438$, $p = 0.0129$) reported in (Table 17). This finding suggests that digital transformation initiatives at the strategic level contribute to shaping the orientation of IT strategy and the prioritization of technological capabilities within organizations. This observation aligns with prior research highlighting the importance of strategic

alignment between business and IT strategies in achieving digital transformation objectives (Bharadwaj et al., 2013; Chen et al., 2010).

The mediation analysis presented in (Table 239), evaluated using the Sobel test, provides insights into the role of IT strategy as an intermediary mechanism. The Sobel results indicate that IT strategy significantly mediates the relationship between digital strategy and innovative benefits (H1), with a p-value of 0.031 and Sobel statistic of 2.153. Similarly, H2 is supported, indicating that IT strategy mediates the relationship between digital strategy and operational benefits, with a p-value of 0.011 and Sobel statistic of 2.535. These findings suggest that digital transformation strategies are positively related to organizational benefits when translated into coherent IT strategies that guide technological implementation and governance (Berman et al., 2012; Bharadwaj et al., 2013; Kollmann et al., 2023).Another study to support this hypothesis is *Engagement and governance***:** An effective IT governance structure, combined with training and alignment mechanisms, links IT strategy to day-to-day operations, further supporting operational benefits (Ross & Weill, 2006).

However, Research Question 3, which examined whether IT strategy mediates the relationship between digital strategy and Agile/DevOps adoption, was not supported according to the Sobel evaluation (H3: $p = 0.062$, Sobel = 1.865). This result indicates that IT strategy does not significantly mediate the relationship between digital strategy and Agile/DevOps adoption. It suggests that Agile and DevOps adoption may depend less on formal IT strategic alignment and more on operational factors such as development practices, team autonomy, technological infrastructure, and organizational culture (Berman et al., 2012; Larson & Chang, 2016).

Influence of spend priorities on Agile/DevOps adoption

The second objective was to analyze how IT spending priorities influence the adoption and intensity of Agile/DevOps practices.

The results demonstrate that spend priorities represent one of the strongest drivers of Agile adoption (SPEN → AGIL, $\beta = 0.3308$, $p < 0.001$), highlighting the critical role of strategic investments in enabling Agile and DevOps practices, particularly through automation, development infrastructure, and collaborative platforms (Bianchi et al., 2021; Crowder & Friess, 2015).

Digital strategy significantly is positively associated with investment prioritization (DSTR → SPEN, $\beta = 0.2171$, $p < 0.001$), indicating that organizations translate digital strategic objectives into budgetary and investment decisions that support technological transformation initiatives (Hobbs & Petit, 2017).

The mediation results (H4: DSTR → SPEN → AGIL) show a robust effect ($p < 0.001$, Sobel = 4.276), suggesting that spend priorities are a key mechanism through which digital strategy is positively related to Agile/DevOps adoption (Bianchi et al., 2021; Dingsøyr et al., 2018; Strode & Sharp, 2022).

Agile/DevOps as a mechanism translating strategy into organizational benefits

Agile/DevOps practices play a central role in generating innovation outcomes (AGIL → BINN, $\beta = 0.2932$, $p < 0.001$) and show a positive and statistically significant relationship with operational improvements (AGIL → BOPR, $\beta = 0.1486$, $p = 0.0156$). These findings reinforce that Agile/DevOps adoption is positively and significantly associated with organizations to convert strategic initiatives and investments into tangible performance outcomes (Kaufmann et al., 2020; S. Sharma et al., 2022; Tam et al., 2020a).

Mediation analyses confirm that Agile/DevOps mediates the relationships between IT strategy and organizational benefits (H5 & H6, Sobel statistics: 3.088 & 2.813) and between spend priorities and organizational benefits (H7 & H8, Sobel statistics: 5.805 & 4.357). These results highlight Agile practices as a critical operational mechanism for translating strategy and financial resources into innovation and operational improvements, and continuous alignment of investments with strategy ensures operational and innovative benefits (Lopez-Fernandez et al., 2022; Sithambaram et al., 2021; Thornley & Crowley, 2017). These findings reinforce the role of Agile and DevOps practices as operational mechanisms that translate organizational investments and strategic priorities into measurable business outcomes, supporting both operational performance and long-term digital transformation objectives (Tam et al., 2020).

Empirical validation of the structural model

Finally, this study provides empirical validation of a structural model that captures the interdependencies between digital strategy, IT strategy, Agile/DevOps practices, and

organizational performance using the PLS-SEM approach. The results demonstrate that the effectiveness of Agile methods in digital transformation initiatives depends not only on their adoption but also on the strategic alignment and financial mechanisms that support their implementation. In this context, strategic orientation and investment priorities play a critical role in enabling Agile and DevOps practices to deliver measurable organizational outcomes.

From an empirical software engineering perspective, the findings suggest that Agile and DevOps function as key operational mechanisms that translate digital transformation strategies into both innovation and operational benefits (Bharadwaj et al., 2013; Larson & Chang, 2016; Sweetman & Conboy, 2018). These practices facilitate iterative development, cross-functional collaboration, and rapid adaptation to changing technological and market conditions, thereby strengthening the link between strategic intent and organizational performance.

Furthermore, these results are consistent with prior research on digital transformation, which emphasizes the importance of integrating technological capabilities, organizational processes, and strategic vision to achieve successful transformation outcomes. In particular, the findings align with the conceptual perspective proposed by (Baslyman, 2022), which highlights the role of digital transformation processes in shaping organizational performance, as well as with the study by (Yucel, 2018), which examines the benefits, drawbacks, and risks associated with digital transformation strategies. Together, these studies provide a theoretical foundation that supports the structural relationships identified in the present research.

5.1 Synthesis of Findings

The findings provide empirical evidence concerning the relationships among Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and digital transformation benefits. The results position Agile/DevOps as an organizational and software engineering capability associated with the implementation of digital transformation initiatives. In particular, the findings highlight the relevance of investment prioritization and Agile/DevOps practices in relation to innovative and operational outcomes.

The mediation analysis using the Sobel test indicates that several proposed indirect relationships are statistically significant. The results suggest that strategic orientations, investment priorities,

and Agile/DevOps practices are interconnected within the proposed model. The strongest relationships identified in the structural model concern investment prioritization and Agile/DevOps adoption, as well as the association between Agile/DevOps practices and innovative benefits.

The findings concerning the relationship between Digital Strategy and Agile/DevOps are consistent with the broader perspective proposed by Yucel (Yucel, 2018), who emphasizes the importance of strategic objectives and the alignment of supporting strategies within digital transformation. In the present study, that strategic orientations, investment priorities, and Agile/DevOps practices are interconnected, provides empirical evidence regarding the association between these constructs within the investigated sample. This result supports the relevance of examining digital transformation through a strategic and organizational lens rather than focusing exclusively on technology adoption.

The comparatively weaker relationship with operational benefits suggests that the proposed mechanisms may differ according to the type of organizational outcome examined. Given the cross-sectional survey design and non-random sampling, these findings represent statistical relationships and mediation effects rather than evidence of causality.

The rejection of H3 indicates that the proposed mediating role of IT Strategy in the relationship between Digital Strategy and Agile/DevOps practices was not supported in the study sample. This finding does not establish that formal IT strategic alignment is irrelevant to Agile/DevOps adoption. Rather, it suggests that the proposed relationship may require consideration of additional organizational, managerial, technological, and software engineering factors. This result therefore provides an opportunity to refine existing explanations of the relationship between strategic orientation and Agile/DevOps implementation.

The theoretical contribution of this research can be considered in terms of confirmation, extension, and refinement. The findings provide additional empirical evidence concerning relationships discussed in previous research, thereby confirming selected aspects of existing knowledge. The study also extends the literature by examining Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and digital transformation benefits within an integrated mediation model. Furthermore, the distinction between innovative and operational benefits, together with the unsupported mediation proposed in H3, refines understanding of the conditions and mechanisms examined in the model.

From an empirical software engineering perspective, this research contributes to the examination of Agile/DevOps practices within a broader organizational context involving strategic priorities, resource allocation, technological conditions, and transformation-related outcomes. Its contribution does not rely solely on the statistical significance of individual hypotheses, but on the integrated examination of relationships and mediation mechanisms connecting strategic and investment-related factors with Agile/DevOps practices and organizational benefits.

CONTRIBUTION DIMENSION	SYNTHESIS
CONFIRMATION	The findings provide additional empirical evidence concerning established relationships among strategic factors, Agile/DevOps practices, and digital transformation benefits.
EXTENSION	The study extends existing literature by integrating Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and transformation benefits within a single mediation model.
REFINEMENT	The distinction between innovative and operational benefits, together with the unsupported IT Strategy mediation in H3, provides a more differentiated understanding of the proposed relationships.

Table 28: Synthesis of Findings and Theoretical Contribution

Overall, the theoretical contribution of this research lies not only in confirming relationships identified in previous studies, but also in integrating strategic, investment, and Agile/DevOps dimensions within a mediation model and refining the understanding of digital transformation benefits.

5.2 Theorical Implications

This study offers several theoretical contributions that advance the understanding of digital transformation, Agile, and DevOps adoption within organizations.

Firstly, the study extends existing literature by examining how digital strategy adoption (DSTR) and strategic alignment (STRA) interact to influence both operational (OPER) and innovative (BINN) performance. By framing the analysis around five hypotheses, the research highlights the mechanisms through which digital initiatives generate value. Hypothesis H1 demonstrates that digital strategy adoption enhances operational performance through strategic alignment, with mediation confirmed by Sobel (2.154), Aroian (1.802), and Goodman (1.934) tests. This finding

emphasizes that technology adoption alone is insufficient; its impact is realized only when organizational strategies and processes are aligned, providing empirical support for the mediating role of strategic alignment in digital transformation models.
Secondly, Hypothesis H2 confirms that strategic alignment similarly mediates the effect of digital strategy adoption on innovative performance. This finding contributes to innovation literature by showing that alignment is positively and significantly associated with organizations to leverage Agile and DevOps practices not only for operational efficiency but also for the generation of new ideas and innovative solutions. By demonstrating this indirect pathway, the study clarifies the theoretical mechanism through which digital transformation initiatives foster both incremental and radical innovation.

Thirdly, the study addresses previously assumed direct effects that were not supported by empirical evidence. Hypothesis H3 was rejected, indicating that Digital strategy does not directly influence Agile/DevOps without considering mediating factors. This challenges prior assumptions in the literature and underscores the importance of contextual and organizational factors in shaping digital transformation outcomes. It suggests that theoretical models must account for indirect and contingent mechanisms rather than assuming uniform direct relationships.

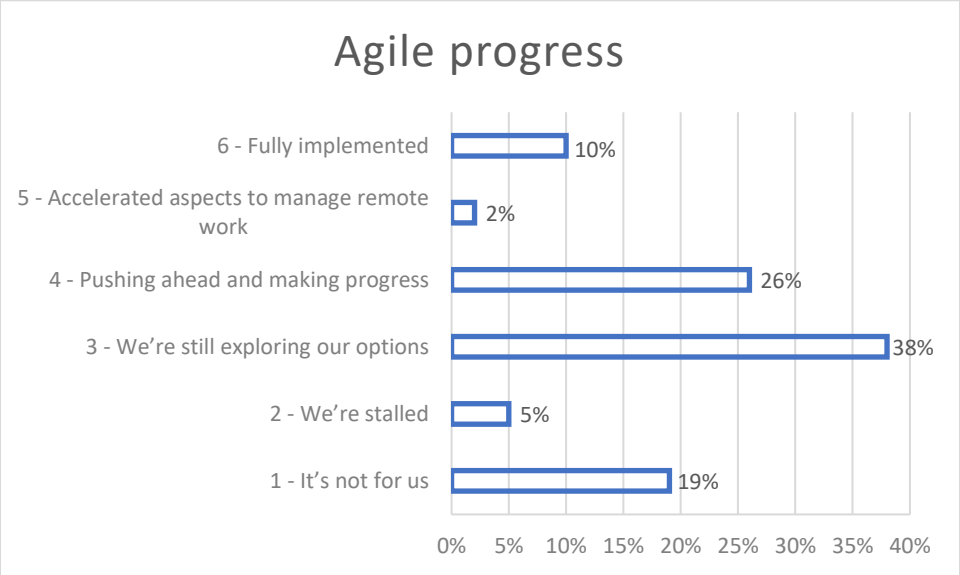
Fourthly, Hypotheses H4 and H5 provide additional insights into the interdependent nature of technological and organizational factors. The results indicate partial mediation of operational and innovative performance outcomes through strategic alignment, highlighting that Agile and DevOps practices must be integrated with organizational processes to be effective. This contribution emphasizes the importance of combining technological adoption with organizational strategy, extending theoretical frameworks that previously treated these factors in isolation.

Finally, the study situates its contributions within the broader context of digital transformation theory. By empirically validating the mediating role of strategic alignment and clarifying the contingent nature of direct effects, the research advances the conceptual understanding of how digital initiatives create value. It underscores the need for organizations to simultaneously develop technological capabilities, align strategic priorities, and foster innovation-oriented cultures to achieve both operational efficiency and innovation. These findings provide a foundation for future

research to explore boundary conditions, cross-industry generalizability, and additional mediating mechanisms in the context of large-scale digital transformation and Agile/DevOps adoption.

5.3 Agile/DevOps utilisation

Our study highlights an important finding Agility/DevOps has yet to be fully implemented in the companies we surveyed. The results suggest that introducing a mediator could help achieve operational and innovation benefits. However, the data also reveals that the adoption of Agile methodology remains low. That said, there is progress, as a growing interest and intent to implement Agile/DevOps is emerging.



This study demonstrated the part of companies in Canada that have not found it easy to implement the methodology. But the purpose of Agile/Devops implementation could do a change important in the organizations generating benefits operational and innovation always with an IT strategy defined observing the spend priorities.

6 Conclusion

This section provides a comprehensive overview of the key contributions of this study, emphasizing its significance in the broader research context. It discusses the study's findings and their implications for both theory and practice, demonstrating how the research adds value to the existing body of knowledge.

Additionally, this section outlines avenues for future research, proposing areas where further exploration could deepen understanding or expand on the current findings. It concludes by summarizing the key insights and emphasizing the study's importance in contributing to knowledge within its field.

The application of PLS-SEM in this study provides a rigorous, predictive, and theoretically grounded framework for analyzing structural relationships. By integrating Partial Least Squares Regression (PLS), PLS modeling, and SmartPLS software, this research ensures methodological robustness while offering valuable insights into the studied phenomena. The findings not only validate the theoretical assumptions but also reinforce the relevance of PLS-SEM as a powerful tool for contemporary research inquiries.

6.1 Relations between variables

In conclusion, the results underscore the importance of strategic performance, agility, and digital strategy in driving innovation and improving operational efficiency. The strongest relationships highlight that strategic performance (SPEN) is a cornerstone of Agile/DevOps (AGIL), which in turn plays a significant role in stimulating innovation (BINN). Furthermore, IT Stategy (STRA) has a notable impact on enhancing operational performance (BOPR), emphasizing its value in improving business outcomes.

Mediation relationships reveal the positive influence of digital strategy (DSTR) on strategic performance (SPEN) and its role in fostering IT Stategy (STRA). While the relationship between agility and operational efficiency (BOPR) is less pronounced, it remains a positive contributing factor.

Finally, weaker but significant relationships indicate that while IT Stategy (STRA) show a positive and statistically significant relationship with innovation (BINN) and Agile/DevOps (AGIL), its influence in these areas is less dominant. This suggests that other factors may play a more critical role in these outcomes.

Overall, these findings highlight the interconnected nature of digital strategy, strategic performance, and Agility/DevOps. By leveraging these relationships, organizations can enhance innovation, optimize operational performance, and align their strategies for sustained success in dynamic environments.

6.2 Contributions of this research

The contributions of this thesis encompass theoretical, methodological, and practical aspects.

6.2.1 Theoretical contributions

The theoretical contributions can be categorized into two segments: IT Strategy and Agile/DevOps.

6.2.1.1 Theorical contribution to IT Strategy

The research about IT strategy shows that in today's digital economy, organizations cannot afford to treat IT as merely a support function. A well-defined IT strategy ensures that technology investments are not only aligned with the company's vision but also drive sustainable competitive advantage. The IT strategy show contributions between two types of contributions of the IT function at the organization level: firm efficiency (e.g., cost savings, operating efficiency, and process improvement) and strategic growth (e.g., return on investment, sales revenue increase, and market share growth) (Chen et al., 2010). Another study tells about the risk management process (Monzelo & Nunes, 2019).

At CEO level another study recommended has new demand as to "find ways for IT to change the company, not just run it" and "to take a much broader role in the business driving business transformation, innovating for competitive advantage and acting as key strategic partners to the CEO and wider organization." (Peppard, 2010).

In this research, we support the IT Strategy should be aligned with overall business objectives and goals using technology as a strategic enabler and it must serve as the backbone of digital transformation, fostering both innovation and operational efficiency. One of the primary ways IT strategy contributes to digital strategy is by enabling innovation.

We found in literature review through emerging technologies such as cloud computing, artificial intelligence, and data analytics, organizations can develop new business models, enhance customer experiences, and optimize decision-making processes. For instance, companies leveraging AI-driven insights can personalize services, automate routine tasks, and improve agility in responding to market changes.

Beyond innovation, IT strategy plays a crucial role in delivering operational benefits. Effective IT governance, cybersecurity frameworks, and enterprise architecture support seamless integration of digital initiatives across departments. Automation and cloud-based solutions streamline operations, reduce costs, and enhance productivity. Additionally, IT strategy ensures scalability, allowing businesses to expand without compromising performance or security.

For an IT strategy to successfully drive digital transformation, organizations must carefully prioritize their IT spending to maximize both innovation and operational efficiency.

6.2.1.2 Theoretical contributions to Agile/DevOps

In one research says applying flexible Agile/DevOps methods requires radical changes in the way projects are negotiated, contracted, procured, organized and, in particular, governed as these activities and processes are often based on more traditional project management approaches (Lappi & Aaltonen, 2017).

Into the Agile/DevOps methodology exist iteration, and it could cause a schedule pression and impact the team behavior. This could be measured by project management performance (van Oorschot et al., 2018). Having a better understanding team member inter actions and communication, we propose a data analysis method to cognition changes (Drury-Grogan, 2021).

In this thesis we found that Agile/DevOps is a central factor: it is influenced by spend priorities and IT Strategy, and in turn, it impacts innovation and operational efficiency.
Another discovery was, digital strategy is key to performance and Agile/DevOps: a better digital strategy improves strategic performance, which in turn strengthens Agile/DevOps and competitiveness.

In another point found was IT Strategy plays a role on several dimensions: it supports innovation and operations, but its impact on Agile/DevOps is weaker. This model shows a strong interdependence between digital strategy, spend priorities, agility and innovation, and highlights the importance of strategic alignment to maximize a company's competitiveness.

6.2.2 Methodological contributions

In the research of survey of Agile practitioners, analyzed using SEM-PLS, shows that team capability and customer involvement play a key role in the success of ongoing Agile software development projects. A focus group was also conducted to validate these findings, adding further support to the results (Tam et al., 2020). While this helps managers and teams prioritize efforts for better project outcomes, the actual impact on project performance hasn't been fully measured. More research is needed to understand how these factors directly influence efficiency, quality, and overall success. For that reason, this research about sees the impact on the results form a point of view business. This research looks at how Agile and DevOps impact business results, especially in terms of innovation and operational efficiency. Agile helps teams move faster, adapt to changes, and continuously improve based on customer feedback, making it easier for businesses to stay competitive. DevOps, on the other hand, streamlines operations by automating processes, improving deployment speed, and reducing system failures. Together, they not only speed up product delivery but also create a more efficient and collaborative work environment, leading to better business outcomes and long-term success.
The only hypothesis that we could not verify was the IT Strategy have no influence on Agile/DevOps. In the other hand, Agile methodologies and IT strategy work together to make business intelligence and analytics more flexible, efficient, and responsive. This is a clear contribution.

6.2.3 Practical contributions

From a practical standpoint, this thesis highlights that the successful implementation of digital transformation initiatives requires a strong digital and IT strategy, supported by well-defined spend priorities and the adoption of Agile and DevOps practices. Together, these elements show a positive and statistically significant relationship to the generation of both innovative and operational benefits, enabling organizations to remain competitive and adaptable in rapidly evolving technological environments.

Previous research suggests that Agile principles and practices have increasingly evolved in conjunction with business intelligence and digital capabilities (Larson & Chang, 2016). However, prior studies often focus primarily on the characteristics of Agile methodologies themselves rather than on the organizational and strategic conditions that enable these methodologies to generate tangible business outcomes. In contrast, this research examines the organizational variables that support the effective use of Agile and DevOps practices to realize both innovation and operational benefits from a business perspective.

In this context, the role of the Chief Information Officer (CIO) becomes particularly important. The CIO plays a critical leadership role in guiding the development and implementation of digital and IT strategies while ensuring that Agile and DevOps practices are effectively integrated into organizational processes. By maintaining a global strategic vision and aligning technological initiatives with business priorities, the CIO can facilitate the adoption of Agile/DevOps practices across the organization and ensure that digital transformation initiatives deliver measurable value. This leadership role also involves balancing innovation initiatives with operational efficiency, managing investment priorities, and fostering collaboration between technical teams and business stakeholders.

The findings of this study provide several practical insights for organizations pursuing digital transformation. First, the results suggest that a digital strategy must be supported by a coherent and well-defined IT strategy to generate meaningful organizational outcomes. Without such alignment, digital transformation initiatives may lack direction and fail to deliver their expected benefits. Second, the alignment of digital and IT strategies with clearly defined spend priorities is positively and significantly associated with organizations to balance investments between innovation and operational efficiency. Finally, the integration of Agile and DevOps methodologies within digital and IT strategies shows a significant relationship with the organization's capacity to

generate both innovative and operational benefits, reinforcing the strategic value of these practices in contemporary digital environments.

6.2.4 Positioning the Present Research in Relation to Digital Transformation Strategy Literature

Yucel (Yucel, 2018) presents a holistic perspective on digital transformation strategy that considers organizational objectives, expected benefits, drawbacks, risks, mitigation plans, supporting corporate strategies, and technological adoption. The paper emphasizes the importance of evaluating digital transformation strategy in relation to the broader organizational context rather than considering technology adoption as an isolated activity. It also identifies the relevance of modern software development and delivery approaches, including Agile and DevOps, within the implementation of digital transformation initiatives.

This perspective provides a conceptual foundation for the present research, which examines the relationships among Digital Strategy, IT Strategy, Spend Priorities, Agile/DevOps practices, and digital transformation benefits. In particular, the emphasis on strategic alignment, supporting strategies, organizational resources, and transformation outcomes informs the selection of the constructs included in the proposed model.

Building on this broader perspective, the present study adopts an empirical approach to examine the proposed relationships among the selected constructs. Digital Strategy represents the strategic orientation of digital transformation, while IT Strategy and Spend Priorities reflect selected strategic and resource-related dimensions. Agile/DevOps practices represent an implementation-oriented construct, and Innovative Benefits and Operational Benefits represent the selected outcome dimensions.

The research model further proposes mediation relationships through IT Strategy and Agile/DevOps practices. These relationships are examined through cross-sectional survey data and Partial Least Squares Structural Equation Modeling (PLS-SEM). Accordingly, the study complements the holistic strategic perspective discussed by Yucel (Yucel, 2018) by providing empirical evidence concerning the specific relationships represented in its conceptual framework. The interpretation of the findings distinguishes between results that are consistent with existing literature and findings that may provide additional insights into the relationships examined in the present study.

6.3 Limitations of this research

Despite the contributions of this study, several limitations should be acknowledged.

First, the scope of Agile and DevOps practices considered in this research may not fully capture the diversity and complexity of Agile implementations in digital transformation initiatives. Agile practices can vary significantly across organizations, industries, and project contexts. As a result, the constructs used in this study represent a generalized view of Agile and DevOps adoption rather than capturing the full range of practices that may exist in real-world environments. Furthermore, because digital transformation initiatives often involve complex and evolving IT ecosystems, defining the precise boundaries of these initiatives remains challenging. Consequently, there may be some degree of uncertainty regarding the extent to which respondents apply Agile practices strictly according to established frameworks or adapt them to their organizational context.

Second, the study relies on survey-based data collected from 477 respondents. Although this sample size is adequate for structural equation modeling analysis, the sampling approach was not randomized. As a result, the findings may be subject to selection bias, and the sample may not fully represent all organizations engaged in digital transformation initiatives. This limitation may affect the generalizability of the results to different industries, organizational sizes, or geographic contexts.

Third, the data collected in this study are based on self-reported perceptions from respondents. While this approach is common in empirical software engineering and information systems research, it may introduce potential biases such as response bias or subjective interpretation of survey questions. Respondents may also have varying levels of familiarity with Agile and DevOps practices, which could influence their evaluation of organizational performance and benefits.

Fourth, the research design is cross-sectional, meaning that data were collected at a single point in time. Digital transformation and Agile adoption are dynamic processes that evolve over time. Consequently, the study cannot fully capture longitudinal changes in organizational practices or establish relationships between the constructs. Future longitudinal studies could provide deeper insights into how Agile and DevOps practices influence organizational performance throughout different stages of digital transformation.

An additional limitation is that measurement invariance across the different years of data collection was not established. Because the dataset covers the period from 2019 to 2022, changes in organizational context, terminology, technology adoption, and the interpretation of digital

transformation concepts may have affected how respondents understood and evaluated the survey items over time for the effects of pandemia. Without formally testing measurement invariance across the years, it cannot be determined whether the constructs were measured equivalently throughout the entire observation period. Therefore, differences in responses across years should not be interpreted as evidence of changes in the underlying constructs without additional longitudinal or measurement-invariance analysis. Future research should assess measurement invariance across time before making direct comparisons between different periods.

Finally, although the PLS-SEM method is well suited for exploratory and predictive research models, it has inherent limitations. In particular PLS-SEM, focuses on variance explanation and prediction rather than establishing definitive causal relationships. Therefore, the results of this study should be interpreted as indicating statistical associations among constructs rather than definitive causal effects.

6.4 Future work

For future research, it could be recommended to analyze a real case to apply all the concepts found in this research and to see the challenge to implement the agile approach in projects of data sciences into the cloud. This research could include a model to implement all in only one model: data sciences, cloud and Agile/DevOps methodology. These subjects have challenges to pass through in the aspects of human resources because it demands a lot of technical knowledge and ask to have continue capacity to implement the needs demanded in a custom project.

The results of this thesis may be helpful to both operational and strategic position in IT management. As managers and executives are required to set directions and best practices, they may rely on the reliable and valid results of our research and empirical findings to develop actionable guidance in adopting agile methods / DevOps in digital transformation projects.

Another potential use is the integration of our findings in such initiatives as the Business Technology Management (BTM) Body of Knowledge (BOK). Such an initiative requires formal validation of its representation of IT job roles and functions, and it has yet to integrate a complete model for Agile/DevOps methods. The opportunity exists after the thesis to strengthen the BTM BOK using the results of this empirical data. https://github.com/Digital-Innovation-Foundation/btmbok.

7 APPENDIXES

7.1 Appendix A: Guidelines for Literature Reviews and Theorical Contributions

1 Literature Reviews		
1.1 (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)	The "systematic literature review" process originated in medical studies. PRISMA is usable in IT/PM. Download/reuse process diagrams: http://prisma-statement.org/	(Moher et al., 2009)
1.2 (Okoli, 2015)	Step-by-step literature review process adapted to IS/IT studies	(Okoli, 2015)
1.3 (Paré, Trudel, Jaana, & Kitsiou, 2015)	Typology of lit. rev., mostly theoretical in nature, followed by narrative reviews, meta-analyses, descriptive reviews, hybrid reviews, critical reviews, and scoping reviews.	(Paré et al., 2015)
1.4 (Webster & Watson, 2002)	Helpful tables to compare authors according to theoretical contributions, methodologies used, managerial implications of findings.	(Webster & Watson, n.d.)
1.5 (Alvesson & Sandberg, 2020)	Critical assessments of several biases in "lit. rev." articles, warnings, and how to avoid traps when writing rev. article.	(Alvesson & Sandberg, 2020)
2 Research Questions		
2.1 (Hällgren, 2012)	RQ in PM.	(Hällgren, 2012)
2.2 (Thuan, Drechsler, & Antunes, 2019)	RQ in Design Science in IT/IS.	(Hoang Thuan et al., 2019)
3 Theoretical Contributions		

3.1 (Presthus & Munkvold, 2016)	How to position your theoretical contribution relative to existing literature.	(Presthus & Munkvold, n.d.)
3.2 (Cornelissen & Durand, 2014)	What kinds of theoretical contributions can be useful to the discipline of management.	(Cornelissen & Durand, 2014)
3.3 (Kuechler, 2012)	Building theory from field research using Design Science methodology.	
3.4 (Lewis & Kelemen, 2002)	Integrating multiple paradigms: positivist, interpretivist, critical, postmodernist, etc.	(Lewis & Kelemen, 2002)
3.5 (Hirschheim, 2019)	Against Theory (cf. Feyerabend's Against Method): refocus on practical knowledge.	(Louisiana State University & Hirschheim, 2019)
4 Writing Review Articles		
4.1 (Ortinau, 2011)	Writing and publishing important scientific articles: A reviewer's perspective (this is focused on Marketing journals, but most lessons apply also to PM/IT/IS journals.	(Ortinau, 2011)
4.2 (Bodolica & Spraggon, 2018)	An end-to-end process of writing and publishing influential literature review articles: do's and don'ts (2 former colleagues from UQO, now in UAE).	(Bodolica & Spraggon, 2018)
4.3 (Martinsuo & Huemann, 2020)	The basics of writing a paper for the International Journal of Project Management (very helpful reminder of what matters to get published).	(Martinsuo & Huemann, 2020)

7.2 Appendix B: Building Blocks of Agile Methods

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
1	Conceptual framework on antecedents of agile capabilities and emerging strategy recognition	**Antecedents** Entrepreneurial Orientation Voice behavior Agile capabilities **Consequences** Emerging strategy recognition Portfolio success Strategic implementation success The project portfolio Corporate strategy Portfolio balance Synergy exploitation Development synergies Risk acceptance High risk projects	Include	Agile portfolio Emerging strategy Project portfolio success Structural equation model	2020	Emerging strategy recognition in agile portfolios, Carsten Kaufmann, Alexander Kock, Hans Georg Gemünden (Kaufmann et al., 2020)
2	Coordination mechanisms after coordination mode	Architecture project meeting Board discussion Business project meeting Demo	Include	Program management, interteam coordination, agile software development, agile	2018	Coordinating Knowledge Work in Multiteam Programs: Findings From a Large-Scale Agile (Dingsøyr et

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
		Experience forum Lunch seminars Metascrum Open Space technology Open work area Scrum of scrum Technical corner Test project meeting Rotation of team members Customer on-site Instant messaging Masterplan Architectural guidelines Team routines Cross-teams routines Solution descriptions in wiki		approaches, software engineering, method tailoring		al., 2018)Development Program, Torgeir Dingsøyr, Nils Brede Moe, and Eva Amdahl Seim (Dyba & Dingsøyr, 2008).
3	Projects as agents in a complex adoptive portfolio Self-organization in portfolio of agile projects	**Agent properties** Self-organizing Common purpose Autonomy Adaptive Requisite variety Exchange of resources	Considerate	Agile, project portfolio management, complex adaptive systems	2018	Portfolios of Agile Projects: A Complex Adaptive Systems' Agent Perspective, Roger Sweetman, Kieran Conboy (Sweetman & Conboy, 2018)

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
4	Project Approaches, Methodologies, and Practices	Project approaches Methodologies Practices	Include	Agile approaches, hybrid approaches, waterfall approaches, project success, project outcomes, stakeholder success, project management methodology, project management approach	2021	Agile, Traditional, and Hybrid Approaches to Project Success: Is Hybrid a Poor Second Choice?, Andrew Gemino, Blaize Horner Reich, and Pedro M. Serrador
5	Visualization of the proposed metamodel	Organizational unit, Individual, know-how, role Resources Processes: Activity artifact Goal: Requirement, strategic/objective Modules: Component, function Tools Product Goal system: Organization system, process system, tool system Product System	Metamodel	Project Management, Synchronization Management, Interdependencies, Project models, Graph Theory	2015	An Initial Metamodel to Evaluate Potentials for Graph based Analyses of Product Development Projects, Nepomuk Chucholowski, Udo Lindemann (Chucholowski & Lindemann, 2015)

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
6	Diagnostic tools PM	Risk approach Methodology to use in project agile/waterfall Diamond approach Software development project management Team size: Project volatility and the nature of project interdependencies Diagnostic framework and health check tool for projects	Include	Project management, Agility, Management practices, Project environment, Hybrid models	2021	Beyond the agile methods: a diagnostic tool to support the development of hybrid models, Michael Jordan Bianchi, Edivandro Carlos Conforto and Daniel Capaldo Amaral (Bianchi et al., 2021a)
7	Interruptions in Agile Software Development Teams	Interruptions Caused by Programming Related Work Impediments Understanding How Agile Approaches Help Teams Manage Interruptions	Include	Agile information systems development, agile software development, interruptions, IT project management, teams	2021	Interruptions in Agile Software Development Teams, Manuel Wiesche
8	Political agendas in the organization interfering in project execution	Lack of agile skillset PMgmt incompetence Lack of Teamwork Poor Customer relationship	How to evaluate	Agile Hybrid Project Management Information Technology Grounded Theory Issues and Challenges	2021	Issues and challenges impacting the successful management of agile-hybrid projects: A grounded theory approach, Jayasaegaran

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
		Lack of proper Communication structure Stakeholder expectations not managed properly Stakeholders do not welcome/embrace change Not able to adopt the agile mindset Not able to adopt the agile mindset Lack of team empowerment				Sithambaram, Mohd Hairul Nizam Bin Md Nasir∗ , Rodina Ahmad (Sithambaram et al., 2021)
9	Team Behavior and project management Performances	Schedule pressure Team Behavior (Overtime) Project Management performance (Quality, Costs, Time)	Considerate	Agile software development, deadlines, schedule pressure, simulation modeling, system dynamics	2018	Under Pressure: The Effects of Iteration Lengths on Agile Software Development Performance, Kim E. van Oorschot, Kishore Sengupta, and Luk N. Van Wassenhove (van Oorschot et al., 2018)
10	How team cognition and cognitive artifact use change as an agile software development (ASD) iteration progresses to better understand team	Data analysis method Team cognition changes as the iteration progresses.	Improve	Project management, team cognition, cognitive artifacts, communication, agile software development	2021	The Changes in Team Cognition and Cognitive Artifact Use During Agile Software Development Project Management,

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
	member interactions and communication					Meghann L. Drury-Grogan (Drury-Grogan, 2021)
11	Overview of mining security requirements from common vulnerabilities and exposures (CVE)	Reporting vulnerabilities Mining vulnerabilities Vulnerabilities Security requirements Test cases	Considerate	Security requirements, common vulnerabilities and exposures, data mining, security testing	2018	Mining Security Requirements from Common Vulnerabilities and Exposures for Agile Project, Wentao Wang, Arushi Gupta, and Nan Niu (Wang et al., 2018)
12	Integrating security requirements in agile	Technical roles Client-Oriented Artefacts Competencies	Considerate	Security requirements engineering, Agile project delivery, qualitative study, empirical research method.	2018	Security Requirements Engineering in the Agile Era: How Does it Work in Practice?, Maya Daneva, Chong Wang (Daneva & Wang, 2018)
13	Metamodel construction framework	Prince 2 Metamodel **Reference framework modelization** Why: Usage world – Value, Time, Quality	Metamodel	MDA; MDE; SCRUM; PRINCE 2; PMBOK; IT	2019	Project Management Metamodel Construction Regarding IT Departments, Ibrahim Hamzane, Abdessamad Belangour (Ibrahim & Abdessamad, 2019)

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
		How: Development world – Activities, Phases, work products By what: System world – metrics, models What: Subject world – Processes, role, indicators Reference framework definition, concept gathering, concepts analysis, metamodel construction				
14	Project metamodel creation methodology	Field of metamodel (Project) Used concepts. Reference Model (PMBOK) Retained concepts. Proposed concepts The project metamodel	Metamodel	Hospital Information System, complex system, metamodel, multidimensional, project management	2016	Multidimensional project metamodel Construction methodology for a HIS deployment, Farid Lahboube, Ounsa Roudiès, Nissrine Souissi (Lahboube et al., 2016)
15	Simple model repository content The task management metamodel	Project type Task Project Taskmodel	Metamodel	Model-Driven Engineering, reverse engineering, megamodels,	2020	Detecting Metamodel Evolutions in Repositories of Model-Driven Projects, Lorenzo Bettini, Davide Di

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
				evolution, quality		Ruscio, Ludovico Iovino, Alfonso Pierantonio (Bettini et al., 2020)

7.3 Appendix C: Concepts to Measure Success

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
1	Effects of agile practices on conditions for project success	Project success	Considerate	Agile methodology, Agile practices, project success.	2021	Agile Practices and Impacts on Project Success, Rebecca Sandstø and Cornelia Reme-Ness (Sandstø & Reme-Ness, 2021)
2	Agile consequences	Team autonomy Team diversity Iterative & incremental development Agile communication Psychological empowerment Innovative Behavior Project performance	Model	N/A	2021	Agile practices and performance: Examining the role of psychological empowerment, Mohsin Malika, Shagufta Sarwar, Stuart Orr (Malik et al., 2021)
3	Balancing between stability and change	Understanding the agile way of working Changing roles and responsibilities Caring for the team Sharing knowledge	Include	Agile, Software development, Paradoxical tension, Grounded theory	2021	Balancing between stability and change in Agile teams, Carin Lindskog, Johan Netz (Lindskog & Netz, 2021)

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
		Building trust Stability / change Understanding the agile way of working Sharing knowledge Caring for the team				
4	Example of a backpropagation model	Input parameters Hidden layers Outputs	Model	Neural nets; Simulation; Artificial intelligence; Project management; Modelling	1998	Neural network as a simulation metamodel in economic analysis of risky projects, Adedeji B. Badiru, David B. Sieger (Badiru & Sieger, 1998)
5	Implementation of Agile Tools for Retail & Construction Management	Duplication of project management teams (PTM) Integrated design project teams (DPT)	Include	Agile; Retail; Project Management; Construction Management; Architecture Teams	2019	ESTIMATION OF SPEED IN DESIGN TEAMS, HUGO SÁNCHEZ VICENTE MANUEL SOLER SEVERINO ALFONSO GARCÍA SANTOS
6	Basic Diagram and Process for Systematic Design	Invention of new forms of innovation management	Considerate	N/A	2011	The Interplay between Creativity Issues and Design Theories: A New Perspective for Design Management Studies, Pascal Le Masson, Armand

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
						Hatchuel and Benoit Weil ("The Interplay between Creativity Issues and Design Theories: A New Perspective for Design Management Studies?," 2011)
7	Research model	Training and learning Agile software development Project success Customer involvement Societal Culture Team Capability Personal Characteristics	Model – results	Agile methodologies Software development People factors Success Mixed-methods	2020	The factors influencing the success of on-going agile software development projects, Carlos Tama, Eduardo Jóia da Costa Mouraa, Tiago Oliveiraa, João Varajão (Tam et al., 2020b)
8	Agile project management(APM) Conceptual framework applied to the case study Using a project management maturity model	Agile project Agility maturity level PKPI Agility Team Project Manager APM Processes	Model	Agile methodologies Software development People factors Success Mixed-methods	2019	THE TRANSITION BETWEEN TRADITIONAL PROJECT MANAGEMENT TO AGILE PROJECT MANAGEMENT, Felipe Sanchez, Eric Bonjour 8

NO	AGILE COMPONENT TO MODEL	KEY CONCEPTS	ANALYTIC FRAMEWORK	KEYWORDS	YEAR	REFERENCES
		New Agile capability Organization CEO				
9	Balance score Board Component	Balance score board Products performance Processes performance Measurements Quality Estimation Scheduling and monitoring control	Considerate	Software project management, software process improvement, effective practices models, repository of assets, processes, small and medium enterprise	2007	PROMEP: A METAMODEL FOR DEFINE, IMPLEMENT AND IMPROVE THE PROJECT MANAGEMENT PROCESSES IN SMES, Cuevas, Gonzalo., Calvo-Manzano, Jose A., Garcia, Ivan. & San Feliu, Tomas
10	Shared model for MBSE-based information exchange between defence and industry	Metamodel requirement baseline	Considerate	Model-Based Systems Engineering (MBSE), Metamodel, Information Model, and Australian Defence Capability Development Process	2012	Requirements for a Metamodel to Facilitate Knowledge Sharing between Project Stakeholders, Quoc Do, Stephen Cook, Peter Campbell, William Scott, Kevin Robinson, Wayne Power and Despina Tramoundanis (Do et al., 2012)

7.4 Appendix D: Categorization of Agile Methods Building Blocks

Category	Code	Theme (Factor)
Model	Mod01	Metamodel requirement baseline
Organisation	Org01	Antecedents
	Org02	Entrepreneurial Orientation
	Org03	Voice behavior
	Org04	Agile capabilities
	Org05	Emerging strategy recognition
	Org06	Portfolio success
	Org07	The project portfolio
	Org08	Corporate strategy
	Org09	Portfolio balance
	Org10	Synergy exploitation
	Org11	Board discussion
	Org12	Business project meeting
	Org13	Customer on-site
	Org14	Common purpose
	Org15	Autonomy
	Org16	Adaptive
	Org17	Project approaches
	Org18	Organizational unit, Individual, know-how, role
	Org19	Product
	Org20	Product System
	Org21	PMgmt incompetence

	Org22	Lack of proper Communication structure
	Org23	Client-Oriented
	Org24	Invention of new forms of innovation management
	Org25	Customer involvement
	Org26	Societal Culture
	Org27	Organization CEO
People	Peo01	Open work area
	Peo02	Instant messaging
	Peo03	Team routines
	Peo04	Cross-teams routines
	Peo05	Self-organizing
	Peo06	Exchange of resources
	Peo07	Resources
	Peo08	Team size: Project volatility and the nature of project interdependencies
	Peo09	Interruptions Caused by Programming Related Work Impediments
	Peo10	Lack of Teamwork
	Peo11	Poor Customer relationship
	Peo12	Stakeholder expectations not managed properly
	Peo13	Stakeholders do not welcome/embrace change
	Peo14	Lack of team empowerment
	Peo15	Team Behavior (Overtime)
	Peo16	Team cognition changes as the iteration progresses
	Peo17	Technical roles
	Peo18	Competencies
	Peo19	Team autonomy
	Peo20	Team diversity
	Peo21	Changing roles and responsibilities

	Peo22	Caring for the team
	Peo23	Caring for the team
	Peo24	Hidden layers
	Peo25	Duplication of project management teams (PTM)
	Peo26	Integrated design project teams (DPT)
	Peo27	Training and learning
	Peo28	Team Capability
	Peo29	Personal Characteristics
	Peo30	Team
	Peo31	Project Manager
Process	Pro01	Risk acceptance
	Pro02	High risk projects
	Pro03	Demo
	Pro04	Experience forum
	Pro05	Lunch seminars
	Pro06	Metascrum
	Pro07	Scrum of scrum
	Pro08	Rotation of team members
	Pro09	Methodologies
	Pro10	Practices
	Pro11	Processes: Activity artifact
	Pro12	Modules: Component, function
	Pro13	Tools
	Pro14	Reporting vulnerabilities
	Pro15	Mining vulnerabilities
	Pro16	Vulnerabilities

	Pro17	Reference framework definition, concept gathering, concepts analysis, metamodel construction
	Pro18	Field of metamodel (Project)
	Pro19	Iterative & incremental development
	Pro20	Agile communication
	Pro21	Psychological empowerment
	Pro22	Innovative Behavior
	Pro23	Project performance
	Pro24	Building trust
	Pro25	Stability / change
	Pro26	Understanding the agile way of working
	Pro27	Sharing knowledge
	Pro28	Outputs
	Pro29	Processes performance
	Pro30	Estimation
Success	Suc01	Consequences
	Suc02	Strategic implementation success
	Suc03	Goal: Requirement, strategic/objective
	Suc04	Goal system: Organization system, process system, tool system
Technical	Tec01	Development synergies
	Tec02	Architecture project meeting
	Tec03	Open Space technology
	Tec04	Technical corner
	Tec05	Test project meeting
	Tec06	Masterplan
	Tec07	Architectural guidelines
	Tec08	Solution descriptions In wiki

Tec09	Requisite variety
Tec10	Risk approach
Tec11	Methodology to use in project agile/waterfall
Tec12	Software development project management
Tec13	Diagnostic framework and health check tool for projects
Tec14	Understanding How Agile Approaches Help Teams Manage Interruptions
Tec15	Lack of agile skillset
Tec16	Not able to adopt the agile mindset
Tec17	Schedule pressure
Tec18	Project Management performance (Quality, Costs, Time)
Tec19	Data analysis method
Tec20	Security requirements
Tec21	Test cases
Tec22	Why: Usage world – Value, Time, Quality
Tec23	How: Development world – Activities, Phases, work products
Tec24	By what: System world – metrics, models
Tec25	What: Subject world – Processes, role, indicators
Tec26	Used concepts
Tec27	Reference Model (PMBOK)
Tec28	Retained concepts
Tec29	Proposed concepts
Tec30	Taskmodel
Tec31	Project success
Tec32	Understanding the agile way of working
Tec33	Input parameters
Tec34	Agile software development Project success
Tec35	Agile project

Tec36	Agility maturity level
Tec37	PKPI
Tec38	Agility
Tec39	New Agile capability
Tec40	Balance score board
Tec41	Products performance
Tec42	Measurements
Tec43	Quality
Tec44	Scheduling and monitoring control

7.5 Appendix E: PMBOK Knowledge Areas and Count of Concepts

PMBOK	Count of Code
Communication Management	12
Goal	6
Human Resource Management	1
Integration Management	24
Procurement Management	1
Quality Management	20
Resource Management	34
Risk Management	7
Schedule Management	5
Scope Management	16
Stakeholder Management	11
Grand Total	**137**

7.6 Appendix F: PMBOK Knowledge Areas Linked to Model Concepts

PMBOK	Code
Communication Management	
	Org10
	Org11
	Org12
	Org22
	Peo02
	Pro06
	Pro07
	Pro20
	Pro27
	Tec02
	Tec05
	Tec14
Goal	
	Mod01
	Org06
	Pro18
	Suc03
	Suc04
	Tec31
Integration Management	
	Org14
	Org19

	Org20
	Pro09
	Pro10
	Pro11
	Pro12
	Pro13
	Pro17
	Pro19
	Pro25
	Pro28
	Pro29
	Suc01
	Suc02
	Tec06
	Tec11
	Tec12
	Tec13
	Tec18
	Tec19
	Tec27
	Tec28
	Tec29
Procurement Management	
	Tec03
Quality Management	
	Org04
	Org05

	Org15
	Org16
	Org24
	Pro23
	Pro24
	Pro26
	Tec15
	Tec16
	Tec21
	Tec30
	Tec32
	Tec34
	Tec37
	Tec38
	Tec40
	Tec41
	Tec42
	Tec43
Human Resource Management	
	Org18
	Org21
	Peo01
	Peo03
	Peo04
	Peo05
	Peo06
	Peo07

Peo08

Peo09

Peo10

Peo14

Peo15

Peo16

Peo17

Peo18

Peo19

Peo20

Peo21

Peo22

Peo23

Peo24

Peo25

Peo26

Peo27

Peo28

Peo29

Peo30

Peo31

Pro05

Pro08

Pro21

Tec04

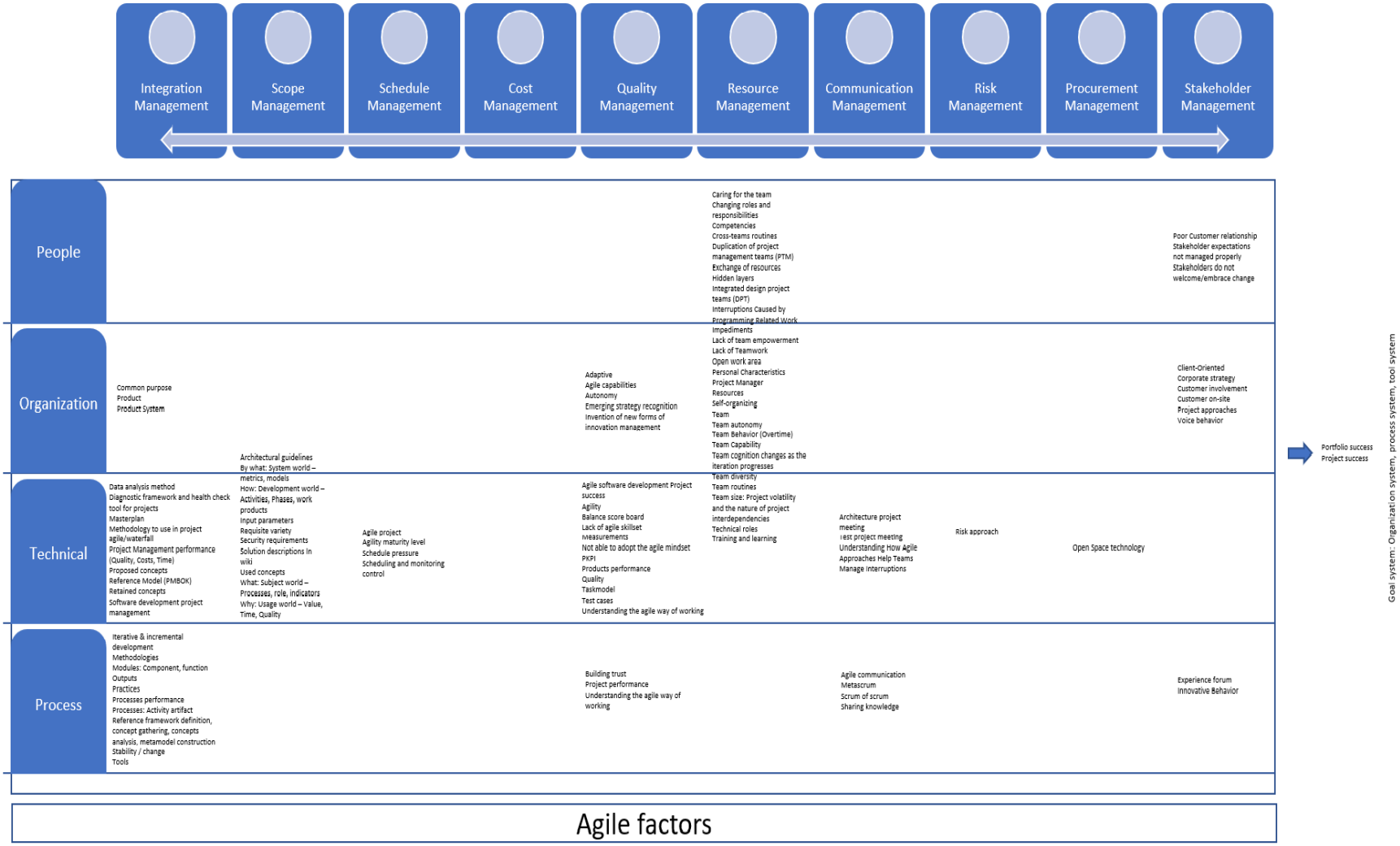
Tec39

Tec01

Risk Management	
	Pro01
	Pro02
	Pro03
	Pro14
	Pro15
	Pro16
	Tec10
Schedule Management	
	Pro30
	Tec17
	Tec35
	Tec36
	Tec44
Scope Management	
	Org01
	Org02
	Org07
	Org09
	Org26
	Org27
	Tec07
	Tec08
	Tec09
	Tec20
	Tec22
	Tec23

	Tec24
	Tec25
	Tec26
	Tec33
Stakeholder Management	
	Org03
	Org08
	Org13
	Org17
	Org23
	Org25
	Peo11
	Peo12
	Peo13
	Pro04
	Pro22

7.7 Appendix G: Mapping the PMBOK Knowledge Areas with Model Concepts



7.8 Appendix H: Aspects to consider doing a PLS analysis

ASPECT	DESCRIPTION	CONCEPTS	
RESEARCH DESIGN	Define the objective, variables, and relationships to be tested. PLS-SEM is often used for exploratory research or when theory is underdeveloped.		
DATA COLLECTION	Ensure an adequate sample size and proper measurement of variables. PLS-SEM works well with smaller samples but requires reliability testing.		
LATENT VARIABLES & INDICATORS	Identify constructs and their indicators. PLS-SEM uses reflective or formative indicators, requiring proper validation.	Latent Variables (LVs)	Variables that are not directly observed but inferred from multiple indicators (observed variables). In PLS-SEM, latent variables represent abstract concepts (e.g., customer satisfaction, brand loyalty) and are measured using either reflective or formative constructs.
		Indicators (Manifest Variables)	Observed variables that serve as measures of a latent variable. Each indicator provides information about the underlying construct, and its relationship with the latent variable depends on whether the construct is reflective or formative.
		Reflective Indicators	Indicators that are effects of the latent variable, meaning changes in the latent variable cause changes in the indicators. They should have high inter-correlations and be reliable. Evaluated using Cronbach's Alpha, Composite Reliability (CR), and AVE.
		Formative Indicators	Indicators that are associated with the latent variable, meaning they define or form the construct rather than being its consequence. These indicators are not necessarily correlated, and their significance is evaluated using outer weights, collinearity (VIF), and indicator relevance (p-values, t-values).

ASPECT	DESCRIPTION	CONCEPTS	
MEASUREMENT MODEL	Assess reliability and validity of indicators. This includes internal consistency (Cronbach's Alpha, Composite Reliability (CR)) and convergent/discriminant validity, use Average Variance Extracted (AVE) to confirm that constructs explain sufficient variance in their indicators.	Internal Consistency Reliability	Evaluates how well the indicators of a construct measure the same concept. Ensures that the items within a construct are highly correlated.
		Cronbach's Alpha	A traditional measure of internal consistency reliability. Values above 0.7 indicate acceptable reliability, though higher values suggest better consistency.
		Composite Reliability (CR)	An improved measure of internal consistency reliability that accounts for different indicator loadings. A CR value above 0.7 is considered acceptable.
		Convergent Validity	Assesses whether indicators of a construct share a high proportion of variance.
		Average Variance Extracted (AVE)	Measures the level of variance captured by a construct relative to the variance due to measurement error. An AVE value above 0.5 indicates adequate convergent validity.
		Discriminant Validity	Ensures that a construct is distinct from others, meaning it measures a unique concept. Common methods to assess this include the Fornell-Larcker Criterion, HTMT (Heterotrait-Monotrait Ratio), and Cross-loadings. HTMT < **0.85** → strong discriminant validity HTMT < **0.90** → acceptable in exploratory research HTMT ≥ **0.90** → discriminant validity problem
STRUCTURAL MODEL	Test relationships between constructs. Evaluate path coefficients, R^2 values, and predictive relevance (Q^2).	Path Coefficients (β)	Represent the strength and direction of relationships between latent variables in the structural model. Typically range from -1 to +1, with values closer to ±1 indicating stronger relationships. Statistical significance is assessed using bootstrapping.
		R^2 (Coefficient of Determination)	Measures the explained variance of an endogenous latent variable. R^2 values of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak, respectively, in social sciences.
		Adjusted R^2	A modified version of R^2 that adjusts for the number of predictors in the model. It provides a more accurate estimate of explained variance, especially in models with multiple predictors.
		f^2 (Effect Size)	Measures the impact of an exogenous variable on an endogenous variable. Values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively.
		Q^2 (Predictive Relevance)	Assesses the predictive validity of the model using the blindfolding procedure. A Q^2 value greater than zero suggests that the model has predictive relevance.
		PLS Predict	A technique to assess out-of-sample predictive power by comparing model predictions to actual values. Used as an alternative to Q^2 when testing predictive validity.

ASPECT	DESCRIPTION	CONCEPTS	
BOOTSTRAPPING & SIGNIFICANCE TESTING	Use bootstrapping to assess significance of paths and factor loadings. Report confidence intervals and t-values.	Bootstrapping	A resampling technique used in PLS-SEM to assess the stability and significance of path coefficients and factor loadings. It involves drawing a large number of subsamples (e.g., 5,000) with replacement to estimate the standard errors and generate statistical significance measures.
		Path Coefficient Significance	The statistical importance of relationships between latent variables in the model. Bootstrapping provides t-values, p-values, and confidence intervals to test hypotheses. A higher t-value and a p-value below 0.05 indicate significant paths.
		Factor Loadings	Represent the strength of the relationship between an observed indicator and its corresponding latent variable. Factor loadings should typically exceed 0.70 to ensure strong indicator reliability. Bootstrapping helps assess the stability of these values.
		Confidence Intervals (CI)	A range of values that contain the true parameter estimate. In SmartPLS, bias-corrected and percentile CIs (e.g., 95%) are commonly used. If a confidence interval does not include zero, the relationship is statistically significant.
		t-Values	Measure the ratio of the estimated coefficient to its standard error. A t-value above 1.96 (for a 95% confidence level) suggests significance, while values above 2.57 (99% level) indicate strong significance.
		p-Values	Represent the probability of obtaining results under the null hypothesis. A p-value below 0.05 indicates that the path coefficient or loading is statistically significant.
MULTICOLLINEARITY & MODEL FIT	Check for variance inflation factors (VIF) to avoid multicollinearity issues. Goodness-of-fit indices in PLS-SEM differ from CB-SEM.	Variance Inflation Factor (VIF)	A measure used to detect multicollinearity in PLS-SEM. VIF values indicate how much variance of a predictor is inflated due to correlation with other predictors. A VIF below 5 (ideally <3) suggests low multicollinearity, ensuring stable and reliable estimates.
		Multicollinearity	Occurs when independent variables in a regression model are highly correlated, leading to unreliable path coefficients. High multicollinearity (VIF > 5) can distort estimates and should be mitigated by removing redundant predictors or using dimension-reduction techniques.
		Goodness-of-Fit in PLS-SEM	Unlike CB-SEM, PLS-SEM does not rely on a single global fit index like Chi-square or RMSEA. Instead, it evaluates model quality using R^2, Q^2, SRMR (Standardized Root Mean Square Residual), and effect sizes (f^2, q^2). SRMR < 0.08 indicates a well-fitting model.

ASPECT	DESCRIPTION	CONCEPTS	
		Difference from CB-SEM	CB-SEM (Covariance-Based SEM) assesses model fit based on discrepancy between observed and estimated covariances, while PLS-SEM focuses on prediction and explained variance (R^2) rather than overall model fit. It is preferred when the goal is maximizing prediction accuracy rather than testing a theoretical model fit.
ONTOLOGY & SEMANTIC ENRICHMENT	If using textual or ontological data, consider feature extraction and enrichment to improve latent variable representation.		
INTERPRETATION & REPORTING	Clearly report results, include effect sizes, and discuss theoretical contributions and practical implications.		

7.9 Appendix I: Descriptive statistics of constructs

Descriptives

	BINN	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.68e−6	−2.83e−5	5.24e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.0130	−0.244	−0.154
Mode	−0.0130	−0.244	−0.295
Sum	8.00e−4	−0.0135	0.00250
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Minimum	−2.06	−3.54	−2.42
Maximum	3.64	2.71	3.36

H1AB – Descriptives

Descriptives

	BINN	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	−2.10e−6	5.87e−6	5.45e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.0208	−0.246	−0.124
Mode	−0.0208	−0.246	−0.303
Sum	−0.00100	0.00280	0.00260
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Minimum	−2.02	−3.66	−2.44
Maximum	3.68	2.72	3.33

H1ABC - Descriptive statistics

Descriptives

	BINN	DSTR
N	477	477
Missing	0	0
Mean	−2.52e−6	1.13e−5
Std. error mean	0.0458	0.0458
Median	−0.0266	−0.102
Mode	−0.0266	−0.102
Sum	−0.00120	0.00540
Standard deviation	1.00	1.00
Variance	1.00	1.00
Minimum	−2.37	−2.10
Maximum	2.99	1.70

H1C - Descriptive statistics

Descriptives

	BOPR	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	−5.24e−6	−3.35e−6	−1.89e−6
Std. error mean	0.0458	0.0458	0.0458
Median	0.0895	−0.245	−0.0692
Mode	0.0895	−0.245	−0.317
Sum	−0.00250	−0.00160	−9.00e−4
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Minimum	−3.17	−3.57	−2.47
Maximum	2.70	2.71	3.26

H2AB - Descriptive statistics

Descriptives

	BOPR	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.26e−6	3.35e−6	−6.29e−7
Std. error mean	0.0458	0.0458	0.0458
Median	0.0889	−0.241	−0.0739
Mode	0.0889	−0.241	−0.316
Sum	6.00e−4	0.00160	−3.00e−4
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	5.85	6.08	5.73
Minimum	−3.15	−3.40	−2.47
Maximum	2.69	2.69	3.26

H2ABC' - Descriptive statistics

Descriptives

	BOPR	DSTR
N	477	477
Missing	0	0
Mean	3.14e−6	−6.08e−6
Std. error mean	0.0458	0.0458
Median	0.0377	−0.249
Mode	0.0377	−0.249
Sum	0.00150	−0.00290
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	6.56	6.65
Minimum	−3.74	−3.93
Maximum	2.81	2.72

H2C - Descriptive statistics

Descriptives

	AGIL	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−2.10e−7	−3.35e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.244	−0.199
Mode	−0.120	−0.244	−0.283
Sum	0.00920	−1.00e−4	−0.00160
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	6.22	5.80
Minimum	−1.54	−3.52	−2.39
Maximum	2.00	2.70	3.41

H3AB - Descriptive statistics

Descriptives

	AGIL	DSTR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	1.15e−5	1.22e−5
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.244	−0.195
Mode	−0.120	−0.244	−0.284
Sum	0.00920	0.00550	0.00580
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	6.26	5.80
Minimum	−1.54	−3.56	−2.39
Maximum	2.00	2.71	3.40

H3ABC' - Descriptive statistics

Descriptives

	AGIL	DSTR
N	477	477
Missing	0	0
Mean	1.93e−5	−3.77e−6
Std. error mean	0.0458	0.0458
Median	−0.120	−0.245
Mode	−0.120	−0.245
Sum	0.00920	−0.00180
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	3.54	6.29
Minimum	−1.54	−3.58
Maximum	2.00	2.71

H3C - Descriptive statistics

Descriptives

	AGIL	DSTR	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−1.01e−5	1.25e−17
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.247	−0.163
Mode	−0.120	−0.247	−0.928
Sum	0.00920	−0.00480	5.92e−15
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	6.44	6.42
Minimum	−1.54	−3.72	−1.93
Maximum	2.00	2.72	4.49

H4AB - Descriptive statistics

Descriptives

	AGIL	DSTR	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	2.73e−6	5.03e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.246	−0.163
Mode	−0.120	−0.246	−0.928
Sum	0.00920	0.00130	0.00240
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	6.38	6.42
Minimum	−1.54	−3.66	−1.93
Maximum	2.00	2.72	4.49

H4ABC' - Descriptive statistics

Descriptives

	AGIL	DSTR
N	477	477
Missing	0	0
Mean	1.93e−5	−3.77e−6
Std. error mean	0.0458	0.0458
Median	−0.120	−0.245
Mode	−0.120	−0.245
Sum	0.00920	−0.00180
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	3.54	6.29
Minimum	−1.54	−3.58
Maximum	2.00	2.71

H4C - Descriptive statistics

Descriptives

	AGIL	BINN	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−2.10e−6	3.98e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.0390	−0.200
Mode	−0.120	−0.0390	−0.200
Sum	0.00920	−0.00100	0.00190
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.28	5.77
Minimum	−1.54	−1.98	−2.14
Maximum	2.00	3.30	3.63

H5AB - Descriptive statistics

Descriptives

	AGIL	BINN	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	4.61e−6	6.29e−7
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.0360	−0.200
Mode	−0.120	−0.0360	−0.200
Sum	0.00920	0.00220	3.00e−4
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.38	5.77
Minimum	−1.54	−2.01	−2.14
Maximum	2.00	3.38	3.63

H5ABC' - Descriptive statistics

Descriptives

	BINN	STRA
N	477	477
Missing	0	0
Mean	−2.73e−6	2.73e−6
Std. error mean	0.0458	0.0458
Median	−0.0204	−0.230
Mode	−0.0204	−0.230
Sum	−0.00130	0.00130
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	5.68	5.81
Minimum	−2.07	−2.24
Maximum	3.61	3.57

H5C - Descriptive statistics

Descriptives

	AGIL	BOPR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−3.56e−6	3.98e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	0.0385	−0.200
Mode	−0.120	−0.219	−0.200
Sum	0.00920	−0.00170	0.00190
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.81	5.77
Minimum	−1.54	−3.11	−2.14
Maximum	2.00	2.70	3.63

H6AB - Descriptive statistics

Descriptives

	AGIL	BOPR	STRA
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	2.52e−6	2.52e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.00420	−0.200
Mode	−0.120	−0.00420	−0.283
Sum	0.00920	0.00120	0.00120
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.93	5.80
Minimum	−1.54	−3.23	−2.39
Maximum	2.00	2.69	3.41

H6ABC' - Descriptive statistics

Descriptives

	BOPR	STRA
N	477	477
Missing	0	0
Mean	−2.73e−6	−4.19e−7
Std. error mean	0.0458	0.0458
Median	0.0880	−0.125
Mode	0.0880	−0.303
Sum	−0.00130	−2.00e−4
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	5.87	5.76
Minimum	−3.17	−2.44
Maximum	2.70	3.33

H6C - Descriptive statistics

Descriptives

	AGIL	BINN	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−2.10e−6	6.50e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.0390	−0.133
Mode	−0.120	−0.0390	−0.903
Sum	0.00920	−0.00100	0.00310
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.28	6.65
Minimum	−1.54	−1.98	−1.90
Maximum	2.00	3.30	4.75

H7AB - Descriptive statistics

Descriptives

	AGIL	BINN	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−2.52e−6	4.19e−7
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	−0.0351	−0.132
Mode	−0.120	−0.0351	−0.894
Sum	0.00920	−0.00120	2.00e−4
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.31	6.72
Minimum	−1.54	−1.98	−1.89
Maximum	2.00	3.33	4.83

H7ABC' Descriptive statistics

Descriptives

	BINN	SPEN
N	477	477
Missing	0	0
Mean	2.31e−6	−4.40e−6
Std. error mean	0.0458	0.0458
Median	−1.00e−4	−0.140
Mode	−1.00e−4	−0.862
Sum	0.00110	−0.00210
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	5.50	6.94
Minimum	−1.99	−1.84
Maximum	3.51	5.10

H7C Descriptive statistics

Descriptives

	AGIL	BOPR	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−3.56e−6	6.50e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	0.0385	−0.133
Mode	−0.120	−0.219	−0.903
Sum	0.00920	−0.00170	0.00310
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.81	6.65
Minimum	−1.54	−3.11	−1.90
Maximum	2.00	2.70	4.75

H8AB Descriptive statistics

Descriptives

	AGIL	BOPR	SPEN
N	477	477	477
Missing	0	0	0
Mean	1.93e−5	−5.03e−6	3.56e−6
Std. error mean	0.0458	0.0458	0.0458
Median	−0.120	0.00440	−0.159
Mode	−0.120	−0.228	−0.926
Sum	0.00920	−0.00240	0.00170
Standard deviation	1.00	1.00	1.00
Variance	1.00	1.00	1.00
Range	3.54	5.93	6.44
Minimum	−1.54	−3.20	−1.93
Maximum	2.00	2.73	4.51

H8ABC' Descriptive statistics

Descriptives

	BOPR	SPEN
N	477	477
Missing	0	0
Mean	−6.29e−7	3.35e−6
Std. error mean	0.0458	0.0458
Median	−0.0920	−0.237
Mode	−0.227	−0.998
Sum	−3.00e−4	0.00160
Standard deviation	1.00	1.00
Variance	1.00	1.00
Range	5.96	5.30
Minimum	−3.30	−2.00
Maximum	2.65	3.30

H8C Descriptive statistics

7.10 Appendix J: Descriptive statistics of constructs

Analysis	*SmartPLS Output*	*Function Description*	*Expected Range / Interpretation*	*Recommended Threshold*
Indicator Reliability	Outer Loadings	Assesses how strongly each indicator reflects its latent construct	0 to 1. Higher values indicate that the indicator shares more variance with its construct.	≥ 0.708 preferred; 0.40–0.70 may be considered for removal only when this improves CR/AVE and theoretical justification supports it. remain adequate
Internal Consistency Reliability	Composite Reliability (CR)	Measures internal consistency without assuming equal indicator loadings	0 to 1. Higher values indicate greater internal consistency.	≥ 0.70 (acceptable); ≥ 0.80 (good); ≥ 0.90 (very good; >0.95 may indicate redundancy)
	Cronbach's Alpha	Traditional reliability estimate assuming tau-equivalence	0 to 1. Higher values indicate greater reliability.	≥ 0.70 acceptable; values substantially >0.95 may indicate redundancy.
	Dijkstra–Henseler's ρA	Consistent reliability estimate (especially relevant in PLSc)	0 to 1. Higher values indicate greater reliability.	≥ 0.70 acceptable; ideally <0.95.
Convergent Validity	Average Variance Extracted (AVE)	Measures the proportion of variance captured by the construct relative to measurement error	0 to 1. Higher values indicate stronger convergent validity.	≥ 0.50
Discriminant Validity	Fornell–Larcker Criterion	Compares AVE with inter-construct correlations	The square root of AVE should be greater than the construct's correlations with other constructs.	AVE must exceed correlations with other constructs
	HTMT Ratio	Assesses discriminant validity via heterotrait-monotrait correlations	0 to 1. Lower values indicate greater distinction between constructs.	≤ 0.85 (conservative); ≤ 0.90 (liberal)
Collinearity Assessment	Variance Inflation Factor (VIF)	Detects multicollinearity (inner or outer model)	1 to ∞. Values closer to 1 indicate lower collinearity.	VIF < 5 (acceptable); < 3 preferred
Coefficient of determination	R^2	Proportion of variance explained in endogenous constructs	0 to 1. Higher values indicate greater explanatory power.	0.25 weak; 0.50 moderate; 0.75 substantial.
Predictive Relevance	Q^2 (Stone–Geisser)	Assesses out-of-sample predictive relevance via blindfolding	$Q^2 > 0$ indicates predictive relevance.	0.02 small; 0.15 medium; 0.35 large.
Effect Size	f^2	Assesses contribution of an exogenous construct to R^2	0 to ∞. Higher values indicate greater effect.	0.02 small; 0.15 medium; 0.35 large.
Path Significance	Bootstrapped Path Coefficients	Tests statistical significance of structural relationships	Path coefficient β generally ranges from −1 to +1. p-values range from 0 to 1.	$p < 0.05$; for two-tailed testing, $t > 1.96$ at 95% confidence.
Mediation	Specific Indirect Effects (Bootstrapping)	Tests indirect effects in mediation models	Indirect effect coefficient may be positive or negative; significance is evaluated using bootstrapping.	$p < 0.05$ and/or bootstrap confidence interval excludes zero. Direct and indirect effects should be examined to determine mediation type.
	Sobel Test	Evaluates the significance of the indirect effect in mediation using a normal approximation	t/z values are compared against the critical value.	> 1.96 for two-tailed testing at $\alpha = 0.05$. Note: bootstrapping is preferred in PLS-SEM.
Moderation	Interaction Term	Evaluates conditional effect of moderator	Interaction coefficient may be positive or negative; significance determined through bootstrapping.	$p < 0.05$ and/or bootstrap confidence interval excludes zero.
Model Fit (PLS-SEM)	SRMR	Global model fit index based on residuals	0 and higher; lower values indicate better fit.	< 0.08 generally considered acceptable; <0.10 may be considered adequate in some contexts.
Out-of-Sample Prediction	PLS Predict	Compares predictive errors (RMSE, MAE)	RMSE/MAE: lower values indicate better prediction. Q^2 predict > 0 indicates predictive relevance.	Lower prediction errors vs. linear model benchmark; positive Q^2 Predict

Summary of SmartPLS metrics

7.11 Appendix K: Zhao classification interpretation

We need to validate the mediation level to see if the dependent variables are significant to obtain the goal the benefits like on our model. This study uses the decisional tree of Zhao **Figure 8** to determinate the mediation type. This tree is used to conceptualize theses five type od mediation and nonmediation to convey to readers what really matters in a mediation analysis (ZHAO et al., 2010).

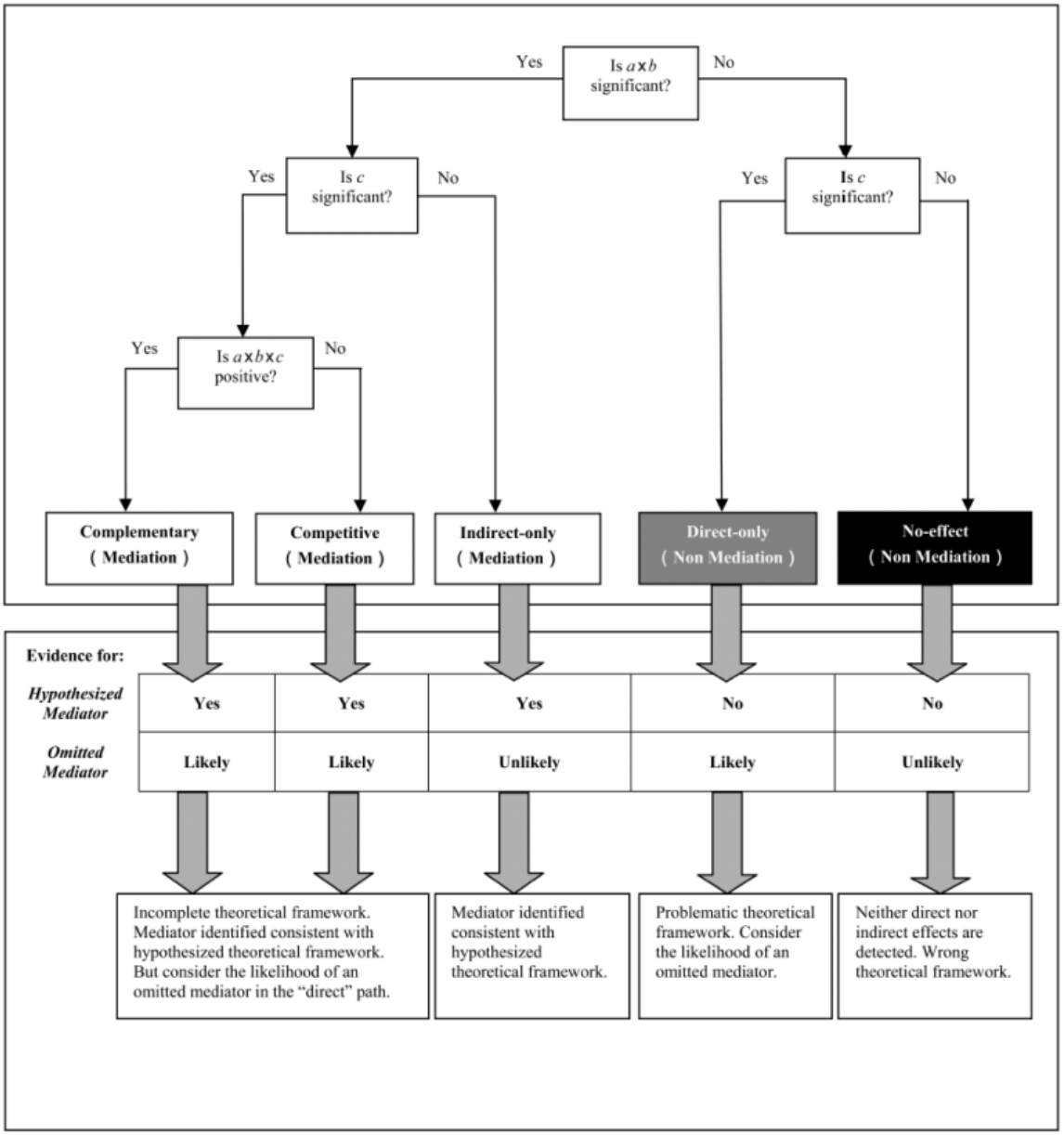


Figure 8: Zhao decision tree

We do the verification with the decisional tree of Zhao of all hypotheses (Table 19 – Chapter 4.1.4).

Following the estimation of the global model using SmartPLS, the results were interpreted in accordance with the mediation analysis framework proposed by Xinshu Zhao et al analysis (ZHAO et al., 2010). The evaluation of the structural relationships allowed the assessment of the direct and indirect effects among the constructs defined in the research model (*Figure 6 - Global PLS Model*). Consistent with the research design, the hypothesis testing process was conducted sequentially by examining the significance and magnitude of the path coefficients obtained through bootstrapping procedures. This approach enabled the identification of the mediating mechanisms within the model and the verification of the proposed hypotheses.

The following sections present the results of the hypothesis testing, beginning with a summary of the mediation hypothesis testing. Subsequently, the analysis proceeds with the detailed examination of Hypothesis, followed by a discussion of the significance of the relationships observed in the research model.

7.12 Appendix L: Hypothesis testing

We have 8 hypotheses, and the results form SmartPLS are in the table below Table 29.

		Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Line	Hypothesis	Paths	Coef-a	Coef-b	Coef-c'	Coef-c	STDEV-a	STDEV -b	STDEV-c'	STDEV-c	T-stats-a	T-stats-b	T-stats-c'	T-stats-c	R^2 a	R^2 b	R^2 b,c'	R^2 c	Sobel	Aroian	Goodman
1	H1a	a,b	0.1447	0.1658			0.0569	0.0412			2.5415	4.0259			0.6791	0.8213			2.1497	2.1038	2.1981
2	H1b	a,b,c'	0.1459	0.1679	-0.0389		0.0686	0.0509	0.1161		2.1257	3.2992	0.3354		0.6787		0.8234		1.7869	1.7315	1.8480
3	H1c	C				0.1209				0.1802				0.6710				0.7683			
4	H2a	a,b	0.1467	0.2895			0.0545	0.0381			2.6893	7.6028			0.6774	0.6855			2.5372	2.5179	2.5569
5	H2b	a,b,c'	0.1454	0.2852	0.0300		0.0574	0.0467	0.0902		2.5314	6.1099	0.3328		0.6775		0.6855		2.3386	2.3120	2.3655
6	H2c	C				0.2536				0.2019				1.2559				0.2829			
7	H3a	a,b	0.1435	0.1541			0.0580	0.0536			2.4746	2.8737			0.6792	1.0000			1.8753	1.8133	1.9441
8	H3b	a,b,c'	0.1437	0.1302	0.1652		0.0626	0.0543	0.0485		2.2967	2.3981	3.4077		0.6792		1.0000		1.6587	1.5882	1.7384
9	H3c	C				0.1841				0.0459				4.0140				1.0000			
10	H4a	a,b	0.2178	0.3471			0.0424	0.0463			5.1336	7.4889			0.7688	1.0000			4.2374	4.2120	4.2633
11	H4b	a,b,c'	0.2171	0.3222	0.1146		0.0431	0.0489	0.0471		5.0321	6.5938	2.4344		0.7688		1.0000		4.0000	3.9715	4.0296
12	H4c	C				0.1841				0.0459				4.0140				1.000			
13	H5a	a,b	0.1579	0.3204			0.0477	0.0358			3.3128	3.3128			1.0000	0.7976			3.1047	3.0877	3.1218
14	H5b	a,b,c'	0.1579	0.2929	0.1215		0.0490	0.0425	0.0466		3.2243	6.8916	2.6085		1.0000		0.8050		2.8068	2.7715	2.8435
15	H5c	C				0.1684				0.0396				4.2503				0.8210			
16	H6a	a,b	0.1579	0.2229			0.0477	0.0421			3.3128	5.2884			1.0000	0.6913			2.8068	2.7715	2.8435
17	H6b	a,b,c'	0.1541	0.1486	0.2563		0.0500	0.0453	0.0614		3.0795	5.6616	2.4196		1.0000		0.7001		1.9025	1.8434	1.9678
18	H6c	c				0.2897				0.0376				7.7105				0.6853			
19	H7a	a,b	0.3493	0.3204			0.0458	0.0358			7.6346	8.9389			1.0000	0.7976			5.6109	5.5897	5.6322
20	H7b	a,b,c'	0.3498	0.2974	0.0601		0.04659	0.0456	0.0545		7.6285	6.5233	1.1015		1.0000		0.7994		4.9578	4.9333	4.9825
21	H7c	c				0.1632				0.0464				3.5164				0.8106			
22	H8a	a,b	0.3493	0.2229			0.0458	0.0421			7.6346	5.2884			1.0000	0.6913			4.3492	4.3242	4.3746
23	H8b	a,b,c'	0.3473	0.1930	0.0953		0.0462	0.0631	0.0826		7.5194	3.0598	1.1541		1.0000		0.6853		1.1407	1.1310	1.1507
24	H8c	c				0.2170				0.0743				2.9223				0.6224			

Table 29: Summary of mediation hypothesis testing

In the (Table 29) we obtained the summary of mediation in the 8 hypotheses. For evaluating the mediation effect, we use the bootstrap test from SmartPLS. This procedure uses sub-example with observations and by hazard. Also, we use the test sobel. The moderator model shows (a) the moderator function of third variables, which partitions a focal independent variable into subgroups that stablish its domains of maximal effectiveness in regard to a given dependent variable, and (b) the mediator function of a variable, which represent the generative mechanism through which the local represents the generative mechanism through which the focal independent variable to influence the dependent variable of interest (Baron & Kenny, 1986). In each hypothesis we measure the mediation. We will measure first the path AB, in second part ABC' and the third C. AB is the path between an independent variable, mediator and dependent. ABC' is the same path AB with the path between independent and dependent variable. C is the path only between independent and dependent variable.

In (Appendix 7.10) we summarize the terms about the evaluation on PLS-SEM.

7.12.1 H1: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Benefits-Innovative (BINN)

Test Variables: DSTR > STRA > BINN

Yucel (Yucel, 2018) emphasizes the importance of aligning digital transformation strategy with supporting corporate strategies and organizational objectives. This perspective provides a rationale for examining the relationship between Digital Strategy and IT Strategy in the context of digital transformation. Building on this strategic alignment perspective, the present research proposes that IT Strategy may serve as an intermediary construct linking Digital Strategy to Innovative Benefits. This proposed relationship is examined empirically through the mediation hypothesis H1.

We resumed the result in the (Table 29) of mediation. In the first 3 lines (1, 2, 3) are the hypothesis H1 with the different paths: AB, ABC and C. In (*7.10 Appendix J - Summary of SmartPLS metrics*) we can see the requirements for the coefficients should be 1.96 or higher.

7.12.1.1 H1AB

We can see in the column (1,2), line (1) of coefficient is Coef-a 0.1447, Coef-b 0.1658 from (Table 29). Hypothesis H1 examines whether IT Strategy acts as a mediating mechanism through which Digital Strategy translates into Innovative Benefits. This hypothesis is grounded in prior research suggesting that digital initiatives require formalized IT strategic alignment to materialize into organizational innovation outcomes.

All three constructs involved in H1 Digital Strategy (DSTR), IT Strategy (STRA), and Innovative Benefits (BINN) were modeled as reflective constructs, consistent with their original operationalizations in the literature(Bharadwaj et al., 2013) (Chen et al., 2010) (Chen et al., 2010) (Ramirez et al., 2018).

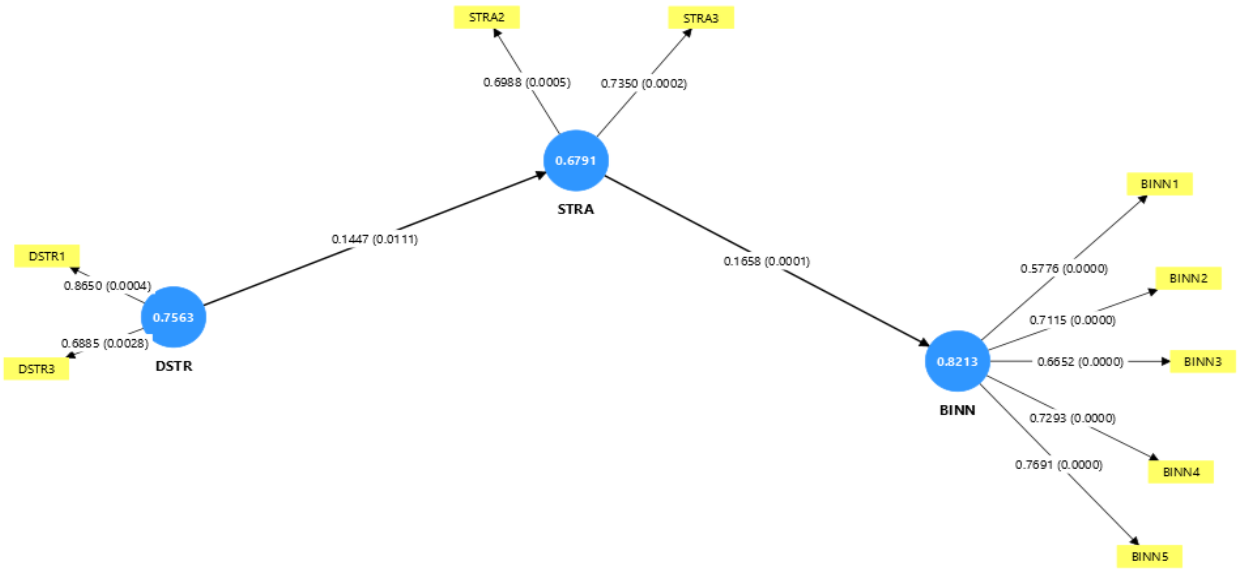


Figure 9: H1AB – Bootstrap Test – AB

Variable	Construct	Loading	AVE	CR
Agile/DevOps	AGIL1	1.0000		
Benefits innovative	BINN1	0.4524	0.8054	0.4625
	BINN2	0.8059		
	BINN3	0.5840		
	BINN4	0.7889		
	BINN5	0.7034		
Benefits operational	BOPR1	0.6152	0.7001	0.2907
	BOPR2	0.5642		
	BOPR3	0.5242		
	BOPR4	0.4675		
	BOPR5	0.6816		
	BOPR6	0.2995		
Digital strategy	DSTR1	0.8548	0.6904	0.5358
	DSTR2	0.5839		
Spend Priorities	SPEN2	0.7459	0.7688	0.6251
	SPEN3	0.8329		
IT strategy	STRA2	0.6827	0.6787	0.5142
	STRA3	0.7499		

Table 30– Standardized Factor Loadings, CR and AVE for H1AB

In (Table 29) the line 1, column 9 and 10, are the T-stats-a 2.542 and T-stats-b 4.026. Here in table of requirements (Table 30) confirms that the measurement model for H1 mostly supports using

these constructs in hypothesis testing, but caution is needed for constructs with lower AVE or factor loadings.

R-Square (R^2)

The coefficient of determination (R^2) represents the proportion of variance in an endogenous construct explained by its predictor variables in the structural model.

As shown in (Table 31), Innovative Benefits (BINN) exhibits an R^2 value of 0.0275, indicating that approximately 2.75% of the variance in innovative benefits is explained by the model. IT Strategy (STRA) shows an R^2 value of 0.0209, suggesting that approximately 2.09% of its variance is explained by its antecedent construct.

According to established guidelines for PLS-SEM (Hair et al., 2018), these values indicate very weak explanatory power. However, low R^2 values are common and acceptable in exploratory research, particularly when investigating complex, high-level organizational constructs such as digital strategy, IT strategy, and innovation outcomes.

Rather than maximizing explained variance, the primary objective of this study is theory development and the examination of mediation mechanisms. Therefore, the R^2 results suggest that while the model captures statistically meaningful relationships, additional explanatory variables should be incorporated in future research to enhance predictive accuracy.

	R-SQUARE	R-SQUARE ADJUSTED
BINN	0.0275	0.0255
STRA	0.0209	0.0189

Table 31:R-Square for H1AB

f-Square

Effect sizes were assessed using Cohen's (1988) guidelines to evaluate the practical relevance of the structural relationships. In (Table 32) R-Square for H1AB we are assessing:

The path Digital Strategy, IT Strategy (DSTR → STRA) exhibits a small and non-significant effect ($f^2 = 0.0214$), indicating that Digital Strategy contributes only marginally to the explained variance of IT Strategy.

The path IT Strategy, Innovative Benefits (STRA → BINN) shows a small but marginally significant effect ($f^2 = 0.0283$), suggesting that IT Strategy plays a limited yet potentially meaningful role in influencing innovative outcomes.

Overall, the small f^2 values indicate weak individual contributions of the predictors to the endogenous constructs. However, such results are consistent with the exploratory nature of this study and with models examining complex, strategic, and organizational phenomena, where effects tend to be incremental rather than large.

	BINN	DSTR	STRA
BINN			
DSTR			0.0214
STRA	0.0283		

Table 32:f-Square for H1AB

Construct reliability and validity

Construct reliability and convergent validity were assessed using Composite Reliability (ρc), Cronbach's alpha (α), and Average Variance Extracted (AVE) (Table 33), following established guidelines for PLS-SEM (Hair, 2014). While Cronbach's alpha is reported for completeness, composite reliability is emphasized, as it provides a more appropriate reliability estimate in variance-based SEM and does not assume equal indicator loadings.

Convergent Validity

Average Variance Extracted (AVE) (Table 33) values above 0.50 indicate adequate convergent validity, meaning that a construct explains more than half of the variance of its indicators.

- **Innovative Benefits (BINN)** presents a slightly lower AVE (0.4811), which suggests borderline convergent validity.
- **Digital Strategy (DSTR)** demonstrates strong convergent validity (AVE = 0.6111).
- **IT Strategy (STRA)** meets the recommended threshold (AVE = 0.5142).

According to Fornell and Larcker (1981), AVE values marginally below 0.50 may still be considered acceptable when composite reliability is satisfactory. Given BINN's strong composite reliability (CR = 0.8213), its convergent validity is deemed acceptable for exploratory research.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.8213	0.4811
DSTR	0.3762	0.7563	0.6111
STRA	0.0555	0.6791	0.5142

Table 33:R-Cronbach, CR and AVE for H1AB

Internal Consistency Reliability

Internal consistency reliability was evaluated using Composite Reliability (CR) and Cronbach's alpha (α). Composite reliability values indicate acceptable reliability (Table 33) for BINN (CR = 0.8213) and DSTR (CR = 0.7563). STRA (ρc = 0.6791) exhibits marginal reliability, slightly below the recommended threshold of 0.70, but remains acceptable in exploratory PLS-SEM studies.

Cronbach's alpha values vary substantially across constructs (Table 33). While BINN shows acceptable internal consistency (α = 0.7313), DSTR (α = 0.3762) and STRA (α = 0.0555) exhibit very low alpha values, indicating poor internal consistency under this metric.

However, Cronbach's alpha is known to underestimate reliability in PLS-SEM, particularly when indicator loadings are heterogeneous or when constructs are conceptually broad, as is often the case with strategic and organizational constructs. Consequently, composite reliability is considered the primary criterion for reliability assessment in this study. Nevertheless, the extremely low Cronbach's alpha values for DSTR and STRA suggest that indicator refinement and construct respecification should be considered in future research to improve internal consistency.

Discriminant Validity

Heterotrait-monotrait ratio (HTMT)

Discriminant validity was assessed using the Heterotrait–Monotrait ratio (HTMT), as recommended for PLS-SEM analysis (Henseler et al., 2015).

As shown in (Table 34), the HTMT value between Digital Strategy (DSTR) and Innovative Benefits (BINN) is 0.1874, which is well below the conservative threshold of 0.85, indicating strong discriminant validity between these constructs.

The HTMT value between IT Strategy (STRA) and Innovative Benefits (BINN) is 0.7937, which remains below the 0.85 threshold and therefore indicates acceptable discriminant validity.
However, the HTMT value between IT Strategy (STRA) and Digital Strategy (DSTR) is 0.9749, exceeding the recommended threshold of 0.90. This result suggests a lack of discriminant validity between these two constructs, indicating that respondents may perceive IT Strategy and Digital Strategy as conceptually overlapping. Given the exploratory nature of this study and the close conceptual relationship between IT Strategy and Digital Strategy in contemporary organizational contexts, this overlap is theoretically plausible. Nevertheless, this finding indicates that future research should further refine measurement items or model higher-order constructs to improve construct distinctiveness.

	BINN	DSTR	STRA
BINN			
DSTR	0.1874		
STRA	0.7937	0.9749	

Table 34- Heterotrait-Monotrait for H1AB

Fornell-Larcker criterion

Discriminant validity was assessed using the Fornell–Larcker criterion (Fornell & Larcker, 1981), which evaluates whether a latent construct shares more variance with its own indicators than with other constructs in the model. According to this criterion, the square root of the Average Variance Extracted (AVE) for each construct should exceed the inter-construct correlations.

As reported in (Table 35), the diagonal elements representing the square roots of AVE are greater than the corresponding off-diagonal correlation coefficients for all constructs. Specifically, the square root of AVE for Innovative Benefits (BINN = 0.6936) exceeds its correlations with Digital Strategy (DSTR = 0.0004) and IT Strategy (STRA = 0.1658). Similarly, Digital Strategy demonstrates a square root of AVE of 0.7817, which is higher than its correlations with BINN (0.0004) and STRA (0.1447). IT Strategy also satisfies the criterion, with a square root of AVE of 0.7171 exceeding its correlations with BINN (0.1658) and DSTR (0.1447).

These results indicate that each construct captures a greater proportion of variance from its associated indicators than from other constructs in the model, thereby providing evidence of discriminant validity under the Fornell–Larcker criterion.

	BINN	DSTR	STRA
BINN	0.6936		
DSTR	0.0004	0.7817	
STRA	0.1658	0.1447	0.7171

Table 35:Fornell-Larcker criterion for H1AB

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
a DSTR -> STRA	0.1447	0.1563	0.0569	2.5415	0.0111
b STRA -> BINN	0.1658	0.1848	0.0412	4.0259	0.0001

Table 36: Path Coefficients for H1AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 36 Path Coefficients for H1AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	.1447	Sobel test:	2.14978654	0.01115983	0.0315721
b	.1658	Aroian test:	2.10386901	0.0114034	0.03538987
s_a	.0569	Goodman test:	2.19884807	0.01091083	0.02788873
s_b	.0412	Reset all	Calculate		

Table 37: Sobel Test for H1AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	2.5415	Sobel test:	2.14909287	0.03162704
t_b	4.0259	Aroian test:	2.10320031	0.03544826
		Goodman test:	2.19812696	0.02794006
		Reset all	Calculate	

Table 38: Sobel Test for H1AB. With T statistics

The results show that the mediation effects, as assessed by the Sobel (2.153) (Table 29 Column 17), Aroian (2.108) (Table 29 Column 18), and Goodman (2.202) (Table 29 Column 19) tests, all exceed the critical value of 1.96, indicating that the effects are statistically significant at the 0.05 level.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H1AB.

7.12.1.2 H1ABC'

In Table 29 we have in line 2, the coefficient column 1 Coef-a 0.1459, column 2 Coef-b 0.1679, and column 3 Coef-c'-0.0389.

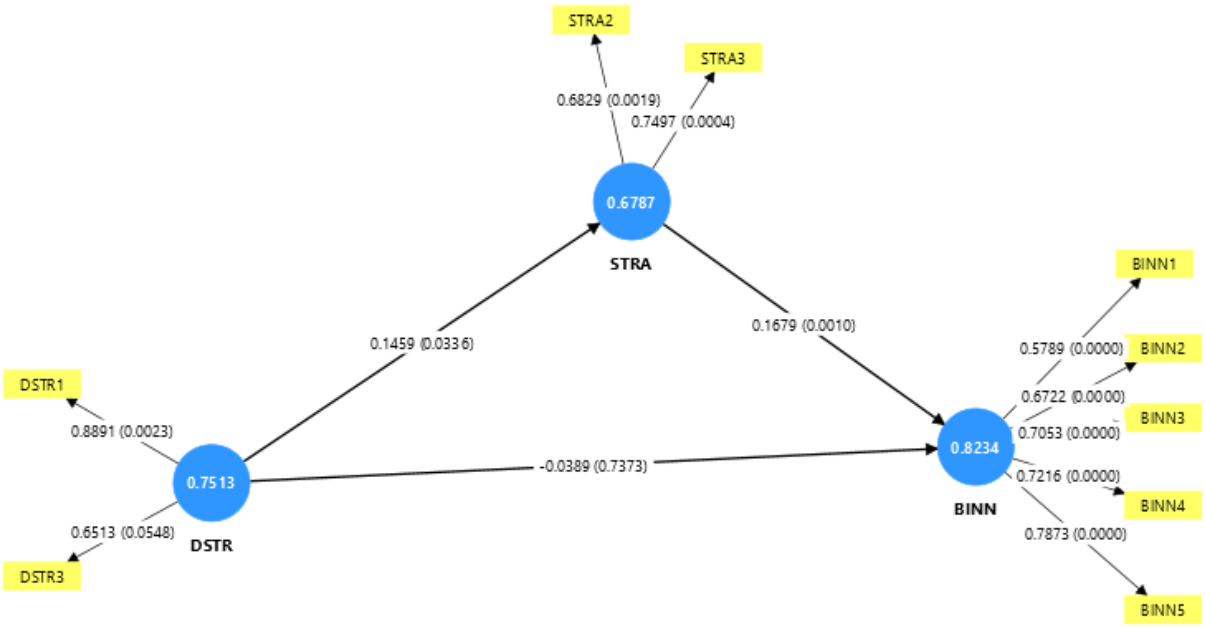


Figure 10: H1 – Bootstrap Test – ABC'.

		Loadings	CR	AVE
Benefits innovative			0.8234	0.4850
	BINN1	0.5789		
	BINN2	0.6722		
	BINN3	0.7053		
	BINN4	0.7216		
	BINN5	0.7873		
Digital strategy			0.7513	0.6073
	DSTR1	0.8891		
	DSTR3	0.6513		
IT strategy			0.6787	0.5142
	STRA2	0.6829		
	STRA3	0.7497		

Table 39: *Standardized Factor Loadings, CR and AVE for H1ABC'*

We have in Table 29 line 2 and column 9 T-stats-a 2.1257, column 10 T-stats-b 3.2992, column 11 T-T-stats-c 0.3354.

R-Square (R^2)

The explanatory power of the structural model was assessed using the coefficient of determination (R^2). As shown in (Table 40), the model explains 2.78% of the variance in Innovative Benefits (BINN) and 2.13% of the variance in IT Strategy (STRA). The corresponding adjusted R^2 values (0.0237 and 0.0192, respectively) indicate that these estimates remain stable after accounting for model complexity.

According to established PLS-SEM guidelines (Hair et al., 2018), these R^2 values reflect very weak explanatory power. While limited, such results are not unusual in exploratory research involving higher-level strategic constructs, where outcomes are typically influenced by a wide range of organizational and contextual factors not fully captured in a prudent model.

These findings suggest that the current model has low predictive capacity, indicating that additional relevant antecedents or contextual variables would be necessary to substantially improve the explained variance.

	R-SQUARE	R-SQUARE ADJUSTED
BINN	0.0278	0.0237
STRA	0.0213	0.0192

Table 40: R-Square for H1ABC

f-Square

To assess the relative contribution of each exogenous construct, effect sizes (f^2) were examined (Table 41). The relationship between Digital Strategy (DSTR) and IT Strategy (STRA) yields a small effect ($f^2 = 0.0217$). Similarly, IT Strategy (STRA) → Innovative Benefits (BINN) shows a small effect ($f^2 = 0.0284$). In contrast, the direct effect of Digital Strategy on Innovative Benefits is negligible ($f^2 = 0.0015$).

Overall, the observed effects are statistically present but substantively limited, reinforcing the weak explanatory power of the model and supporting its characterization as exploratory.

	BINN	DSTR	STRA
BINN			
DSTR	0.0015		0.0217
STRA	0.0284		

Table 41: f-Square for H1ABC

Convergent Validity

Convergent validity (Table 42) was assessed via Average Variance Extracted (AVE).

DSTR (AVE = 0.6073) and STRA (AVE = 0.5142) exceed the 0.50 threshold, indicating adequate convergent validity. BINN (AVE = 0.4850) falls marginally below the threshold.

Following Fornell and Larcker (1981), AVE values slightly below 0.50 may be acceptable when composite reliability exceeds 0.70. Given BINN's strong CR (0.8234), convergent validity is considered borderline but defensible within the exploratory scope of the study.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.8234	0.4850
DSTR	0.3762	0.7513	0.6073
STRA	0.0555	0.6787	0.5142

Table 42: R-Cronbach, CR and AVE for H1ABC

Internal Consistency Reliability

Internal consistency was assessed using Composite Reliability (CR) and Cronbach's alpha (Table 42). Consistent with PLS-SEM guidelines, composite reliability is prioritized due to its relaxed assumptions regarding indicator loadings.

BINN demonstrates satisfactory reliability (CR = 0.8234).

DSTR reaches acceptable reliability (CR = 0.7513).

STRA shows marginal reliability (CR = 0.6787), slightly below the conventional 0.70 threshold but acceptable in exploratory contexts.

Cronbach's alpha values for DSTR (0.3762) and STRA (0.0555) are notably low. Nonetheless, the extremely low alpha for STRA suggests potential measurement specification issues that warrant future refinement.

Discriminant Validity

Heterotrait–Monotrait Ratio (HTMT)

Discriminant validity was further examined using the HTMT ratio (Table 43). The HTMT value between DSTR and BINN (0.1874) falls well below the conservative threshold of 0.85, indicating satisfactory discriminant validity.

The HTMT (Table 43) value between STRA and BINN (0.7937) approaches, but does not exceed, the 0.85 threshold, suggesting a high yet acceptable degree of association.

However, the HTMT value between STRA and DSTR (0.9749) exceeds recommended limits, indicating a lack of discriminant validity between these constructs. This finding suggests substantial conceptual and empirical overlap between IT Strategy and Digital Strategy within the present sample.

Given the theoretical proximity of these constructs and the exploratory nature of the model, this overlap does not invalidate the structural relationships but highlights the need for clearer conceptual delineation and potential measurement refinement in future research.

	BINN	DSTR	STRA
BINN			
DSTR	0.1874		
STRA	0.7937	0.9749	

Table 43- Heterotrait-monotrait ratio (HTMT) for H1ABC

Fornell–Larcker Criterion

Discriminant validity was first evaluated using the Fornell–Larcker criterion (Table 44). The square root of AVE for each construct exceeds its corresponding inter-construct correlations. Specifically:

BINN (AVE = 0.6964) exceeds its correlations with DSTR (-0.0144) and STRA (0.1622).

DSTR (AVE = 0.7793) exceeds its correlations with BINN and STRA (0.1459).

STRA (AVE = 0.7171) exceeds its correlations with BINN and DSTR.

These results provide initial support for discriminant validity

	BINN	DSTR	STRA
BINN	0.6964		
DSTR	-0.0144	0.7793	
STRA	0.1622	0.1459	0.7171

Table 44- Fornell-Larcker criterion for H1ABC

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
c DSTR -> BINN	-0.0389	-0.0315	0.1161	0.3354	0.7373
a DSTR -> STRA	0.1459	0.1482	0.0686	2.1257	0.0336
b STRA -> BINN	0.1679	0.1809	0.0509	3.2992	0.0010

Table 45: Path Coefficients for H1ABC'

In (Table 29) **f**or line 2 column 17, 18, 19 we run the test Sobel and obtained Sobel 1.7869, Aroian 1.7315 and 1.8480 shows in (Table 46).

Input:		Test statistic:	*p*-value:
t_a 2.1257	Sobel test:	1.78691309	0.07395154
t_b 3.2992	Aroian test:	1.73158862	0.08334683
	Goodman test:	1.84790353	0.0646163
	Reset all	Calculate	

Table 46: Sobel Test for H1 ABC'. With coefficient (a b) and standard deviation ($s_{a,}$ s_b).

The Descriptive statistics of constructs are in Appendix I in 7.10 for H1ABC'

7.12.1.3 H1C

We run only the path between the DSTR and BINN the p-value is not significant because is higher than 0.05.

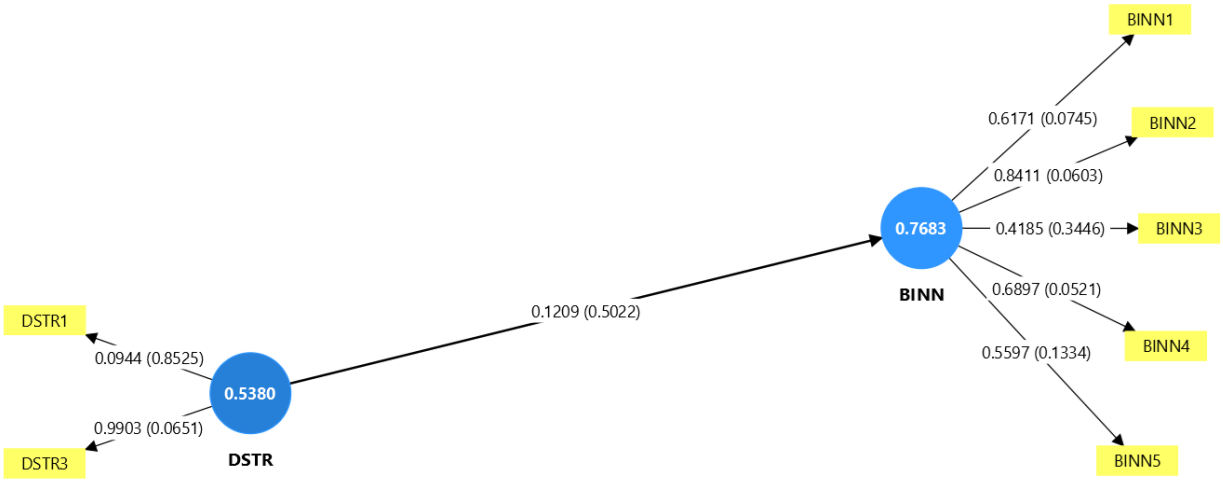


Figure 11: H1 – Boostrap Test – C

		Loadings	CR	AVE
Benefits innovative			0.7683	0.4105
	BINN1	0.6171		
	BINN2	0.8411		
	BINN3	0.4185		
	BINN4	0.6897		
	BINN5	0.5597		
Digital strategy			0.5380	0.4948
	DSTR1	0.0944		
	DSTR3	0.9903		

Table 47: Standardized Factor Loadings, CR and AVE for H1C

Coefficient of Determination (R^2)

The explanatory power of the structural model for H1C was assessed using the coefficient of determination (R^2). As reported in (Table 48), the model explains **1.46%** of the variance in Innovative Benefits (BINN), with an adjusted R^2 of 0.0126.

This value indicates very weak explanatory power, well below the threshold typically associated with even modest predictive relevance (Hair et al., 2018). The result suggests that Digital Strategy (DSTR), when considered in isolation, provides minimal explanation of variance in Innovative

Benefits. From a predictive standpoint, the structural relationship appears limited in substantive magnitude.

	R-SQUARE	R-SQUARE ADJUSTED
BINN	0.0146	0.0126

Table 48:R-Square for H1C

f-Square

Effect size analysis further supports this conclusion. As shown in (Table 49), the path from Digital Strategy (DSTR) to Innovative Benefits (BINN) yields an f^2 of 0.0148, which falls below Cohen's (1988) threshold of 0.02 for a small effect.

This indicates that the removal of Digital Strategy from the model would have a negligible impact on the explained variance of Innovative Benefits. The structural effect is therefore statistically weak and practically minimal.

	BINN	DSTR
BINN		
DSTR	0.0148	

Table 49:f-Square for H1C

Convergent Validity

Internal consistency was evaluated using Composite Reliability (ρc) and Cronbach's alpha (Table 50), with composite reliability serving as the primary reliability indicator in accordance with PLS-SEM guidelines.

Innovative Benefits (BINN) demonstrates acceptable composite reliability (ρc = 0.7683), exceeding the minimum threshold of 0.70.

Digital Strategy (DSTR) exhibits weak reliability (ρc = 0.5380), substantially below the recommended level.

Cronbach's alpha results reinforce this concern. While BINN achieves acceptable internal consistency (α = 0.7313), DSTR presents a very low alpha coefficient (α = 0.3762), indicating poor internal consistency under traditional reliability assumptions.

Taken together, these results suggest that while BINN is measured with acceptable reliability, the operationalization of Digital Strategy in this reduced model lacks internal consistency. This may reflect limited indicator coherence or conceptual breadth within the construct.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.7683	0.4105
DSTR	0.3762	0.5380	0.4948

Table 50: R-Cronbach, CR and AVE for H1C

Convergent validity was assessed using the Average Variance Extracted (AVE). Neither construct fully satisfies the recommended threshold of 0.50:

BINN reports an AVE of 0.4105.

DSTR reports an AVE of 0.4948.

Although DSTR approaches the threshold, both constructs fall below the conventional criterion. According to Fornell and Larcker (1981), convergent validity may be considered acceptable if composite reliability exceeds 0.70; however, in this case, only BINN meets that condition. Consequently, convergent validity for H1C must be regarded as weak, particularly for Digital Strategy.

These findings suggest that the indicators may not sufficiently capture the latent constructs in this simplified structural configuration.

Discriminant Validity

Heterotrait–Monotrait Ratio (HTMT)

The HTMT ratio (Table 51) further supports discriminant validity. The HTMT value between BINN and DSTR is 0.1874, which is substantially below the conservative threshold of 0.85 (Henseler et al., 2015). This indicates a clear empirical distinction between the two constructs.

	BINN	DSTR
BINN		
DSTR	0.1874	

Table 51: Heterotrait-monotrait ratio (HTMT) for H1C

Fornell–Larcker Criterion

Discriminant validity was first assessed using the Fornell–Larcker criterion (Table 52). The square root of AVE for BINN (0.6407) exceeds its correlation with DSTR (0.1209). Similarly, the square root of AVE for DSTR (0.7034) exceeds its correlation with BINN.

These results indicate that, under the Fornell–Larcker criterion, discriminant validity between BINN and DSTR is established.

	BINN	DSTR
BINN	0.6407	
DSTR	0.1209	0.7034

Table 52:Fornell-Larcker criterion for H1C

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
DSTR -> BINN	0.1209	0.0102	0.1802	0.6710	0.5022

Table 53: Path Coefficients for H1C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H1C.

7.12.1.4 H1 verification with decisional tree of Zhao

For validating the decisional tree of Zhao, we need to get the products between the P-Values for each path (AB, C, ABC').

Hypothesis	*A*B (DSTR*STRA) Is significant?*	*C (BINN) Is significant?*	*A*B*C (DSTR* STRA*BINN) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H1	0.03162704 Significant	0.5022 Not significant	0.1459* 0.1679*-0.0389 = -0.0009565 Negative	Indirect-only (**Full mediation**)	Yes

Table 54: Verification with decisional tree of Zhao - H1

Where: A = DSTR = Digital Strategy

B = STRA = IT Strategy

C = BINN = Benefits Innovative

According to Zhao's typology, this configuration corresponds to indirect-only mediation. This means that, within this sample, the association between Digital Strategy and Innovative Benefits is statistically supported only through IT Strategy, rather than through a direct relationship.

It is important to emphasize that, given the variance-based nature of PLS-SEM, these findings indicate predictive mediation rather than causal mediation. The results suggest that the inclusion of IT Strategy improves the predictive relationship between Digital Strategy and Innovative Benefits under the proposed structural model.

Table 46 presents the analysis of Hypothesis 1 (H1) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis. The mediation is very strong. The relationship operates primarily through the mediating mechanism
- The variable strategy (STRA) is essential to have effect on Digital strategy to have benefits (BINN). Digital Strategy does not translate into benefits independently.
- The relation C (DSTR BINN) alone not is valid and alone is worse.
- The relation AB (DSTR STRA) is very strong.
- Innovative Benefits (BINN) are more likely to materialize when IT Strategy (STRA) is established
- If there is a digital strategy, there is little possibility of having an innovation effect, unless you have an aligned IT strategy.

- We need to have a strategy based onto human resources, the developing field has taken the concern of "humanize management" seriously by bringing human actors to the center of the strategy (Gürbüz et al., 2017). The poste to have a “Digital transformation” it could be Chief Digital Officier-CDO (Kollmann et al., 2023) and uses the AI to generate "Digital Innovation" of new, business models and processes as well as the associated corporate management in the form of "Digital Leadership".

7.12.2 H2: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Benefits Operational (BOPR)

Test Variables: DSTR > STRA > BOPR.

The alignment of IT-related strategies with broader digital transformation objectives may be relevant to the realization of operational improvements. Yucel (Yucel, 2018) identifies efficiency, productivity, quality, and process-related improvements among the objectives and benefits associated with digital transformation. Based on this perspective, the present study examines whether IT Strategy mediates the relationship between Digital Strategy and Operational Benefits, as specified in H2.

We resumed the result in the (Table 29) of mediation. In the second 3 lines (4, 5, 6) are the hypothesis H2 with the different paths: AB, ABC and C.

7.12.2.1 H2AB

We can see in the (Table 29) column (1,2), line (4) of coefficient is Coef-a 0.1467, Coef-b 0.2895.

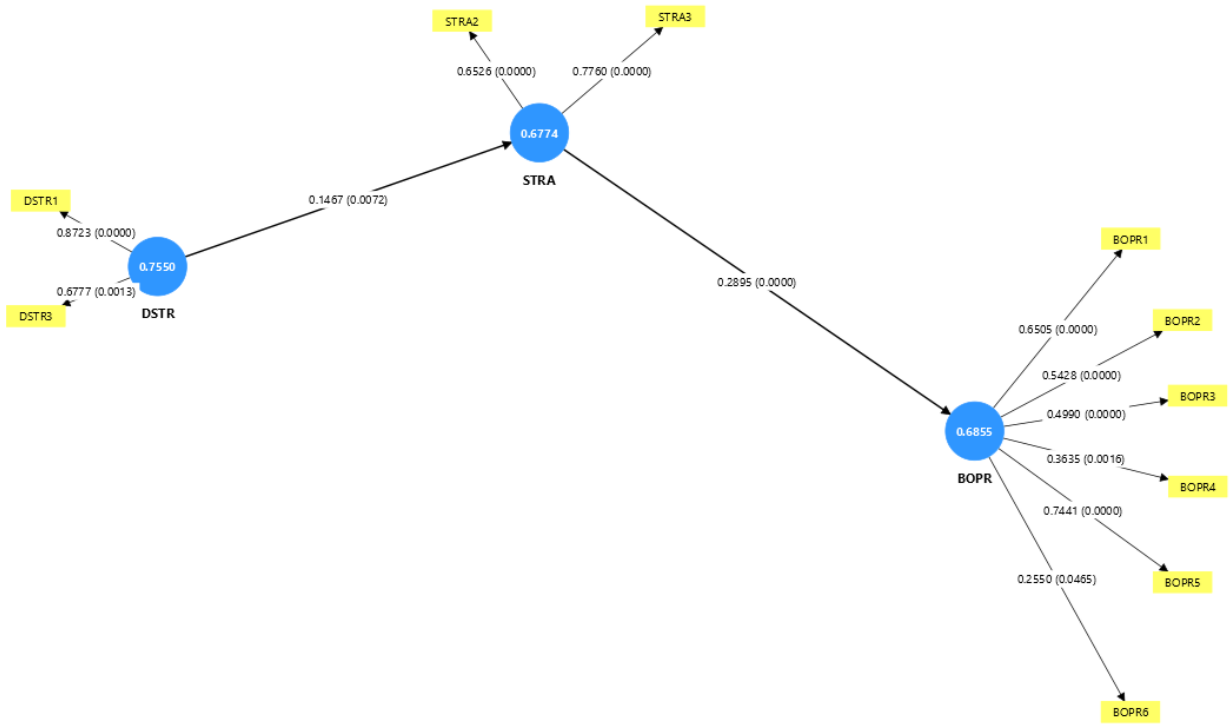


Figure 12: H2 – Boostrap Test - AB

		Loadings	CR	AVE
Benefits Operational			0.6855	0.2863
	BOPR1	0.6505		
	BOPR2	0.5428		
	BOPR3	0.4990		
	BOPR4	0.3635		
	BOPR5	0.7441		
	BOPR6	0.2550		
Digital strategy			0.7550	0.6101
	DSTR1	0.8723		
	DSTR3	0.6777		
IT strategy			0.6774	0.5140
	STRA2	0.6526		
	STRA3	0.7760		

Table 55: Standardized Factor Loadings, CR and AVE for H2AB

R-Square (R^2)

The explanatory power of the model for H2AB is presented in (Table 56).

The model explains 8.38% of the variance in BOPR ($R^2 = 0.0838$; adjusted $R^2 = 0.0819$).

The model explains 2.15% of the variance in STRA ($R^2 = 0.0215$; adjusted $R^2 = 0.0195$).

The R^2 value for BOPR indicates modest predictive power, while the explanatory power for STRA remains weak. These results suggest that, although the included predictors show some association with Benefits Operational (BOPR), a substantial portion of variance remains unexplained, indicating that additional variables may influence the construct.

	R-SQUARE	R-SQUARE ADJUSTED
BOPR	0.0838	0.0819
STRA	0.0215	0.0195

Table 56:R-Square for H2AB

f-Square

Effect sizes (f^2) were assessed to evaluate the relative contribution of each predictor construct (Table 57).

STRA → BOPR: $f^2 = 0.0915$

DSTR → STRA: $f^2 = 0.0220$

Effect sizes (f^2) were calculated to assess the relative contribution of each predictor (Table 49). The effect of STRA on BOPR ($f^2 = 0.0915$) and of DSTR on STRA ($f^2 = 0.0220$) are both small according to conventional thresholds, suggesting that these predictors have a limited impact on the variance of their respective endogenous constructs within this model.

	BOPR	DSTR	STRA
BOPR			
DSTR			0.0220
STRA	0.0915		

Table 57:f-Square for H2AB

Internal Consistency Reliability

Internal consistency reliability was assessed using Cronbach's alpha and Composite Reliability (Table 58).

BOPR: $\alpha = 0.5107$; CR = 0.6855

DSTR: $\alpha = 0.3762$; CR = 0.7550

STRA: α = 0.0555; CR = 0.6774

Composite reliability values approach or exceed the recommended threshold of 0.70 for DSTR and are slightly below for BOPR and STRA. However, Cronbach's alpha values are low, particularly for STRA and DSTR, suggesting potential internal consistency limitations.

Given that Cronbach's alpha may underestimate reliability in PLS contexts and that composite reliability is generally preferred, these findings should nevertheless be interpreted with caution. The low alpha values may reflect a limited number of indicators or conceptual heterogeneity within the constructs.

Convergent Validity

Convergent validity was assessed through the Average Variance Extracted (AVE) (Table 58).

BOPR: AVE = 0.2863

DSTR: AVE = 0.6101

STRA: AVE = 0.5140

DSTR and STRA exceed the recommended threshold of 0.50, indicating acceptable convergent validity. However, BOPR does not meet the threshold, suggesting that the indicators may not adequately capture the variance of the latent construct. This limitation should be acknowledged when interpreting structural relationships involving BOPR.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6855	0.2863
DSTR	0.3762	0.7550	0.6101
STRA	0.0555	0.6774	0.5140

Table 58: R-Cronbach, CR and AVE for H2AB

Discriminant Validity

Discriminant validity was assessed using both the HTMT ratio (Table 51) and the Fornell-Larcker criterion (Table 59).

Heterotrait-monotrait ratio (HTMT)

HTMT values (Table 59) between constructs remain below the conservative threshold of 0.85 in most cases.

However, the HTMT value between STRA and BOPR (1.5147) exceeds acceptable thresholds, indicating potential discriminant validity concerns. This suggests that STRA and BOPR may not be empirically distinct in this dataset, or that measurement issues may be present.

These findings indicate that discriminant validity is not fully established for all construct pairs, which may affect the robustness of the structural interpretation.

	BOPR	DSTR	STRA
BOPR			
DSTR	0.2955		
STRA	1.5147	0.9749	

Table 59: Heterotrait-monotrait ratio (HTMT) for H2AB

Fornell-Larcker criterion

The Fornell-Larcker criterion (Table 60) is generally satisfied, as the square roots of AVE exceed the inter-construct correlations for most constructs. Nevertheless, the potential overlap between STRA and BOPR highlighted by the HTMT suggests that discriminant validity is not fully established for all pairs, which may affect the interpretation of structural relationships in this model.

	BOPR	DSTR	STRA
BOPR	0.5351		
DSTR	0.0615	0.7811	
STRA	0.2895	0.1467	0.7170

Table 60:Fornell-Larcker criterion for H2AB

Path Coefficients

In (Table 61) the line 4, column 9 and 10, are the T-stats-a 2.6893 and T-stats-b 7.6028. Here in table of requirements (Table 21) says these values should be higher than 1.96 and both cases are significant.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
a DSTR -> STRA	0.1467	0.1563	0.0545	2.6893	0.0072
b STRA -> BOPR	0.2895	0.3061	0.0381	7.6028	0.0000

Table 61: Path Coefficients for H2AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 61 Path Coefficients for H2AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1467	Sobel test:	2.5372437	0.0167385	0.01117291
b	0.2895	Aroian test:	2.51794337	0.0168668	0.01180423
s_a	0.0545	Goodman test:	2.55699476	0.0166092	0.01055808
s_b	0.0381	Reset all	Calculate		

Table 62: Sobel Test for H2AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	2.6893	Sobel test:	2.53535964	0.01123319
t_b	7.6028	Aroian test:	2.51608928	0.01186651
		Goodman test:	2.55507965	0.01061635
		Reset all	Calculate	

Table 63: Sobel Test for H2AB. With T statistics

The results show (Table 62 and 63) that the mediation effects, as assessed by Sobel, 2.5372 (Table 29 column 17), Aroian, 2.5179 (Table 29 column 18), Goodman, 2.5569 (Table 29 column 19. These values are higher than 1.96 and are significantly acceptable.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H2AB.

7.12.2.2 H2ABC'

In **Table 29** we have in line 5, the coefficient column 1 Coef-a 0.1454, column 2 Coef-b 0.2852, and column 3 Coef-c'0.0300.

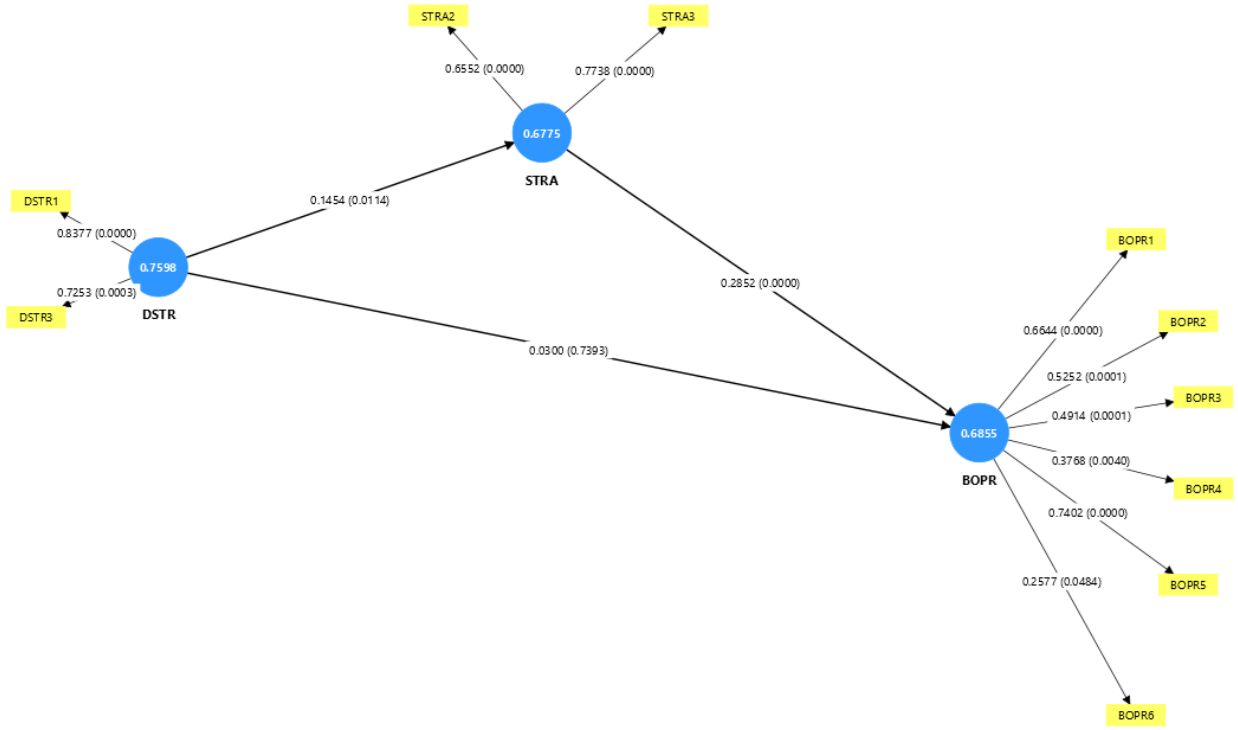


Figure 13: H2 – Boostrap Test - ABC'.

	Loadings	CR	AVE
Benefits Operational		0.6855	0.2858
BOPR1	0.6644		
BOPR2	0.5252		
BOPR3	0.4914		
BOPR4	0.3768		
BOPR5	0.7402		
BOPR6	0.2577		
Digital strategy		0.7598	0.6139
DSTR1	0.8377		
DSTR3	0.7253		
IT strategy		0.6775	0.5141
STRA2	0.6552		
STRA3	0.7738		

Table 64: Standardized Factor Loadings, CR and AVE for H2ABC

Coefficient of Determination (R^2)

The explanatory power of the model is presented in (Table 65).

BOPR: $R^2 = 0.0847$ (Adjusted $R^2 = 0.0809$)

STRA: $R^2 = 0.0211$ (Adjusted $R^2 = 0.0191$)

The model explains approximately 8.5% of the variance in BOPR and 2.1% in STRA. While the explanatory power for BOPR can be considered modest, the predictive power for STRA remains weak.

	R-SQUARE	R-SQUARE ADJUSTED
BOPR	0.0847	0.0809
STRA	0.0211	0.0191

Table 65:R-Square for H2ABC

f-Square

Effect sizes were calculated to evaluate the relative contribution of each predictor (Table 66).

STRA → BOPR: $f^2 = 0.0870$

DSTR → STRA: $f^2 = 0.0216$

DSTR → BOPR: $f^2 = 0.0010$

According to conventional thresholds, these effect sizes are small, with the direct effect of DSTR on BOPR being negligible. This suggests that, within this model, the predictive contribution of DSTR to BOPR is minimal when STRA is included. The association between STRA and BOPR remains small but comparatively stronger than the direct DSTR–BOPR relationship.

	BOPR	DSTR	STRA
BOPR			
DSTR	0.0010		0.0216
STRA	0.0870		

Table 66:f-Square for H2ABC

Internal Consistency Reliability

Internal consistency was assessed using Cronbach's alpha and Composite Reliability (Table 67).

BOPR: $\alpha = 0.5107$; CR = 0.6855

DSTR: $\alpha = 0.3762$; CR = 0.7598

STRA: $\alpha = 0.0555$; CR = 0.6775

Composite reliability values approach or slightly exceed recommended thresholds for DSTR but remain below 0.70 for BOPR and STRA. Cronbach's alpha values are notably low, particularly for STRA, indicating potential internal consistency concerns. Although composite reliability is generally preferred in PLS-SEM, these results suggest that the measurement quality of some constructs may be limited.

Convergent Validity

Convergent validity was evaluated through the Average Variance Extracted (AVE) (Table 57).

BOPR: AVE = 0.2858

DSTR: AVE = 0.6139

STRA: AVE = 0.5141

DSTR and STRA meet the recommended threshold of 0.50, indicating acceptable convergent validity. However, BOPR falls below the threshold, suggesting that its indicators may not sufficiently capture the variance of the latent construct. This limitation should be considered when interpreting relationships involving BOPR.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6855	0.2858
DSTR	0.3762	0.7598	0.6139
STRA	0.0555	0.6775	0.5141

Table 67: R-Cronbach, CR and AVE for H2ABC

Discriminant Validity

Discriminant validity was assessed using the HTMT ratio (Table 68) and the Fornell-Larcker criterion (Table 69).

Most HTMT values are below conservative thresholds; however, the HTMT value between STRA and BOPR (1.5147) exceeds acceptable limits. This indicates a potential lack of empirical distinctiveness between these two constructs within the present sample.

The Fornell-Larcker criterion is generally satisfied, as the square roots of AVE exceed inter-construct correlations in most cases. Nonetheless, the elevated HTMT value suggests that discriminant validity between STRA and BOPR is not fully established.

	BOPR	DSTR	STRA
BOPR			
DSTR	0.2955		
STRA	1.5147	0.9749	

Table 68: Heterotrait-monotrait ratio (HTMT) for H2ABC

	BOPR	DSTR	STRA
BOPR	0.5346		
DSTR	0.0715	0.7835	
STRA	0.2896	0.1454	0.7170

Table 69:Fornell-Larcker criterion for H2ABC

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
c DSTR -> BOPR	0.0300	0.0313	0.0902	0.3328	0.7393
a DSTR -> STRA	0.1454	0.1531	0.0574	2.5314	0.0114
b STRA -> BOPR	0.2852	0.2986	0.0467	6.1099	0.0000

Table 70: Path Coefficients for H2ABC'

Input:		Test statistic:	*p*-value:
t_a 2.5314	Sobel test:	2.33862791	0.0193547
t_b 6.1099	Aroian test:	2.31234378	0.02075875
	Goodman test:	2.36582922	0.01798974
	Reset all	Calculate	

Table 71: Sobel Test for H2ABC'. With coefficient (a b) and standard deviation (s_a, s_b).

The Descriptive statistics of constructs are in Appendix I in 7.10 for H2ABC'.

7.12.2.3 H2C

We run only the path between the DSTR and BOPR the p-value is not significant because is higher than 0.05.

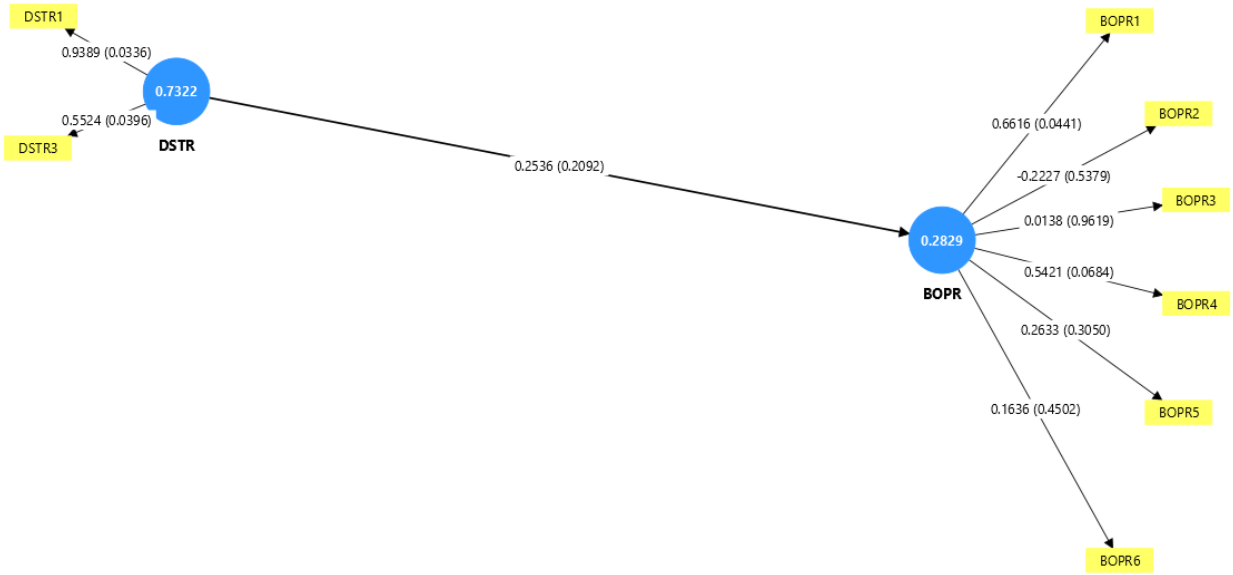


Figure 14: H2 – Boostrap Test - C.

	Loadings	CR	AVE
Benefits Operational		0.2829	0.1463
BOPR1	0.6616		
BOPR2	-0.2227		
BOPR3	0.0138		
BOPR4	0.5421		
BOPR5	0.2633		
BOPR6	0.1636		
Digital strategy		0.7322	0.5933
DSTR1	0.9389		
DSTR3	0.5524		

Table 72: Standardized Factor Loadings, CR and AVE for H2C

R-Square (R2)

The explanatory power of the model is presented in (Table 73).

BOPR: $R^2 = 0.0643$ (Adjusted $R^2 = 0.0623$)

The model explains approximately 6.4% of the variance in BOPR. This indicates weak predictive power, suggesting that Digital Strategy (DSTR) accounts for only a small proportion of the variance in Benefits Operational (BOPR) within this sample.

	R-SQUARE	R-SQUARE ADJUSTED
BOPR	0.0643	0.0623

Table 73:R-Square for H2C

f-Square

The effect size of DSTR on BOPR is reported in (Table 74):

DSTR → BOPR: $f^2 = 0.0687$

According to conventional thresholds, this effect size is small. This suggests that the predictive contribution of DSTR to BOPR is limited in magnitude in the present model.

	BOPR	DSTR
BOPR		
DSTR	0.0687	

Table 74:f-Square for H2C

Internal Consistency Reliability

Internal consistency reliability was assessed using Cronbach's alpha and Composite Reliability (Table 75).

BOPR: $\alpha = 0.5107$; CR = 0.2829

DSTR: $\alpha = 0.3762$; CR = 0.7322

While DSTR demonstrates acceptable composite reliability, BOPR exhibits a very low composite reliability (CR = 0.2829), well below recommended thresholds. Cronbach's alpha values are also low for both constructs.

These results indicate substantial reliability concerns for BOPR and suggest that the measurement quality of this construct may be insufficient in the current specification. Consequently, structural interpretations involving BOPR should be treated with caution.

Convergent Validity

Convergent validity was evaluated using the Average Variance Extracted (AVE) (Table 75).

BOPR: AVE = 0.1463

DSTR: AVE = 0.5933

DSTR exceeds the recommended threshold of 0.50, indicating acceptable convergent validity. However, BOPR falls substantially below the threshold, suggesting that its indicators do not adequately capture the variance of the latent construct. This further reinforces concerns regarding the robustness of findings related to BOPR.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.2829	0.1463
DSTR	0.3762	0.7322	0.5933

Table 75: R-Cronbach, CR and AVE for H2C

Discriminant Validity

Discriminant validity was evaluated using both the Heterotrait–Monotrait ratio (HTMT) (see Table 76) and the Fornell–Larcker criterion (see Table 77).

The HTMT value between DSTR and BOPR is 0.2955, which is well below commonly accepted thresholds (e.g., 0.85 or 0.90). This indicates that there are no significant concerns regarding discriminant validity between these two constructs.

The Fornell–Larcker criterion is also satisfied, as the square root of the Average Variance Extracted (AVE) for each construct is higher than its correlation with the other construct. This further supports that DSTR and BOPR are empirically distinct.

However, despite the absence of discriminant validity issues, the low reliability and weak convergent validity of BOPR reduce the robustness of the model. As a result, the interpretation of findings related to this construct should be made with caution.

	BOPR	DSTR
BOPR		
DSTR	0.2955	

Table 76: Heterotrait-monotrait ratio (HTMT) for H2C

	BOPR	DSTR
BOPR	0.3824	
DSTR	0.2536	0.7703

Table 77:Fornell-Larcker criterion for H2C

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
DSTR -> BOPR	0.2536	0.1917	0.2019	1.2559	0.2092

Table 78: Path Coefficients for H2C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H2C.

7.12.2.4 H2 verification with decisional tree of Zhao

Hypothesis	*A*B (DSTR*STRA) Is significant?*	*C (BOPR) Is significant?*	*A*B*C (DSTR* STRA* BOPR) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H2	.01123319 Significant	0.2092 Not significant	.1454* 0.2852*0.0300 Positive	Complementary (**Mediation**)	Yes

Table 79: Verification with decisional tree of Zhao – H2

Where: A = DSTR = Digital Strategy

B = STRA = IT Strategy

C = BOPR = Benefits Operational

Table 79 presents the analysis of Hypothesis 2 (H2) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis
- The mediation effect of IT Strategy (STRA) between Digital Strategy (DSTR) and Operational Benefits (BOPR) is relatively **strong**, suggesting that the presence of an aligned IT strategy may enhance the potential benefits of a digital strategy.
- The variable strategy (STRA) is essential to have effect on Digital strategy to have benefits (BOPR). Without strategy there are not benefits.
- The relation C (DSTR BOPR) alone not is valid and alone is worse.
- The relation AB (DSTR STRA) is very strong.
- If we have an IT Strategy (STRA), we will have benefits (BOPR).
- If there is a digital strategy, there is little possibility of having an operational effect, unless you have an aligned IT strategy.
- These findings suggest that organizations with a well-defined IT strategy may have a higher likelihood of realizing operational benefits from digital initiatives.
- In this hypothesis we see different factors: IT support to have benefits operational, and the leadership side. We can examine three antecedents (CIO human capital, CIO structural power, and organizational support for IT) and two effects (IT contribution to firm efficiency and strategic growth) of CIO leadership (Chen et al., 2010).

7.12.3 H3: IT Strategy (STRA) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps (AGIL)

Test Variables: DSTR > STRA > AGIL

Yucel (Yucel, 2018) highlights the importance of aligning supporting strategies and organizational capabilities with digital transformation objectives. The paper also discusses the adoption of modern software development and delivery approaches, including Agile and DevOps. Building on these considerations, this study examines whether IT Strategy mediates the relationship between Digital Strategy and Agile/DevOps practices. This proposed relationship is evaluated through H3. We resumed the result in the (Table 29) of mediation. In the lines (7, 8, 9) are the hypothesis H3 with the different paths: AB, ABC and C. In (Table 21) we can see the requirements for the coefficients should be 1.96 or higher.

7.12.3.1 H3AB

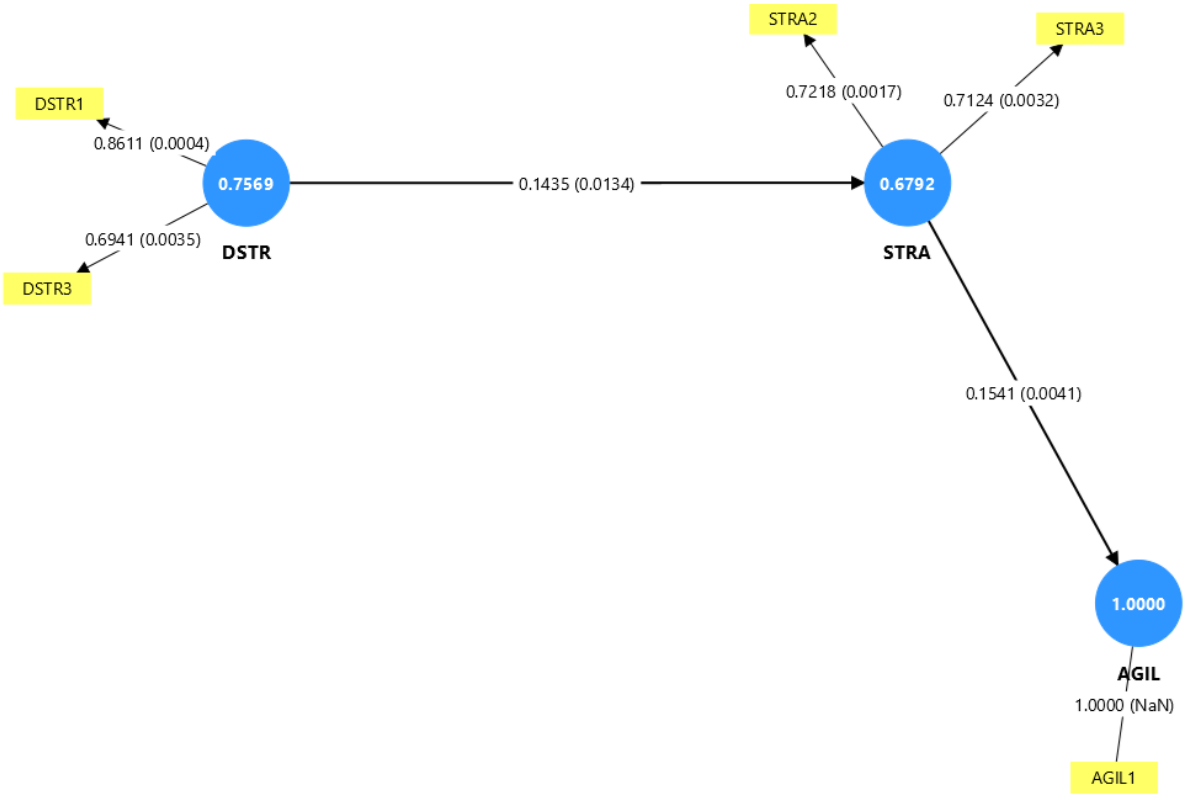


Figure 15: H3 – Boostrap Test –AB.

		Loadings	CR	AVE
Agile/DevOps				
	AGIL1	1.0000		
Digital strategy			0.7569	0.6116
	DSTR1	0.8611		
	DSTR3	0.6941		
IT strategy			0.6792	0.5143
	STRA2	0.7218		
	STRA3	0.7124		

Table 80: Standardized Factor Loadings, CR and AVE for H3AB

In (Table 29) the line 7, column 9 and 10, are the T-stats-a 2.4746 and T-stats-b 2.8737. Here in table of requirements says these values should be higher than 1.96 and both cases are significant.

R-Square (R2)

The explanatory power of the model is reported in (Table 81).

AGIL: $R^2 = 0.0237$ (Adjusted $R^2 = 0.0217$)

STRA: $R^2 = 0.0206$ (Adjusted $R^2 = 0.0185$)

The model explains approximately 2.4% of the variance in AGIL and 2.1% in STRA. These values indicate weak predictive power, suggesting that the included predictors account for only a small proportion of variance in the endogenous constructs.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0237	0.0217
STRA	0.0206	0.0185

Table 81:R-Square for H3AB

f-Square

Effect sizes were calculated to assess the relative contribution of each predictor (Table 82).

STRA → AGIL: $f^2 = 0.0243$

DSTR → STRA: $f^2 = 0.0210$

According to conventional thresholds, these effect sizes are small. This indicates that the predictive contribution of the exogenous constructs to their respective endogenous variables is limited in magnitude within this model.

	AGIL	DSTR	STRA
AGIL			
DSTR			0.0210
STRA	0.0243		

Table 82:f-Square for H3AB

Internal Consistency Reliability

Internal consistency was evaluated using Cronbach's alpha and Composite Reliability (Table 83).

DSTR: $\alpha = 0.3762$; CR = 0.7569

STRA: $\alpha = 0.0555$; CR = 0.6792

While DSTR demonstrates acceptable composite reliability (CR), STRA remains slightly below the recommended threshold of 0.70. Cronbach's alpha values are low for both constructs, particularly for STRA, suggesting potential internal consistency concerns. Although composite reliability is generally preferred in PLS-SEM, these results indicate that measurement robustness especially for STRA may be limited.

Convergent Validity

Convergent validity was assessed through the Average Variance Extracted (AVE) (Table 83).

- DSTR**:** AVE = 0.6116
- STRA**:** AVE = 0.5143

Both constructs exceed the recommended threshold of 0.50, indicating acceptable convergent validity.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7569	0.6116
STRA	0.0555	0.6792	0.5143

Table 83: R-Cronbach, CR and AVE for H3AB

Discriminant Validity

Discriminant validity was examined using the HTMT ratio (Table 84) and the Fornell-Larcker criterion (Table 85).

Most HTMT values are below the conservative threshold of 0.85, suggesting adequate discriminant validity between construct pairs. However, the HTMT value between STRA and

DSTR (0.9749) exceeds recommended thresholds, indicating potential lack of empirical distinctiveness between these two constructs in the present sample.

The Fornell-Larcker criterion is generally satisfied, as the square roots of AVE exceed inter-construct correlations. Nevertheless, the elevated HTMT value suggests that discriminant validity between STRA and DSTR may not be fully established.

These results indicate that structural relationships involving STRA and DSTR should be interpreted with caution, as potential construct overlap may influence path estimates.

	AGIL	DSTR	STRA
AGIL			
DSTR	0.2920		
STRA	0.6532	0.9749	

Table 84: Heterotrait-monotrait ratio (HTMT) for H3AB

	AGIL	DSTR	STRA
AGIL	1.0000		
DSTR	0.1837	0.7821	
STRA	0.1541	0.1435	0.7171

Table 85:Fornell-Larcker criterion for H3AB

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
a DSTR -> STRA	0.1435	0.1572	0.0580	2.4746	0.0134
b STRA -> AGIL	0.1541	0.1560	0.0536	2.8737	0.0041

Table 86: Path Coefficients for H3AB

Next steps do the Sobel test of the **Table 29** the line 7, column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 86 Path Coefficients for H3AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1435	Sobel test:	1.87532647	0.01179173	0.06074782
b	0.1541	Aroian test:	1.8133641	0.01219466	0.06977568
s_a	0.0580	Goodman test:	1.94410802	0.01137455	0.05188243
s_b	0.0536	Reset all	Calculate		

Table 87: Sobel Test for H3AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	2.4746	Sobel test:	1.87516661	0.06076981
t_b	2.8737	Aroian test:	1.81318827	0.06980279
		Goodman test:	1.94396849	0.05189925
		Reset all	Calculate	

Table 88: Sobel Test for H3AB. With T statistics

The results show (Table 87 and 88) that the mediation effects, as assessed by Sobel, 1.8753 (Table 29 column 17), Aroian, 1.8133 (Table 29 column 18), Goodman, 1.9441 (Table 29 column 19. These values are slightly below the conventional significance threshold of 1.96 for a two-tailed test at $p < 0.05$.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H3AB.

7.12.3.2 H3ABC'

In **Table 29** we have in line 8, the coefficient column 1 Coef-a 0.1437, column 2 Coef-b 0.1302, and column 3 Coef-c'0.1652.

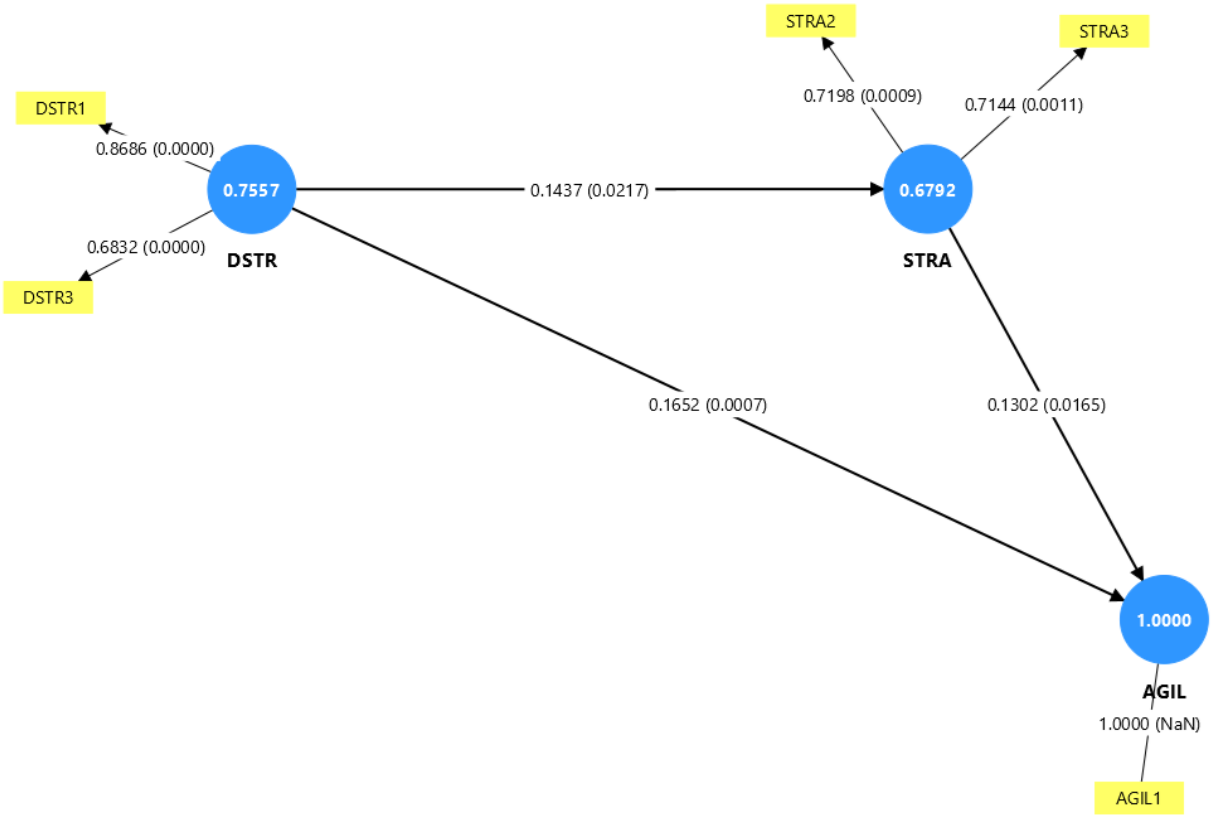


Figure 16: H3 – Boostrap Test – ABC'.

		Loadings	CR	AVE
Agile/DevOps				
	AGIL1	1.0000		
Digital strategy			0.7557	0.6106
	DSTR1	0.8686		
	DSTR3	0.6832		
IT strategy			0.6792	0.5143
	STRA2	0.7198		
	STRA3	0.7144		

Table 89: *Standardized Factor Loadings, CR and AVE for H3ABC'*

R-Square (R2)

The explanatory power of the model is presented in (Table 89).

- **AGIL:** $R^2 = 0.0504$ (Adjusted $R^2 = 0.0464$)
- **STRA:** $R^2 = 0.0207$ (Adjusted $R^2 = 0.0186$)

The model explains approximately 5.0% of the variance in AGIL and 2.1% in STRA. While the explanatory power for AGIL is slightly higher compared to H3AB, both R^2 values remain weak according to established benchmarks. This indicates that the included predictors account for only a limited proportion of variance in the endogenous constructs.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0504	0.0464
STRA	0.0207	0.0186

Table 90:R-Square for H3ABC'

f-Square

Effect sizes were assessed to determine the relative contribution of each predictor construct (Table 91).

DSTR → AGIL: $f^2 = 0.0282$

DSTR → STRA: $f^2 = 0.0211$

STRA → AGIL: $f^2 = 0.0175$

According to conventional guidelines, all reported effect sizes fall within the small range. This suggests that each exogenous construct contributes only modestly to explaining its respective endogenous variable within the model.

	AGIL	DSTR	STRA
AGIL			
DSTR	0.0282		0.0211
STRA	0.0175		

Table 91:f-Square for H3ABC'

Internal Consistency Reliability

Internal consistency was evaluated using Cronbach's alpha and Composite Reliability (Table 92).

- **DSTR:** $\alpha = 0.3762$; CR = 0.7557
- **STRA:** $\alpha = 0.0555$; CR = 0.6792

DSTR demonstrates acceptable composite reliability, although Cronbach's alpha is low. STRA exhibits particularly low Cronbach's alpha and a composite reliability slightly below the recommended threshold of 0.70, indicating potential internal consistency limitations. While composite reliability is generally preferred in PLS-SEM, these findings suggest that STRA's measurement properties remain weak and may influence structural estimates.

Convergent Validity

Convergent validity was assessed using Average Variance Extracted (AVE) (Table 92).

- **DSTR:** AVE = 0.6106
- **STRA:** AVE = 0.5143

Both constructs exceed the 0.50 threshold, indicating acceptable convergent validity.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7557	0.6106
STRA	0.0555	0.6792	0.5143

Table 92: R-Cronbach, CR and AVE for H3ABC'

Discriminant Validity

Discriminant validity was examined using the HTMT ratio (Table 93) and the Fornell-Larcker criterion (Table 94).

Most HTMT values fall below conservative thresholds, indicating acceptable discriminant validity across most construct pairs. However, the HTMT value between STRA and DSTR (0.9749) substantially exceeds recommended cutoffs (0.85–0.90), suggesting a lack of clear empirical distinction between these two constructs.

The Fornell-Larcker criterion appears satisfied, as the square roots of AVE exceed inter-construct correlations. Nevertheless, given the elevated HTMT value, discriminant validity between STRA and DSTR remains questionable.

Accordingly, structural relationships involving STRA and DSTR should be interpreted with caution, as potential construct overlap may inflate or attenuate path estimates.

	AGIL	DSTR	STRA
AGIL			
DSTR	0.2920		
STRA	0.6532	0.9749	

Table 93: Heterotrait-monotrait ratio (HTMT) for H3ABC'

	AGIL	DSTR	STRA
AGIL	1.0000		
DSTR	0.1840	0.7814	
STRA	0.1540	0.1437	0.7171

Table 94:Fornell-Larcker criterion for H3ABC'

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
c DSTR -> AGIL	0.1652	0.1691	0.0485	3.4077	0.0007
a DSTR -> STRA	0.1437	0.1505	0.0626	2.2967	0.0217
b STRA -> AGIL	0.1302	0.1318	0.0543	2.3981	0.0165

Table 95: Path Coefficients for H3ABC

Input:		Test statistic:	*p*-value:
t_a 2.2967	Sobel test:	1.65870131	0.097176
t_b 2.3981	Aroian test:	1.58823995	0.11223209
	Goodman test:	1.73945778	0.08195427
	Reset all	Calculate	

Table 96: Sobel Test for H3ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H3ABC.

7.12.3.3 H3C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

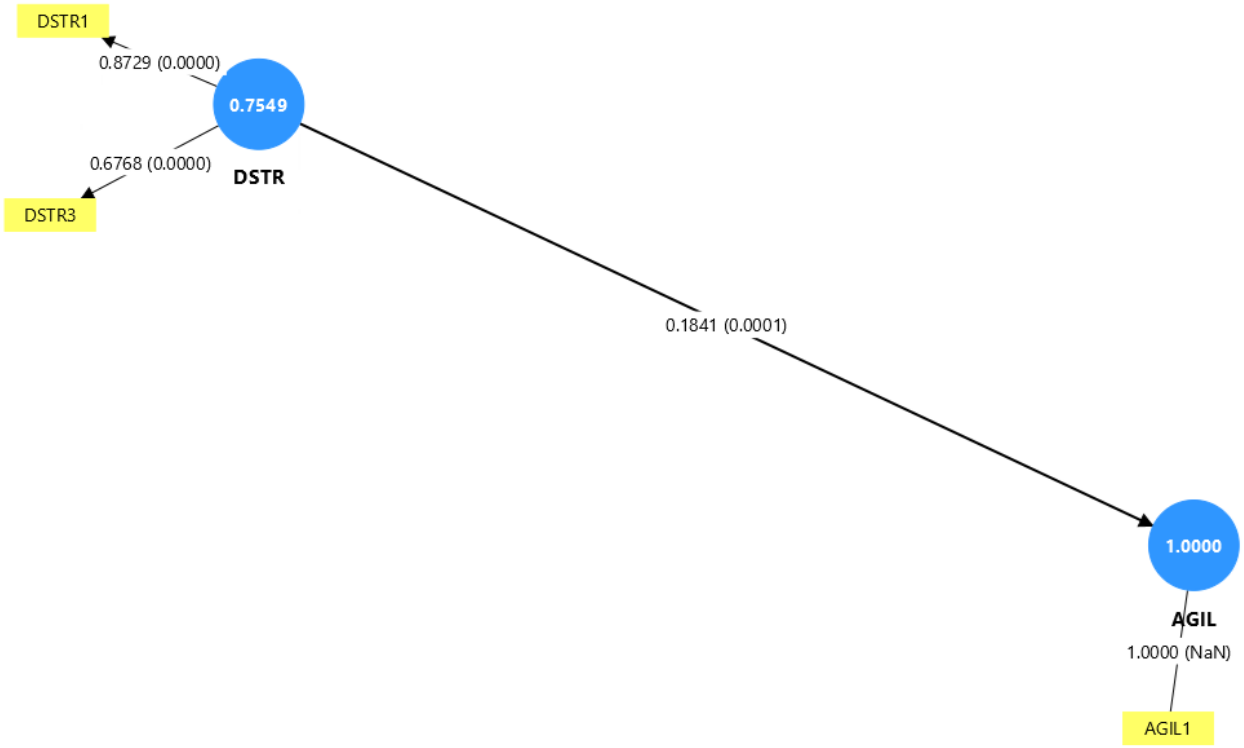


Figure 17: H3 – Boostrap Test – C

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Digital strategy		0.7549	0.6100
DSTR1	0.8729		
DSTR3	0.6768		

Table 97: *Standardized Factor Loadings, CR and AVE for H3C*

R-Square (R2)

The explanatory power of the model is presented in (Table 98).

AGIL: $R^2 = 0.0339$ (Adjusted $R^2 = 0.0319$)

The model explains approximately 3.4% of the variance in AGIL. According to established benchmarks, this represents weak explanatory power, indicating that DSTR accounts for only a small proportion of variance in AGIL.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0339	0.0319

Table 98:R-Square for H3C

f-Square

Effect size was assessed to evaluate the magnitude of the predictive contribution (Table 99).

DSTR → AGIL: $f^2 = 0.0351$

Based on conventional thresholds, this effect size can be considered small. This indicates that the contribution of DSTR to explaining AGIL is limited in magnitude within the context of this model.

	AGIL	DSTR
AGIL		
DSTR	0.0351	

Table 99:f-Square for H3C

Internal Consistency Reliability

Internal consistency was assessed using Cronbach's alpha and Composite Reliability (Table 100).

- **DSTR:**
  - Cronbach's alpha = 0.3762
  - Composite Reliability (CR) = 0.7549

While composite reliability exceeds the recommended threshold of 0.70, Cronbach's alpha remains low. In PLS-SEM, composite reliability is generally preferred; therefore, DSTR can be considered to demonstrate acceptable internal consistency. However, the low alpha value suggests that the reliability of the construct should be interpreted cautiously.

Convergent Validity

Convergent validity was evaluated using the Average Variance Extracted (AVE) (Table 100).

- **DSTR:** AVE = 0.6100

The AVE exceeds the recommended threshold of 0.50, indicating satisfactory convergent validity.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7549	0.6100

Table 100: R-Cronbach, CR and AVE for H3C

Discriminant Validit

HTMT

Discriminant validity was assessed using both the HTMT ratio (Table 101) and the Fornell-Larcker criterion (Table 102).

HTMT (DSTR–AGIL): 0.2920

This value is well below conservative thresholds (0.85–0.90), indicating adequate discriminant validity between DSTR and AGIL.

	AGIL	DSTR
AGIL		
DSTR	0.2920	

Table 101: Heterotrait-monotrait ratio (HTMT) for H3C

Fornell-Larcker criterion

The Fornell-Larcker criterion is also satisfied, as the square root of AVE for DSTR (0.7810) exceeds its correlation with AGIL (0.1841). Thus, discriminant validity appears to be established for this model.

	AGIL	DSTR
AGIL	1.0000	
DSTR	0.1841	0.7810

Table 102:Fornell-Larcker criterion for H3C

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
DSTR -> AGIL	0.1841	0.1906	0.0459	4.0140	0.0001

Table 103: Path Coefficients for H3C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H3C.

7.12.3.4 H3 verification with decisional tree of Zhao

Hypothesis	*A*B (DSTR*STRA) Is significant?*	*C (AGIL) Is significant?*	*A*B*C (DSTR* STRA* AGIL) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H3	0.06074782 Not Significant	0.0000 Significant	0.1437*0.1302 *0.1652 Positive	Direct-only (**Non**-Mediation)	Not

Table 104: Verification with decisional tree of Zhao - H3

Where: A = DSTR = Digital Strategy

B = STRA = IT Strategy

C = AGIL = Agile/DevOps

Table 104 presents the analysis of Hypothesis 3 (H3) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is not a Consistent Hypothesis
- The mediation is null.
- The variable strategy (STRA) is not essential to have effect on Digital strategy to have Agile/DevOps (AGIL). It not necessary a strategy to have AGIL.
- The relation C (DSTR AGIL) alone not is valid and alone is worse.
- The relation AB (DSTR STRA) is very strong.
- We can have IT Strategy (STRA), but it will not influence Agile/Ops (AGIL).
- If there is a digital strategy, and IT strategy is not necessarily having an influence on Agile/Ops.
- The project teams applied a rather safety-oriented strategy and made use of all activities in the AoNG(Activity-on-the-Node-Graph), including the "buffer" between activities (Jahr, 2014). The strategy in agile is to have buffers. Here says that methodology helps to strategy.
- Incremental is a staging and scheduling strategy where the scope of delivery is adjusted as necessary (Cockburn, 2008). Increments deal with the staging and scheduling of deliverables which may occur at different rates. Iterations are cycles to revise and improve the deliverable. Increments are scheduled as part of a roadmap or release plan tied to an overall BI strategy that outlines what information capabilities are needed and when. Iterations will happen within the increment (Larson & Chang, 2016). The methodology helps to Strategy.
- The implementation of agile approaches introduces many significant changes in the roles and responsibilities within the organization. It also introduces two new roles – product owner and ScrumMaster (Hobbs & Petit, 2017). The project owner as a new organizational role is central to agile.

7.12.4 H4: Spend Priorities (SPEN) positively and significantly mediates the relationship between Digital Strategy (DSTR) and Agile/DevOps (AGIL)

Test Variables: DSTR > SPEN > AGIL

Digital transformation strategy involves decisions concerning financial resources, investment priorities, and supporting organizational strategies. Yucel (Yucel, 2018) emphasizes the relevance of costs and financial resources in evaluating digital transformation strategies. Informed by this perspective, H4 examines whether Spend Priorities mediate the relationship between Digital Strategy and Agile/DevOps practices. The proposed mediation relationship is tested empirically using the study's PLS-SEM model.

We resumed the result in the (Table 29) of mediation. In the lines (10, 11, 12) are the hypothesis H4 with the different paths: AB, ABC and C.

7.12.4.1 H4AB

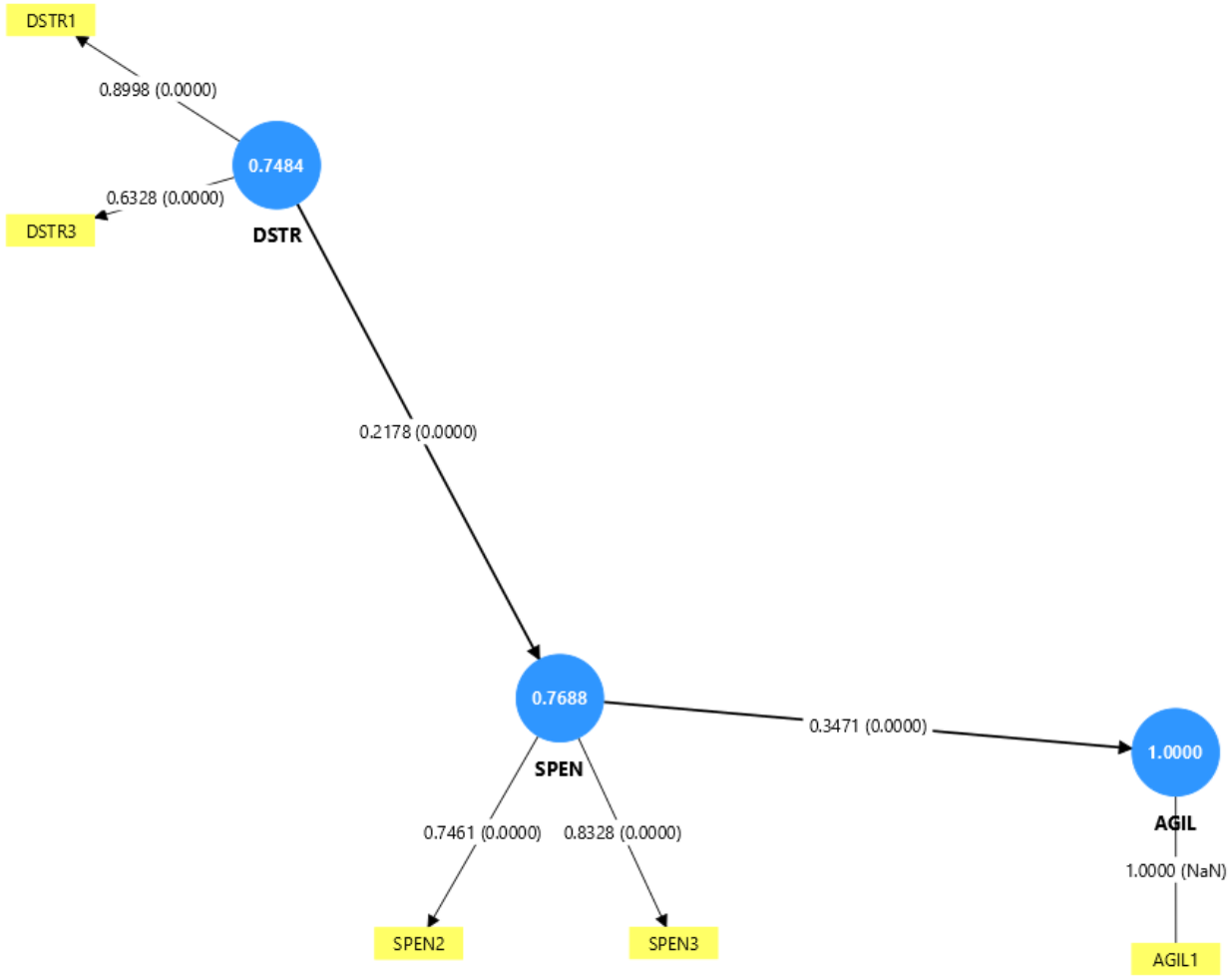


Figure 18: H4 – Boostrap Test – AB

		Loadings	CR	AVE
Agile/DevOps				
	AGIL1	1.0000		
Digital strategy			0.7484	0.6051
	DSTR1	0.8998		
	DSTR3	0.6328		
Spend Priorities			0.7688	0.6251
	SPEN2	0.7461		
	SPEN3	0.8328		

Table 105: Standardized Factor Loadings, CR and AVE for H4AB

In (Table 29) the line 10, column 9 and 10, are the T-stats-a 5.1336 and T-stats-b 7.4889,these values should be higher than 1.96 and both cases are significant.

R-Square

The explanatory power of the model is reported in (Table 106).

- **AGIL:** $R^2 = 0.1205$ (Adjusted $R^2 = 0.1186$)
- **SPEN:** $R^2 = 0.0474$ (Adjusted $R^2 = 0.0454$)

The model explains approximately 12.1% of the variance in AGIL and 4.7% in SPEN. While the explanatory power for SPEN remains weak, the R^2 value for AGIL approaches a modest level compared to previous models, indicating an improved predictive performance in explaining AGIL.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1205	0.1186
SPEN	0.0474	0.0454

Table 106:R-Square for H4AB

f-Square

Effect sizes were calculated to assess the relative contribution of each predictor construct (Table 107).

SPEN → AGIL: $f^2 = 0.1370$

DSTR → SPEN: $f^2 = 0.0498$

The effect of SPEN on AGIL ($f^2 = 0.1370$) falls within the small-to-moderate range according to conventional thresholds, indicating a more substantive predictive contribution compared to earlier hypotheses. In contrast, the effect of DSTR on SPEN ($f^2 = 0.0498$) remains small, suggesting a limited predictive influence. Overall, H4AB demonstrates stronger structural effects than the H3 models, particularly regarding the SPEN → AGIL relationship.

	AGIL	DSTR	SPEN
AGIL			
DSTR			0.0498
SPEN	0.1370		

Table 107:f-Square for H4AB

Internal Consistency Reliability

Internal consistency was evaluated using Cronbach's alpha and Composite Reliability (Table 108).

DSTR: $\alpha = 0.3762$; CR = 0.7484

SPEN: α = 0.4036; CR = 0.7688

Although Cronbach's alpha values are low for both constructs, composite reliability exceeds the recommended threshold of 0.70. Given that composite reliability is preferred in PLS-SEM, both constructs can be considered to demonstrate acceptable internal consistency, albeit with caution due to the low alpha coefficients.

Convergent Validity

Convergent validity was assessed using Average Variance Extracted (AVE) (Table 108).

DSTR: AVE = 0.6051

SPEN: AVE = 0.6251

Both constructs exceed the 0.50 threshold, indicating satisfactory convergent validity.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7484	0.6051
SPEN	0.4036	0.7688	0.6251

Table 108: R-Cronbach, CR and AVE for H4AB

Discriminant Validity

HTMT

Discriminant validity was examined using the HTMT ratio (Table 109) and the Fornell-Larcker criterion (Table 110).

All HTMT values remain well below conservative thresholds (0.85–0.90), indicating adequate discriminant validity among constructs.

	AGIL	DSTR	SPEN
AGIL			
DSTR	0.2920		
SPEN	0.5395	0.5374	

Table 109: Heterotrait-monotrait ratio (HTMT) for H4AB

Fornell-Larcker criterion

The Fornell-Larcker criterion is also satisfied (Table 110), as the square roots of AVE (0.7779 for DSTR and 0.7906 for SPEN) exceed their respective inter-construct correlations. These further supports discriminant validity.

	AGIL	DSTR	SPEN
AGIL	1.0000		
DSTR	0.1848	0.7779	
SPEN	0.3471	0.2178	0.7906

Table 110:Fornell-Larcker criterion for H4AB

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
a DSTR -> SPEN	0.2178	0.2231	0.0424	5.1336	0.0000
b SPEN -> AGIL	0.3471	0.3474	0.0463	7.4889	0.0000

Table 111: Path Coefficients for H4AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 111 Path Coefficients for H4AB**. For the column 17 Sobel, 4.2374, column 18 Aroian, 4.2120, column 19 Goodman, 4.2633. These values are higher than 1.96 and are significantly acceptable.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.2178	Sobel test:	4.23747386	0.01784044	0.0000226
b	0.3471	Aroian test:	4.21205023	0.01794812	0.00002531
s_a	0.0424	Goodman test:	4.26336349	0.0177321	0.00002014
s_b	0.0463	Reset all	Calculate		

Table 112: Sobel Test for H4AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	5.1336	Sobel test:	4.23426198	0.00002293
t_b	7.4889	Aroian test:	4.20881163	0.00002567
		Goodman test:	4.26017967	0.00002043
		Reset all	Calculate	

Table 113: Sobel Test for H4AB. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H4AB.

7.12.4.2 H4ABC'

In (Table 29) we have in line 8, the coefficient column 1 Coef-a 0.2171, column 2 Coef-b 0.3222, and column 3 Coef-c'0.1146.

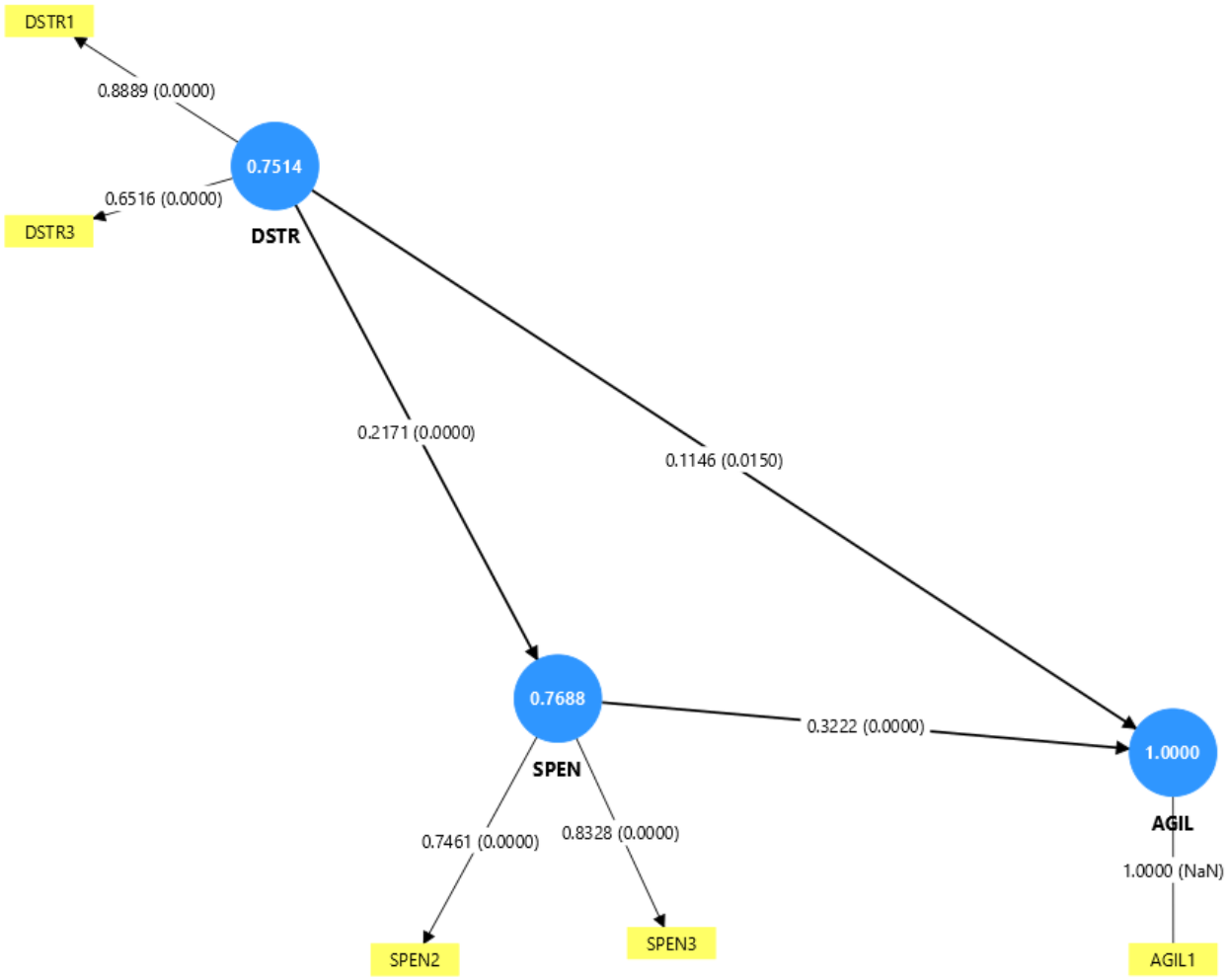


Figure 19: H4 – Boostrap Test – ABC'.

(Table 114) reports standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) for Agile/DevOps (AGIL), Digital Strategy (DSTR), and Spend Priorities (SPEN).

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Digital strategy		0.7514	0.6073
DSTR1	0.8889		
DSTR3	0.6516		
Spend Priorities		0.7688	0.6251
SPEN2	0.7461		
SPEN3	0.8328		

Table 114: Standardized Factor Loadings, CR and AVE for H4ABC'

All retained indicators load satisfactorily on their respective constructs. DSTR demonstrates strong loading for DSTR1 (0.8889) and acceptable loading for DSTR3 (0.6516). SPEN indicators load robustly (0.7461 and 0.8328), indicating adequate indicator reliability. The AGIL construct is operationalized as a single-item measure (loading = 1.000), which prevents internal consistency assessment but is statistically admissible in PLS-SEM when the construct is conceptually concrete and unambiguous.

R-Square

As shown in (Table 115), the model explains:

13.30% of the variance in Agile/DevOps (AGIL) ($R^2 = 0.1330$)

4.71% of the variance in Spend Priorities (SPEN) ($R^2 = 0.0471$)

The explanatory power for AGIL can be interpreted as modest according to PLS-SEM benchmarks, while the variance explained in SPEN remains limited. These findings suggest that Digital Strategy show a positive and statistically significant relationship with Agile/DevOps adoption but plays a comparatively smaller role in shaping spending priorities.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1330	0.1293
SPEN	0.0471	0.0451

Table 115:R-Square for H4ABC

f-Square

Effect size estimates (Table 116) provide further insight into the relative impact of the structural paths:

DSTR → AGIL ($f^2 = 0.0144$) indicates a small effect.

AGIL → SPEN ($f^2 = 0.1141$) approaches a moderate effect.

DSTR → SPEN ($f^2 = 0.0495$) reflects a small effect.

Notably, the strongest contribution within the model emerges from Agile/DevOps to Spend Priorities, suggesting that agile capability may function as an operational mechanism through which strategic orientation translates into resource allocation patterns. In contrast, the direct impact of Digital Strategy on Agile practices remains comparatively limited in magnitude.

	AGIL	DSTR	SPEN
AGIL			
DSTR	0.0144		0.0495
SPEN	0.1141		

Table 116:f-Square for H4ABC

Convergent Validity

Table 117 presents Cronbach's alpha, composite reliability (ρc), and average variance extracted (AVE) for the constructs Digital Strategy (DSTR) and Spend Priorities (SPEN).

Composite reliability values exceed the recommended threshold of 0.70 for both constructs (DSTR = 0.7514; SPEN = 0.7688), indicating satisfactory internal consistency reliability. In variance-based structural equation modeling (PLS-SEM), composite reliability is preferred over Cronbach's alpha, as it does not assume equal indicator loadings and therefore provides a more accurate estimate of construct reliability.

Convergent validity is also established, as AVE values are above the recommended threshold of 0.50 (DSTR = 0.6073; SPEN = 0.6251). This indicates that each construct explains more than half of the variance of its indicators, meeting established PLS-SEM criteria.

Although Cronbach's alpha values are relatively low (DSTR = 0.3762; SPEN = 0.4036), this does not undermine the measurement quality, as composite reliability is considered a more appropriate and robust indicator in PLS-SEM due to its less restrictive assumptions.

Overall, the measurement model for H4ABC demonstrates acceptable reliability and convergent validity.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7514	0.6073
SPEN	0.4036	0.7688	0.6251

Table 117: R-Cronbach, CR and AVE for H4ABC

Discriminant Validity

Fornell–Larcker Criterion

Discriminant validity was assessed using the Fornell–Larcker criterion. As presented in (Table 118), the square root of the average variance extracted (AVE) for each construct exceeds its correlations with the other constructs.

Specifically, AGIL (1.0000) is greater than its correlations with Digital Strategy (DSTR = 0.1846) and Spend Priorities (SPEN = 0.3471). Similarly, DSTR (0.7793) exceeds its correlations with AGIL and SPEN (0.2171), while SPEN (0.7906) is higher than its correlations with both AGIL and DSTR.

These results indicate that each construct shares more variance with its own indicators than with other constructs, thereby confirming discriminant validity according to the Fornell–Larcker criterion.

	AGIL	DSTR	SPEN
AGIL	1.0000		
DSTR	0.1846	0.7793	
SPEN	0.3471	0.2171	0.7906

Table 118:Fornell-Larcker criterion for H4ABC

HTMT

The Heterotrait–Monotrait ratio (HTMT) was also used to further assess discriminant validity (Table 119). The HTMT values between the constructs are as follows: Digital Strategy–Agility (DSTR–AGIL = 0.2920), Agility–Spend Priorities (AGIL–SPEN = 0.5395), and Digital Strategy–Spend Priorities (DSTR–SPEN = 0.5374).

All values are well below the conservative threshold of 0.85, indicating that the constructs demonstrate satisfactory discriminant validity and are empirically distinct from one another.

	AGIL	DSTR	SPEN
AGIL			
DSTR	0.2920		
SPEN	0.5395	0.5374	

Table 119: Heterotrait-monotrait ratio (HTMT) for H4ABC

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
c DSTR -> AGIL	0.1146	0.1178	0.0471	2.4344	0.0150
a DSTR -> SPEN	0.2171	0.2210	0.0431	5.0321	0.0000
b SPEN -> AGIL	0.3222	0.3214	0.0489	6.5938	0.0000

Table 120: Path Coefficients for H4ABC

Input:		Test statistic:	*p*-value:
t_a 5.0321	Sobel test:	4.00027725	0.00006327
t_b 6.5938	Aroian test:	3.97151868	0.00007142
	Goodman test:	4.02966973	0.00005586
	Reset all	Calculate	

Table 121: Sobel Test for H4ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H4ABC'.

7.12.4.3 H4C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

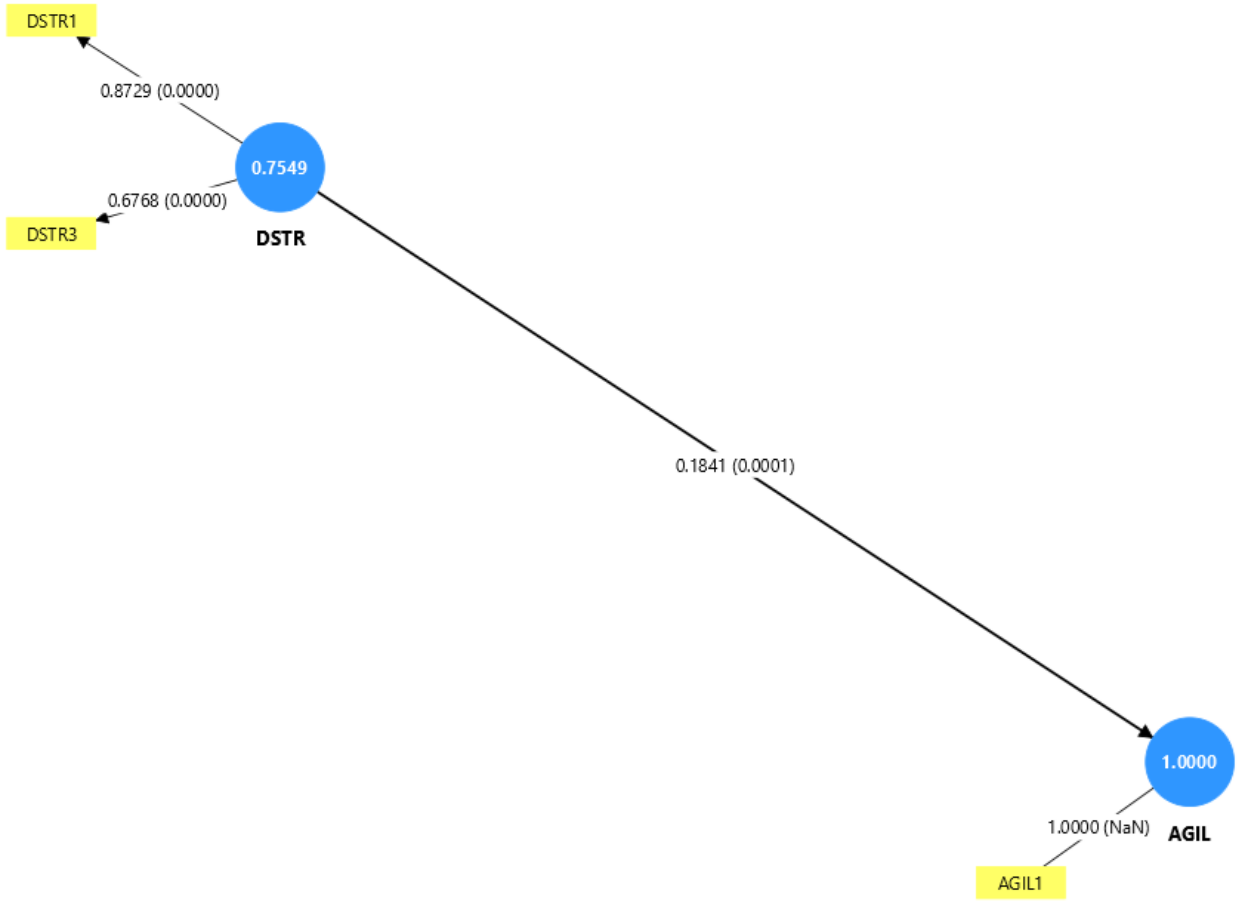


Figure 20: H4 – Boostrap Test – C.

In (Table 122) presents the standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) for Agile/DevOps (AGIL) and Digital Strategy (DSTR).

The AGIL construct is measured using a single indicator (loading = 1.000).

For Digital Strategy (DSTR), the indicator loadings show some variability. DSTR1 demonstrates a satisfactory loading (0.7567), while DSTR3 has a lower loading (0.5015). Although this value is close to the minimum acceptable threshold, it remains above 0.40 and therefore show a positive and statistically significant relationship to the construct's measurement.

The composite reliability for DSTR (CR = 0.7549) exceeds the recommended threshold of 0.70, indicating adequate internal consistency. In addition, the AVE value (0.6100) is above the 0.50

point of reference, confirming convergent validity, as the construct explains more than half of the variance of its indicators.

Overall, the results suggest that the measurement of DSTR is reliable and demonstrates acceptable convergent validity, while the single-item measurement of AGIL remains methodologically acceptable within the PLS-SEM framework.

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Digital strategy		0.7549	0.6100
DSTR1	0.7567		
DSTR3	0.5015		

Table 122: *Standardized Factor Loadings, CR and AVE for H4C*

R-Square

As shown in (Table 123), Digital Strategy explains 3.39% of the variance in Agile/DevOps (R^2 = 0.0339). The adjusted R^2 (0.0319) confirms the stability of this estimate.

According to established PLS-SEM benchmarks, this represents weak explanatory power. While statistically meaningful, Digital Strategy accounts for only a limited proportion of the variance in Agile/DevOps practices, suggesting that additional organizational or contextual drivers likely shape Agile/DevOps capability adoption.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0339	0.0319

Table 123:R-Square for H4C

f-Square

In (Table 124) presents the effect size (f^2) of Digital Strategy (DSTR) on Agile/DevOps (AGIL). The observed value (f^2 = 0.0351) falls within the small effect size range, indicating that the impact of Digital Strategy on Agile/DevOps is limited in magnitude.

Although Digital Strategy has a statistically significant effect on Agile/DevOps, its impact is relatively small. Combined with the low R^2, this suggests that Digital Strategy plays a limited role and is not a key driver of Agile/DevOps capability in this model.

	AGIL	DSTR
AGIL		
DSTR	0.0351	

Table 124:f-Square for H4C

Convergent Validity

As shown in (Table 125), Digital Strategy demonstrates satisfactory composite reliability (ρc = 0.7549), exceeding the recommended 0.70 threshold. Although Cronbach's alpha is low (α = 0.3762), this may reflect the limited number of indicators and unequal loadings and is sensitive to short scales. In PLS-SEM, composite reliability is considered the more appropriate estimate; thus, internal consistency is deemed acceptable.

Convergent validity is supported, with AVE (0.6100) exceeding the 0.50 benchmark, indicating that the construct explains more than half of the variance in its indicators.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
DSTR	0.3762	0.7549	0.6100

Table 125: R-Cronbach, CR and AVE for H4C

Fornell–Larcker Criterion

As reported in (Table 126), the square root of AVE for Digital Strategy (0.7810) exceeds its correlation with Agile/DevOps (0.1841), satisfying the Fornell–Larcker criterion. The AGIL construct (1.0000) similarly exceeds inter-construct correlations.

These results provide support for discriminant validity at the correlation level.

	AGIL	DSTR
AGIL	1.0000	
DSTR	0.1841	0.7810

Table 126:Fornell-Larcker criterion for H4C

HTMT

The HTMT value (Table 127) between Digital Strategy and Agile/DevOps is 0.2920, well below the conservative threshold of 0.85. This confirms satisfactory discriminant validity and indicates that the two constructs are empirically distinct despite their conceptual proximity.

	AGIL	DSTR
AGIL		
DSTR	0.2920	

Table 127: Heterotrait-monotrait ratio (HTMT) for H4C

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
DSTR -> AGIL	0.1841	0.1906	0.0459	4.0140	0.0001

Table 128: Path Coefficients for H4C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H4C.

7.12.4.4 H4 verification with decisional tree of Zhao

Hypothesis	*A*B (SPEN*STRA) Is significant?*	*C (AGIL) Is significant?*	*A*B*C (SPEN * STRA* AGIL) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H4	0.0000226 Significant	0.0000 Significant	0.2171* 0.3222* 0.1146 Positive	Complementary (**Mediation**)	Yes

Table 129: Verification with decisional tree of Zhao - H4

Where: A = SPEN = Spend Priorities

B = STRA = Digital Strategy

C = AGIL = Agile/DevOps

In (Table 129) presents the analysis of Hypothesis 4 (H4) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis
- The mediation is strong.
- The variable Spend Priorities (SPEN) is essential to have effect on Digital Strategy to implement (AGIL). Without Spend Priorities there is not Agile/DevOps implementation.
- The relation C (DSTR AGIL) alone not is valid and alone is worse.
- The relation AB (DSTR SPEN) is very strong.
- If we have an IT Strategy (SPEN), we will have benefits (AGIL).
- If there is a Spend Priorities, there is little possibility of having an Agile/DevOps implementation effect, unless you have an aligned Digital strategy.
- Interestingly, the implementation of agile, and particularly, the reprioritization at the beginning of each sprint, and the closer contact between the product owner and the development teams created a context in which these product managers provided more precise and more frequent decisions regarding priorities. The product owner needs to be available, knowledgeable of business needs, and authority to make decisions. All three of these characteristics pose problems. Making people with these characteristics available to development teams means making then less available to development teams means making them less available for other roles within the business unit, which creates tension around the issue of their availability.(Hobbs & Petit, 2017).
- The PM was responsible for administrative project tasks. At the beginning of the project, PM prepared a brief project plan, which comprised a routine check list of all issues that needed to be taken care of during project implementation and that were not included in the development of the solution. PM monitored the budget allocated to the project and followed the project's planned schedule. PM also prepared a monthly report on the status of the project, which was delivered to the project steering group and the project office. The responsibilities of Agency and the SW vendor were described in the project contract. These included both higher-level responsibilities and responsibilities related to agile practices. In addition, Agency used a RACI matrix (responsibility assignment matrix; RACI stands for Responsible, Accountable, Consulted, and Informed) to describe internal responsibilities related to the project (Nuottila et al., 2017).

7.12.5 H5: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Digital Strategy (STRA) and Benefits Innovative (BINN)

Test Variables: STRA > AGIL > BINN

Yucel (Yucel, 2018) discusses the importance of aligning IT-related capabilities and modern software development and delivery approaches with digital transformation objectives. This perspective provides a conceptual basis for investigating the relationship between IT Strategy and Agile/DevOps practices. The present study extends this line of inquiry by examining whether Agile/DevOps practices mediate the relationship between IT Strategy and innovative benefits (H5) and between IT Strategy and operational benefits (H6). We resumed the result in the (Table 29) of mediation. In the lines (13, 14, 15) are the hypothesis H5 with the different paths: AB, ABC and C.

7.12.5.1 H5AB

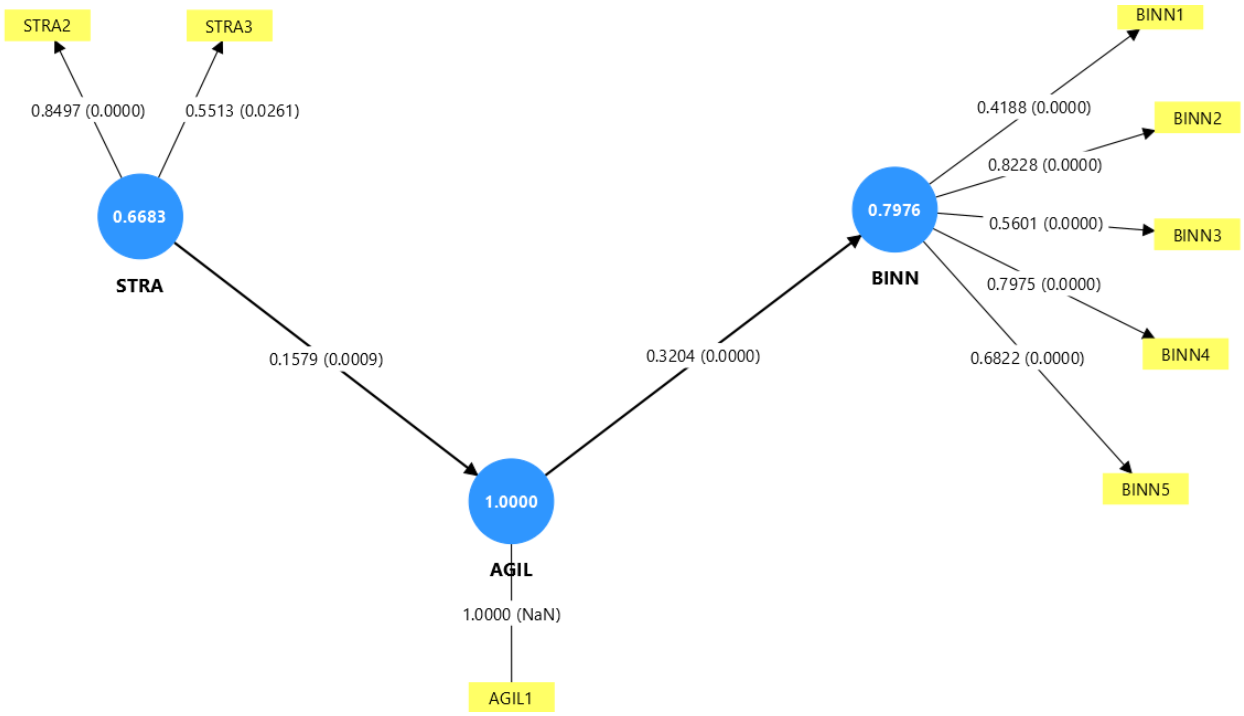


Figure 21: H5 – Boostrap Test – AB.

In (Table 130) presents standardized loadings, composite reliability (CR), and average variance extracted (AVE) for Agile/DevOps (AGIL), Innovative Benefits (BINN), and Strategy (STRA).

AGIL is modeled as a single-item construct (loading = 1.000), which does not permit internal consistency assessment but is statistically acceptable for concrete constructs in PLS-SEM. For BINN, most indicators load satisfactorily, although BINN1 (0.4188) falls below the preferred 0.70 threshold. Despite this weaker loading, composite reliability is acceptable (CR = 0.7976). However, AVE (0.4535) falls slightly below the 0.50 benchmark, indicating marginal convergent validity. Given that CR exceeds 0.70, convergent validity may be considered borderline but tolerable in exploratory contexts. For STRA, composite reliability is marginal (CR = 0.6683), slightly below the 0.70 guideline.

		Loadings	CR	AVE
Agile/DevOps				
	AGIL1	1.0000		
Benefits Innovative			0.7976	0.4535
	BINN1	0.4188		
	BINN2	0.8228		
	BINN3	0.5601		
	BINN4	0.7975		
	BINN5	0.6822		
Digital Strategy			0.6683	0.5130
	STRA2	0.8497		
	STRA3	0.5513		

Table 130: Standardized Factor Loadings, CR and AVE for H5AB

R-Square

As shown in (Table 131) the model explains 2.49% of the variance in Agile/DevOps ($R^2 = 0.0249$). It explains 10.27% of the variance in Innovative Benefits ($R^2 = 0.1027$).

The explanatory power for AGIL is weak, whereas the variance explained in BINN approaches a modest level. These findings suggest that the predictors employ limited influence on Agile/DevOps show a positive and statistically significant relationship with more meaningfully to Benefits Innovative.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0249	0.0229
BINN	0.1027	0.1008

Table 131:R-Square for H5AB

f-Square

Effect size estimates presented in (Table 132) indicate that Agile/DevOps (AGIL) has a meaningful impact on Innovative Benefits (BINN), with an effect size of $f^2 = 0.1144$, approaching a moderate level. In contrast, the effect of Strategy (STRA) on Agile/DevOps is considerably weaker ($f^2 = 0.0256$), falling within the small effect size range.

These results suggest that Agile/DevOps plays a more substantial role in driving Innovative Benefits, whereas Strategy contributes only marginally to the development of Agile/DevOps capabilities within the model.

	AGIL	BINN	STRA
AGIL		0.1144	
BINN			
STRA	0.0256		

Table 132:f-Square for H5AB

Convergent Validity

As shown in (Table 133), Innovative Benefits (BINN) demonstrates acceptable internal consistency ($\alpha = 0.7313$; $\rho c = 0.7976$). Although its AVE (0.4535) falls slightly below the recommended 0.50 threshold, the composite reliability exceeds 0.70, suggesting borderline but tolerable convergent validity in line with established PLS-SEM guidance.

For Strategy (STRA), Cronbach's alpha is extremely low ($\alpha = 0.0555$). This result likely reflects the small number of indicators and substantial differences in outer loadings, conditions under which alpha becomes unstable due to its assumption of tau-equivalence. Composite reliability ($\rho c = 0.6683$) is marginal but close to the 0.70 benchmark, while AVE (0.5130) exceeds the recommended threshold, indicating that the construct captures more than half of the variance in its indicators.

Taken together, these results suggest that convergent validity for STRA is supported, but internal consistency should be interpreted with caution. Future research may benefit from refining or expanding the indicator set to improve measurement stability.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.7976	0.4535
STRA	0.0555	0.6683	0.5130

Table 133: R-Cronbach, CR and AVE for H5AB

Fornell–Larcker Criterion

Discriminant validity was evaluated using the Fornell–Larcker criterion. As shown in (Table 134), the square root of the AVE for each construct is greater than its correlations with the other constructs.

AGIL (1.0000) is higher than its correlations with Innovative Benefits (BINN = 0.3204) and Strategy (STRA = 0.1579).

BINN (0.6734) exceeds its correlation with STRA (0.1667).

STRA (0.7162) is greater than its correlations with both AGIL and BINN.

These results indicate that each construct shares more variance with its own indicators than with other constructs, thereby confirming discriminant validity under the Fornell–Larcker criterion.

	AGIL	BINN	STRA
AGIL	1.0000		
BINN	0.3204	0.6734	
STRA	0.1579	0.1667	0.7162

Table 134:Fornell-Larcker criterion for H5AB

HTMT

Discriminant validity was further assessed using the Heterotrait–Monotrait (HTMT) ratio. As reported in (Table 135), all HTMT values are below the conservative threshold of 0.85:

AGIL–BINN = 0.2896

AGIL–STRA = 0.6532

BINN–STRA = 0.7937

While the association between BINN and STRA is relatively higher, it remains below the threshold, indicating that the constructs are empirically distinct and satisfy discriminant validity criteria.

	AGIL	BINN	STRA
AGIL			
BINN	0.2896		
STRA	0.6532	0.7937	

Table 135: Heterotrait-monotrait ratio (HTMT) for H5AB

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
b AGIL -> BINN	0.3204	0.3289	0.0358	8.9389	0.0000
a STRA -> AGIL	0.1579	0.1645	0.0477	3.3128	0.0009

Table 136: Path Coefficients for H5AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 128 Path Coefficients for H5AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1579	Sobel test:	3.10470519	0.016295	0.00190469
b	0.3204	Aroian test:	3.0877959	0.01638423	0.00201647
s_a	0.0477	Goodman test:	3.12189535	0.01620527	0.00179691
s_b	0.0358	Reset all	Calculate		

Table 137: Sobel Test for H5AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	3.3128	Sobel test:	3.10633677	0.00189421
t_b	8.9389	Aroian test:	3.08938594	0.00200571
		Goodman test:	3.12356971	0.00178672
		Reset all	Calculate	

Table 138: Sobel Test for H5AB. With T statistics

The results show (Table 137 and 138) that the mediation effects, as assessed by Sobel, 3.1047 (Table 20 column 17), Aroian 3.0877 (Table 29 column 18), Goodman, 3.1218 (Table 29 column 19. These values are higher than 1.96 and are significantly acceptable.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H5AB.

7.12.5.2 H5ABC'

In (Table 29) we have in line 14, the coefficient column 1 Coef-a 0.1579, column 2 Coef-b 0.2929, and column 3 Coef-c'0.1215.

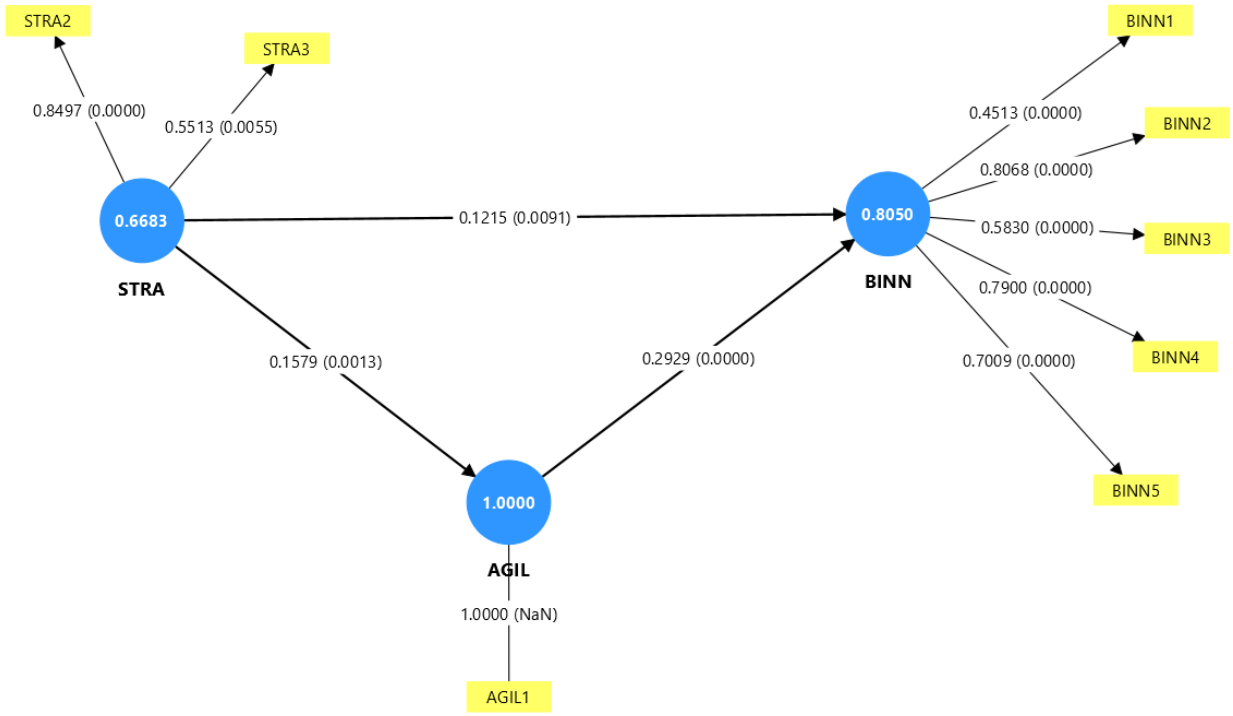


Figure 22: H5 – Boostrap Test – ABC'.

In (Table 139) presents standardized loadings, composite reliability (CR), and average variance extracted (AVE), and Agile/DevOps is modeled as a single-item construct and therefore does not require internal consistency assessment. Benefits Innovative demonstrates satisfactory internal consistency (CR = 0.8050), but AVE (0.4620) falls below the recommended threshold of 0.50, suggesting limited convergent validity, largely driven by the weak loading of BINN1. Digital Strategy presents acceptable convergent validity (AVE = 0.5130); however, composite reliability (0.6683) is marginal, likely due to the heterogeneous loadings and the restricted number of indicators.

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Benefits Innovative		0.8050	0.4620
BINN1	0.4513		
BINN2	0.8068		
BINN3	0.5830		
BINN4	0.7900		
BINN5	0.7009		
Digital Strategy		0.6683	0.5130
STRA2	0.8497		
STRA3	0.5513		

Table 139: Standardized Factor Loadings, CR and AVE for H5ABC'

R-Square

The explanatory power of the structural model was evaluated using the coefficient of determination (R^2, Table 140). Agile/DevOps (AGIL) exhibits very low explained variance (R^2 = 0.0249; R^2_adjusted = 0.0229), reflecting the limited contribution of the antecedent constructs in predicting this single-item construct. Benefits Innovative (BINN) shows a higher R^2 of 0.1118 (adjusted = 0.1081), indicating modest explanatory power. According to conventional PLS-SEM benchmarks (Hair et al., 2018), these values are considered weak, which is expected in exploratory models examining complex organizational and strategic constructs influenced by multiple external factors.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0249	0.0229
BINN	0.1118	0.1081

Table 140:R-Square for H5ABC'

f-Square

The contribution of each exogenous variable to the endogenous constructs was assessed using Cohen's f^2 (Table 141). The results indicate:

- AGIL → BINN: f^2 = 0.0942, representing a small effect
- STRA → AGIL: f^2 = 0.0256, representing a small effect
- STRA → BINN: f^2 = 0.0162, representing a negligible effect

These findings suggest that, although the structural relationships are statistically supported, their practical impact is modest. This aligns with the exploratory nature of the proposed framework, where the goal is to identify potential associations rather than dominant drivers.

	AGIL	BINN	STRA
AGIL		0.0942	
BINN			
STRA	0.0256	0.0162	

Table 141:f-Square for H5ABC'

Construct Reliability and Convergent Validity

Internal consistency and convergent validity were assessed using Composite Reliability (CR) and Average Variance Extracted (AVE), with Cronbach's alpha reported for reference (Table 142).

For BINN, internal consistency is satisfactory (CR = 0.8050), although the AVE (0.4620) is slightly below the recommended 0.50 threshold, largely due to a low-loading indicator. Despite this, the construct demonstrates acceptable reliability and contributes meaningfully to the model.

For STRA, convergent validity is acceptable (AVE = 0.5130), but internal consistency is marginal (CR = 0.6683), reflecting heterogeneous indicator loadings and a small number of indicators. Cronbach's alpha for STRA is very low ($\alpha = 0.0555$), illustrating its sensitivity to unequal indicator loadings. Therefore, reliability interpretations are based primarily on CR, which is more robust in variance-based SEM.

Overall, the measurement model for H5ABC' demonstrates adequate construct reliability and convergent validity, supporting the use of these constructs in the structural model.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.8050	0.4620
STRA	0.0555	0.6683	0.5130

Table 142: R-Cronbach, CR and AVE for H5ABC'

Fornell-Larcker criterion

Discriminant validity was first evaluated using the Fornell–Larcker criterion (Table 143). For all constructs, the square root of the AVE exceeds the correlations with other constructs, indicating that each construct shares more variance with its own indicators than with other constructs.

Specifically, BINN (0.6797) and STRA (0.7162) both exceed their correlations with AGIL and with each other, supporting acceptable discriminant validity for these constructs within the H5ABC' model.

	AGIL	BINN	STRA
AGIL	1.0000		
BINN	0.3121	0.6797	
STRA	0.1579	0.1678	0.7162

Table 143:Fornell-Larcker criterion for H5ABC'

HTMT

Discriminant validity was further assessed using the **Heterotrait–Monotrait (HTMT) ratio** (Table 144). The HTMT values are as follows:

BINN - AGIL = 0.2896 – well below the conservative threshold of 0.85, confirming empirical distinctiveness.

STRA - BINN = 0.7937 – approaching the threshold but still within acceptable limits, indicating a substantial yet acceptable association.

AGIL - STRA = 0.6532 – well below 0.85, supporting the distinctiveness of the constructs.

Overall, these results corroborate that all constructs in the H5ABC' model are empirically distinct, confirming discriminant validity.

	AGIL	BINN	STRA
AGIL			
BINN	0.2896		
STRA	0.6532	0.7937	

Table 144: Heterotrait-monotrait ratio (HTMT) for H5ABC'

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
b AGIL -> BINN	0.2929	0.2969	0.0425	6.8916	0.0000
a STRA -> AGIL	0.1579	0.1620	0.0490	3.2243	0.0013
c STRA -> BINN	0.1215	0.1264	0.0466	2.6085	0.0091

Table 145: Path Coefficients for H5ABC

Input:		Test statistic:	*p*-value:
t_a 3.2243	Sobel test:	2.92047001	0.00349504
t_b 6.8916	Aroian test:	2.89556798	0.00378473
	Goodman test:	2.94602578	0.00321886
	Reset all	Calculate	

Table 146: Sobel Test for H5ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H5ABC'.

7.12.5.3 H5C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

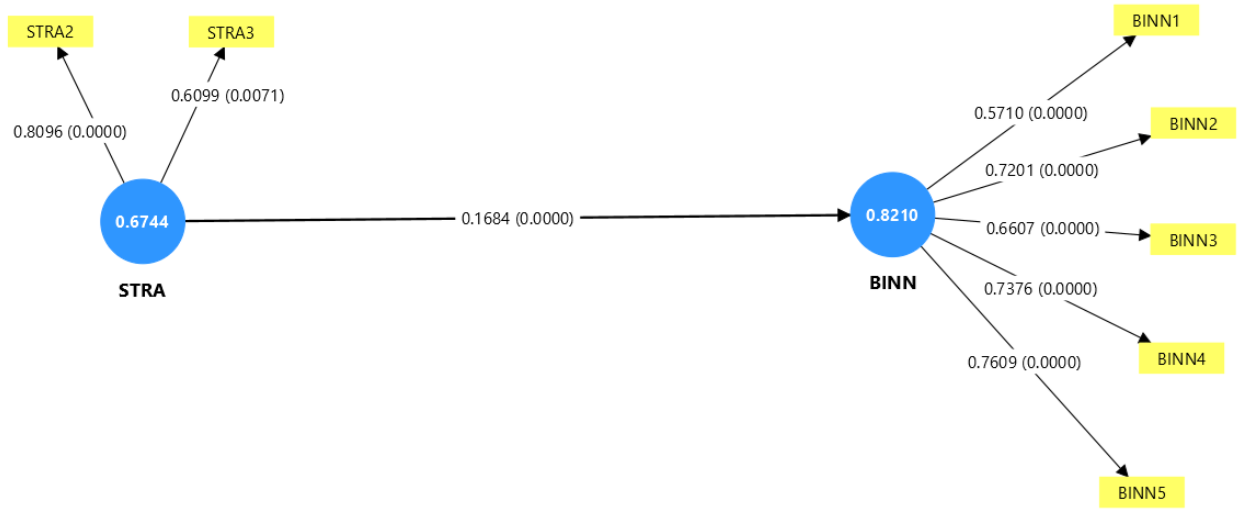


Figure 23: H5C – Boostrap Test – C.

The standardized factor loadings (Table 147) reflect the contribution of individual indicators to their respective constructs. For Benefits Innovative (BINN), loadings range from 0.5710 (BINN1) to 0.7609 (BINN5), indicating moderate to strong associations with the latent variable. Notably, BINN2 (0.7201) and BINN4 (0.7376) contribute most substantially, while BINN1 (0.5710) is the weakest but remains acceptable in exploratory research contexts.

For Digital Strategy (STRA), loadings are 0.8096 (STRA2) and 0.6099 (STRA3), showing that STRA2 is the primary indicator driving the construct, whereas STRA3 provides a moderate contribution. The overall pattern of loadings supports the theoretical specification of the constructs, with all items demonstrating meaningful relationships with their respective latent variables.

The composite reliability (CR) values 0.8210 for BINN and 0.6744 for STRA indicate satisfactory internal consistency, while AVE values of 0.4808 (BINN) and 0.5137 (STRA) suggest adequate convergent validity, particularly for Digital Strategy. BINN's AVE is slightly below the conventional threshold of 0.50 but acceptable given the strong CR and exploratory nature of the study.

	Loadings	CR	AVE
Benefits Innovative		0.8210	0.4808
BINN1	0.5710		
BINN2	0.7201		
BINN3	0.6607		
BINN4	0.7376		
BINN5	0.7609		
Digital Strategy		0.6744	0.5137
STRA2	0.8096		
STRA3	0.6099		

Table 147: Standardized Factor Loadings, CR and AVE for H5C

R-Square

The explanatory power of the structural model for H5C was assessed using the coefficient of determination (R^2, Table 148). Benefits Innovative (BINN) exhibits very low explained variance (R^2 = 0.0283; R^2_adjusted = 0.0263), indicating that the antecedent construct, Digital Strategy (STRA), accounts for only a small proportion of variance in BINN. According to conventional PLS-SEM benchmarks (Hair et al., 2018), this represents a weak predictive capacity, which is consistent with exploratory research examining complex strategic outcomes.

	R-SQUARE	R-SQUARE ADJUSTED
BINN	0.0283	0.0263

Table 148:R-Square for H5C

f-Square

The local effect size of STRA on BINN was examined using Cohen's f^2 (Table 149). The effect is small (f^2 = 0.0292), indicating that Digital Strategy contributes minimally to explaining the variance in Innovative Benefits. These findings align with the weak R^2 and suggest that additional antecedents or contextual variables would be needed to enhance the predictive capacity of the model.

	BINN	STRA
BINN		
STRA	0.0292	

Table 149:f-Square for H5C

Construct Reliability and Convergent Validity

Internal consistency and convergent validity were evaluated using Composite Reliability (CR) and Average Variance Extracted (AVE), complemented by Cronbach's alpha (Table 150).

BINN demonstrates satisfactory internal consistency (CR = 0.8210) despite an AVE slightly below the recommended 0.50 threshold (AVE = 0.4808), reflecting moderate item loadings for BINN.

STRA exhibits adequate convergent validity (AVE = 0.5137) but marginal internal consistency (CR = 0.6744).

Cronbach's alpha for STRA is extremely low (α = 0.0555), consistent with heterogeneous loadings and the small number of indicators. As with previous models, reliability interpretation prioritizes CR over alpha.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.8210	0.4808
STRA	0.0555	0.6744	0.5137

Table 150: R-Cronbach, CR and AVE for H5C

Fornell-Larcker Criterion

Discriminant validity was assessed using the Fornell–Larcker criterion. As shown in (Table 151), the square root of the AVE for each construct exceeds its correlations with the other construct, indicating that each construct is empirically distinct.

- BINN (AVE = 0.6934) is greater than its correlation with STRA (0.1684).
- STRA (AVE = 0.7167) exceeds its correlation with BINN.

These results support the discriminant validity of both constructs in the H5C model.

	BINN	STRA
BINN	0.6934	
STRA	0.1684	0.7167

Table 151:Fornell-Larcker criterion for H5C

HTMT

HTMT analysis (Table 152) indicates a value of 0.7937 between STRA and BINN, which falls below the conservative threshold of 0.85, further supporting discriminant validity.

	BINN	STRA
BINN		
STRA	0.7937	

Table 152: Heterotrait-monotrait ratio (HTMT) for H5C

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
STRA -> BINN	0.1684	0.1899	0.0396	4.2503	0.0000

Table 153: Path Coefficients for H5C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H5C.

7.12.5.4 H5 verification with decisional tree of Zhao

Hypothesis	*A*B (AGIL*SPEN) Is significant?*	*C (BINN) Is significant?*	*A*B*C (AGIL* SPEN* BINN) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H5	0.00190469 Significant	0.000 Significant	0.1579* 0.2929* 0.1215 Positive	Complementary (**Mediation**)	Yes

Table 154: Verification with decisional tree of Zhao – H5

Where: A = AGIL = Agile/DevOps

B = STRA = IT Strategy

C = BINN = Benefits Innovative

Table 154 presents the analysis of Hypothesis 5 (H5) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- a Consistent Hypothesis. The mediation is strong.
- The variable Agile/Ops (AGIL) shows a significant relationship with Spend Priorities and Benefits Innovative (BINN). Without Agile/DevOps implementation predicts there is not Benefits Innovative (BINN).
- The relation C (STRA BINN) alone not is valid and alone is worse.
- The relation AB (AGIL STRA) is strong.
- If we have Spend Priorities (STRA), we will have Benefits Innovative (BINN).
- If there is a STRA, there is little possibility of having Benefits Innovative effect, unless you have an aligned Agile/Ops implementation.
- In a study was proven findings validated the proposed model wherein employee personality traits, such as mindfulness, have a key impact on the initiation of project employees' innovative work behaviour (J. Khan et al., 2022). For that reason, the IT Strategy is important to have benefits innovative.
- The Future of Agile Development Productivity Tools. Automation has always resulted in allowing engineers, managers, and others to move on to more important tasks, allowing more innovation, mentoring, and continued education (Crowder & Friess, 2015).
- Six sigma. Six sigma was developed in the mid-1980s by Motorola engineer Bill Smith. Six sigma is a business improvement methodology that focuses on critical process outputs in the eyes of customers to identify and eliminate the causes of errors or mistakes in business processes (Manzoor et al., 2022).

7.12.6 H6: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Digital Strategy (STRA) and Benefits Operational (BOPR)

Test Variables: STRA > AGIL > BOPR.

We resumed the result in the (Table 29) of mediation. In the lines (16, 17, 18) are the hypothesis H6 with the different paths: AB, ABC and C.

7.12.6.1 H6AB

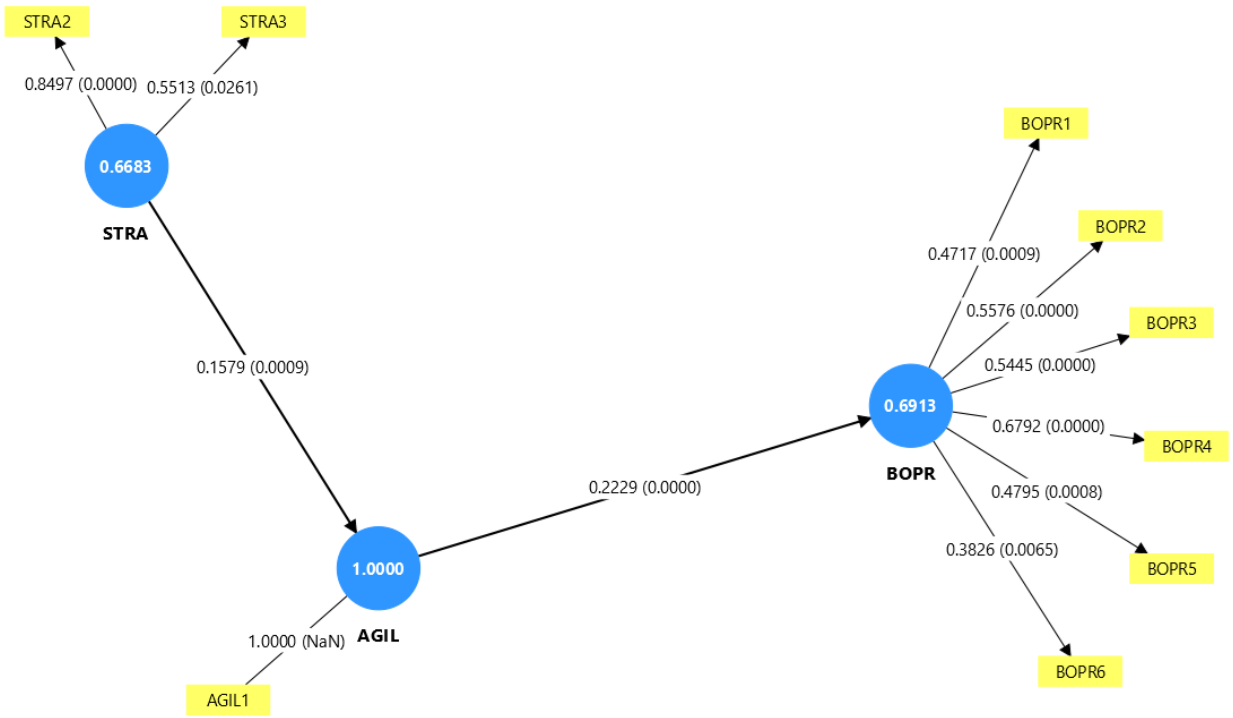


Figure 24: H6 – Boostrap Test – AB.

In (Table 155) presents the standardized factor loadings for the H6AB model. For Benefits Operational (BOPR), loadings range from 0.3826 (BOPR6) to 0.6792 (BOPR4), reflecting generally moderate contributions of the indicators to the latent construct. Indicators BOPR2 (0.5576), BOPR3 (0.5445), and BOPR4 (0.6792) demonstrate the strongest associations, whereas BOPR6 (0.3826) contributes weaklier, suggesting it may provide limited explanatory power within the construct.

For Digital Strategy (STRA), loadings are 0.8497 (STRA2) and 0.5513 (STRA3), indicating that STRA2 is the dominant indicator, while STRA3 contributes moderately.

The composite reliability (CR) and average variance extracted (AVE) for BOPR (CR = 0.6913, AVE = 0.2779) and STRA (CR = 0.6683, AVE = 0.5130) reflect acceptable internal consistency for exploratory purposes, although BOPR's AVE falls below the conventional threshold of 0.50, suggesting that indicator refinement may be considered in future research.

	Loadings	CR	AVE
Agile/DevOps	1.0000		
AGIL1			
Benefits Operational		0.6913	0.2779
BOPR1	0.4717		
BOPR2	0.5576		
BOPR3	0.5445		
BOPR4	0.6792		
BOPR5	0.4795		
BOPR6	0.3826		
Digital Strategy		0.6683	0.5130
STRA2	0.8497		
STRA3	0.5513		

Table 155: Standardized Factor Loadings, CR and AVE for H6AB

R-Square

The explanatory power of the H6AB structural model was assessed using the coefficient of determination (R^2) (Table 156). Agile/DevOps (AGIL) shows an R^2 of 0.0249 (adjusted R^2 = 0.0229), while Operational Benefits (BOPR) has an R^2 of 0.0497 (adjusted R^2 = 0.0477). These values indicate very weak explanatory power, consistent with exploratory models of complex organizational constructs.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0249	0.0229
BOPR	0.0497	0.0477

Table 156:R-Square for H6AB

f-Square

Effect sizes were evaluated using Cohen's (1988) f^2 (Table 157). The impact of AGIL on BOPR is small (f^2 = 0.0523), and the effect of STRA on AGIL is also small (f^2 = 0.0256). Overall, the structural relationships exist but exert limited practical impact, reinforcing the exploratory character of the model.

	AGIL	BOPR	STRA
AGIL		0.0523	
BOPR			
STRA	0.0256		

Table 157:f-Square for H6AB

Construct Reliability and Convergent Validity

In (Table 158) summarizes internal consistency and convergent validity metrics. For BOPR, composite reliability (CR = 0.6913) indicates acceptable internal consistency, though the average variance extracted (AVE = 0.2779) falls below the 0.50 threshold, suggesting that its indicators explain only a limited portion of variance. For STRA, CR = 0.6683 and AVE = 0.5130 reflect adequate reliability and convergent validity. Cronbach's alpha is low for both constructs (BOPR = 0.5107; STRA = 0.0555), consistent with known limitations in PLS-SEM, particularly for constructs with heterogeneous or few indicators. Reliability conclusions therefore rely primarily on composite reliability.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6913	0.2779
STRA	0.0555	0.6683	0.5130

Table 158: R-Cronbach, CR and AVE for H6AB

Discriminant Validity

Discriminant validity was assessed using both the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT) (Tables 159–160).

The Fornell–Larcker results indicate that the square root of the AVE for each construct exceeds its correlations with other constructs, providing initial support for discriminant validity. This suggests that each construct shares more variance with its own indicators than with other constructs in the model.

However, the HTMT results reveal a potential issue. While most HTMT values remain below the recommended threshold of 0.85, the value for the relationship between STRA and BOPR (HTMT = 1.5147) substantially exceeds this limit. This indicates a lack of discriminant validity between these two constructs and suggests a possible conceptual or measurement overlap.

Taken together, these findings imply that, despite acceptable results under the Fornell–Larcker criterion, the HTMT analysis highlights a serious discriminant validity concern between STRA

and BOPR. This issue should be interpreted with caution and may require refinement of construct definitions or measurement items in future research.

	AGIL	BOPR	STRA
AGIL	1.0000		
BOPR	0.2229	0.5272	
STRA	0.1579	0.2210	0.7162

Table 159:Fornell-Larcker criterion for H6AB

HTMT

	AGIL	BOPR	STRA
AGIL			
BOPR	0.2744		
STRA	0.6532	1.5147	

Table 160: Heterotrait-monotrait ratio (HTMT) for H6AB

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
b AGIL -> BOPR	0.2229	0.2441	0.0421	5.2884	0.0000
a STRA -> AGIL	0.1579	0.1645	0.0477	3.3128	0.0009

Table 161: Path Coefficients for H6AB

Next steps do the Sobel test of the **(Table 29)** column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 162 Path Coefficients for H6AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1579	Sobel test:	2.80682264	0.01253941	0.00500328
b	0.2229	Aroian test:	2.77150642	0.0126992	0.00557976
s_a	0.0477	Goodman test:	2.84352426	0.01237757	0.00446176
s_b	0.0421	Reset all	Calculate		

Table 162: Sobel Test for H6AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	3.3128	Sobel test:	2.80744593	0.00499361
t_b	5.2884	Aroian test:	2.77207897	0.00556995
		Goodman test:	2.84420204	0.00445228
		Reset all	Calculate	

Table 163: Sobel Test for H6AB. With T statistics

The results show (Table 162 and 163) that the mediation effects, as assessed by Sobel, 2.8068 (Table 20 column 17), Aroian, 2.7715 (Table 20 column 18), Goodman, 2.8435 (Table 20 column 19. These values are higher than 1.96 and are significantly acceptable.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H6AB.

7.12.6.2 H6ABC'

In (Table 29) we have in line 17, the coefficient column 1 Coef-a 0.1541, column 2 Coef-b 0.1486, and column 3 Coef-c'0.2563.

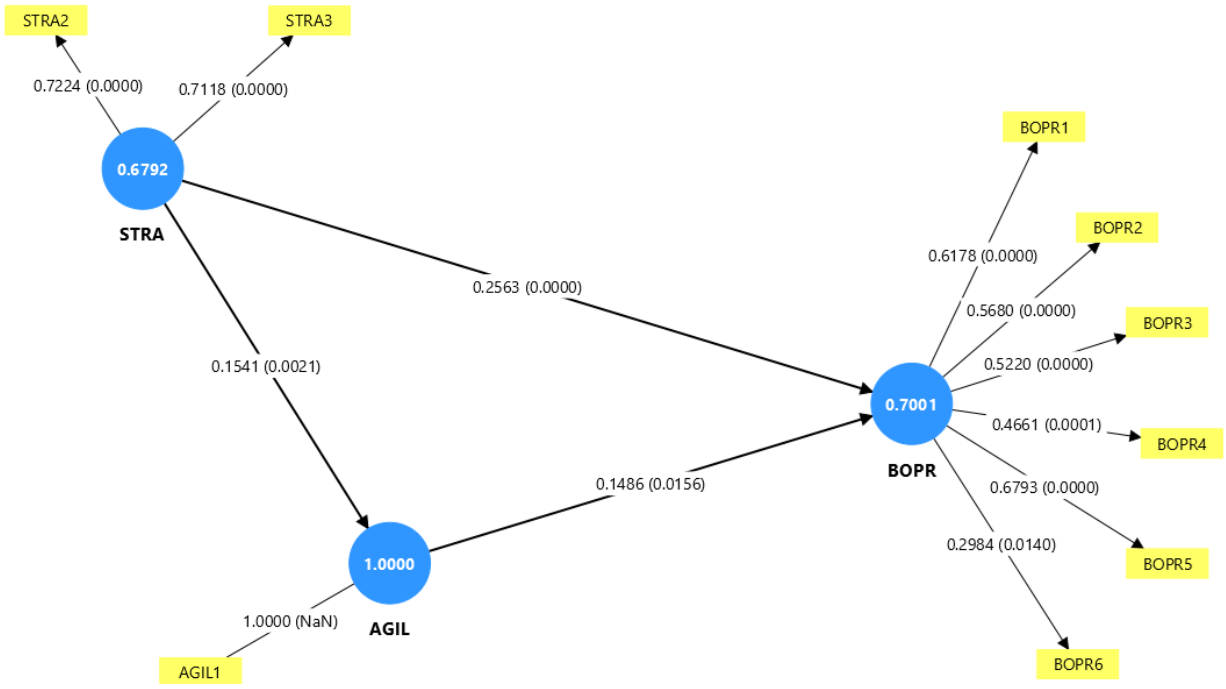


Figure 25: H6 – Boostrap Test – ABC'.

In (Table 164) presents the standardized factor loadings for the H6ABC' model. Agile/DevOps (AGIL) is represented by a single indicator (AGIL1) with a loading of 1.0000, reflecting perfect representation of the latent construct.

Benefits Operational (BOPR) exhibits heterogeneous indicator loadings, ranging from 0.1189 (BOPR6) to 0.4197 (BOPR5), with most items falling between 0.2742 and 0.4197. This variability contributes to a modest composite reliability (CR = 0.7001) and low average variance extracted (AVE = 0.2908), suggesting that the construct's indicators explain only a limited portion of the latent variance.

Digital Strategy (STRA) shows more consistent loadings across its two indicators (STRA2 = 0.7027; STRA3 = 0.6917), resulting in acceptable composite reliability (CR = 0.6792) and convergent validity (AVE = 0.5143).

Overall, while STRA demonstrates adequate convergent validity, the low and heterogeneous loadings for BOPR indicate potential measurement limitations, highlighting the need for indicator refinement in future research.

	Loadings	CR	AVE
Agile/DevOps	1.0000		
AGIL1			
Benefits Operational		0.7001	0.2908
BOPR1	0.3717		
BOPR2	0.2955		
BOPR3	0.2742		
BOPR4	0.2979		
BOPR5	0.4197		
BOPR6	0.1189		
Digital Strategy		0.6792	0.5143
STRA2	0.7027		
STRA3	0.6917		

Table 164: Standardized Factor Loadings, CR and AVE for H6ABC'

R-Square

The explanatory power of the structural model was assessed using the coefficient of determination (R^2; Table 165). Agile/DevOps (AGIL) shows very low explanatory variance ($R^2 = 0.0237$), while Benefits Operational (BOPR) exhibits slightly higher but still modest, explained variance ($R^2 = 0.0995$). According to conventional PLS-SEM benchmarks, these values indicate weak predictive

power, which is not uncommon in exploratory models where multiple contextual factors influence operational benefits beyond the measured constructs.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.0237	0.0217
BOPR	0.0995	0.0957

Table 165:R-Square for H6ABC'

f-Square

Effect sizes were evaluated using Cohen's (1988) guidelines (Table 166). The influence of AGIL on BOPR is small ($f^2 = 0.0239$), and the impact of STRA on BOPR is also small ($f^2 = 0.0712$). Similarly, the effect of STRA on AGIL is negligible ($f^2 = 0.0243$). These results indicate that the structural relationships, while present, have limited practical impact, reinforcing the exploratory nature of this model.

	AGIL	BOPR	STRA
AGIL		0.0239	
BOPR			
STRA	0.0243	0.0712	

Table 166:f-Square for H6ABC'

Construct Reliability and Convergent Validity

Composite reliability (CR) and Cronbach's alpha were assessed to determine internal consistency (Table 167). STRA demonstrates acceptable reliability (CR = 0.6792) and convergent validity (AVE = 0.5143). In contrast, BOPR exhibits heterogeneous indicator loadings and limited variance explained (AVE = 0.2908), resulting in lower reliability (CR = 0.7001) and a moderate Cronbach's alpha ($\alpha = 0.5107$). The low alpha values, particularly for BOPR, reflect the small number of indicators and non-equivalent loadings, highlighting a need for potential measurement refinement.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.7001	0.2908
STRA	0.0555	0.6792	0.5143

Table 167: R-Cronbach, CR and AVE for H6ABC'

Discriminant Validity

Discriminant validity was evaluated using both the Fornell–Larcker criterion (Table 168) and the Heterotrait–Monotrait ratio (HTMT; Table 169). The square root of AVE for each construct generally exceeds its correlations with other constructs, providing partial support for discriminant validity. However, the HTMT value between STRA and BOPR exceeds conservative thresholds (HTMT = 1.5147), suggesting substantial conceptual overlap. This finding indicates that, while the constructs are theoretically distinct, their empirical separation is limited within the current sample, warranting further conceptual refinement in future research.

	AGIL	BOPR	STRA
AGIL	1.0000		
BOPR	0.1881	0.5392	
STRA	0.1541	0.2792	0.7171

Table 168:Fornell-Larcker criterion for H6ABC'

	AGIL	BOPR	STRA
AGIL			
BOPR	0.2744		
STRA	0.6532	1.5147	

Table 169: Heterotrait-monotrait ratio (HTMT) for H6ABC'

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
b AGIL -> BOPR	0.1486	0.1504	0.0614	2.4196	0.0156
a STRA -> AGIL	0.1541	0.1566	0.0500	3.0795	0.0021
c STRA -> BOPR	0.2563	0.2696	0.0453	5.6616	0.0000

Table 170: Path Coefficients for H6-ABC'

Input:			Test statistic:	*p*-value:
t_a	3.0795	Sobel test:	1.902578	0.05709563
t_b	2.4196	Aroian test:	1.84343235	0.06526591
		Goodman test:	1.96780818	0.04909011
		Reset all	Calculate	

Table 171: Sobel Test for H6ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H6ABC'.

7.12.6.3 H6C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

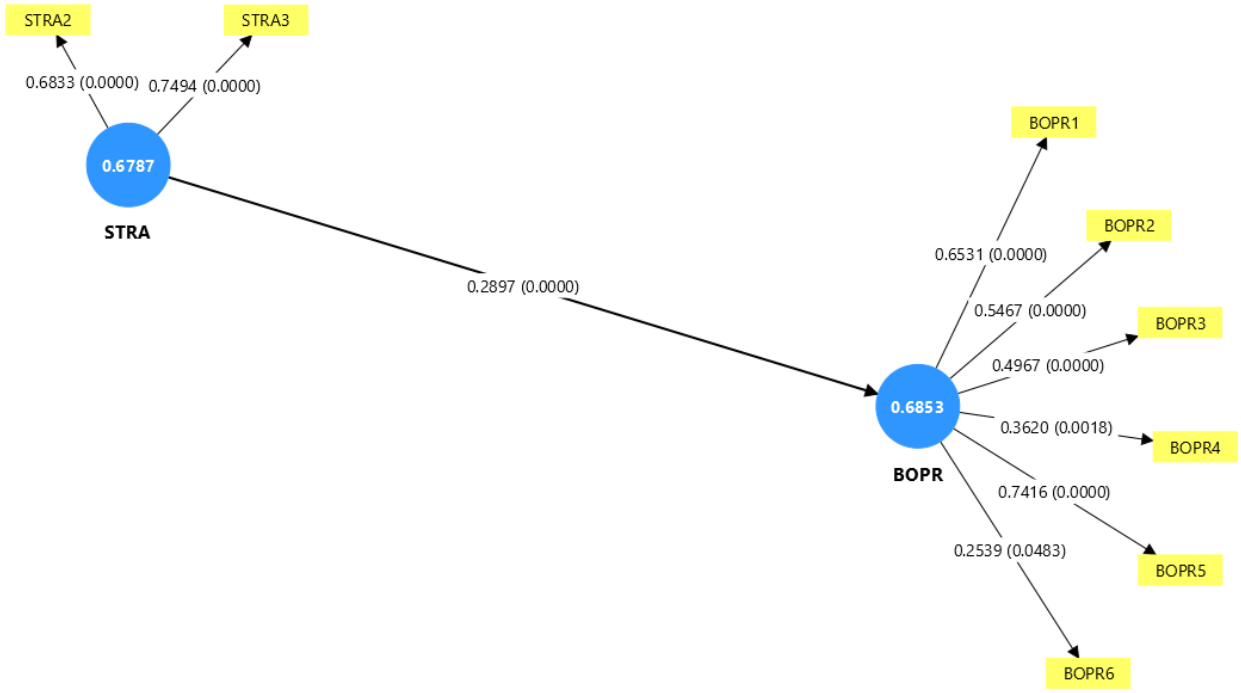


Figure 26: H6 – Boostrap Test – C.

In (Table 172) presents the standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) for H6C. The Benefits Operational (BOPR) construct demonstrates loadings ranging from 0.2539 (BOPR6) to 0.7416 (BOPR5), reflecting heterogeneous contributions of its indicators. The composite reliability of BOPR is 0.6853, indicating moderate internal consistency, while the AVE of 0.2863 suggests that less than one-third of the variance in its indicators is explained by the latent construct.

For Digital Strategy (STRA), loadings range from 0.6833 (STRA2) to 0.7494 (STRA3), supporting a more balanced representation of the construct. The composite reliability of 0.6787 and AVE of 0.5142 indicate adequate internal consistency and convergent validity, respectively. Overall, while STRA demonstrates satisfactory measurement properties, the BOPR construct exhibits weaker indicator representation, suggesting potential refinement in future research.

	Loadings	CR	AVE
Benefits Operational		0.6853	0.2863
BOPR1	0.6531		
BOPR2	0.5467		
BOPR3	0.4967		
BOPR4	0.3620		
BOPR5	0.7416		
BOPR6	0.2539		
Digital Strategy		0.6787	0.5142
STRA2	0.6833		
STRA3	0.7494		

Table 172: Standardized Factor Loadings, CR and AVE for H6C

R-Square

The explanatory power of the structural model for H6C is presented in (Table 173). The model accounts for 8.39% of the variance in Benefits Operational (BOPR), with an adjusted R^2 of 0.0820, reflecting modest predictive power according to conventional PLS-SEM benchmarks. This level of explained variance is typical for exploratory models addressing complex operational outcomes influenced by multiple contextual factors beyond the scope of the current framework.

	R-SQUARE	R-SQUARE ADJUSTED
BOPR	0.0839	0.0820

Table 173:R-Square for H6C

f-Square

The individual contribution of Digital Strategy (STRA) to BOPR is small ($f^2 = 0.0916$; Table 166), suggesting limited practical impact of the predictor on Benefits Operational within this model.

	BOPR	STRA
BOPR		
STRA	0.0916	

Table 174:f-Square for H6C

Construct Reliability and Convergent Validity

Reliability and validity were evaluated using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) (Table 175). BOPR exhibits moderate internal consistency (CR = 0.6853), though the AVE of 0.2863 indicates limited variance explained by its indicators. STRA shows adequate reliability (CR = 0.6787) and convergent validity (AVE = 0.5142). Cronbach's

alpha remains low for both constructs, consistent with previous models, likely due to heterogeneous loadings and a small number of indicators. In variance-based SEM, CR is prioritized; thus, the measurement model is deemed acceptable but suggests the potential need for refinement of Benefit Operational indicators.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6853	0.2863
STRA	0.0555	0.6787	0.5142

Table 175: R-Cronbach, CR and AVE for H6C

Discriminant Validity

Fornell-Larcker criterion

Discriminant validity was assessed using both the Fornell-Larcker criterion (Table 168) and the Heterotrait-Monotrait ratio (Table 176).

According to the Fornell-Larcker criterion (Table 168), the square root of AVE for each construct exceeds its correlation with the other construct: BOPR (AVE = 0.5351) exceeds its correlation with STRA (0.2897), and STRA (AVE = 0.7171) exceeds its correlation with BOPR. This provides initial support for discriminant validity.

	BOPR	STRA
BOPR	0.5351	
STRA	0.2897	0.7171

Table 176:Fornell-Larcker criterion for H6C

HTMT

The HTMT ratio reported in (Table 177) is 1.5147, which substantially exceeds the conventional threshold of 0.85. This result indicates a lack of discriminant validity between Operational Benefits (BOPR) and Digital Strategy (STRA).

Such a high HTMT value suggests a significant overlap between the two constructs, implying that they may not be empirically distinct within the sample. While this finding may be partially explained by the theoretical proximity of Operational Benefits and Digital Strategy, it raises concerns regarding their measurement and conceptual separation.

Therefore, the distinctiveness of these constructs should be interpreted with caution, and future research should consider refining measurement items or reassessing construct definitions to better differentiate between them.

	BOPR	STRA
BOPR		
STRA	1.5147	

Table 177: Heterotrait-monotrait ratio (HTMT) for H6C

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
STRA -> BOPR	0.2897	0.3074	0.0376	7.7105	0.0000

Table 178: Path Coefficients for H6C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H6C.

7.12.6.4 H6 verification with decisional tree of Zhao

Hypothesis	*A*B (AGIL*SPEN) Is significant?*	*C (BINN) Is significant?*	*A*B*C (AGIL* SPEN* BOPR) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H6	.00500328 Significant	0.0000 Significant	.1541* 0.1486* 0.2563 Positive	Complementary (**Mediation**)	Yes

Table 179: Verification with decisional tree of Zhao - H6

Where: A = AGIL = Agile/DevOps

B = STRA = IT Strategy

C = BOPR= Benefits Operational

Table 179 presents the analysis of Hypothesis 6 (H6) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis
- The mediation is strong.
- The variable Agile/Ops (AGIL) is essential to have effect on IT Strategy (STRA) to have Benefits Operational (BOPR). Without Agile/DevOps implementation there is not Benefits Operational (BOPR).
- The relation C (STRA BOPR) alone not is valid and alone is worse.
- The relation AB (AGIL STRA) is strong.
- If we have IT Strategy (STRA), we will have Benefits Operational (BOPR).
- If there is a STRA, there is little possibility of having Benefits Operational effect, unless you have an aligned Agile/Ops implementation.
- A higher level of agility can in this case yield benefits compared to traditional development, not only because of frequent customer feedback but also because shorter iterations create a series of deadlines that increase a sense of urgency, pacing of work, and team productivity (van Oorschot et al., 2018).
- The cognition of impact is the degree to which an employee has influence on the administrative, operational, or strategic outcomes of a job (Spreitzer, De Janasz & Quinn, 1999). The psychological empowerment construct provides an important mechanism for describing how team contributions can affect the outcomes of innovative projects.
- The ability of organizational leadership to motivate and empower staff has proven to be a major contributor to project performance. Project management practice tends to prioritize deadlines, and this can have consequences for staff empowerment and, subsequently, project performance (Malik et al., 2021).

7.12.7 H7: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Benefits Innovative (BINN)

Test Variables: SPEN > AGIL > BINN

Yucel (Yucel, 2018) identifies financial resources, competing priorities, and organizational support as relevant considerations in the evaluation of digital transformation strategy. These considerations provide a rationale for examining the relationship between Spend Priorities and Agile/DevOps practices. Accordingly, the present research investigates whether Agile/DevOps practices mediate the relationship between Spend Priorities and Innovative Benefits (H7) and between Spend Priorities and Operational Benefits (H8). We resumed the result in the (Table 29) of mediation. In the lines (19, 20, 21) are the hypothesis H7 with the different paths: AB, ABC and C.

7.12.7.1 H7AB

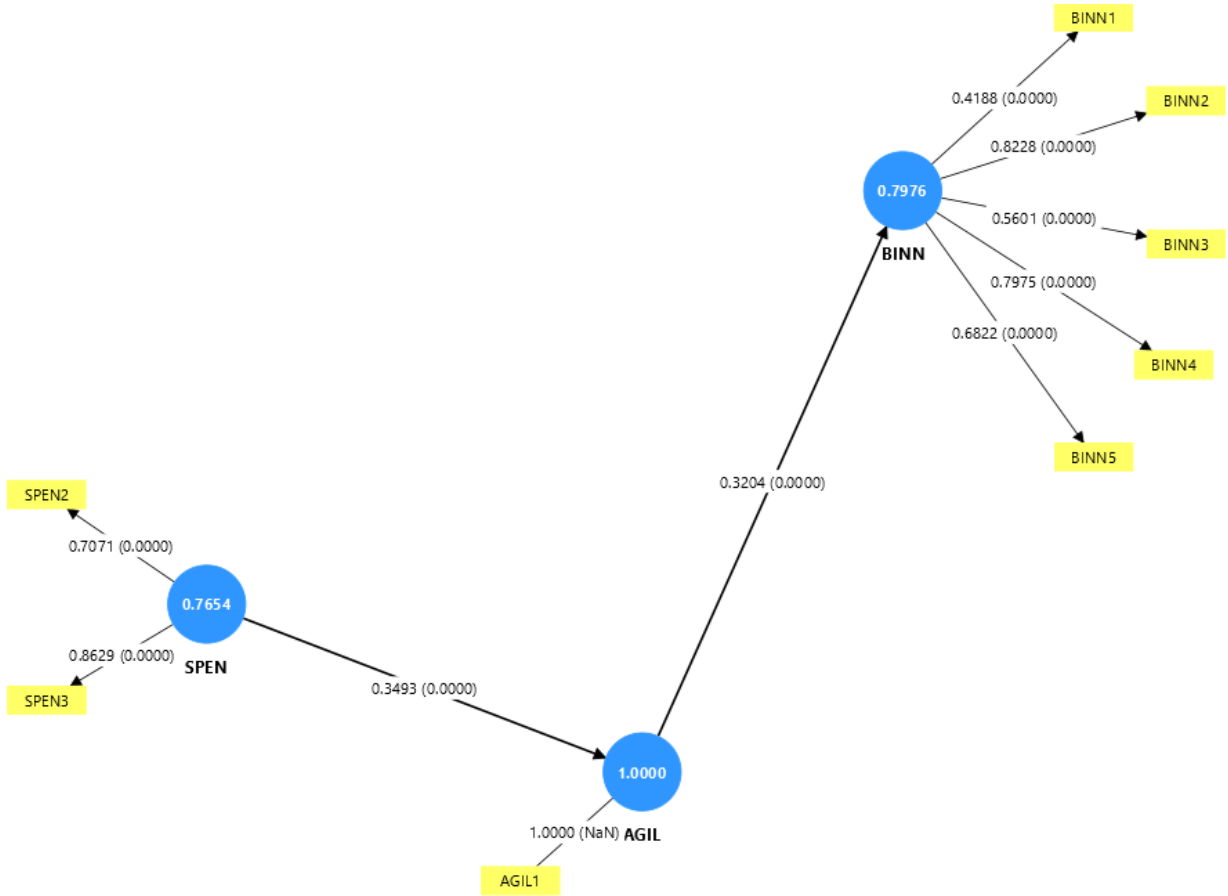


Figure 27: H7 – Boostrap Test – AB.

In (Table 29) the line 19, column 9 and 10, are the T-stats-a 7.6346 and T-stats-b 8.9389. Here in table of requirements (Table 21) says these values should be higher than 1.96 and both cases are significant.

In (Table 180) presents the standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) for H7AB.

Agile/DevOps (AGIL) is represented by a single indicator, AGIL1, with a fixed loading of 1.0000. Benefits Innovative (BINN) exhibits loadings ranging from 0.4188 (BINN1) to 0.8228 (BINN2), reflecting moderate to strong indicator contributions. The composite reliability (CR = 0.7976) and AVE (0.4535) indicate acceptable internal consistency and borderline convergent validity.

Spend Priorities (SPEN) shows strong indicator loadings (SPEN2 = 0.7071; SPEN3 = 0.8629), with CR = 0.7654 and AVE = 0.6223, suggesting good reliability and convergent validity. Overall, the loadings demonstrate that most indicators contribute meaningfully to their respective constructs, although one BINN indicator (BINN1 = 0.4188) is relatively low and may warrant careful interpretation in subsequent analyses.

	Loadings	CR	AVE
Agile/DevOps	1.0000		
AGIL1			
Benefits Innovative		0.7976	0.4535
BINN1	0.418805		
BINN2	0.822848		
BINN3	0.560055		
BINN4	0.797531		
BINN5	0.682176		
Spend Priorities		0.7654	0.6223
SPEN2	0.707113		
SPEN3	0.862886		

Table 180: Standardized Factor Loadings, CR and AVE for H7AB

R-Square

The explanatory power of the structural model was assessed using the coefficient of determination (R^2) (Table 181). Agile/DevOps (AGIL) exhibits an R^2 of 0.1220, indicating that approximately 12.2% of its variance is explained by the predictors. Benefits Innovative (BINN) shows an R^2 of 0.1027, reflecting modest explanatory power. These values suggest limited but meaningful

variance explanation, which is typical in exploratory models involving strategic and operational constructs.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1220	0.1202
BINN	0.1027	0.1008

Table 181:R-Square for H7AB

f-Square

Effect sizes were evaluated to determine the contribution of each exogenous construct to the endogenous constructs (Table 182). AGIL has a small effect on BINN ($f^2 = 0.1144$), and SPEN exerts a small effect on AGIL ($f^2 = 0.1390$). Collectively, these effects indicate that the structural relationships exist but are modest in magnitude, consistent with the exploratory nature of this model.

	AGIL	BINN	SPEN
AGIL		0.1144	
BINN			
SPEN	0.1390		

Table 182:f-Square for H7AB

Construct Reliability and Convergent Validity

In (Table 183) presents Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). BINN exhibits satisfactory reliability (CR = 0.7976; $\alpha = 0.7313$) and borderline convergent validity (AVE = 0.4535). SPEN shows good reliability (CR = 0.7654) and adequate convergent validity (AVE = 0.6223), although Cronbach's alpha is relatively low ($\alpha = 0.4036$), likely due to heterogeneous indicator loadings and a limited number of items. Overall, composite reliability is prioritized, supporting the internal consistency of the constructs.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.7976	0.4535
SPEN	0.4036	0.7654	0.6223

Table 183: R-Cronbach, CR and AVE for H7AB

Discriminant Validity

Fornell-Larcker Criterion

As shown in (Table 184), the square root of AVE for each construct exceeds its correlations with other constructs, indicating satisfactory discriminant validity. Specifically, BINN (AVE = 0.6734) and SPEN (AVE = 0.7889) are higher than their inter-construct correlations with AGIL and each other.

	AGIL	BINN	SPEN
AGIL	1.0000		
BINN	0.3204	0.6734	
SPEN	0.3493	0.1635	0.7889

Table 184:Fornell-Larcker criterion for H7AB

HTMT

Heterotrait-Monotrait Ratio (HTMT): (Table 185) shows that all HTMT values are below the conservative threshold of 0.85, confirming adequate discriminant validity among the constructs.

	AGIL	BINN	SPEN
AGIL			
BINN	0.2896		
SPEN	0.5395	0.2495	

Table 185: Heterotrait-monotrait ratio (HTMT) for H7AB

Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
AGIL -> BINN	0.3204	0.3289	0.0358	8.9389	0.0000
SPEN -> AGIL	0.3493	0.3506	0.0458	7.6346	0.0000

Table 186: Path Coefficients for H7AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 186 Path Coefficients for H7AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.3204	Sobel test:	5.61091042	0.01994609	2e-8
b	0.3493	Aroian test:	5.58977175	0.02002152	2e-8
s_a	0.0358	Goodman test:	5.63229073	0.01987037	2e-8
s_b	0.0485	Reset all	Calculate		

Table 187: Sobel Test for H7AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:			Test statistic:	*p*-value:
t_a	8.9389	Sobel test:	5.80537673	1e-8
t_b	7.6346	Aroian test:	5.78448515	1e-8
		Goodman test:	5.82649632	1e-8
		Reset all	Calculate	

Table 188: Sobel Test for H7AB. With T statistics

The results show (Table 187 and 188) that the mediation effects, as assessed by Sobel, 5.6109 (Table 29 column 17), Aroian, 5.5897 (Table 29 column 18), Goodman, 5.6322 (Table 29 column 19. These values are higher than 1.96 and are significantly acceptable.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H7AB.

7.12.7.2 H7ABC'

In (Table 29) we have in line 20, the coefficient column 1 Coef-a 0.350, column 2 Coef-b 0.297, and column 3 Coef-c'0.060.

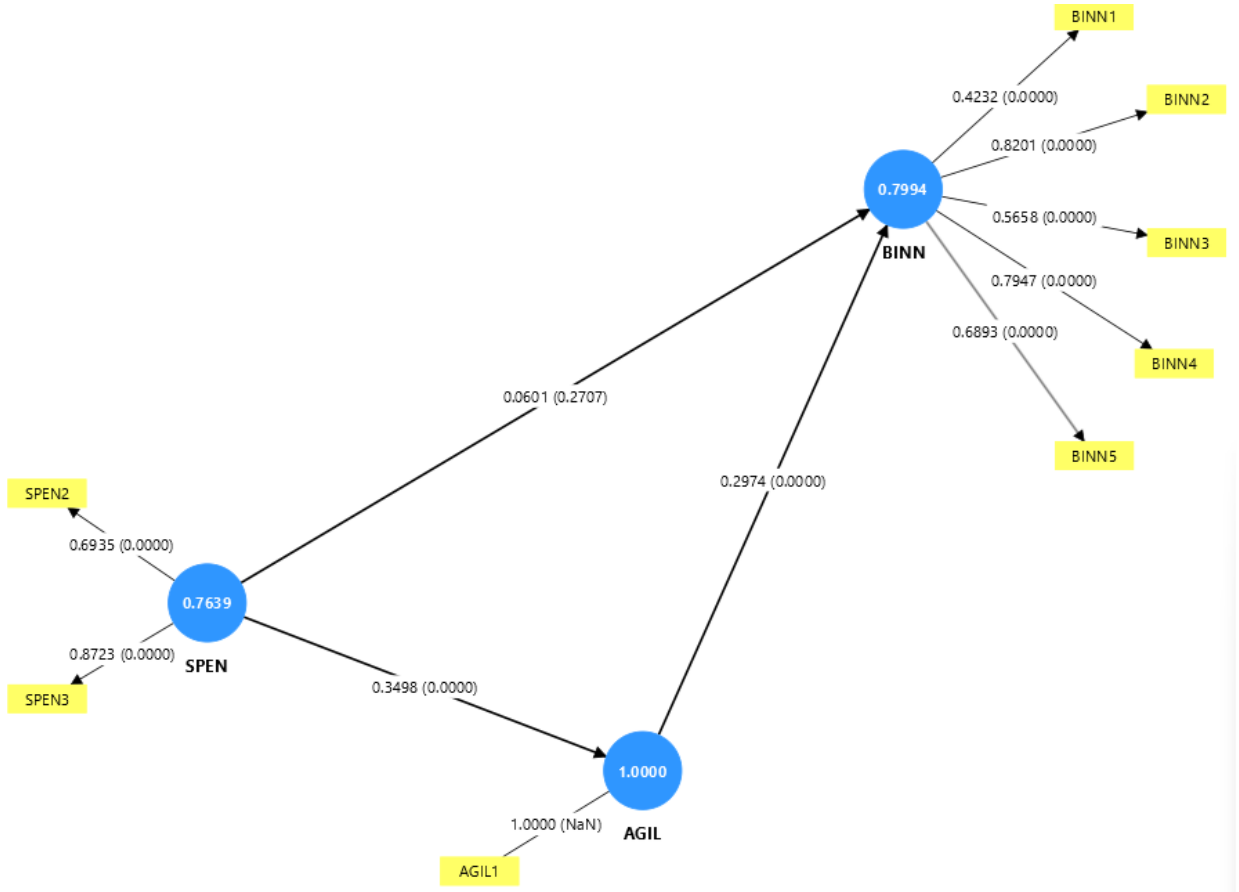


Figure 28: H7 – Boostrap Test – ABC'.

Standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) are presented in (Table 189). The Agile/DevOps construct is measured by a single indicator (AGIL1) with a loading of 1.0000. For Benefits Innovative (BINN), indicator loadings range from 0.4232 to 0.8201, resulting in a CR of 0.7994 and an AVE of 0.4557. Spend Priorities (SPEN) shows indicator loadings between 0.6935 and 0.8723, with a CR of 0.7994 and an AVE of 0.4557. Although the AVE values for BINN and SPEN are just below the recommended 0.50 threshold, they indicate a satisfactory degree of convergent validity. The CR values exceed the recommended 0.70 benchmark, supporting the internal consistency of the constructs. These results suggest that the indicators capture the underlying constructs sufficiently for exploratory purposes, though

future research may benefit from refinement of lower-loading items to enhance convergent validity.

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Benefits Innovative		0.7994	0.4557
BINN1	0.4232		
BINN2	0.8201		
BINN3	0.5658		
BINN4	0.7947		
BINN5	0.6893		
Spend Priorities		0.7994	0.4557
SPEN2	0.6935		
SPEN3	0.8723		

Table 189: Standardized Factor Loadings, CR and AVE for H7ABC'

R-Square

The explanatory power of the model was evaluated using the coefficient of determination (R^2) (Table 190). The model accounts for 12.24% of the variance in Agile/DevOps (AGIL) and 10.45% of the variance in Benefits Innovative (BINN), with adjusted R^2 values of 0.1205 and 0.1008, respectively. According to conventional PLS-SEM thresholds, these values indicate low to moderate explanatory power, which is consistent with the exploratory nature of the study and the complex, multifaceted constructs under investigation.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1224	0.1205
BINN	0.1045	0.1008

Table 190:R-Square for H7ABC

f-Square

Effect sizes were examined to assess the individual contribution of exogenous constructs to the endogenous constructs (Table 191). The path from AGIL to BINN demonstrates a small effect ($f^2 = 0.0867$), while SPEN's contribution to AGIL ($f^2 = 0.1394$) is slightly larger but still within the

small-to-moderate range. The effect of SPEN on BINN ($f^2 = 0.0035$) is negligible. These findings suggest that the structural relationships are present but exert limited practical influence.

	AGIL	BINN	SPEN
AGIL		0.0867	
BINN			
SPEN	0.1394	0.0035	

Table 191:f-Square for H7ABC

Construct Reliability and Convergent Validity

Internal consistency was evaluated using composite reliability (CR) and Cronbach's alpha (Table 192). BINN exhibits satisfactory reliability (CR = 0.7994, α = 0.7313), while SPEN demonstrates acceptable reliability (CR = 0.7639, α = 0.4036). Cronbach's alpha for SPEN is low, reflecting heterogeneous indicator loadings and a limited number of items; however, composite reliability is prioritized in PLS-SEM, supporting overall measurement adequacy.

Convergent validity was assessed via the Average Variance Extracted (AVE). BINN (AVE = 0.4557) is slightly below the conventional 0.50 threshold, whereas SPEN (AVE = 0.6210) exceeds it, indicating acceptable convergent validity for both constructs in an exploratory context.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.7994	0.4557
SPEN	0.4036	0.7639	0.6210

Table 192: R-Cronbach, CR and AVE for H7ABC

Discriminant Validity

Discriminant validity was examined using both the Fornell-Larcker criterion (Table 185) and the Heterotrait-Monotrait ratio (HTMT) (Table 193). The square roots of AVE for all constructs exceed their respective inter-construct correlations, supporting initial discriminant validity. HTMT values are all below the conservative threshold of 0.85, indicating that constructs are empirically distinct and that multicollinearity is not a concern.

	AGIL	BINN	SPEN
AGIL	1.0000		
BINN	0.3184	0.6750	
SPEN	0.3498	0.1641	0.7880

Table 193:Fornell-Larcker criterion for H7ABC

	AGIL	BINN	SPEN
AGIL			
BINN	0.2896		
SPEN	0.5395	0.2495	

Table 194: Heterotrait-monotrait ratio (HTMT) for H7ABC

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
b AGIL -> BINN	0.2974	0.3024	0.0456	6.5233	0.0000
a SPEN -> AGIL	0.3498	0.3507	0.0459	7.6285	0.0000
c SPEN -> BINN	0.0601	0.0625	0.0545	1.1015	0.2707

Table 195: Path Coefficients for H7ABC'

Input:		Test statistic:	*p*-value:
t_a 7.6285	Sobel test:	4.95780521	7.1e-7
t_b 6.5233	Aroian test:	4.93338177	8.1e-7
	Goodman test:	4.98259503	6.3e-7
	Reset all	Calculate	

Table 196: Sobel Test for H7ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H7ABC'.

7.12.7.3 H7C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

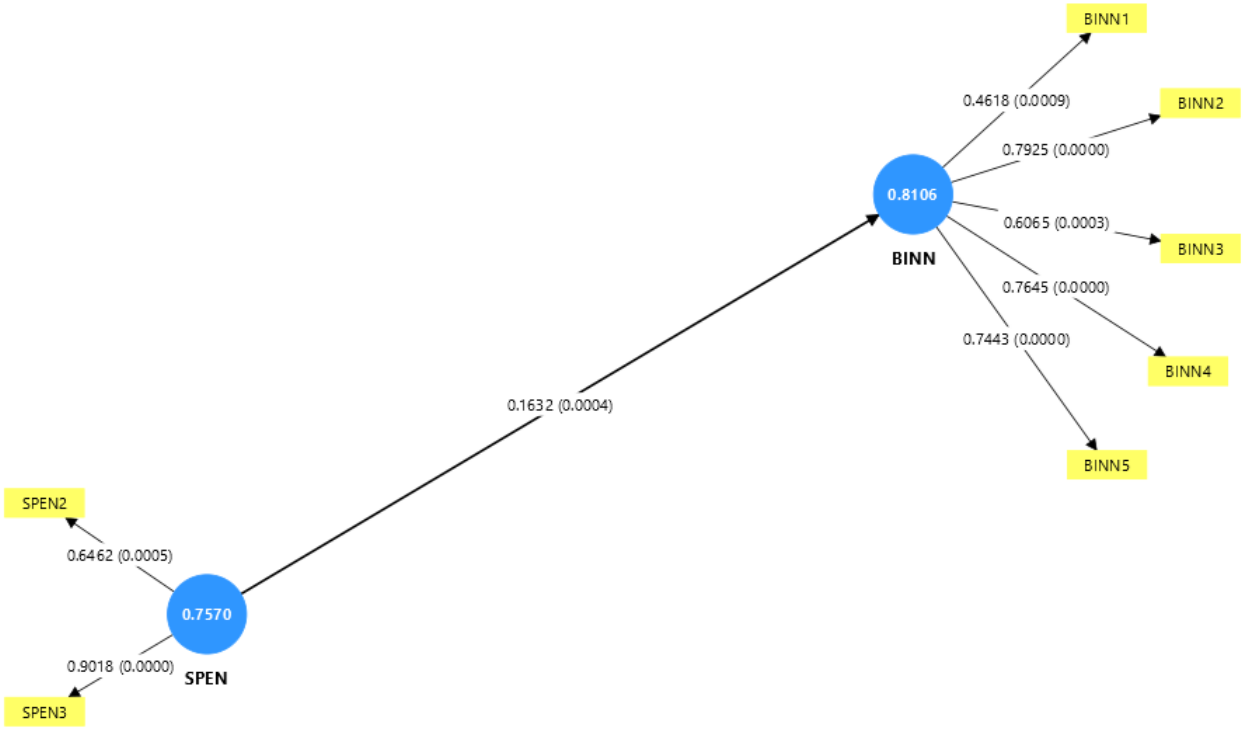


Figure 29: H7 – Boostrap Test –C.

In (Table 197) presents the standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) for H7C. The construct Benefits Innovative (BINN) demonstrates loadings ranging from 0.4618 to 0.7925 across its five indicators, with an overall CR of 0.8106 and an AVE of 0.4695. While BINN's lower-loading item (BINN1 = 0.4618) slightly reduces the average, the construct maintains satisfactory reliability and convergent validity for exploratory research.

The Spend Priorities (SPEN) construct exhibits strong loadings, from 0.6462 to 0.9018, with a CR of 0.7570 and an AVE of 0.6153, indicating solid internal consistency and convergent validity. Overall, the indicator loadings support the measurement model, with both constructs demonstrating acceptable reliability and validity for subsequent structural analysis.

	Loadings	CR	AVE
Benefits Innovative		0.8106	0.4695
BINN1	0.4618		
BINN2	0.7925		
BINN3	0.6065		
BINN4	0.7645		
BINN5	0.7443		
Spend Priorities		0.7570	0.6153
SPEN2	0.6462		
SPEN3	0.9018		

Table 197: Standardized Factor Loadings, CR and AVE for H7C

R-Square

The explanatory power of the structural model for H7C was assessed using the coefficient of determination (R^2). The model explains 2.66% of the variance in Benefits Innovative (BINN), with an adjusted R^2 of 0.0246 (Table 198). According to conventional PLS-SEM benchmarks, this indicates very weak explanatory power. However, such low R^2 values are typical in exploratory models of complex strategic constructs, where outcomes are influenced by multiple contextual factors beyond those included in the current model.

	R-SQUARE	R-SQUARE ADJUSTED
BINN	0.0266	0.0246

Table 198:R-Square for H7C

f-Square

Effect sizes were examined to assess the contribution of Spend Priorities (SPEN) to Benefits Innovative (BINN). The f^2 value of 0.0274 (Table 199) indicates a small effect according to Cohen's (1988) guidelines, suggesting that SPEN exerts a limited, yet detectable, influence on BINN.

	BINN	SPEN
BINN		
SPEN	0.0274	

Table 199:f-Square for H7C

Construct Reliability and Convergent Validity

Reliability and convergent validity were evaluated using Cronbach's alpha, composite reliability (CR), and AVE (Table 200). BINN demonstrates satisfactory composite reliability (CR = 0.8106) and near-threshold AVE (0.4695), supporting acceptable internal consistency despite a lower alpha (α = 0.7313). SPEN shows robust reliability and convergent validity (CR = 0.7570, AVE = 0.6153), confirming the adequacy of its indicators for structural modeling.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BINN	0.7313	0.8106	0.4695
SPEN	0.4036	0.7570	0.6153

Table 200: R-Cronbach, CR and AVE for H7C

Discriminant Validity

Discriminant validity was assessed using both the Fornell-Larcker criterion (Table 201) and the Heterotrait-Monotrait (HTMT) ratio (Table 194). According to the Fornell-Larcker criterion (Table 202), the square root of AVE for BINN (0.6852) and SPEN (0.7844) exceeds their mutual correlation (0.1632), indicating adequate discriminant validity. Similarly, HTMT values remain below the conservative threshold of 0.85 (0.2495, Table 202).

	BINN	SPEN
BINN	0.6852	
SPEN	0.1632	0.7844

Table 201:Fornell-Larcker criterion for H7C

	BINN	SPEN
BINN		
SPEN	0.2495	

Table 202: Heterotrait-monotrait ratio (HTMT) for H7C

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
SPEN -> BINN	0.1632	0.1846	0.0464	3.5164	0.0004

Table 203: Path Coefficients for H7C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H7C.

7.12.7.4 H7 verification with decisional tree of Zhao

Hypothesis	*A*B (AGIL*STRA) Is significant?*	*C (BINN) Is significant?*	*A*B*C (AGIL* STRA* BINN) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H7	0.00000001 Significant	0.000 Significant	0.3498* 0.2974* 0.0601 Positive	Complementary (**Mediation**)	Yes

Table 204: Verification with decisional tree of Zhao - H7

Where: A = AGIL = Agile/DevOps

B = SPEN = Spend Priorities

C = BINN = Benefits Innovative

Table 204 presents the analysis of Hypothesis 7 (H7) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis
- The mediation is strong.
- The variable Agile/Ops (AGIL) is essential to have effect on Spend Priorities to have Benefits Innovative (BINN). Without Agile/DevOps implementation there is not Benefits Innovative (BINN).
- The relation C (SPEN BINN) alone not is valid and alone is worse.
- The relation AB (AGIL SPEN) is strong.
- If we have Spend Priorities (SPEN), we will have Benefits Innovative (BINN).
- If there is a Spend Priorities, there is little possibility of having Benefits Innovative effect, unless you have an aligned Agile/Ops implementation.
- Project contract includes several sanction mechanisms for the situations SW vendor does not deliver according to the commitments. On the other hand, Agency pays attention to non-monetary benefits for working in the project. Good spirit and cooperation with the teams and individuals in the project were emphasised (Nuottila et al., 2017).
- Significant benefits available for a public organisation in adopting agile methods in software development and software subcontracting. First, it is possible to free in-house resources to concentrate on business requirements of the developed software system while the detailed software design is done during the software project by contracted specialists. Second, it is possible to decrease administrative costs of software projects and increase productivity of resources available. Third, agile methods make it possible for the project owner to constantly monitor and guide development and the project as there is a possibility to flexibly make changes during the project (Nuottila et al., 2017).

7.12.8 H8: Agile/DevOps (AGIL) positively and significantly mediates the relationship between Spend Priorities (SPEN) and Benefits Operational (BOPR)

Test Variables: SPEN > AGIL > BOPR.

We resumed the result in the (Table 29) of mediation. In the lines (22, 23, 24) are the hypothesis H8 with the different paths: AB, ABC and C.

7.12.8.1 H8AB

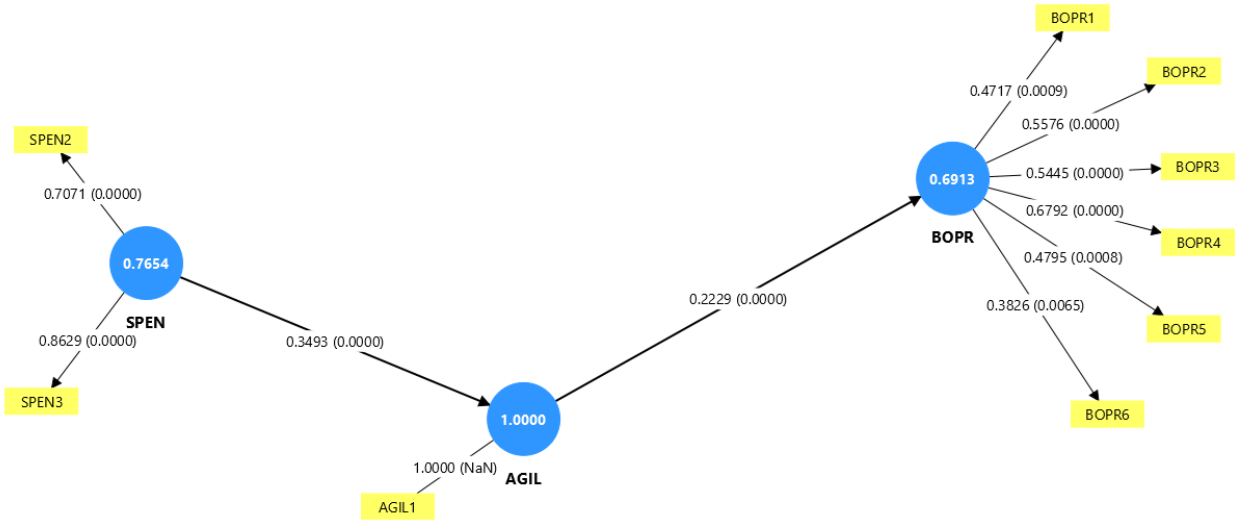


Figure 30: H8 – Boostrap Test – AB.

In (Table 29) the line 22, column 9 and 10, are the T-stats-a 7.6346 and T-stats-b 5.2884. These values should be higher than 1.96 and both cases are significant.

Agile/DevOps (AGIL1) is represented by a single indicator with a standardized loading of 1.0000, serving as the reference for the latent construct (Table 205).

Benefits Operational (BOPR) is measured with six indicators (BOPR1–BOPR6), exhibiting loadings ranging from 0.3826 to 0.6792 and a composite reliability (CR) of 0.6913 with an AVE of 0.2779 (Table 206). The loadings suggest moderate representation of the construct by its indicators, with some variability, particularly for BOPR6 (0.3826). The relatively low AVE reflects that the indicators capture a limited portion of the construct's variance, which is not uncommon in exploratory research involving operational benefits.

Spend Priorities (SPEN) is captured by two indicators (SPEN2 and SPEN3), with strong loadings of 0.7071 and 0.8629, respectively. The construct demonstrates solid reliability (CR = 0.7654) and

convergent validity (AVE = 0.6223), indicating that the indicators reliably represent the latent variable.

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Benefits Operational		0.6913	0.2779
BOPR1	0.4717		
BOPR2	0.5576		
BOPR3	0.5445		
BOPR4	0.6792		
BOPR5	0.4795		
BOPR6	0.3826		
Spend Priorities		0.7654	0.6223
SPEN2	0.7071		
SPEN3	0.8629		

Table 205: Standardized Factor Loadings, CR and AVE for H8AB

R-Square

The explanatory power of the structural model was evaluated using the coefficient of determination (R^2) (Table 206). The results indicate that Agile/DevOps (AGIL) explains 12.20% of the variance in the dependent construct (adjusted R^2 = 0.1202), suggesting a moderate level of predictive accuracy according to established PLS-SEM benchmarks.

In contrast, Operational Benefits (BOPR) exhibit a lower R^2 value of 0.0497 (adjusted R^2 = 0.0477), indicating that the model accounts for a relatively small proportion of its variance.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1220	0.1202
BOPR	0.0497	0.0477

Table 206:R-Square for H8AB

f-Square

The individual contribution of exogenous constructs to endogenous constructs was assessed using f^2 (Table 207). SPEN exerts a small-to-moderate effect on AGIL ($f^2 = 0.1390$), while AGIL has a small effect on BOPR ($f^2 = 0.0523$). These values suggest that, although the relationships are present, their practical impact is limited, highlighting the exploratory nature of the model.

	AGIL	BOPR	SPEN
AGIL		0.0523	
BOPR			
SPEN	0.1390		

Table 207:f-Square for H8AB

Construct Reliability and Convergent Validity

Internal consistency reliability was evaluated using Composite Reliability (CR) and Cronbach's alpha (Table 208). BOPR shows moderate reliability (CR = 0.6913, $\alpha = 0.5107$) with an AVE of 0.2779, reflecting that the indicators capture a limited proportion of variance but are acceptable for exploratory analysis. SPEN demonstrates strong reliability (CR = 0.7654, $\alpha = 0.4036$) and convergent validity (AVE = 0.6223), indicating that the construct is well represented by its indicators.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6913	0.2779
SPEN	0.4036	0.7654	0.6223

Table 208: R-Cronbach, CR and AVE for H8AB

Discriminant Validity

Discriminant validity was examined using the Fornell-Larcker criterion (Table 209) and HTMT ratio (Table 210). The square root of AVE for each construct exceeds its correlations with other constructs, supporting discriminant validity. HTMT values are all below the conservative threshold of 0.85, confirming that the constructs are empirically distinct.

Collectively, these results indicate that, while some constructs such as BOPR show limited variance explained and moderate reliability, the measurement and structural model exhibit

adequate reliability and validity, supporting the interpretation of the hypothesized relationships in this exploratory framework.

	AGIL	BOPR	SPEN
AGIL	1.0000		
BOPR	0.2229	0.5272	
SPEN	0.3493	0.1398	0.7889

Table 209:Fornell-Larcker criterion for H8AB

	AGIL	BOPR	SPEN
AGIL			
BOPR	0.2744		
SPEN	0.5395	0.3258	

Table 210: Heterotrait-monotrait ratio (HTMT) for H8AB

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
AGIL -> BOPR	0.2229	0.2441	0.0421	5.2884	0.0000
SPEN -> AGIL	0.3493	0.3506	0.0458	7.6346	0.0000

Table 211: Path Coefficients for H8AB

Next steps do the Sobel test of the (Table 29) column 17, 18 and 19. We use this link: Interactive Mediation Tests (quantpsy.org) to measure de mediation. In the Input a and b, we put the coefficient a and b, for s_a and s_b we put the standard deviation of **Table 203 Path Coefficients for H8AB**.

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.2229	Sobel test:	4.34923816	0.01790175	0.00001366
b	0.3493	Aroian test:	4.3242273	0.01800529	0.00001531
s_a	0.0421	Goodman test:	4.37468808	0.0177976	0.00001216
s_b	0.0458	Reset all	Calculate		

Table 212: Sobel Test for H8AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:		Test statistic:	*p*-value:
t_a 5.2884	Sobel test:	4.34730617	0.00001378
t_b 7.6346	Aroian test:	4.32232268	0.00001544
	Goodman test:	4.37272796	0.00001227
	Reset all	Calculate	

Table 213: Sobel Test for H8AB. With T statistics

The results show (Table 212 and 213) that the mediation effects, as assessed by Sobel, 4.3492 (Table 29 column 17), Aroian, 4.3242 (Table 29 column 18), Goodman, 4.3746 (Table 29 column 19. These values are higher than 1.96 and are significantly acceptable.

The Descriptive statistics of constructs are in Appendix I in 7.10 for H8AB.

7.12.8.2 H8ABC'

In (Table 29) we have in line 23, the coefficient column 1 Coef-a 0.3473, column 2 Coef-b 0.1930, and column 3 Coef-c'0.0953.

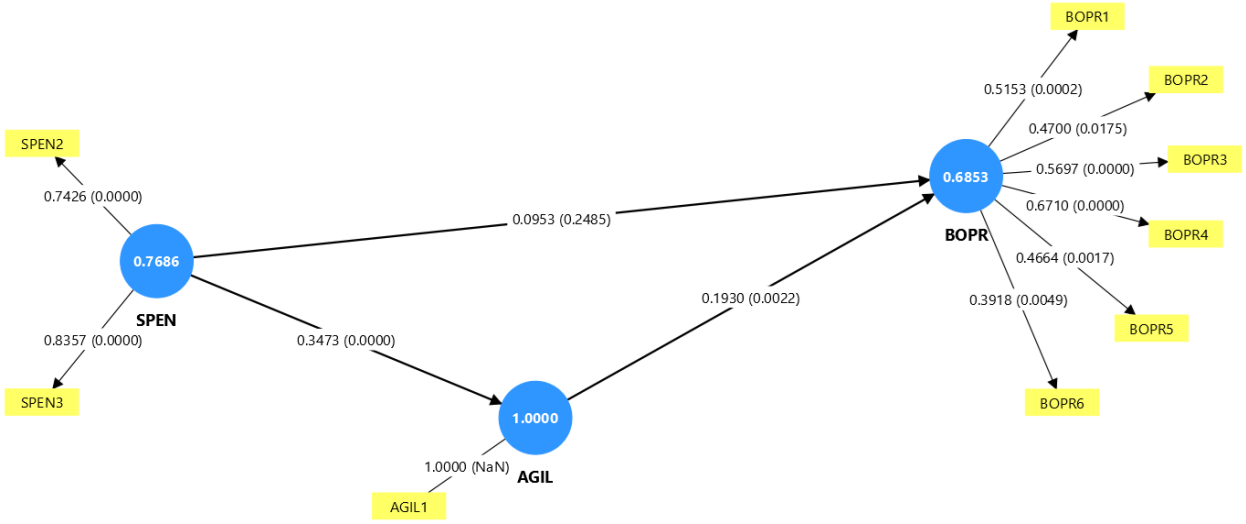


Figure 31: H8 – Boostrap Test ABC'.

The standardized factor loadings for H8ABC' are presented in (Table 214). For Benefits Operational (BOPR), loadings range from 0.3918 to 0.6710, with BOPR4 showing the highest contribution (0.6710) and BOPR6 the lowest (0.3918). The composite reliability for BOPR is 0.6853, and the AVE is 0.2720, indicating that the indicators capture a moderate portion of the construct's variance, though some indicators show weaker contributions.

For Spend Priorities (SPEN), loadings are higher and more consistent, ranging from 0.7426 (SPEN2) to 0.8357 (SPEN3), with a CR of 0.7686 and AVE of 0.6249. These values indicate that SPEN is well represented by its indicators and demonstrates good convergent validity.

Overall, the loadings suggest that SPEN is robustly measured, while BOPR shows more heterogeneous contributions across indicators, consistent with the exploratory nature of operational benefits in this model.

	Loadings	CR	AVE
Agile/DevOps			
AGIL1	1.0000		
Benefits Operational		0.6853	0.2720
BOPR1	0.5153		
BOPR2	0.4700		
BOPR3	0.5697		
BOPR4	0.6710		
BOPR5	0.4664		
BOPR6	0.3918		
Spend Priorities		0.7686	0.6249
SPEN2	0.7426		
SPEN3	0.8357		

Table 214: Standardized Factor Loadings, CR and AVE for H8AB

R-Square

The explanatory power of the structural model is presented in (Table 215). The model explains 12.06% of the variance in Agile/DevOps (AGIL) and 5.91% of the variance in Benefits Operational (BOPR), with adjusted R^2 values of 0.1188 and 0.0552, respectively. These values indicate weak to modest explanatory power, which is consistent with exploratory research in complex organizational and strategic contexts.

	R-SQUARE	R-SQUARE ADJUSTED
AGIL	0.1206	0.1188
BOPR	0.0591	0.0552

Table 215:R-Square for H8ABC'

f-Square

Effect sizes (Table 216) reveal that SPEN contributes moderately to AGIL ($f^2 = 0.1372$), while its effect on BOPR is negligible ($f^2 = 0.0085$). AGIL's effect on BOPR is small ($f^2 = 0.0348$), indicating limited but present practical influence of these predictors within the model.

	AGIL	BOPR	SPEN
AGIL		0.0348	
BOPR			
SPEN	0.1372	0.0085	

Table 216:f-Square for H8ABC'

Construct Reliability and Convergent Validity

Internal consistency was assessed using Composite Reliability (CR) and Cronbach's alpha (Table 209). BOPR demonstrates moderate reliability (CR = 0.6853), with a low Cronbach's alpha (0.5107) reflecting heterogeneous indicator loadings and the small number of indicators. SPEN exhibits satisfactory reliability (CR = 0.7686; α = 0.4036).

Average Variance Extracted (AVE) indicates that SPEN (0.6249) shows good convergent validity, while BOPR (0.2720) captures a smaller proportion of its indicators' variance, consistent with exploratory measurement of operational benefits.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6853	0.2720
SPEN	0.4036	0.7686	0.6249

Table 217: R-Cronbach, CR and AVE for H8ABC'

Discriminant Validity

Discriminant validity assessed via the Fornell-Larcker criterion (Table 218) shows that each construct's square root of AVE exceeds its correlations with other constructs, supporting initial discriminant validity. The HTMT ratios (Table 219) are below the conservative threshold of 0.85 for most pairs, indicating acceptable discriminant validity, though BOPR and SPEN show moderate association (HTMT = 0.3258), consistent with theoretical overlap between operational benefits and spending priorities.

	AGIL	BOPR	SPEN
AGIL	1.0000		
BOPR	0.2261	0.5216	
SPEN	0.3473	0.1624	0.7905

Table 218:Fornell-Larcker criterion for H8ABC'

	AGIL	BOPR	SPEN
AGIL			
BOPR	0.2744		
SPEN	0.5395	0.3258	

Table 219: Heterotrait-monotrait ratio (HTMT) for H8ABC'

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
b AGIL -> BOPR	0.1930	0.2027	0.0631	3.0598	0.0022
a SPEN -> AGIL	0.3473	0.3483	0.0462	7.5194	0.0000
c SPEN -> BOPR	0.0953	0.1059	0.0826	1.1541	0.2485

Table 220: Path Coefficients for H8ABC'

Input:		Test statistic:	*p*-value:
t_a 7.5194	Sobel test:	1.14074197	0.25397732
t_b 1.1541	Aroian test:	1.13101237	0.25804988
	Goodman test:	1.15072706	0.24984454
	Reset all	Calculate	

Table 221: Sobel Test for H8ABC'. With T statistics

The Descriptive statistics of constructs are in Appendix I in 7.10 for H8ABC'.

7.12.8.3 H8C

We run only the path between the DSTR and AGIL the p-value is significant because is less than 0.05.

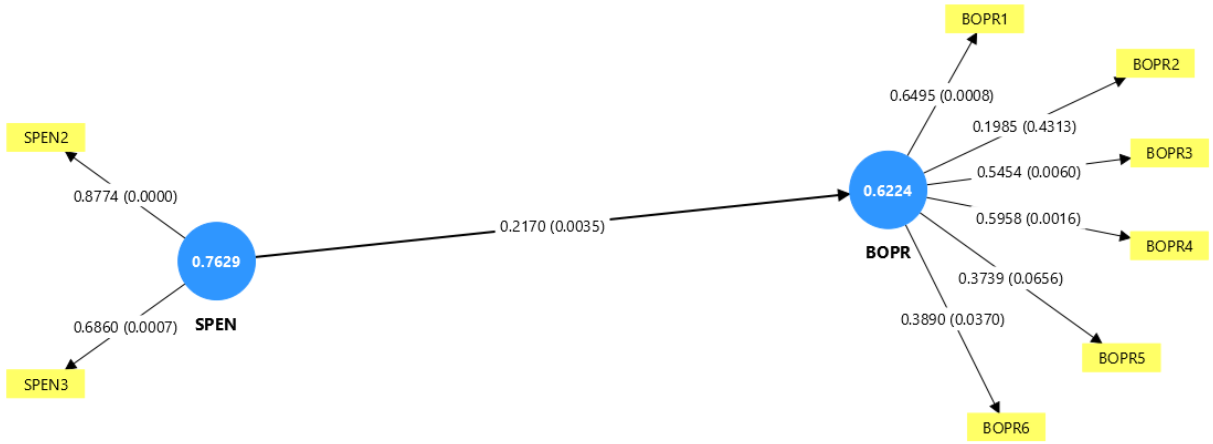


Figure 32: H8 – Boostrap Test C.

The standardized factor loadings for H8C are presented in (Table 222). The construct Benefits Operational (BOPR) demonstrates heterogeneous loadings, ranging from 0.1985 (BOPR2) to 0.6495 (BOPR1), reflecting variability in how individual indicators capture the operational benefits construct. Despite this heterogeneity, the composite reliability (CR = 0.6224) indicates moderate internal consistency, while the average variance extracted (AVE = 0.2341) suggests that a relatively small proportion of variance in BOPR indicators is explained by the latent construct.

In contrast, Spend Priorities (SPEN) shows strong loadings (0.6860–0.8774), robust composite reliability (CR = 0.7629), and good convergent validity (AVE = 0.6202), confirming that the latent construct is well represented by its indicators.

These results indicate that while SPEN is reliably measured, the operational benefits construct (BOPR) requires cautious interpretation due to lower indicator coherence, a common feature in exploratory assessment of complex organizational outcomes.

	Loadings	CR	AVE
Benefits Operational		0.6224	0.2341
BOPR1	0.6495		
BOPR2	0.1985		
BOPR3	0.5454		
BOPR4	0.5958		
BOPR5	0.3739		
BOPR6	0.3890		
Spend Priorities		0.7629	0.6202
SPEN2	0.8774		
SPEN3	0.6860		

Table 222: Standardized Factor Loadings, CR and AVE for H8C

R-Square

The explanatory power of the structural model for H8C was assessed using R^2 (Table 223). Benefits Operational (BOPR) shows an R^2 of 0.0471 (adjusted R^2 = 0.0451), indicating a weak proportion of variance explained by the predictors. While limited, this result is typical in exploratory models addressing complex organizational outcomes.

	R-SQUARE	R-SQUARE ADJUSTED
BOPR	0.0471	0.0451

Table 223:R-Square for H8C

f-Square

Effect sizes (f^2) were examined to assess the contribution of exogenous constructs to BOPR (Table 224). Spend Priorities (SPEN) exerts a small effect on BOPR (f^2 = 0.0494), suggesting that its practical impact on operational benefits is limited.

	BOPR	SPEN
BOPR		
SPEN	0.0494	

Table 224:f-Square for H8C

Construct Reliability and Convergent Validity

Internal consistency reliability and convergent validity were evaluated using Cronbach's alpha, composite reliability (CR), and AVE (Table 225).

BOPR shows moderate composite reliability (CR = 0.6224), but a low Cronbach's alpha (α = 0.5107), reflecting heterogeneous indicator loadings. Its AVE is 0.2341, indicating limited variance explained by its indicators.

SPEN demonstrates robust composite reliability (CR = 0.7629) and acceptable internal consistency (α = 0.4036). The AVE of 0.6202 confirms adequate convergent validity.

These results indicate that BOPR should be interpreted with caution, while SPEN is measured reliably.

	CRONBACH'S ALPHA	COMPOSITE RELIABILITY (RHO_C)	AVERAGE VARIANCE EXTRACTED (AVE)
BOPR	0.5107	0.6224	0.2341
SPEN	0.4036	0.7629	0.6202

Table 225: R-Cronbach, CR and AVE for H8C

Discriminant Validity

Discriminant validity was assessed using the Fornell–Larcker criterion and HTMT (Tables 226–227): The square root of AVE for both constructs exceeds their correlations with other constructs, supporting discriminant validity. HTMT values are below the conservative threshold of 0.85, confirming that BOPR and SPEN are empirically distinct.

	BOPR	SPEN
BOPR	0.4839	
SPEN	0.2170	0.7875

Table 226:Fornell-Larcker criterion for H8C

	BOPR	SPEN
BOPR		
SPEN	0.3258	

Table 227: Heterotrait-monotrait ratio (HTMT) for H8C

Path Coefficients

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
SPEN -> BOPR	0.2170	0.2390	0.0743	2.9223	0.0035

Table 228: Path Coefficients for H8C

The Descriptive statistics of constructs are in Appendix I in 7.10 for H8C.

7.12.8.4 H8 verification with decisional tree of Zhao

Hypothesis	*A*B (AGIL*STRA) Is significant?*	*C (BINN) Is significant?*	*A*B*C (AGIL* STRA* BINN) Is Positive?*	*Mediation Type*	*Hypothesized Mediator*
H8	0.00001378 Significant	0.003 Significant	0.3473* 0.1930* 0.0953 Positive	Complementary (**Mediation**)	Yes

Table 229: Verification with decisional tree of Zhao - H8

Where: A = AGIL = Agile/DevOps

B = SPEN = Spend Priorities

C = BOPR = Benefits Operational

Table 229 presents the analysis of Hypothesis 8 (H8) based on the current PLS-SEM results. The following observations should be interpreted as tentative and context-dependent findings, rather than definitive facts:

- is a Consistent Hypothesis
- The mediation is strong.
- The variable Agile/Ops (AGIL) is essential to have effect on Spend Priorities to have Benefits Operational (BOPR). Without Agile/DevOps implementation there is not Benefits Operational (BOPR).
- The relation C (SPEN BOPR) alone not is valid and alone is worse.
- The relation AB (AGIL SPEN) is strong.
- If we have Spend Priorities (SPEN), we will have Benefits Operational (BOPR).
- If there is a Spend Priorities, there is little possibility of having Benefits Operational effect, unless you have an aligned Agile/Ops implementation.
- The iterative requirements are key (Heeager & Nielsen, 2018) to implement agile/DevOps and to have benefits operational.
- Establish an Environment of Mentoring, Learning, and Creativity: invariably, teams are composed of a combination of experience levels. This provides an excellent atmosphere of mentoring and learning if the agile manager allows this. This must be built into the sprint schedules, understanding that an atmosphere of mentoring, learning, and creativity will increase efficiencies as the team progresses, not just on this project, but on future projects as well, as the team members learn from each other(Crowder & Friess, 2015) .

7.13 Appendix M: Discriminant Validity – Fornell–Larcker Criterion

The Fornell–Larcker criterion was also examined as a traditional assessment of discriminant validity. The results are presented in Table 243.

	AGIL	BENE	DSTR	SPEN	STRA
AGIL	1.0000				
BENE	0.3553	0.8396			
DSTR	0.1690	0.0048	1.0000		
SPEN	0.3474	0.1633	0.2074	0.7905	
STRA	0.0854	0.0659	0.1349	0.1387	1.0000

Table 230: Discriminant Validity – Fornell–Larcker Criterion, Exploratory BENE Model

The Fornell–Larcker results are presented in **Table 230**. The diagonal values, representing the square root of AVE, are greater than the corresponding correlations with the other constructs for the multi-construct comparisons in the exploratory specification.

For the BENE construct, the square root of AVE was **0.8396**, while its correlations with AGIL, DSTR, SPEN, and STRA were **0.3553, 0.0048, 0.1633, and 0.0659**, respectively. These results are consistent with the HTMT assessment and provide additional evidence supporting discriminant validity in the exploratory BENE specification.

As indicated previously in this thesis, the Fornell–Larcker criterion is considered a traditional discriminant-validity assessment, whereas HTMT is given primary consideration in the evaluation of discriminant validity.

7.14 Appendix N: Hypothesis testing Zhao and Sobel exploratory Analysis

We have 5 hypotheses, and the results form SmartPLS are in the table below. We will analyze one by one with its explanation.

		Column	1	2	3	4	5	6	7	8	9	10	11	17	18	19
	Hypothesis	Paths	Coef-a	Coef-b	Coef-c'	Coef-c	Stdev-a	Stdev-b	stdev-c'	stdev-c	T-stats-a	T-stats -b	T-stats -c'	Sobel	Aroian	Goodman
1	H1/H2	a,b	0.1349	0.1007			0.0477	0.0471			2.8267	2.1400		1.7054	1.64144	1.7776
2	H3	a,b	0.1349	0.0854			0.0477	0.0471			2.8267	1.8151		1.5263	1.4629	1.5988
3	H4	a,b	0.2074	0.3474			0.0424	0.0463			4.8972	7.5104		4.0976	4.0723	4.1234
4	H5/H6	a,b	0.1534	0.3164			0.0428	0.0445			3.5884	7.1116		3.2009	3.1760	3.2264
5	H7/H8	a,b	0.3365	0.3493			0.0388	0.0458			8.6681	7.6346		5.7271	5.7058	5.7487

Table 231: Summary of mediation hypothesis testing from exploratory analysis

7.14.1.1 H1/H2 AB exploratory analysis

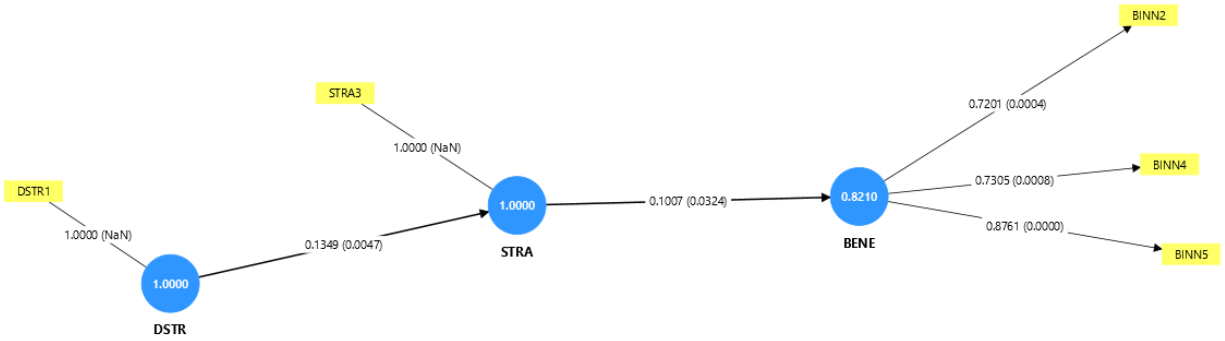


Figure 33: H1/H2 – Boostrap Test AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
A DSTR -> STRA	0.1349	0.1345	0.0477	2.8267	0.0047
B STRA -> BENE	0.1007	0.1156	0.0471	2.1400	0.0324

Table 232: Path Coefficients for H1/H2AB

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
BENE	0.8210	0.7579	0.1453	5.6512	0.0000
DSTR	1.0000	1.0000	0.0000	n/a	n/a
STRA	1.0000	1.0000	0.0000	n/a	n/a

Table 233: Composite reliability (RHO_C) for H1/H2AB

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1349	Sobel test:	1.70548879	0.00796512	0.0881033
b	0.1007	Aroian test:	1.64144194	0.00827591	0.10070571
s_a	0.0477	Goodman test:	1.77766971	0.00764171	0.07545812
s_b	0.0471	Reset all	Calculate		

Table 234: Sobel Test for H1/H2AB. With coefficient (a b) and standard deviation (s_a, s_b)

Input:		Test statistic:	*p*-value:
t_a 2.8267	Sobel test:	1.7061953	0.08797172
t_b 2.1400	Aroian test:	1.64212511	0.10056408
	Goodman test:	1.77840205	0.07533785
	Reset all	Calculate	

Table 235: Sobel Test for H1/H2AB. With T statistics

7.14.1.2 H1/H2 C exploratory analysis

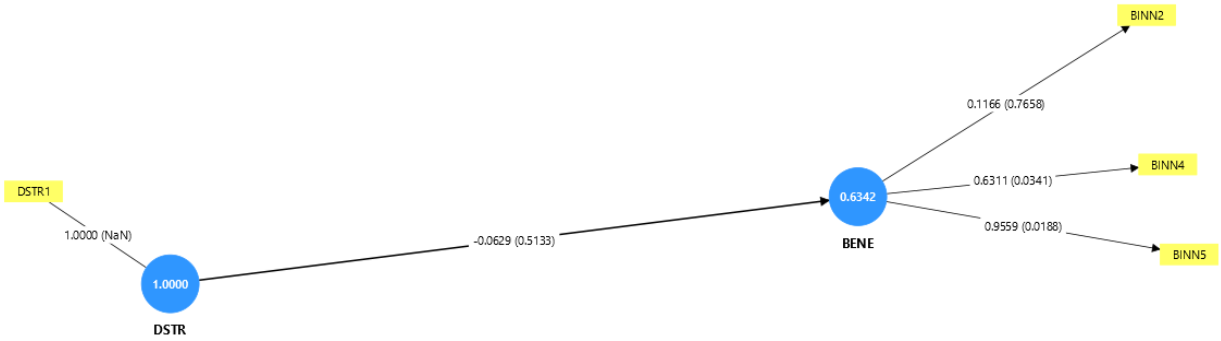


Figure 34: H1/H2 – Boostrap Test C exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> BENE	-0.0629	-0.0347	0.0963	0.6537	0.5133

Table 236 Path Coefficients for H1/H2 C exploratory analysis

7.14.1.3 H3 AB exploratory analysis

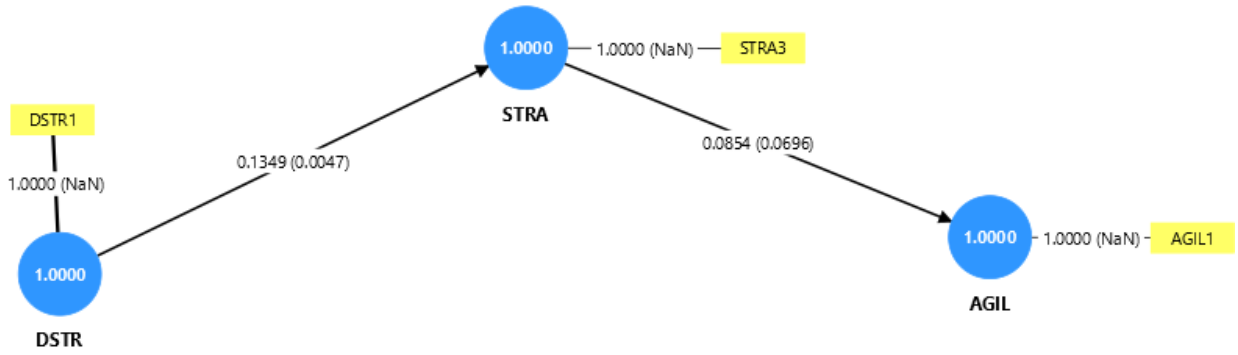


Figure 35: H3 – Boostrap Test AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> STRA	0.1349	0.1345	0.0477	2.8267	0.0047
STRA -> AGIL	0.0854	0.0851	0.0471	1.8151	0.0696

Table 237: Path Coefficients for H3 AB

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
AGIL	1.0000	1.0000	0.0000	n/a	n/a
DSTR	1.0000	1.0000	0.0000	n/a	n/a
STRA	1.0000	1.0000	0.0000	n/a	n/a

Table 238: Composite reliability (RHO_C) for H3AB

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1349	Sobel test:	1.52639491	0.0075475	0.12691154
b	0.0854	Aroian test:	1.46295563	0.00787478	0.14347952
s_a	0.0477	Goodman test:	1.59887419	0.00720536	0.10984856
s_b	0.0471	Reset all	Calculate		

7.14.1.4 H3 C exploratory analysis

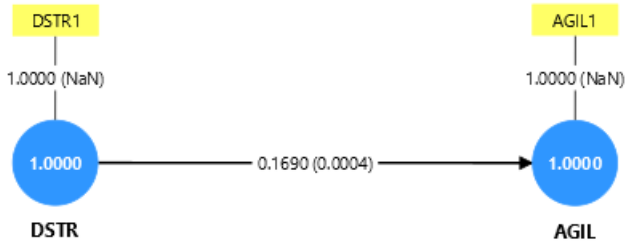


Figure 36: H3 – Boostrap Test C exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> AGIL	0.1690	0.1701	0.0476	3.5506	0.0004

*Table **239:** Path Coefficients for H3C exploratory analysis*

7.14.1.5 H4 AB exploratory analysis

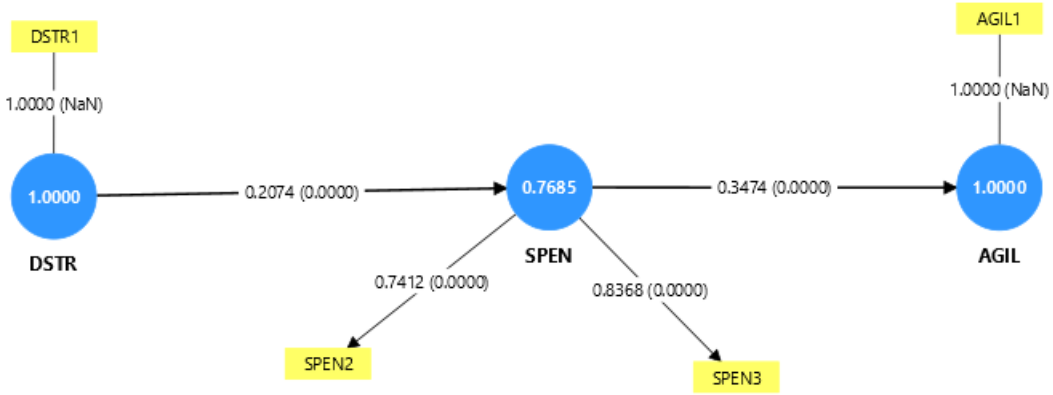


Figure 37: H4 – Boostrap Test AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> SPEN	0.2074	0.2088	0.0424	4.8972	0.0000
SPEN -> AGIL	0.3474	0.3479	0.0463	7.5104	0.0000

*Table **240:** Path Coefficients for H4AB*

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
AGIL	1.0000	1.0000	0.0000	n/a	n/a
DSTR	1.0000	1.0000	0.0000	n/a	n/a
SPEN	0.7685	0.7669	0.0184	41.7116	0.0000

Table 241: Composite reliability (RHO_C) for H4AB

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.2074	Sobel test:	4.09765679	0.01758341	0.00004174
b	0.3474	Aroian test:	4.07235471	0.01769265	0.00004654
s_a	0.0424	Goodman test:	4.12343643	0.01747347	0.00003733
s_b	0.0463	Reset all	Calculate		

Input:			Test statistic:	*p*-value:
t_a	4.8972	Sobel test:	4.10216827	0.00004093
t_b	7.5104	Aroian test:	4.07688928	0.00004564
		Goodman test:	4.1279234	0.00003661
		Reset all	Calculate	

7.14.1.6 H4 C exploratory analysis

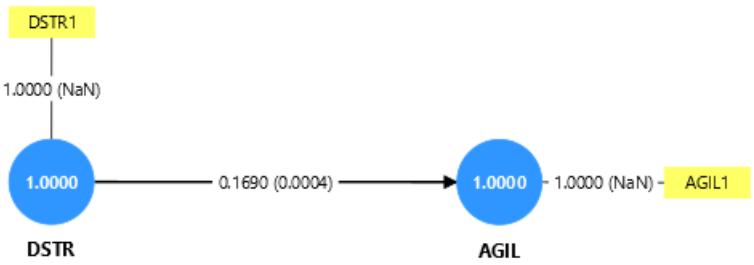


Figure 38: H4 – Boostrap Test C exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> AGIL	0.1690	0.1701	0.0476	3.5506	0.0004

Table 242: Path Coefficients for H4C

7.14.1.7 H5/H6 AB exploratory analysis

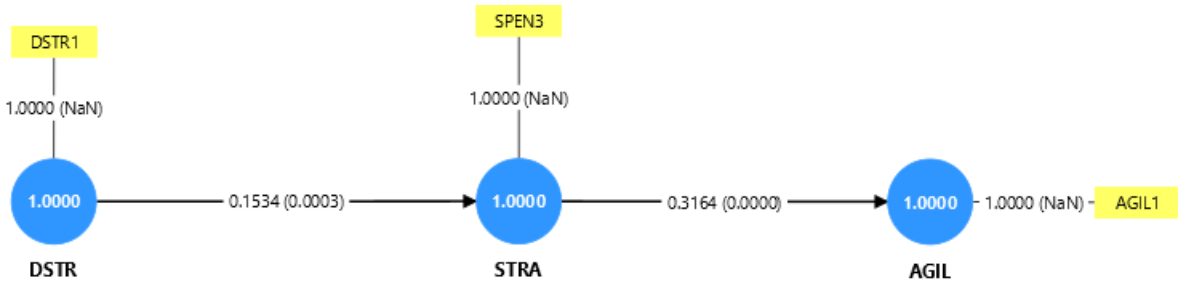


Figure 39: H5/H6 – Boostrap Test AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> STRA	0.1534	0.1539	0.0428	3.5847	0.0003
STRA -> AGIL	0.3164	0.3153	0.0445	7.1116	0.0000

Table 243: Path Coefficients for H5/H6 AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
AGIL	1.0000	1.0000	0.0000	n/a	n/a
DSTR	1.0000	1.0000	0.0000	n/a	n/a
STRA	1.0000	1.0000	0.0000	n/a	n/a

Table 244: Composite reliability (RHO_C) for H5/H6 AB

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.1534	Sobel test:	3.20097014	0.01517433	0.00136966
b	0.31664	Aroian test:	3.17605029	0.01529339	0.00149295
s_a	0.0428	Goodman test:	3.22648592	0.01505433	0.0012532
s_b	0.0445	Reset all	Calculate		

Input:		Test statistic:	*p*-value:
t_a	3.5847	Sobel test:	3.20103294	0.00136936
t_b	7.1116	Aroian test:	3.17609266	0.00149273
		Goodman test:	3.22657014	0.00125284
		Reset all	Calculate	

7.14.1.8 H5/H6 C exploratory analysis

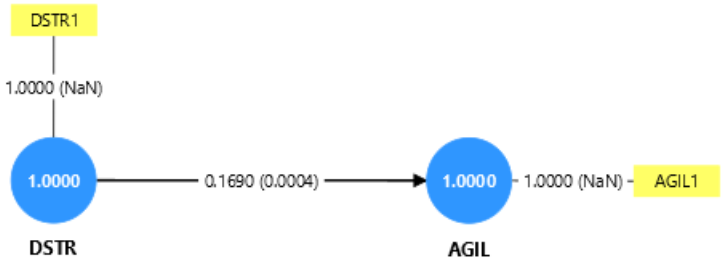


Figure 40: H5/H6 – Boostrap Test C exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
DSTR -> AGIL	0.1690	0.1701	0.0476	3.5506	0.0004

Table 245: Composite reliability (RHO_C) for H5/H6 C

7.14.1.9 H7/H8 AB exploratory analysis

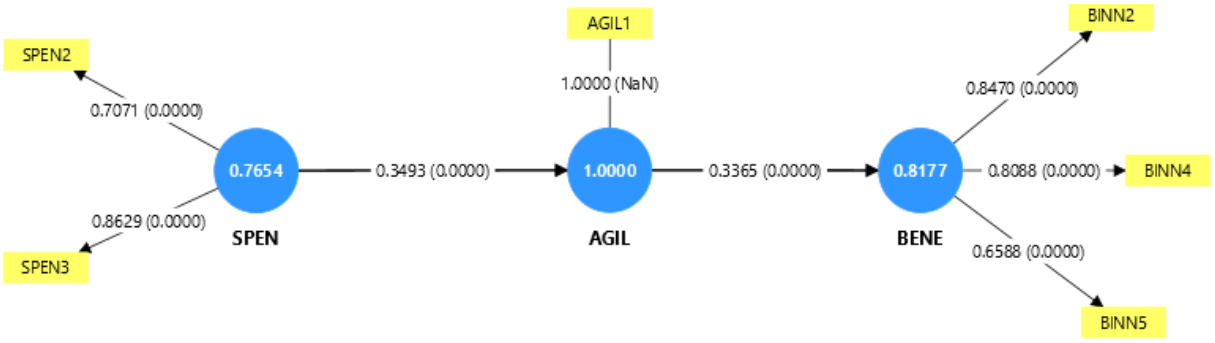


Figure 41: H7/H8 – Boostrap Test AB exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
AGIL -> BENE	0.3365	0.3398	0.0388	8.6681	0.0000
SPEN -> AGIL	0.3493	0.3506	0.0458	7.6346	0.0000

Table 246: Path Coefficients for H7/H8 AB exploratory analysis

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.3365	Sobel test:	5.72716228	0.02052316	1e-8
b	0.3493	Aroian test:	5.70581306	0.02059995	1e-8
s_a	0.0388	Goodman test:	5.74875294	0.02044608	1e-8
s_b	0.0458	Reset all	Calculate		

Input:			Test statistic:	*p*-value:
t_a	8.6681	Sobel test:	5.72920983	1e-8
t_b	7.6346	Aroian test:	5.70785968	1e-8
		Goodman test:	5.75080136	1e-8
		Reset all	Calculate	

7.14.1.10 H7/H8 C exploratory analysis

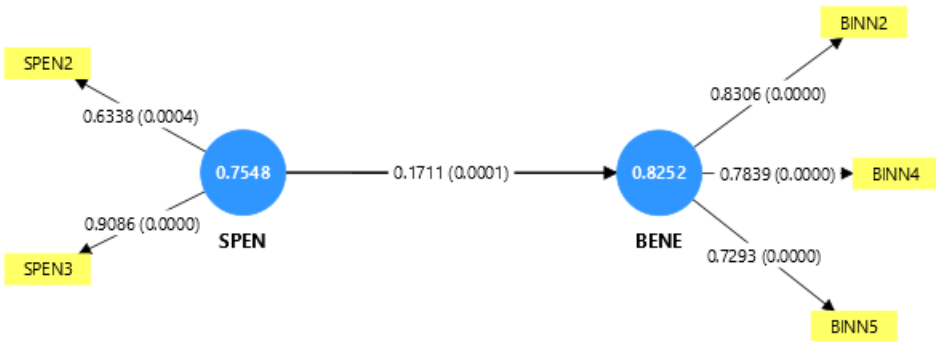


Figure 42: H7/H8 – Boostrap Test C exploratory analysis

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
SPEN -> BENE	0.1711	0.1847	0.0448	3.8204	0.0001

7.15 Appendix O : Multi-group Analysis for Years

To examine whether the structural relationships between the study variables remained stable over time, a multi-group analysis (MGA) was conducted across the four yearly sub-samples (2019, 2020, 2021, and 2022). The objective was to determine whether the strength and significance of the hypothesized relationships differed significantly across years.

Prior to comparing structural paths, the measurement model was assessed to ensure validity and reliability within each yearly group. Confirmatory factor analysis was performed to verify indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Establishing measurement adequacy ensured that comparisons across years were meaningful and not affected by measurement inconsistencies.

Subsequently, Partial Least Squares Structural Equation Modelling (PLS-SEM) was conducted separately for each year to estimate path coefficients and assess the significance of direct and indirect relationships within each temporal group.

Finally, a multi-group analysis was performed using SmartPLS with 5,000 bootstrap resamples to test whether differences in path coefficients between years were statistically significant. The MGA procedure allows for the comparison of structural relationships across independent groups and supports whether observed variations in path strengths reflect statistically significant differences rather than random fluctuations.

This approach enables the assessment of temporal stability and provides insights into whether the relationships among IT Strategy, Digital Strategy, Agile/DevOps, Spend Priorities, and benefit constructs evolved across the 2019–2022 period.

7.15.1 Multi-Group Analysis: Hypothesis 1

The multi-group analysis (MGA) results presented in (Table 247) reveal notable longitudinal instability in both the measurement and structural models for H1 (DSTR → STRA → BINN).

	2019	2020	2021	2022
Benefits Innovative				
BINN1	0.5495	0.5421	0.2138	0.4592
BINN2	0.5694	0.8798	0.7641	0.8057
BINN3	0.8175	0.1262	0.5525	0.6537
BINN4	0.4797	0.4608	0.8760	0.7916
BINN5	0.6484	0.1887	0.7677	0.7014
Digital Strategy				
DSTR1	0.2565	0.8553	-0.2798	0.4142
DSTR3	0.9988	0.8163	0.8682	0.9425
IT Strategy				
STRA2	0.9486	0.6238	0.7755	0.8181
STRA3	-0.3682	0.8420	-0.5990	0.5215
Composite reliability				
BINN	0.7545	0.5683	0.7881	0.8177
DSTR	0.6272	0.8227	0.2287	0.6619
STRA	0.2588	0.7044	0.0291	0.6289
Average variance extracted				
BINN	0.3890	0.2664	0.4583	0.4812
DSTR	0.5317	0.6989	0.4161	0.5299
STRA	0.5177	0.5491	0.4801	0.4706
Hypothesis testing - Direct Effects				
H1: DSTR -> STRA -> BINN				
DSTR -> BINN	0.0705	0.1917	-0.0971	0.1246
	0.7462	0.3018	0.6289	0.5523
DSTR -> STRA	0.1350	0.1625	0.2159	0.1440
	0.5064	0.2149	0.3732	0.2996
STRA -> BINN	0.2844	0.1901	0.3167	0.1089
	0.3540	0.1535	0.2669	0.5635
Hypothesis testing - Indirect Effects				
DSTR -> STRA -> BINN	0.0384	0.0309	0.0684	0.0157
	0.6427	0.4049	0.4339	0.6883
R^2				
BINN	0.0912	0.0847	0.0965	0.0313
STRA	0.0182	0.0264	0.0466	0.0207
f^2				
DSTR -> BINN	0.0054	0.0391	0.0100	0.0157
DSTR -> STRA	0.0186	0.0271	0.0489	0.0212
STRA -> BINN	0.0874	0.0384	0.1059	0.0120

Table 247 – H1 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

At the measurement level, indicator loadings fluctuate substantially across years, with several items exhibiting weak or even negative loadings (e.g., DSTR1 in 2021; STRA3 in 2019 and 2021), indicating potential construct inconsistency over time. Composite reliability (CR) values further reflect this instability, particularly for STRA (CR = 0.2588 in 2019; 0.0291 in 2021) and DSTR (CR = 0.2287 in 2021), suggesting insufficient internal consistency in certain periods. Convergent validity, assessed via AVE, remains below the recommended 0.50 threshold for BINN across all years and is marginal for STRA in 2021 and 2022, reinforcing concerns regarding measurement robustness.

At the structural level, none of the direct paths reach statistical significance across the four years. The relationship DSTR → BINN remains non-significant throughout (p-values ranging from 0.3018 to 0.7462), as do DSTR → STRA and STRA → BINN. Similarly, the indirect effect (DSTR → STRA → BINN) is positive but consistently non-significant in all years ($p > 0.40$), indicating the absence of statistically supported mediation in the longitudinal MGA analysis. The explanatory power of the model is weak, with R^2 values for BINN ranging from 0.0313 to 0.0965 and for STRA from 0.0182 to 0.0466, suggesting limited predictive capacity. Effect sizes (f^2) are negligible to small, with the strongest observed effect (STRA → BINN in 2021, $f^2 = 0.1059$) remaining below the threshold for a moderate effect.

Overall, the longitudinal MGA findings do not provide empirical support for H1 across the 2019–2022 period. The combination of measurement instability, low explanatory power, and non-significant structural relationships indicates that the proposed mediation mechanism lacks temporal robustness in this multi-year analysis.

Across 2019–2022:

- Measurement quality fluctuates substantially.
- Structural relationships remain consistently non-significant.
- Explanatory power remains weak.
- No strengthening or weakening trend is observed over time.
- Effect sizes remain small.

Therefore, H1 does not receive support in the MGA analysis across the four years.

The absence of significant direct or indirect effects, combined with measurement instability (particularly for STRA), suggests that the proposed mediation mechanism lacks longitudinal robustness.

	2019	2020	2021	2022
		Differences		
2019		0.0075	-0.0300	0.0227
2020			-0.0375	0.0152
2021				0.0527
2022				
		P-values		
2019	-	0.4398	0.6013	0.3812
2020	0.8797	-	0.6626	0.3832
2021	0.7973	0.6749	-	0.2940
2022	0.7625	0.7665	0.5880	-

Table 248 – H1 Multi-group Analysis – Differences & p-values

7.15.2 Multi-Group Analysis: Hypothesis 2

The multi-group analysis (MGA) results for H2 (DSTR → STRA → BOPR) (Table 249) reveal substantial longitudinal variability at both the measurement and structural levels across the 2019–2022 period.

	2019	2020	2021	2022
Benefits Operational				
BOPR1	0.6896	0.5982	0.8095	0.7199
BOPR2	0.2209	0.6408	0.5506	0.7753
BOPR3	0.3251	0.4121	0.3320	0.2746
BOPR4	0.4390	-0.0765	0.3629	0.2825
BOPR5	0.6971	0.5684	0.7680	0.3966
BOPR6	0.3490	0.0447	0.0123	0.3481
Digital Strategy				
DSTR1	0.8634	0.9232	0.8403	0.8407
DSTR3	0.7432	0.7206	0.7233	0.6119
IT Strategy				
STRA2	0.8698	0.6546	0.9423	0.9961
STRA3	0.4448	0.8198	0.3732	-0.1517
Composite reliability				
BOPR	0.6183	0.5029	0.6563	0.6376
DSTR	0.7861	0.8113	0.7603	0.6967
STRA	0.6230	0.7073	0.6401	0.4200
Average variance extracted				
BOPR	0.2384	0.2116	0.2984	0.2588
DSTR	0.6489	0.6858	0.6146	0.5406
STRA	0.4772	0.5502	0.5136	0.5076
Hypothesis testing - Direct Effects				
H2: DSTR -> STRA -> BOPR				
DSTR -> BOPR	0.2475	-0.1190	0.2201	-0.1808
	0.1640	0.6341	0.2610	0.4543
DSTR -> STRA	0.1649	0.1641	0.0884	0.0805
	0.2713	0.1983	0.6197	0.5842
STRA -> BOPR	0.2843	0.3227	0.3045	0.3867
	0.1090	0.0668	0.0315	0.0092
Hypothesis testing - Indirect Effects				
DSTR -> STRA -> BOPR	0.0469	0.0529	0.0269	0.0311
	0.4453	0.3165	0.6580	0.5824
R^2				
BOPR	0.1653	0.1057	0.1530	0.1710
STRA	0.0272	0.0269	0.0078	0.0065
f^2				
DSTR -> BOPR	0.0714	0.0154	0.0568	0.0392
DSTR -> STRA	0.0279	0.0277	0.0079	0.0065
STRA -> BOPR	0.0942	0.1133	0.1086	0.1792

Table 249 – H2 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

At the measurement level, the construct Benefits Operational (BOPR) demonstrates notable instability. Indicator loadings fluctuate considerably over time, with several items exhibiting weak or problematic loadings (e.g., BOPR2 = 0.2209 in 2019; BOPR4 = –0.0765 in 2020; BOPR6 = 0.0123 in 2021), suggesting limited indicator reliability and potential construct misspecification. Composite reliability (CR) for BOPR remains below the recommended threshold of 0.70 in all four years (ranging from 0.5029 to 0.6563), indicating insufficient internal consistency. Convergent validity is also inadequate, as AVE values for BOPR remain well below the 0.50 benchmark across all periods (0.2116–0.2984).

The Digital Strategy (DSTR) construct shows comparatively stronger measurement properties. Indicator loadings remain high and stable, with CR values between 0.6967 and 0.8113 and AVE values consistently above 0.50, supporting acceptable reliability and convergent validity.

For IT Strategy (STRA), measurement quality varies across years. While AVE exceeds 0.50 from 2020 onward, composite reliability drops substantially in 2022 (CR = 0.4200), largely due to the negative loading of STRA3 (–0.1517), indicating potential measurement instability in the final period.

At the structural level, the direct path DSTR → BOPR is non-significant across all four years (p-values ranging from 0.1640 to 0.6341), with coefficients fluctuating between positive and negative values, suggesting no consistent direct effect of digital strategy on operational benefits. Similarly, the path DSTR → STRA remains non-significant throughout the period ($p > 0.19$), indicating that digital strategy does not significantly predict IT strategy within the yearly subsamples.

In contrast, the path STRA → BOPR demonstrates increasing statistical significance over time. While marginally non-significant in 2019 ($p = 0.1090$) and 2020 ($p = 0.0668$), it becomes statistically significant in 2021 ($\beta = 0.3045$, $p = 0.0315$) and strengthens further in 2022 ($\beta = 0.3867$, $p = 0.0092$). This pattern suggests that IT strategy exerts a progressively stronger positive effect on operational benefits in the later years of the analysis.

Regarding mediation, the indirect effect (DSTR → STRA → BOPR) remains positive but consistently non-significant across all periods (p-values between 0.3165 and 0.6580), indicating no empirical support for mediation under H2 in any specific year.

The model's explanatory power (R^2) for BOPR ranges from 0.1057 to 0.1710, indicating modest predictive capacity, with a slight upward trend in 2022. Conversely, R^2 values for STRA remain

extremely low (0.0065–0.0272), confirming the weak predictive role of DSTR on IT strategy within the annual subsamples.

Effect size estimates (f^2) further clarify these dynamics. The effect of STRA → BOPR increases over time, reaching 0.1792 in 2022, approaching a moderate effect according to conventional benchmarks. In contrast, effect sizes for DSTR → STRA and DSTR → BOPR remain negligible to small across all years.

Overall, the longitudinal MGA findings for H2 do not support the hypothesized mediation mechanism. While IT strategy demonstrates a significant and strengthening direct effect on operational benefits in the later years, digital strategy neither directly is positively associated with operational benefits nor indirectly affects them through IT strategy. The results suggest that operational benefits are increasingly driven by IT strategy alignment rather than by the broader digital strategy construct within the observed period.

	2019	2020	2021	2022
		Differences		
2019		-0.0061	0.0200	0.0157
2020			0.0260	0.0218
2021				-0.0042
2022				
		P-values		
2019	-	0.5380	0.4078	0.4270
2020	0.9240	-	0.3681	0.3870
2021	0.8156	0.7361	-	0.5191
2022	0.8540	0.7739	0.9618	-

Table 250 – H2 Multi-group Analysis – Differences & p-values

7.15.3 Multi-Group Analysis: Hypothesis 3

Across 2019–2022 for H3 in (Table 251), measurement quality for Agile/DevOps (AGIL) remains perfect and stable (CR = 1.0000, AVE = 1.0000). Digital Strategy (DSTR) shows moderate to high reliability (CR: 0.6642–0.8106) and convergent validity (AVE: 0.5354–0.6850) across all years, whereas IT Strategy (STRA) exhibits notable fluctuations in both CR (0.1306–0.7087) and AVE (0.4690–0.5508), indicating measurement instability, particularly in 2021. Factor loadings reflect this variability, with some negative or low loadings observed for STRA in 2019 and 2021.

Regarding structural relationships, the direct effect of DSTR → AGIL is significant in 2020 ($p = 0.0051$) and 2022 ($p < 0.001$), while non-significant in 2019 and 2021. The effect of STRA → AGIL reaches significance only in 2019 ($p = 0.0340$) and 2022 ($p = 0.0486$). The mediated (indirect) effect DSTR → STRA → AGIL is consistently non-significant across all years ($p > 0.23$), indicating a lack of robust mediation.

Explanatory power remains moderate for AGIL ($R^2 = 0.0688–0.1717$) and low for STRA ($R^2 = 0.0165–0.0415$). Effect sizes are generally small, with the highest observed for DSTR → AGIL in 2022 ($f^2 = 0.1388$).

Overall, the longitudinal MGA indicates that while some direct relationships strengthen in certain years, the proposed mediation mechanism through STRA lacks consistent support. Measurement instability for STRA, combined with small effect sizes, limits the robustness of H3 over time.

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Digital Strategy				
DSTR1	0.9997	0.9253	0.5196	0.9055
DSTR3	0.3290	0.7168	0.9521	0.5009
IT Strategy				
STRA2	0.0617	0.6733	0.8633	0.7740
STRA3	0.9932	0.8051	-0.4689	0.5823
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
DSTR	0.6642	0.8106	0.7245	0.6803
STRA	0.5243	0.7087	0.1306	0.6340
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
DSTR	0.5538	0.6850	0.5882	0.5354
STRA	0.4951	0.5508	0.4826	0.4690
Hypothesis testing - Direct Effects				
H3: DSTR -> STRA -> AGIL				
DSTR -> AGIL	0.1397	0.2103	0.1374	0.3432
	0.3319	0.0051	0.2894	0.0000
DSTR -> STRA	0.2037	0.1614	0.1284	0.1545
	0.2379	0.2194	0.5862	0.1270
STRA -> AGIL	0.3044	0.1790	0.2066	0.1852
	0.0340	0.1162	0.3729	0.0486
Hypothesis testing - Indirect Effects				
DSTR -> STRA -> AGIL	0.0620	0.0289	0.0265	0.0286
	0.3415	0.3579	0.6588	0.2369
R^2				
AGIL	0.1295	0.0884	0.0688	0.1717
STRA	0.0415	0.0261	0.0165	0.0239
f^2				
DSTR -> BINN	0.0215	0.0473	0.0199	0.1388
DSTR -> STRA	0.0433	0.0268	0.0168	0.0244
STRA -> BINN	0.1020	0.0342	0.0451	0.0404

Table 251 – H3 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

	2019	2020	2021	2022
		Differences		
2019		0.0331	0.0355	0.0334
2020			0.0024	0.0003
2021				-0.0021
2022				
		P-values		
2019	-	0.2867	0.3343	0.2700
2020	0.5735	-	0.5292	0.4754
2021	0.6685	0.9415	-	0.4535
2022	0.5399	0.9508	0.9070	-

Table 252 – H3 Multi-group Analysis – Differences & p-values

7.15.4 Multi-Group Analysis: Hypothesis 4

Hypothesis 4 posited that digital strategy (DSTR) is positively associated with Agile/DevOps adoption (AGIL) indirectly through spend priorities (SPEN). In (Table 253) shows across 2019–2022, measurement quality remained robust for AGIL (CR = 1.0000, AVE = 1.0000), while DSTR and SPEN exhibited moderate to high reliability and convergent validity, with DSTR showing a slight decline in 2022 (CR = 0.6703, AVE = 0.5324). Structural path analysis revealed that DSTR's direct effect on AGIL was significant in 2020 (0.1905, p = 0.0070) and 2022 (0.2553, p = 0.0008), but non-significant in 2019 (0.0359, p = 0.8006) and 2021 (0.1040, p = 0.3464). In contrast, DSTR consistently exerted a significant effect on SPEN across all years (0.2068–0.3622, $p \leq 0.0504$), and SPEN significantly influenced AGIL in all four years (0.2263–0.3567, $p \leq 0.0243$), supporting the hypothesized mediation. Indirect effects of DSTR on AGIL via SPEN were significant in 2019 (0.1242, p = 0.0404) and 2022 (0.1184, p = 0.0116), and marginally significant in 2020 (0.0527, p = 0.0597) and 2021 (0.0738, p = 0.0974), indicating partial mediation over time. R^2 values for AGIL ranged from 0.1076 to 0.2324, reflecting moderate explanatory power, while R^2 for SPEN ranged from 0.0428 to 0.1288, showing low-to-moderate power. Effect sizes (f^2) were small to moderate across all paths, with DSTR -> SPEN (0.0447–0.1478), SPEN -> AGIL (0.0543–0.1438), and DSTR -> AGIL (0.0013–0.0738). *Overall, the longitudinal MGA results suggest that H4 is generally supported: spend priorities act as a stable mediator in the DSTR–AGIL relationship, although the magnitude of both direct and indirect effects exhibits modest fluctuations over the four-year period*

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Digital Strategy				
DSTR1	0.8874	0.9487	0.9038	0.9281
DSTR3	0.7091	0.6684	0.6271	0.4510
Spend Priorities				
SPEN2	0.7082	0.6183	0.6383	0.8846
SPEN3	0.8424	0.8723	0.9414	0.6965
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
DSTR	0.7822	0.8001	0.7479	0.6703
SPEN	0.7530	0.7217	0.7794	0.7734
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
DSTR	0.6451	0.6733	0.6051	0.5324
SPEN	0.6056	0.5716	0.6468	0.6338
Hypothesis testing - Direct Effects				
H4: DSTR -> SPEN -> AGIL				
DSTR -> AGIL	0.0359	0.1905	0.1040	0.2553
	0.8006	0.0070	0.3464	0.0008
DSTR -> SPEN	0.3589	0.2330	0.2068	0.3622
	0.0007	0.0052	0.0504	0.0000
SPEN -> AGIL	0.3460	0.2263	0.3567	0.3268
	0.0035	0.0243	0.0004	0.0004
Hypothesis testing - Indirect Effects				
DSTR -> SPEN -> AGIL	0.1242	0.0527	0.0738	0.1184
	0.0404	0.0597	0.0974	0.0116
R^2				
AGIL	0.1299	0.1076	0.1533	0.2324
SPEN	0.1288	0.0543	0.0428	0.1312
f^2				
DSTR -> AGIL	0.0013	0.0384	0.0122	0.0738
DSTR -> SPEN	0.1478	0.0574	0.0447	0.1510
SPEN -> AGIL	0.1199	0.0543	0.1438	0.1209

Table 253 – H4 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

Across 2019–2022:

- Measurement quality for AGIL remained consistently strong, while DSTR and SPEN showed moderate stability, with a slight decline in 2022.
- The direct effect of DSTR on AGIL was intermittent, significant only in 2020 and 2022.

- The mediating path through SPEN remained largely consistent, with SPEN significantly influencing AGIL in all years.
- Indirect effects of DSTR on AGIL via SPEN were significant in 2019 and 2022 and marginal in 2020 and 2021, indicating partial mediation.
- Explanatory power (R^2) ranged from low to moderate, with AGIL slightly improving over time and SPEN remaining stable.
- Effect sizes (f^2) were generally small to moderate.

Overall, H4 receives partial support in the longitudinal MGA analysis. The mediation mechanism via spend priorities appears robust across years, though the strength of direct and indirect effects fluctuates slightly.

	2019	2020	2021	2022
		Differences		
2019		0.0714	0.0504	0.0058
2020			-0.0210	-0.0656
2021				-0.0446
2022				
		P-values		
2019	-	0.1325	0.2477	0.4741
2020	0.2649	-	0.6632	0.8915
2021	0.4954	0.6736	-	0.7579
2022	0.9481	0.2170	0.4843	-

Table 254 – H3 Multi-group Analysis – Differences & p-values

7.15.5 Multi-Group Analysis: Hypothesis 5

Longitudinal MGA Hypothesis 5 (Table 255) proposed that IT strategy (STRA) affects Benefits Innovative (BINN) indirectly through Agile/DevOps adoption (AGIL). Across 2019–2022, measurement quality was consistently strong for AGIL (CR = 1.0000, AVE = 1.0000), while BINN exhibited moderate-to-high reliability and acceptable convergent validity (CR = 0.7252–0.8020; AVE = 0.3685–0.4653). STRA demonstrated variable measurement quality, with CR ranging from 0.1404 to 0.7013 and AVE from 0.4796 to 0.5479, indicating moderate reliability in some years and weaker convergent validity in others. Structural path analysis showed that STRA's direct effect on AGIL was significant in 2020 (0.2260, p = 0.0068) and 2022 (0.2328, p = 0.0113), but non-significant in 2019 (0.3305, p = 0.0881) and 2021 (0.2240, p = 0.3024). AGIL significantly

influenced BINN in 2020 (0.4609, p = 0.0000) and 2021 (0.2563, p = 0.0492), while its effect was non-significant in 2019 (0.3546, p = 0.0989) and 2022 (0.2122, p = 0.1355). STRA's direct effect on BINN was non-significant across all four years. Indirect effects of STRA on BINN through AGIL were significant only in 2020 (0.1041, p = 0.0152), suggesting partial mediation, while other years showed non-significant indirect effects. R^2 values indicate modest explanatory power for AGIL (0.0502–0.1092) and BINN (0.0653–0.2336), with small-to-moderate effect sizes (f^2) across all paths. *Overall, the longitudinal MGA results suggest that H5 receives partial support: the mediating role of AGIL in the STRA–BINN relationship is evident in 2020, while both direct and indirect effects fluctuate across years, reflecting limited longitudinal robustness*.

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Benefits Innovative				
BINN1	0.3932	0.3000	0.3762	0.3774
BINN2	0.8772	0.7558	0.8397	0.8221
BINN3	0.4590	0.4230	0.5307	0.5784
BINN4	0.5733	0.7805	0.8297	0.8037
BINN5	0.6653	0.6269	0.7142	0.6891
IT Strategy				
STRA2	-0.0802	0.8592	0.8693	0.9297
STRA3	0.9997	0.5979	-0.4583	0.3079
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
BINN	0.7401	0.7252	0.8020	0.7969
STRA	0.4596	0.7013	0.1404	0.5954
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
BINN	0.3812	0.3685	0.4653	0.4547
STRA	0.5029	0.5479	0.4828	0.4796
Hypothesis testing - Direct Effects				
H5: STRA -> AGIL -> BINN				
AGIL -> BINN	0.3546	0.4609	0.2563	0.2122
	0.0989	0.0000	0.0492	0.1355
STRA -> AGIL	0.3305	0.2260	0.2240	0.2328
	0.0881	0.0068	0.3024	0.0113
STRA -> BINN	-0.1738	0.0748	0.2302	0.1011
	0.5626	0.3931	0.3172	0.4589

Hypothesis testing - Indirect Effects				
STRA -> AGIL -> BINN	0.1172	0.1041	0.0574	0.0494
	0.2433	0.0152	0.3781	0.2141
R^2				
AGIL	0.1092	0.0511	0.0502	0.0542
BINN	0.1152	0.2336	0.1451	0.0653
f^2				
AGIL -> BINN	0.1266	0.2631	0.0730	0.0456
STRA -> AGIL	0.1226	0.0538	0.0528	0.0573
STRA -> BINN	0.0304	0.0069	0.0589	0.0103

Table 255 – H5 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

Across 2019–2022:

Measurement quality remained consistently strong for AGIL, while BINN showed moderate reliability and STRA exhibited variable reliability and convergent validity across years. Direct effects of STRA on AGIL were significant in 2020 and 2022, and AGIL significantly affected BINN in 2020 and 2021. STRA's direct effect on BINN was non-significant in all years. Indirect effects of STRA on BINN via AGIL were significant only in 2020, indicating partial mediation. Explanatory power remained modest for both AGIL and BINN, and effect sizes were generally small to moderate. *Overall, H5 receives partial support, with the mediating influence of AGIL observed intermittently, highlighting limited longitudinal stability in the STRA–AGIL–BINN relationship.*

	2019	2020	2021	2022
		Differences		
2019		0.0131	0.0598	0.0678
2020			0.0467	0.0547
2021				0.0080
2022				
		P-values		
2019	-	0.4134	0.2907	0.2548
2020	0.8268	-	0.2850	0.1628
2021	0.5814	0.5700	-	0.4160
2022	0.5095	0.3256	0.8319	-

Table 256 – H5 Multi-group Analysis – Differences & p-values

7.15.6 Multi-Group Analysis: Hypothesis 6

Longitudinal MGA Hypothesis 6 (Table 257) posited that IT strategy (STRA) is positively associated with benefit operational (BOPR) indirectly through Agile/DevOps adoption (AGIL). Across 2019–2022, measurement quality for AGIL remained consistently strong (CR = 1.0000, AVE = 1.0000), while STRA and BOPR exhibited fluctuating reliability and convergent validity, with BOPR particularly weak in 2019 (CR = 0.0814, AVE = 0.1832) and improving in subsequent years. The structural paths indicate that STRA's direct effect on AGIL was significant in 2020 ($p = 0.0095$), whereas AGIL significantly affected BOPR in 2020 ($p = 0.0117$) and 2021 ($p = 0.0853$). STRA's direct effect on BOPR was significant in 2020 ($p = 0.0238$) and 2022 ($p = 0.0222$), but the indirect effect of STRA on BOPR via AGIL was non-significant across all years. R^2 values suggest low explanatory power for AGIL (0.0443–0.1108) and modest explanatory power for BOPR (0.1075–0.1491), with effect sizes (f^2) generally small to moderate.

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Benefits Operational				
BOPR1	-0.0007	0.5801	0.7153	0.7686
BOPR2	-0.3587	0.6064	0.5681	0.7313
BOPR3	-0.4200	0.5439	0.5108	0.3444
BOPR4	0.7425	0.1931	0.4769	0.4386
BOPR5	0.3261	0.5517	0.7249	0.2627
BOPR6	0.3696	0.0408	0.3904	0.3304
IT Strategy				
STRA2	0.0405	0.8106	0.9987	0.9939
STRA3	0.9954	0.6665	0.0923	0.0464
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
BOPR	0.0814	0.5762	0.7414	0.6535
STRA	0.5158	0.7082	0.5449	0.5172
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
BOPR	0.1832	0.2239	0.3334	0.2691
STRA	0.4963	0.5506	0.5029	0.4950
Hypothesis testing - Direct Effects				
H6: STRA -> AGIL -> BOPR				
AGIL -> BOPR	0.3447	0.2632	0.2852	-0.0330
	0.3452	0.0117	0.0853	0.8833
STRA -> AGIL	0.3329	0.2241	0.1801	0.2104
	0.0818	0.0095	0.3647	0.0545
STRA -> BOPR	-0.0716	0.2297	0.1951	0.3866
	0.7834	0.0238	0.3028	0.0222
Hypothesis testing - Indirect Effects				
STRA -> AGIL -> BOPR	0.1148	0.0590	0.0514	-0.0069
	0.3967	0.1054	0.5191	0.8922
R^2				
AGIL	0.1108	0.0502	0.0324	0.0443
BOPR	0.1075	0.1491	0.1394	0.1452
f^2				
AGIL -> BOPR	0.1184	0.0773	0.0914	0.0012
STRA -> AGIL	0.1246	0.0529	0.0335	0.0463
STRA -> BOPR	0.0051	0.0589	0.0428	0.1671

Table 257 – H6 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

Across 2019–2022:

Measurement quality for AGIL remained consistently strong (CR = 1.0000, AVE = 1.0000), while BOPR and STRA exhibited fluctuating reliability and convergent validity, with BOPR particularly weak in 2019 (CR = 0.0814, AVE = 0.1832) and moderate in subsequent years. Structural path analysis indicates that STRA's direct effect on AGIL was significant only in 2020 (p = 0.0095), whereas AGIL significantly influenced BOPR in 2020 (p = 0.0117) and 2021 (p = 0.0853). STRA's direct effect on BOPR was significant in 2020 (p = 0.0238) and 2022 (p = 0.0222). The indirect effect of STRA on BOPR through AGIL was non-significant across all years, suggesting that the hypothesized mediation mechanism lacks longitudinal stability. R^2 values reveal low explanatory power for AGIL (0.0443–0.1108) and modest explanatory power for BOPR (0.1394–0.1491), while f^2 values indicate generally small to moderate effect sizes across all paths. *Overall, the MGA results demonstrate that H6 is only partially supported, with inconsistent direct effects and no evidence of robust mediation across the four-year period.*

	2019	2020	2021	2022
		Differences		
2019		0.0558	0.0634	0.1217
2020			0.0076	0.0659
2021				0.0583
2022				
		P-values		
2019	-	0.3325	0.3422	0.2087
2020	0.6650	-	0.4975	0.1443
2021	0.6844	0.9950	-	0.2542
2022	0.4174	0.2885	0.5085	-

Table 258 – H6 Multi-group Analysis – Differences & p-values

7.15.7 Multi-Group Analysis: Hypothesis 7

Longitudinal MGA Hypothesis 7 (Table 259) posited that spend priorities (SPEN) influence benefits innovative (BINN) indirectly through Agile/DevOps adoption (AGIL). In the table 226, across 2019–2022, measurement quality for AGIL remained consistently strong (CR = 1.0000, AVE = 1.0000), while BINN and SPEN demonstrated moderate to high reliability and convergent validity, with BINN showing lower AVE in 2019 (AVE = 0.3783) and 2020 (AVE = 0.3698). Structural path analysis indicates that SPEN had a significant direct effect on AGIL in all years ($p \leq 0.0014$), whereas AGIL significantly influenced BINN only in 2020 (p = 0.0000). SPEN's direct

effect on BINN was largely non-significant across the four years, supporting the hypothesized full mediation through AGIL. The indirect effect of SPEN on BINN via AGIL was significant in 2020 ($p = 0.0034$) and marginally non-significant in 2019, 2021, and 2022, indicating partial support for the mediating mechanism. R^2 values suggest low-to-moderate explanatory power for AGIL (0.0840–0.1758) and BINN (0.0624–0.2269), while f^2 values indicate small-to-moderate effect sizes along the mediation paths. *Overall, the MGA results indicate that H7 is generally supported, with Agile/DevOps adoption acting as a key mediator between spend priorities and innovative benefits, though the strength of the indirect effect fluctuates across the four-year period.*

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Benefits Innovative				
BINN1	0.3819	0.2867	0.4652	0.3388
BINN2	0.8677	0.7504	0.8356	0.8192
BINN3	0.4186	0.4307	0.5853	0.5235
BINN4	0.6333	0.7826	0.7873	0.8065
BINN5	0.6452	0.6370	0.7106	0.6877
Spend Priorities				
SPEN2	0.6625	0.3248	0.6880	0.8845
SPEN3	0.8746	0.9847	0.9169	0.6966
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
BINN	0.7364	0.7257	0.8139	0.7817
SPEN	0.7479	0.6496	0.7897	0.7734
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
BINN	0.3783	0.3698	0.4764	0.4366
SPEN	0.6019	0.5376	0.6570	0.6338
Hypothesis testing - Direct Effects				
H7: SPEN -> AGIL -> BINN				
AGIL -> BINN	0.2668	0.4762	0.2536	0.2469
	0.2195	0.0000	0.1353	0.1356
SPEN -> AGIL	0.3593	0.2898	0.3718	0.4193
	0.0012	0.0014	0.0003	0.0000
SPEN -> BINN	0.0965	0.0003	0.1454	0.0068
	0.6043	0.9973	0.3479	0.9589
Hypothesis testing - Indirect Effects				
SPEN -> AGIL -> BINN	0.0959	0.1380	0.0943	0.1035
	0.2670	0.0034	0.1983	0.1674
R^2				
AGIL	0.1291	0.0840	0.1383	0.1758
BINN	0.0990	0.2269	0.1129	0.0624
f^2				
AGIL -> BINN	0.0688	0.2687	0.0625	0.0536
SPEN -> AGIL	0.1482	0.0917	0.1605	0.2133
SPEN -> BINN	0.0090	0.0000	0.0205	0.0000

Table 259 – H7 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

	2019	2020	2021	2022
		Differences		
2019		-0.0422	0.0016	-0.0077
2020			0.0437	0.0345
2021				-0.0092
2022				
		P-values		
2019	-	0.6643	0.4772	0.5354
2020	0.6713	-	0.2944	0.3432
2021	0.9544	0.5888	-	0.5688
2022	0.9291	0.6863	0.8625	-

Table 260 – H7 Multi-group Analysis – Differences & p-values

7.15.8 Multi-Group Analysis: Hypothesis 8

Longitudinal MGA Hypothesis 8 (Table 261) shows across 2019–2022, measurement quality for AGIL remained consistently strong (CR = 1.0000, AVE = 1.0000), while BOPR exhibited fluctuating reliability and low-to-moderate convergent validity, particularly weak in 2022 (CR = 0.2025, AVE = 0.1747). SPEN maintained moderate-to-high reliability and convergent validity throughout the period (CR = 0.6849–0.7945, AVE = 0.5529–0.6619). Structural path analysis shows that SPEN exerted a consistently significant direct effect on AGIL in all years ($p \leq 0.0110$), whereas AGIL significantly influenced BOPR only in 2020 and 2021 ($p = 0.0136$ and 0.0156, respectively). SPEN's direct effect on BOPR was non-significant across all years. The indirect effect of SPEN on BOPR via AGIL approached significance in 2020 and 2021 ($p = 0.0587$ and 0.0657), but was non-significant in 2019 and 2022, indicating weak and inconsistent mediation. R^2 values suggest low-to-moderate explanatory power for AGIL (0.0821–0.1765) and BOPR (0.1110–0.2031), with f^2 values indicating small-to-moderate effect sizes across the paths. *Overall, the MGA results indicate that H8 is partially supported, with Agile/DevOps adoption playing a limited and inconsistent mediating role between spend priorities and operational benefits over the four-year period*.

	2019	2020	2021	2022
Agile/DevOps				
AGIL1	1.0000	1.0000	1.0000	1.0000
Benefits Operational				
BOPR1	0.7936	0.5518	0.6426	-0.1017
BOPR2	-0.2110	0.5175	0.4970	0.2287
BOPR3	0.0754	0.6444	0.5197	0.3335
BOPR4	0.2247	0.2651	0.5409	0.8649
BOPR5	0.5770	0.5020	0.6137	-0.3316
BOPR6	0.4217	-0.0698	0.5818	0.1277
Spend Priorities				
SPEN2	0.9147	0.4381	0.7168	0.9055
SPEN3	0.5922	0.9560	0.9000	0.6621
Composite reliability				
AGIL	1.0000	1.0000	1.0000	1.0000
BOPR	0.4266	0.5537	0.7395	0.2025
SPEN	0.7365	0.6849	0.7945	0.7681
Average variance extracted				
AGIL	1.0000	1.0000	1.0000	1.0000
BOPR	0.2069	0.2191	0.3230	0.1747
SPEN	0.5937	0.5529	0.6619	0.6291
Hypothesis testing - Direct Effects				
H8: SPEN -> AGIL -> BOPR				
AGIL -> BOPR	0.0292	0.3056	0.3115	0.2588
	0.9216	0.0136	0.0156	0.2545
SPEN -> AGIL	0.3285	0.2866	0.3672	0.4201
	0.0110	0.0022	0.0003	0.0000
SPEN -> BOPR	0.4402	0.0714	0.1068	0.2103
	0.0904	0.7175	0.5610	0.4231
Hypothesis testing - Indirect Effects				
SPEN -> AGIL -> BOPR	0.0096	0.0876	0.1144	0.1087
	0.9348	0.0587	0.0657	0.2712
R^2				
AGIL	0.1079	0.0821	0.1348	0.1765
BOPR	0.2031	0.1110	0.1329	0.1570
f^2				
AGIL -> BOPR	0.0010	0.0965	0.0968	0.0654
SPEN -> AGIL	0.1209	0.0895	0.1558	0.2143
SPEN -> BOPR	0.2169	0.0053	0.0114	0.0432

Table 261 – H8 Standardized Factor Loadings, CR, AVE, Hypothesis Testing, R^2, f^2

	2019	2020	2021	2022
		Differences		
2019		-0.0780	-0.1048	-0.0991
2020			-0.0268	-0.0212
2021				0.0056
2022				
		P-values		
2019	-	0.7499	0.7985	0.7473
2020	0.5001	-	0.6397	0.6475
2021	0.4031	0.7207	-	0.5380
2022	0.5055	0.7050	0.9240	-

Table 262 – H8 Multi-group Analysis – Differences & p-values

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