

Article

Critical Success Factors in Agile-Based Digital Transformation Projects

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Abstract

Digital transformation (DT) requires organizations to navigate complex technological and organizational changes, often under conditions of uncertainty. While agile methodologies are widely adopted to address the iterative and cross-functional nature of DT, limited attention has been paid to identifying critical success factors (CSFs) from a socio-technical systems (STS) perspective. This study addresses that gap by integrating and prioritizing CSFs as interdependent elements within a layered socio-technical framework. Drawing on a systematic review of 17 empirical and conceptual studies, we adapt Chow and Cao's agile success model and validate a set of 14 CSFs across five domains—organizational, people, process, technical, and project—through a Delphi-informed Analytic Hierarchy Process (AHP). The findings reveal that organizational and people-related enablers, particularly management commitment, team capability, and organizational environment, carry the greatest weight in agile-based DT contexts. These results inform a three-layered framework—comprising organizational readiness, agile delivery, and project artefacts—which reflects how social, technical, and procedural factors interact systemically. The study contributes both theoretically, by operationalizing STS theory in the agile DT domain, and practically, by providing a prioritized CSF model to guide strategic planning and resource allocation in transformation initiatives.

Keywords: digital transformation; agile; critical success factors; socio-technical systems

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1. Introduction

Digital transformation (DT) represents a profound reconfiguration of how organizations create value, deliver services, and respond to uncertainty, through embracing emergent technologies, such as AI, big data, cloud platforms, and IoT [1–3]. These technologies reshape decision-making, team coordination, and the competencies required for effective project execution [4].

Despite these benefits, DT remains a high-risk endeavor: McKinsey estimates that only around 20–26% of digital transformations succeed fully, while Gartner and other reports suggest failure rates between 70 and 84%. Common stumbling blocks include unclear goals, fractured data strategies, and insufficient organizational readiness [5–7].

These high failure rates underscore the imperative for more adaptive and people-centered approaches. Agile Project Management (APM), originally rooted in software engineering [8,9], has evolved into a broader governance paradigm that enables iterative

learning, rapid decision-making, and flexible coordination across organizational units [10,11]. APM abandons rigid, phase-based frameworks in favor of iterative cycles, stakeholder collaboration, and flexibility, traits well aligned with DT challenges [12–14]. In DT contexts, agile methods support continuous feedback, cross-functional collaboration, and real-time responsiveness, making them increasingly essential for effective implementations [15,16].

Empirical studies have further validated this alignment between agile principles and DT imperatives. Kudyba et al. [17] described how Scrum-based delivery enables continuous refinement and stakeholder alignment; Shaba et al. [11] highlighted agile's capacity to foster systemic, cross-departmental collaboration; and Sun and Tell [5] demonstrated how agile prototyping maintains coherence between temporary project teams and long-term organizational structures. These insights reflect not only agile's technical efficiency but also its role as a systemic governance mechanism—integrating people, processes, and technologies, in alignment with socio-technical systems (STS) theory.

STS theory posits that successful transformation relies on the joint optimization of social and technical subsystems, including leadership, team capabilities, organizational structure, and digital tools [18,19]. From this perspective, agility is not merely a methodology, but a dynamic, system-level capability that enables organizations to adapt to uncertainty and complexity in digital contexts.

Despite the growing interest in agile DT practices, there has been limited attention given to critical success factors (CSFs) from a socio-technical perspective. Existing studies have tended to emphasize discrete dimensions—such as leadership and governance [20,21], organizational culture [22,23], technical infrastructure [24,25], or team agility [17,26], but rarely explored how these elements interact as a system. This fragmented view limits the ability of organizations to develop coherent transformation strategies.

To address this gap, this study investigates the following research question:

What are the critical success factors for agile-based digital transformation, and how can these be prioritized within a socio-technical systems framework?

Theoretically, this study not only integrates and refines fragmented CSF frameworks by adapting Chow and Cao's agile success factor model, but also advances the literature by developing an empirically validated, hierarchical framework grounded in socio-technical systems (STS) theory. By mapping critical success factors across interdependent layers—organizational readiness, agile delivery, and project artefacts—the study offers a system-aware conceptualization of agile-based digital transformation that highlights how social and technical elements interact dynamically to shape transformation outcomes. Practically, the findings provide a diagnostic tool to guide managers in allocating resources toward high-impact enablers—particularly within the organizational and personnel domains—thereby supporting more holistic and system-aware transformation strategies.

The structure of the paper is as follows: Section 2 reviews relevant empirical literature on agile project management, digital transformation, and CSFs. Section 3 outlines the research methodology, detailing the Delphi-informed Analytic Hierarchy Process (AHP) used to prioritize the CSFs. Section 4 presents the findings, followed by Section 5, which discusses the results through the lens of STS theory. Section 6 concludes with implications for theory and practice, as well as directions for future research.

2. Literature Review

2.1. Digital Transformation and Agile

DT entails a fundamental reconfiguration of how organizations generate value by integrating digital technologies into core processes and decision-making routines [2,3]. Rather than merely adopting tools such as AI, blockchain, or IoT [4], DT reshapes inter-

organizational coordination, team capabilities, and project governance, thereby challenging existing managerial logics [4,27]. The potential of DT to enhance productivity, streamline operations, and improve competitiveness has made it a central concern for both scholars and practitioners [3,28].

DT is commonly conceptualized as a three-stage process: digitization, digitalization, and digital transformation—which represent increasing levels of organizational integration and innovation [29–31]. Digitization refers to converting analogue processes into digital formats, to increase task efficiency [32]. Digitalization extends this by embedding digital tools into workflows to enhance coordination and performance [33]. The final stage, digital transformation, involves reconfiguring organizational structures, roles, and strategies, to integrate digital capabilities fully [34,35]. As such, DT is not merely a technological upgrade but a strategic and cultural shift demanding substantial organizational adaptation [23,36–38].

However, implementing DT in practice presents significant challenges. Ambiguity in transformation goals, fragmented interpretations across departments, and inconsistencies in data infrastructure often hinder coordination and execution [5–7]. In particular, organizations face difficulty aligning strategic intent with operational realities, especially when data strategies are inconsistent or internal capabilities insufficient—challenges that are especially pronounced in entrepreneurial and resource-constrained settings [39].

In response to these complexities, Agile Project Management (APM) has emerged as a governance-oriented methodology well suited to dynamic transformation contexts. Initially developed in the software sector through the Agile Manifesto [10], which is a set of guiding values and principles, APM has been widely adopted across sectors, to address the fluid and innovation-intensive nature of contemporary projects [40]. In contrast to traditional project management (TPM), which is linear and predictive, APM emphasizes adaptability, stakeholder engagement, and iterative delivery cycles [10,41].

The core principles of APM—incremental delivery, collaborative problem-solving, and responsiveness to change—align closely with the evolving and uncertain nature of DT initiatives [14]. Agile management's flat, informal structures facilitate rapid feedback and learning, enabling teams to navigate uncertainty, while delivering continuous value. These qualities allow APM to bridge the tension between temporary project activities and enduring strategic goals, reconciling experimentation with institutionalization [5,10]. Moreover, by placing human capital at its center, APM highlights the importance of team competence, cross-functional communication, and engagement as critical enablers of successful DT execution [15,16].

Building on these capabilities, recent research has increasingly conceptualized agile not only as a delivery method, but as a systemic governance logic that embeds strategic responsiveness within DT ecosystems [10,42]. This governance-oriented view sees agile as a mechanism for enabling cross-level coordination, decentralized decision-making, and adaptive feedback loops—governance capacities that are especially vital in volatile, fast-evolving environments. Agile governance is operationalized through both formal structures (e.g., sprints, defined roles like product owners) and informal routines (e.g., team learning, iterative sense-making), creating an integrated system for ongoing alignment between project-level actions and strategic objectives [10]. For example, Sweetman et al. [43], drawing on complexity theory, portray agile portfolios as complex adaptive systems in which autonomous teams function as agents that continuously adjust to changing environmental signals. In this sense, agile becomes a structural enabler of DT—not simply a project technique, but a governance paradigm for navigating systemic transformation.

Empirical studies have reinforced agile's governance potential in DT contexts. For instance, Kudyba and Cruz [17] illustrated how Scrum enabled iterative development and stakeholder alignment, while Shaba et al. [11] and Sun and Tell [5] demonstrated agile's capacity to foster cross-functional learning and mediate structural tensions across

organizational boundaries. These insights affirm that agile is not merely a management tool but a central mechanism for driving organizational adaptability in the digital era.

2.2. Critical Success Factor of Agile-Based DT Project

Given the complexity and diversity of elements influencing project success [44], scholars have long sought to identify the most critical factors that consistently determine positive outcomes. Rockart [45] defined CSFs as “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization.” Since then, the CSF concept has been broadly adopted in project management research [46].

CSFs play a central role in shaping project strategies and enhancing the likelihood of success. Rather than representing outcomes themselves, CSFs are the conditions, resources, or practices that enable successful project execution. They help maintain operational continuity, improve managerial efficiency, and synchronize diverse project components [47,48]. However, their identification is often shaped by specific project contexts and research perspectives, leading to varied interpretations and prioritizations [49].

Leidecker et al. [50] emphasized the strategic utility of CSFs in evaluating project environments, integrating resources, and setting directions. Similarly, Freund [51] highlighted their role in aligning projects with broader organizational goals, optimizing resource investments, and clarifying management priorities. Wuni et al. [52] underscored the interdependencies among CSFs, suggesting they function as part of a dynamic ecosystem that supports effective, coordinated project execution.

Recent literature has broadened the evaluation of DT project success beyond financial performance to include intangible dimensions such as cultural adaptability, stakeholder engagement, and organizational maturity. Gertzen et al. [23] highlighted that as organizations progress digitally, their performance benchmarks evolve accordingly. Cordeiro et al. [21] presented a maturity model capturing readiness across IT infrastructure, workforce skills, and digital culture. Similarly, Bandara et al. [20] and Baier et al. [53] stressed the critical role of socio-technical alignment, governance fit, and stakeholder coordination.

These findings underscore that successful DT is contingent on a constellation of enabling factors, spanning people, processes, infrastructure, and leadership, reflecting an STS perspective [54]. Baxter et al. [42] showed that institutional complexity and regulatory ambiguity hinder agile DT efforts, barriers that can only be overcome through leadership commitment, clearly defined roles, and adaptive policy frameworks. Expanding on this, Grall et al. [55] introduced the concept of “bridging practices”—including co-design workshops, alignment mapping, and cross-departmental sense-making routines—as mechanisms that function as cross-level CSFs. These practices connect agile teams with executive leadership and external stakeholders, enabling coherence between operational agility and strategic intent. This perspective affirms that organizational readiness for digital transformation depends not only on technical capabilities but also on a constellation of critical success factors—including strategic leadership, structural alignment, and governance capacity—which enable organizations to navigate institutional, procedural, and project-level complexities effectively [10,43].

2.3. Rationale for Framework Selection

The selection of an appropriate CSF framework is crucial for ensuring both analytical robustness and empirical relevance. For agile-based DT projects, such a framework must meet three criteria: (1) offer structural clarity for empirical analysis; (2) align with agile principles and socio-technical perspectives; and (3) support adaptability across organizational levels.

Traditional CSF models, such as those by Pinto and Slevin [56] and Shenhar et al. [57], fall short of these criteria. The former provides a static checklist that lacks iterative agility, while the latter emphasizes outcome measures over enabling processes. Similarly,

foundational works by Rockart and Freund [51] underscored the strategic value of CSFs but did not provide operational classification mechanisms.

Broader governance frameworks like PMBOK [58], McKinsey's 7S [59], and TOGAF [60] also present limitations. Although useful for structuring processes or aligning enterprise strategy, they prioritize procedural and architectural coherence over dynamic factor identification. PMBOK is lifecycle-oriented, McKinsey's components are conceptually interwoven and hard to operationalize, and TOGAF overlooks the human and socio-technical elements vital for DT.

In contrast, Chow and Cao's [61] CSF framework offers a five-dimensional, empirically grounded model that directly responds to the needs of agile-based DT projects. Its classification—Organizational, People, Process, Technical, and Project-specific—mirrors the complexity of socio-technical systems, while remaining operationally clear for empirical tools like Delphi or AHP. Developed through a large-scale study of agile implementations, it captures the governance dynamics and human–technical interplay central to transformation contexts.

Chow and Cao's framework introduced 12 factors within five dimensions. These dimensions reflect a comprehensive socio-technical perspective, encompassing both managerial enablers and operational conditions.

- Organizational factors include management commitment, organizational environment, and team environment, highlighting the contextual support essential for agile implementation.
- People factors focus on team capability and customer involvement, emphasizing human resource quality and stakeholder collaboration.
- Process factors involve the project management process and project definition process, capturing procedural clarity and adaptability.
- Technical factors consist of agile software techniques and delivery strategy, pointing to the technical foundations of agile execution.
- Project factors relate to project nature, project type, and project schedule, acknowledging the unique features of each project context.

To assess the reliability and applicability of Chow and Cao's [61] framework, this study systematically reviewed 17 empirical and conceptual studies on agile-based digital transformation (see Table 1). The selected literature spans diverse organizational contexts, including large multinational corporations; small and medium-sized enterprises (SMEs); and entities operating in the manufacturing, service, and public sectors. This cross-sectoral and cross-organizational scope was deliberately chosen to capture both the shared patterns and contextual specificities of agile implementations across different digital transformation scenarios. Notably, many of these studies do not confine their analysis to a single industry, but instead focus on agile teams functioning within varied organizational structures. This approach provides a robust empirical foundation for identifying CSFs that are both generalizable and adaptable across multiple DT contexts.

Table 1. Overview of selected studies and extracted CSFs for agile-based digital transformation.

Reference	Sector	Original Texts	CSF Dimension
		Empowering leadership	Management commitment
[62]	Review paper	Aligning digital strategy with overall strategy and culture; Continuous learning and improvement processes; Organizational agility to reconfigure structures, processes, and outputs; Culture of mindfulness toward digital transformation	Organizational environment

[20]	Not specified	Agile IT management; Integration of agile and business analysis	Project manager capability
		Use of digital platforms; Creating innovation-focused IT subunits; Developing information processing capabilities	Technological adaptability
		Service-Oriented Architecture (SOA); Balancing weak and strong signals using digital tools	Digital solution delivery strategy
		Top Management Support	Management commitment
		Stakeholder Input	Customer involvement
		Modeler Expertise	Team capability
[25]	Service sector	Project Management Capabilities	Project manager capability
		Modelling Tool Usage	Technological adaptability
		Process Complexity	Project nature
		Remote signing of any type of document; Cloud enables you to manage business operations efficiently; Cloud usage offers new opportunities; Using the cloud allows you to perform specific tasks more quickly; Use of the cloud allows managers to increase business productivity	Technological adaptability
		Skills needed to implement digital transformation; Knowing how the benefits of digital transformation can be used to support operations	Team capability
		ERP Cloud; CRM Cloud; Professional management applications in the cloud	Digital solution delivery strategy
[22]	Conceptual paper	Efficiency improvement; Decentralize decisions; Reduce costs; Adaptation to New Technologies; Improve Customer Service; Increase customer loyalty; Increased productivity; Market share increase; Information management	Organizational environment
		Management commits to implementing digital transformation; Management leads and is involved in the process; Management is willing to assume risks involved in the adoption of digital transformation	Management commitment
		Structure; People; Technology; Processes	Organizational environment; Team environment; Technological adaptability; Project management process
		SMACIT-enabled transformation; Innovation for broader customer focus; Apps to be intuitive and reliable	Technological adaptability; Customer involvement
		Agile transformational practices; New operating models	Project definition process; Project nature
		Customer feedback loops; Embedded user control; Connected devices	Customer involvement
[63]	Manufacturing	From planning to discovery; Cultural openness; Agile mindset; Innovative mindset; Recruitment of digitally compatible employees	Organizational environment; Team environment
		From scarcity to abundance; Data-rich environment; Data-centered understanding; Recruitment of data-literate employees; Data-centered services	Team capability; Technological adaptability; Digital solution delivery strategy
		From hierarchy to partnership; Multi-actor coupling; Reciprocal value propositions; Customer data exchange; Trust-based collaboration	Organizational environment; Customer involvement

[23]	Not specified	Strategic fit; Strategic alignment; Extension of market; Business goals; Improved decision-making	Management commitment; Organizational environment
		Improved morale and attitude; Internal communication network; Employee turnover; Inclusion and diversity	Team environment
		Digital skills; Reskilling; Upskilling; Managing workforce changes; Learning space	Team capability
		Customer experience; Customer satisfaction; Improved customer feedback; Omnichannel alignment; Ease of doing business; Reduced waiting times	Customer involvement
		Production efficiency; Production rates; Turnaround time; Scalability; Capacity	Project management process
		Improved digital integration; Digital migration; Platform adoption	Project definition process
		Cloud storage; Data lakes; System integration; AI; Chat-bots; Predictive maintenance; Mobile applications; Videoconferencing	Technological adaptability
		Digital platform strategy; Use of data in business strategy; Personalized value propositions; Development of digital capabilities	Digital solution delivery strategy
		Project cost; ROI; Payback period; Completion time; Financial risk; Legal exposure	Project schedule; Project cost
		Project risks; Internal operating issues; Management support	Project nature; Project type
[64]	Not specified	Customer Involvement; Customer Decision Making	Customer involvement
		Unit Autonomy and Empowerment; Unit Collaboration; Effective Communication	Organizational environment
		Personal Growth; Psychological Safety	Team capability
		Value Delivery Planning; Change Orientation	Management commitment
		Value Delivery Actualization; Data Driven Dev and Ops; Testing; Design and Coding Practices	Digital solution delivery strategy
		Continuous Improvement	Technological adaptability
		Iterative and Incremental Value Delivery; Flexibility in Value Delivery	Project management process
[65]	Not specified	Proactive action; securing/developing business model	Management commitment; Digital solution delivery strategy
		Relief of activities; support with complex tasks	Team capability; Project management process
		Management has to create the preconditions; teams with agile methods	Management commitment; Team environment; Project management process
		Diversification of the workforce; promotion of knowledge exchange; stabilization of change	Organizational environment; Team environment; Team capability
		Promoting the targeted exchange of data inside and outside the company	Technological adaptability; Digital solution delivery strategy
		Adaptation of work to different levels of performance and demands of employees; transparent communication of objectives	Team environment; Team capability; Project manager capability

[21]	Manufacturing	Networking beyond industry boundaries on specific topics; set new challenges	Organizational environment; Project nature
		Creation of innovation areas; involvement of strategic partners	Management commitment; Organizational environment; Digital solution delivery strategy
		Business model innovation; Smart products; Data-based service offerings	Digital solution delivery strategy; Project nature
		Digitalization of products and services; Sales channels expansion; Product customization	Digital solution delivery strategy
		Digitalization and value chain integration; Information access and real-time sharing with stakeholders	Technological adaptability; Organizational environment; Project management process
		Data and analytics as core capabilities; Self-learning; Business intelligence	Project management process; Technological adaptability
		Agile IT architecture; Infrastructure integration; Safe data sharing	Technological adaptability; Digital solution delivery strategy
		Compliance; Security; Legal and tax	Project definition process
		Digital culture; Employee engagement; Collaboration	Organizational environment; Team environment
		Create cross-functional teams that extend beyond the IT function, including product design, operations, and consumer behavior roles; Leverage team workshops before a project starts, to build empathy and a common understanding; Balance self-empowerment with accountability with feedback at critical junctures; Establish psychological safe zones for members to take risks and experiment	Team environment
[66]	Not specified	Include team members who are T-shaped, having both deep, functional expertise and the ability to engage with stakeholders across the business; Use “ninja” teams to bring in specific expertise at different points in a project; Use gamification to model creative behaviors	Team capability
		Practice servant leadership to remove barriers	Management commitment
		Use stretch goals to go beyond incremental innovation; Ensure continuous alignment between project objectives and business strategy	Project definition process
		Pitch for funding over time	Project cost
		Gain customer feedback from the outset using design thinking	Customer involvement
		Establish digital hubs as centers of excellence for agile and design thinking processes	Digital solution delivery strategy
		Train and mentor digital team members through leadership and onboarding programs; Train members on not only agile/design thinking methods, but also leadership behaviors	Project manager capability
[67]	Not specified	ENA06: Support from top management; communication via events with leadership	Management commitment
		ENA02: Appropriate organizational structure for agile adoption; organizational restructurings such as changing	Organizational environment

[68]	Literature review	HR functions; ENA08: Agile climate assessment; ENA09: Dissemination of agile principles and values	
		ENA10: Appreciation of people; ENA11: Adequacy of the physical or virtual work environment	Team environment
		ENA04: Training/knowledge transfer; investment in training	Team capability
		ENA01: Definition of agile processes; ENA07: Mechanism for improvement and adaptation of the adopted agile processes	Project management process
		ENA05: Conducting assessments to understand current maturity and readiness	Project definition process
		ENA03: Pilot project creation to experiment with agility	Project nature
		F01 Top management support	Management commitment
		F02 Team empowerment	
		F05 Decentralized decision-making	
		F06 Team accountability	
[69]	Manufacturing (SMEs)	F10 Adoption of participatory management	Team environment
		F11 Good communication	
		F12 Building strong teams	
		F04 Customer focus	Customer involvement
		F07 Team personal characteristics	
		F08 Experimentation with new solutions	Team capability
		F09 Servant leader mindset	Project manager capability
		F03 Adapting the process to agile	Project management process
		Technological Affordance and Complexity: "Technology affordability refers to the potential behavior possibilities provided by digital technology relative to specific entities... gives rise to different paths of digital innovation realization... facilitates digital devices (reprogrammability)... combination of digital technologies... complexity is widely regarded as the reserve condition for companies to introduce new technologies and implement new strategies."	Technological adaptability; Digital solution delivery strategy
		Organizational Agility and Unlearning: "Organizational agility... allows enterprises to redesign existing processes and quickly create new ones... proactively identify emerging business opportunities... agile organizations require a flexible front-end and a stable back-end... Unlearning... abandonment of past cognition, dominant logic... continuous updating of situational cognition and knowledge exploration... information sharing mechanisms and workflows."	Organizational environment; Team capability; Project management process
		Environmental Dynamics and Munificence: "Business environment driven by digital technology... variability, complexity, uncertainty... rapid changes in consumer demand, industry competition, policy... high-munificent environment facilitates firms to access resources... firms devoid the necessary resource support when launching innovation strategies... demand for external resources increases... industry competition becomes more serious."	Project nature; Project type; Project cost

[53]	Manufacturing	Top Management Support	Management commitment
		Organizational Agility; Innovation Attitude	Organizational environment
		Team Support; Team Portfolio	Team environment
		Employee Domain Knowledge; Employee Technology Knowledge	Team capability
		Customer Integration; Customer Knowledge	Customer involvement
		Management Domain Knowledge; Management Technology Knowledge; Management Agility	Project manager capability
		Project Monitoring; Project Preparation	Project management process
		Process Knowledge; Process Design; Process Goal Clarity	Project definition process
		Technology Complexity; Technology Maturity; Technology Comprehensibility	Technological adaptability
		Infrastructural Readiness; Digital Ambition; Strategy Integration	Digital solution delivery strategy
		Project Type; Project Goal Clarity	Project nature
		Project Monitoring	Project schedule
[26]	Service sector	- Strong foundation in terms of competencies in place and excellent communication to differentiate the transformation method and goals - Awareness of change brought about by the methods a number of years prior to the transformation - Evidence of value in large-scale transformation, e.g., shorter decision paths	Management commitment
		- Emphasis on need for collaboration, dependencies, and the connection to the central administrative system team	Organizational environment
		- Improved sense of satisfaction with an agile way of working and more ownership and responsibility as a team	Team environment
		- Planned induction of agile training provided prior to transformation and implementation of an agile culture - Introduced a project to build competence on agile methods	Team capability
		- Recruitment of two agile coaches to assist in the transition process	Project manager capability
[17]	Manufacturing	"The combination of new technologies... has increased the demand for evolving skills from human capital and constant communication with the marketplace, relational capital."	Team capability; Customer involvement
		"Various attributes of structural capital enabled the analytics team (human capital) to more effectively meet the needs of the project management team (relational capital)..."	
		"Teams that have worked together and who are well versed in technological skills are essential to project success."	
		"The development team... included business SMEs, data engineers, data scientists who had worked in multiple projects..."	

[70]	Public sector	“...skills and experience base of the development team was found to be an essential element to achieving successful outcomes...”	
		“Digital surveys, systemized ticketed feedback, instructional video content, data, data repositories and software systems enabled the analytics team to understand the decision support needs of project teams and stakeholders...”	Digital solution delivery strategy
		“...to develop and roll out an interactive dashboard that provided critical information for users (customers) to track activities and manage resource utilization.”	
		“The structural framework of the agile approach including scrums, sprints and MVP enables developers to better manage dynamic project environments.”	Project management process
		“...agile methodology promoted the relational capital through the utilization of scrums, MVP and sprints...”	
		“All the elements of IC should be balanced within agile teams to make them efficient.”	Team environment
		“Technology is the foundation of digital transformation”; “Choosing the right technology is critical to achieving digital transformation”; “Access to technical resources like hardware, software, and networks is crucial”	Technological adaptability
		“Employee engagement and empowerment to embrace change are essential to success”; “Employees engaged and empowered... can effect significant change”; “Technology alone is insufficient; a successful digital transformation requires combining technology and people”	Organizational environment; Team capability
		“Collaborating with suppliers is vital to success”; “Partnerships with vendors such as TETCO and TCO... are essential”	Organizational environment
		“A well-planned budget can assist organizations in achieving their objectives”; “Budgeting... is about managing risks and optimizing returns”	Project cost
		“Support from upper management... to ensure change is successful”; “Top management support... ensures the success of the Ministry’s digital transformation”	Management commitment
		“Existence of a culture of change... is among the main factors”; “Investing in cultural transformation is more important...”	Organizational environment
		“Digital transformation strategy aligned with Vision 2030”; “Strategic tasks and objectives taken seriously and responsibly”	Project definition process

Each study was carefully examined to extract reported success factors, which were then categorized into the framework’s five core dimensions: Organizational, People, Process, Technical, and Project-related factors. Through comparative analysis of the original textual descriptions and framework classifications, a total of 14 sub-factors were identified (see Table 2 for the classification and explanation of sub-factors). Two additional sub-factors—project cost (within Project-related factors) and project manager capability (within People factors)—were incorporated based on their recurrence in the reviewed literature, thereby enhancing the framework’s representativeness for agile-based digital transformation initiatives.

Table 2. Conceptual descriptions of CSFs in agile-based digital transformation projects.

Category	Code	Critical Success Factor	Conceptual Summaries
1. Organizational	C1	Management commitment	Active and sustained leadership engagement that champions agile principles and digital transformation goals, ensuring strategic alignment and continuous support.
	C2	Organizational environment	The structural, cultural, and governance settings that shape agile DT, influencing adaptability, cross-functional collaboration, and an innovative climate.
	C3	Team environment	A collaborative and empowered work setting where trust, psychological safety, and transparency foster agile iteration and responsiveness to change.
2. People	C4	Team capability	The skills, diversity, and agile maturity of team members, including their ability to learn, innovate, and collaborate across disciplines in fast-paced DT contexts.
	C5	Customer involvement	The active participation of end users or clients in shaping requirements, giving feedback, and co-developing agile solutions that meet evolving needs.
	C6	Project manager capability	The agile leadership and facilitation skills of project managers, enabling adaptive planning, conflict resolution, and stakeholder communication in DT initiatives.
3. Process	C7	Project management process	Agile planning, sprint monitoring, and feedback-driven control mechanisms that guide DT project execution and align progress with transformation goals.
	C8	Project definition process	Agile-driven early-stage clarification of scope, user stories, and goals, establishing a flexible yet structured basis for continuous delivery and iteration.
4. Technical	C9	Technological adaptability	The capacity of digital infrastructure to support agile experimentation, rapid integration of emerging technologies, and responsive adjustments to technical changes.
	C10	Digital solution delivery strategy	Agile deployment practices that prioritize speed, user feedback, and iterative rollouts of digital tools, aligned with transformation goals.
5. Project-specific factors	C11	Project nature	The degree of complexity, uncertainty, and innovation inherent in DT projects, influencing the selection of agile methods and adaptive strategies.
	C12	Project type	The classification of projects (e.g., ERP, AI, cloud services), shaping how agile practices are applied and success is measured.
	C13	Project schedule	Agile timeboxing and milestone tracking approaches that ensure timely delivery through iterative planning and adaptive pacing.
	C14	Project cost	Financial management practices that align with agile principles, including flexible budgeting, value-based prioritization, and cost visibility across sprints.

3. Methodology

3.1. Research Design

This study seeks to systematically identify and rank the CSFs that influence the outcomes of agile-based DT projects, an area where dynamic complexity and stakeholder diversity challenge traditional prioritization methods. Due to the complexity and interdisciplinary nature of DT initiatives, a robust methodological framework is required to capture expert knowledge and evaluate the relative importance of diverse influencing factors.

Accordingly, a Delphi–AHP integrated method is employed. The Delphi method enables iterative consensus-building among experts, to reduce conceptual ambiguity in CSF

selection, while the AHP supports quantitative prioritization through structured pairwise comparisons. This integrated approach is particularly suited to agile-DT contexts, where CSFs are often interdependent, dynamic, and cross-disciplinary.

Data collection was conducted using structured online questionnaires, enabling participants from different locations to engage asynchronously and independently. This method was chosen for its convenience, flexibility, and ability to gather rich, expert-based comparative input [71].

3.2. Delphi Method

Originally developed by the RAND Corporation [72], the Delphi method is a widely used technique for eliciting expert consensus on complex or emerging topics. It is particularly suitable for digital transformation research, which often involves multiple stakeholders, unclear boundaries, and evolving practices [73].

The process began with the formulation of a preliminary list of potential CSFs based on a literature review and initial expert input. These factors were then subjected to a two-round Delphi process involving domain experts from academia and industry. Participants provided initial ratings, received anonymized feedback on group results, and were invited to adjust their responses accordingly [74,75]. This iterative process facilitated the convergence of expert views, while preserving independent judgment.

The Delphi method's key strengths, including anonymity, controlled feedback, and statistical aggregation, are particularly beneficial in the context of agile-DT projects, where stakeholder roles and success definitions are fluid, geographically dispersed, and sometimes conflicting. Anonymity reduces reputational bias, controlled feedback promotes reflective reconsideration, and aggregation methods yield stable convergence, even when respondents differ in their professional background [76].

3.3. Sampling Strategy

To ensure the validity and relevance of the expert input, a purposive expert sampling approach was adopted [77]. Given the technical and managerial complexities of DT projects, participants were selected based on their experience in managing, studying, or advising on digital transformation initiatives.

The expert panel consisted of university professors and doctoral researchers specializing in digital strategy, agile management, and IT innovation, as well as senior project managers with practical DT implementation experience. According to Bhardwaj [78], expert sampling ensures that participants possess the domain-specific knowledge required to make informed judgments, particularly in exploratory and high-complexity research domains.

As detailed in Section 3.2, the Delphi technique provided a structured means for consensus development. In this section, we outline how the expert sample engaged with the Delphi–AHP process through iterative participation.

To ensure robust expert input and refine judgment consistency, this study employed the Delphi method, a structured multi-round process designed to obtain a reliable consensus from a panel of experts [72,79]. The Delphi technique is especially suitable for complex, multi-criteria decision-making studies such as identifying CSFs for digital transformation, where expert-based evaluations enhance analytical validity [73].

A total of 19 experts, including university researchers, senior project managers, and digital transformation consultants, were initially invited. In the first round, 13 valid responses were received. Experts were asked to provide pairwise comparisons of CSFs using a 9-point scale. Following Saaty's method, the responses were averaged, and a consolidated matrix was formed. The results were shared with the panel, and experts were asked to review and revise their assessments in Round 2. This process aimed to reduce

variability and enhance consensus, leading to 11 finalized responses with improved internal consistency, as shown in Table 3.

Table 3. Delphi experts.

Expert ID	Expert Type	Expertise Area	Round 1 Response	Round 2 Response
E1	Professor	Digital Strategy and Agile Transformation	Yes	Yes
E2	Professor	Organizational Change and Technology Integration	Yes	Yes
E3	Professor	Agile Methodology and Project Evaluation	Yes	Yes
E4	Senior Project Manager	Large-Scale Project Delivery	Yes	Yes
E5	Senior Project Manager	Enterprise IT Management	Yes	Yes
E6	Senior Project Manager	Agile PMO Leadership	Yes	Yes
E7	Senior Project Manager	Business Agility and Innovation	Yes	Dropped
E8	Senior Project Manager	DT Governance and Risk	Yes	Dropped
E9	Consultant	Strategic IT Consulting	Yes	Yes
E10	Consultant	Transformation Planning	Yes	Yes
E11	Consultant	Agile Adoption and Coaching	Yes	Yes
E12	Consultant	Agile Training and Facilitation	Yes	Yes
E13	Consultant	Business Process Digitization	Yes	Yes

The Delphi rounds ensured that subjective judgments were refined through iteration and reflection, reducing the risk of individual bias and enhancing the credibility of the final AHP inputs [74,76].

3.4. Analytic Hierarchy Process

AHP was employed to quantify the relative importance of CSFs contributing to digital transformation success. Developed by [80], AHP facilitates decision-making in complex environments by decomposing a problem into a structured hierarchy and applying pairwise comparisons to evaluate the priority of each element.

To implement AHP, this research followed a structured six-step procedure. First, the problem was hierarchically structured into three levels: the overall objective (effective digital transformation), five main CSF categories (Organizational, People, Process, Technical, and Project), and 14 sub-factors. This hierarchical model served as the foundation for the subsequent comparisons.

Next, the experts conducted pairwise comparisons of elements within each level of the hierarchy using a standardized 9-point AHP scale. The individual judgments were aggregated by averaging the responses to construct comparison matrices.

Each matrix was then normalized by dividing each element by the total of its respective column. The priority weight for each factor was calculated by averaging the normalized values across each row, thereby indicating the relative importance of each element within its group.

To verify the consistency of the expert judgments, a Consistency Index (CI) and Consistency Ratio (CR) were computed using the following formulas:

$$CI = \frac{\lambda_{max} - n}{n - 1}, \quad CR = \frac{CI}{RI}$$

where λ_{max} is the maximum eigenvalue, n is matrix order, and RI is the Random Index. A CR below 0.1 is considered acceptable [80].

Following the consistency check, local weights (LWi) were derived to express the relative importance of each sub-factor within its respective CSF category. Finally, global weights were calculated by multiplying each sub-factor's local weight by its category's

weight. These global weights informed the prioritization of critical success factors for agile-based digital transformation initiatives.

4. Findings

This chapter presents the results of the Delphi-informed AHP used to prioritize CSFs for agile-based DT. The findings emphasize the dominant influence of organizational and people-related factors, highlighting the central role of leadership, organizational alignment, and team capabilities over purely technical or procedural elements. Based on pairwise comparisons by eleven expert participants, the results demonstrate high logical consistency, as indicated by a CR below the threshold of 0.1.

4.1. Prioritization of CSF Categories

To assess the relative importance of the five main CSF categories—Organizational (B1), People (B2), Process (B3), Technical (B4), and Project (B5)—the experts conducted pairwise comparisons using the AHP scale. The aggregated comparison matrix (Table 4) reveals that Organizational factors (B1) received the highest priority, with a local weight (LWi) of 0.34, followed by People-related factors (B2) at 0.30. Together, these two categories account for 64% of the total weight, underlining the importance of strategic leadership, a supportive culture, and team competence in driving agile-based transformation. Process (B3) and Technical (B4) factors followed, with moderate weights of 0.15 and 0.12, respectively, while Project-related factors (B5) received the lowest weight of 0.09, suggesting that traditional project attributes like cost or scheduling, although relevant, are perceived as less critical in agile DT contexts. Table 5 summarizes the final prioritization of these categories.

Table 4. Pairwise comparison matrix of middle layer (B1–B5).

	Organizational B1	People B2	Process B3	Technical B4	Project B5	Wi
Organizational B1	1	1.31	3.02	2.84	2.60	0.34
People B2	0.76	1	2.12	3.11	3.20	0.30
Process B3	0.33	0.47	1	1.92	1.48	0.15
Technical B4	0.35	0.32	0.52	1	2.01	0.12
Project B5	0.38	0.31	0.68	0.50	1	0.09

Table 5. Relative importance of critical success factor categories in agile-based digital transformation projects.

The Importance of CSF in DT	LWi	AW
Organizational B1	0.34	1.76
People B2	0.30	1.54
Process B3	0.15	0.77
Technical B4	0.12	0.60
Project B5	0.09	0.48

4.2. Prioritization of Sub-Factors

Further prioritization within each category was conducted to determine the relative significance of the 14 identified sub-factors, with local weights presented in Table 6. Within the Organizational category (B1), Management commitment (C1) was the most influential factor, assigned a weight of 0.48. This was notably higher than the weights for Organizational environment (C2) at 0.30 and Team environment (C3) at 0.22, underscoring the critical role of leadership in aligning strategic vision with agile transformation goals. In the People category (B2), Team capability (C4) emerged as the most significant sub-factor, with a local weight of 0.48, indicating that internal team agility, cross-

functional skills, and collaborative capacity are essential drivers of success. Customer involvement (C5) and Project manager capability and experience (C6) were also recognized as important, but with lower weights of 0.27 and 0.25, respectively, reflecting the strong emphasis placed on team dynamics.

Table 6. Local weights (C1–C14).

Sub-factor	Local Weight
Organizational B1	LWi
C1. Management commitment	0.48
C2. Organizational environment	0.3
C3. Team environment	0.22
People B2	LWi
C4. Team capability	0.48
C5. Customer involvement	0.27
C6. Project manager capability and experience	0.25
Process B3	LWi
C7. Project management process	0.55
C8. Project definition process	0.45
Technical B4	LWi
C9. Technological adaptability	0.42
C10. Digital solution delivery strategy	0.58
Project B5	LWi
C11. Project nature	0.45
C12. Project type	0.22
C13. Project schedule	0.14
C14. Project cost	0.2

In the Process category (B3), the Project management process (C7) received a higher weight (0.55) than the Project definition process (C8) at 0.45, suggesting that the ability to manage and adapt execution processes is slightly more valued than upfront project design. Within the Technical category (B4), Digital solution delivery strategy (C10) was assigned a higher weight (0.58) than Technological adaptability (C9) at 0.42, indicating that structured approaches to delivering digital solutions are viewed as more critical than general technical responsiveness. Finally, in the Project category (B5), Project nature (C11) held the highest weight at 0.45, suggesting that factors such as project complexity and innovation level carry more strategic relevance than Project type (C12, 0.22), Project schedule (C13, 0.14), or Project cost (C14, 0.20).

4.3. Global Prioritization of CSFs

To derive a comprehensive view of the critical success factors (CSFs) influencing digital transformation, the global weight of each sub-factor was calculated by multiplying its local weight by the weight of its parent category. This aggregation provided a ranked list of CSFs that reflects their overall significance across all evaluated dimensions, see Table 7 and Figure 1.

Table 7. Global ranking of critical success factor.

Category	Code	Sub-Factor Name	Local Weight	Category Weight	Global Weight	Global Rank
Organizational (B1)	C1	Management commitment	0.48	0.34	0.1632	1

Organizational (B1)	C2	Organizational environment	0.30	0.34	0.102	3
Organizational (B1)	C3	Team environment	0.22	0.34	0.0748	7
People (B2)	C4	Team capability	0.48	0.30	0.144	2
People (B2)	C5	Customer involvement	0.27	0.30	0.081	5
People (B2)	C6	Project manager capability	0.25	0.30	0.075	6
Process (B3)	C7	Project management process	0.55	0.15	0.0825	4
Process (B3)	C8	Project definition process	0.45	0.15	0.0675	9
Technical (B4)	C9	Technological adaptability	0.42	0.12	0.0504	10
Technical (B4)	C10	Digital solution delivery strategy	0.58	0.12	0.0696	8
Project (B5)	C11	Project nature	0.45	0.09	0.0405	11
Project (B5)	C12	Project type	0.22	0.09	0.0198	12
Project (B5)	C13	Project schedule	0.14	0.09	0.0126	14
Project (B5)	C14	Project cost	0.20	0.09	0.018	13

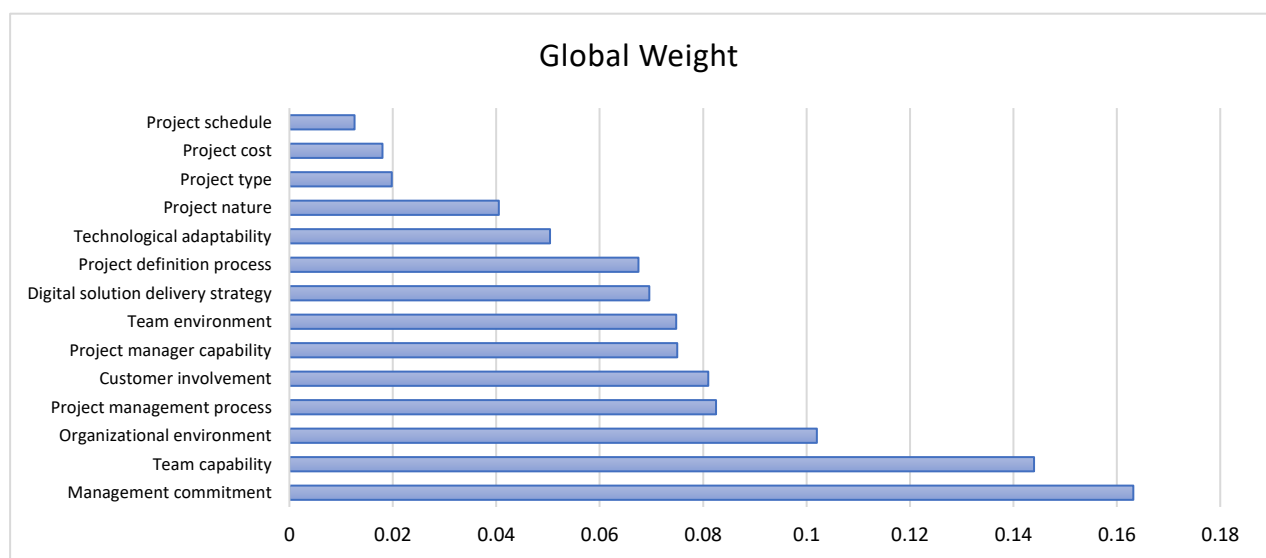


Figure 1. Rank of subfactors.

Accordingly, the global weights were categorized into three tiers, including critical factors, important factors, and lower-priority factors.

Critical factors (Rank 1–3) represent the most influential elements for agile-based digital transformation (DT) success. These are management commitment (C1), team capability (C4), and organizational environment (C2). Together, they highlight the foundational role of strategic leadership, skilled teams, and supportive cultural and structural contexts in enabling agile transformation. These factors form the core of organizational readiness, ensuring alignment, commitment, and capacity at the outset of change initiatives.

Important factors (Rank 4–10) act as essential operational enablers, supporting but not individually driving transformation outcomes. This category includes the project management process (C7) and customer involvement (C5)—both crucial for maintaining adaptive planning and end-user focus. It also encompasses project manager capability (C6), team environment (C3), digital solution delivery strategy (C10), project definition

process (C8), and technological adaptability (C9). These factors collectively represent the agile delivery layer, where technical systems and social practices converge to execute transformation initiatives responsively and iteratively.

Lower-priority factors (Rank 11–14) show limited strategic influence in this context. These included project nature (C11), project type (C12), project cost (C14), and project schedule (C13). While still relevant, their lower ranking suggests that traditional project parameters are perceived as less critical compared to dynamic, human-centric, and organizational enablers in agile-based digital transformation initiatives.

This prioritization can guide organizations in allocating resources, designing change strategies, and setting realistic expectations for digital transformation initiatives.

5. Discussion

The findings of this study identified a hierarchy of critical, important, and lower-priority factors contributing to the success of agile-based DT initiatives. This distribution reveals a layered system of interdependences that closely aligns with STS theory. As originally conceptualized by Emery and Trist [54], STS emphasizes that technological tools and innovations can only deliver sustainable value when embedded within supportive social systems. These systems are defined by complex interactions between people (the social components), technical tools and methods (the technical components), and the broader organizational environment [81].

STS posits that both social and technical dimensions must be jointly optimized for successful change [82]. In DT, this principle is particularly salient, as DT entails not only the adoption of new technologies, but also deep shifts in organizational structures, roles, and governance practices [34,35,37,38]. Prior research has acknowledged the multidimensional nature of DT and has identified a wide array of CSFs. However, these studies often treated CSFs as discrete or sector-specific variables, lacking a unified framework that reflects their systemic interdependence.

Our study advances this discourse by integrating diverse success factors from across 17 empirical and conceptual studies and validating them through a structured Delphi-AHP approach. This process yielded a hierarchy of 14 sub-factors that map onto three interrelated layers—organizational readiness, agile delivery, and project artefacts, as shown in Figure 2. This layered framework offers a novel contribution by aligning the empirical findings with the core logic of STS theory, revealing how the outer structural enablers condition the effectiveness of the inner technical processes.

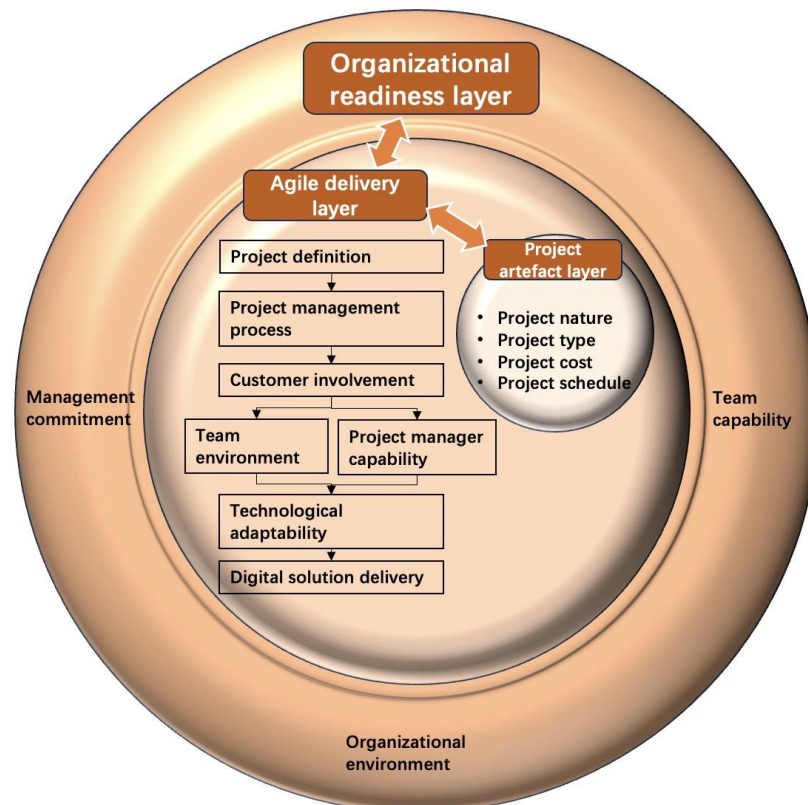


Figure 2. Layered structure of critical success factors in agile-based digital transformation projects.

Unlike previous literature, which tended to emphasize isolated dimensions of success, our framework captures the dynamic interplay among social, technical, and procedural elements in agile-based DT projects. It thus provides both a theoretical advancement in operationalizing STS principles and practical guidance for managers seeking to prioritize transformation efforts in a holistic, system-aware manner.

The outermost layer of our proposed framework—Organizational Readiness—represents the foundational enablers of agile-based digital transformation (DT). This layer encompasses key factors such as management commitment, team capability, and the broader organizational environment. These dimensions reflect an organization’s strategic alignment, cultural adaptability, and institutional capacity to support agile practices at scale. Guided by socio-technical systems (STS) theory—which emphasizes the joint optimization of technical and social subsystems for sustainable transformation [83,84]—this layer constitutes the critical social infrastructure that allows agile methodologies to be effectively embedded and sustained. Agile tools and processes alone are insufficient when implemented within rigid hierarchies or misaligned governance structures.

This theoretical framing is consistently reinforced by the reviewed empirical literature. Marino-Romero et al. [25] highlighted that digital transformation requires leadership engagement, managerial risk acceptance, and strategic clarity (C1), alongside decentralized decision-making and productivity-focused agility (C2). Similarly, Gertzen et al. [23] identified strategic alignment and enhanced decision-making as key drivers of success (C1, C2), while also underscoring workforce reskilling as a crucial enabler (C4). Tuncel et al. [64] stressed change orientation and value-driven leadership (C1), as well as autonomy, collaboration, and psychological safety (C2, C4), as essential to transformation. Andrade et al. [68] elaborated practical readiness mechanisms, including HR restructuring, agile climate assessment, and the institutionalization of agile values (C1, C2). These findings were echoed by Baier et al. [53], who emphasized innovation-oriented cultures and top management support (C1, C2), along with the importance of team knowledge (C4).

Carroll et al. [26] added that early competence development, clear communication, and active stakeholder engagement can help differentiate transformation goals and support collective learning (C1, C4). Collectively, these studies affirm that organizational readiness—anchored in coherent governance, integrative authority structures, and cross-functional alignment practices—is vital for enabling agile adaptability, particularly in highly regulated or complex environments [10,42,55].

From a managerial perspective, these insights reinforce that the success of agile-based DT extends beyond the adoption of agile tools or ceremonies. It requires the cultivation of a strategically aligned, culturally adaptive, and structurally agile environment. Leaders should begin by conducting organizational diagnostics to assess readiness across key dimensions—such as leadership commitment, governance adaptability, and team capability. This entails securing top-level sponsorship, reconfiguring decision structures to support agility, and promoting cross-functional collaboration, to facilitate cultural change.

The middle layer, Agile Delivery, represents the operational engine of transformation, where strategic intent is translated into iterative, user-centered execution. Encompassing elements such as project management processes, customer involvement, project manager capability, team environment, digital solution delivery strategy, project definition, and technological adaptability, this layer reflects the dynamic, cross-functional coordination required for agile success. Rather than following static templates, Agile Delivery is inherently adaptive—governance, feedback, and responsiveness must continuously interact to operationalize transformation within evolving contexts.

Our findings confirm that agile delivery teams function as decentralized, empowered agents navigating between top-level directives and emergent project complexities [43]. This aligns with socio-technical systems (STS) theory, which emphasizes that effective transformation depends on the integration of social components (e.g., team dynamics, communication routines) and technical elements (e.g., tools, processes) [82]. Across the literature, this interdependence is consistently highlighted. For example, Bandara et al. [20] and Cordeiro et al. [21] emphasize the criticality of robust project management capabilities and leadership development (C6), while Kudyba and Cruz [17] highlight the operational value of structured agile mechanisms—such as scrums, MVPs, and iterative dashboards—that help teams respond fluidly to changing project needs (C7). These mechanisms not only support delivery speed and alignment but also reinforce feedback-driven governance.

Customer involvement is another cornerstone of agile delivery, underscored by Ivanov [22], Cordeiro et al. [21], and Gertzen et al. [23], who detailed practices such as embedded user feedback, co-design processes, and omnichannel integration (C5). These studies collectively affirm that stakeholder engagement is not a supplementary activity, but a fundamental driver of responsiveness and relevance in agile projects. Equally important is technological adaptability—described by Wolf et al. [65] and Gertzen et al. [23] through concepts like digital platform integration, AI-enabled decision systems, and mobile toolkits (C9, C10). These tools are not just enablers of speed but serve as platforms for real-time coordination and organizational learning.

From a managerial perspective, these insights suggest that agile delivery cannot be achieved through process adoption alone. Leaders must proactively cultivate environments that support adaptive delivery by embedding agile-enabling structures—such as decentralized leadership, iterative scoping, real-time data integration, and team empowerment. Training investments should target both technical fluency and collaborative behaviors, while project scoping should remain fluid, to accommodate evolving goals and insights. As Dong et al. [10] argued, agile delivery mechanisms provide the connective infrastructure that binds local autonomy with strategic coherence, allowing organizations to continuously innovate, without losing sight of broader transformation objectives. In

this sense, the Agile Delivery layer embodies the socio-technical core of transformation—where human capabilities, technological fluidity, and procedural frameworks converge to drive successful and sustainable change.

The innermost layer, Project Artefact, includes project nature, type, cost, and schedule—dimensions traditionally treated as fixed metrics in project management. However, in agile-based digital transformation, these artefacts function more fluidly as adaptive coordination mechanisms. Drawing on STS theory, their effectiveness is contingent not only on technical accuracy, but on their contextual integration within social systems and organizational processes [85,86].

Multiple studies affirm this dynamic interpretation. For instance, Gertzen et al. [23] frame artefacts like ROI, payback period, and project cost as evolving indicators that reflect digital maturity and strategic shifts, rather than static baselines. Guinan et al. [66] emphasize how funding pitches and cost projections adapt over time, highlighting the iterative nature of project artefacts in entrepreneurial settings. Similarly, Li et al. [69] demonstrate how budgeting and resource allocation are shaped by environmental uncertainty and external opportunity structures, showing artefacts as tools for ongoing sense-making. Baier et al. [53] stress the role of goal clarity and project monitoring, not as rigid control points, but as elements within feedback-driven agile processes.

These perspectives support our theoretical stance that project artefacts are not standalone technical deliverables but socio-technical instruments—constantly reinterpreted through interaction with stakeholders, evolving technologies, and institutional dynamics. From a managerial standpoint, this implies a shift from compliance-oriented control to adaptive project governance. Managers should promote flexible review cycles, enable transparent communication about evolving constraints, and support project leaders in reframing artefacts in response to strategic realignment. Ultimately, when treated as living instruments embedded in a broader system, project artefacts can serve as critical enablers of agile transformation and organizational adaptability.

6. Conclusions

This study examined the CSFs for agile-based DT, addressing a significant research gap concerning the intersection between organizational agility and digital innovation. By systematically reviewing 17 empirical and conceptual studies and adapting Chow and Cao's [61] framework, we identified five overarching CSF dimensions—organizational, people, process, technical, and project-related—comprising 14 specific sub-factors, including management commitment, team capability, and digital solution delivery strategy. These factors were evaluated using a Delphi-informed AHP, which engaged expert participants to assess their relative importance.

The results reveal a clear prioritization: organizational and people-related factors—particularly management commitment, team capability, and organizational environment—are perceived as significantly more influential than technical or project-specific dimensions. This finding aligns with STS theory, which posits that technological change must be embedded within supportive social and organizational structures to achieve sustainable transformation. Our prioritization thus reinforces the view that digital transformation success depends not solely on tools and technologies, but on leadership, cultural readiness, and human capability.

Based on these findings, we proposed a conceptual framework comprising three interdependent layers: organizational readiness, agile delivery, and project artefacts. The outer layer encompasses foundational enablers, such as leadership engagement, cultural fit, and team capacity. The middle layer captures agile delivery mechanisms, including collaborative team environments, adaptive planning, and digital execution strategies. The innermost layer comprises conventional project elements, such as cost, schedule, and

project type. This layered model reflects the systemic interdependencies emphasized in STS theory, highlighting how outer organizational structures condition the effectiveness of inner technical and procedural processes.

This study offers significant contributions to both theory and practice in the domain of agile-based DT. Theoretically, it fills a critical gap by systematically identifying and prioritizing CSFs. While prior research has acknowledged the multidimensional nature of DT, existing studies often treat CSFs as isolated or sector-specific. Our study advances this discourse by synthesizing these factors into a unified, empirically validated, and theoretically grounded framework, comprising three interrelated layers: organizational readiness, agile delivery, and project artefacts. This layered model operationalizes STS theory in a digital transformation context, illustrating how social, procedural, and technical elements interact dynamically. In doing so, it bridges fragmented literatures, across agile project management, digital innovation, and organizational change.

Practically, the framework offers transformation leaders a strategic diagnostic tool. The prioritization results highlight the dominant influence of leadership commitment, cultural adaptability, and team capability—suggesting that agile transformation requires more than technical readiness; it demands deeply embedded organizational support. The middle layer, focusing on agile delivery mechanisms such as adaptive governance and stakeholder alignment, offers actionable guidance for managing operational complexity. Furthermore, by reframing traditional project artefacts (e.g., cost, scope, and schedule) as flexible coordination tools, rather than static benchmarks, the study encourages adaptive project governance, suited to volatile environments. Collectively, the findings can help organizations assess their transformation readiness, allocate resources effectively, and steer digital change with greater agility and systemic awareness.

Despite the contributions of this study, several limitations should be acknowledged. First, although the literature reviewed covers a broad spectrum of organizational contexts—including public and private sectors, as well as manufacturing and service-based organizations—the study did not conduct a comparative analysis across these domains. This inclusive scope was intended to identify generalizable success factors applicable across digital transformation settings. However, it limited the ability to examine sector-specific variations in how critical success factors interact. Future research should explore these differences by adopting comparative or sector-focused designs.

Second, while the use of expert judgement through the Delphi method added rigor, the relatively small panel size may affect the generalizability of the results. Expanding the expert pool across diverse industries, roles, and regions could improve the robustness of the prioritization framework.

Finally, the current study is cross-sectional and relies on expert perception, rather than longitudinal evidence. Future research should consider longitudinal or mixed-method approaches, to examine causal relationships among CSFs and evaluate the framework's applicability over time and in evolving organizational environments.

In summary, this study offers a theoretically grounded and practically relevant model for understanding and managing agile-based digital transformation, serving both as a foundation for future academic inquiry and a strategic guide for practitioners navigating complex transformation landscapes.

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Abbreviations

The following abbreviations are used in this manuscript:

DT	Digital transformation
CSFs	Critical success factors
AHP	Analytic hierarchy process
STS	Socio-technical systems
APM	Agile project management
TPM	Traditional project management
CI	Consistency index
CR	Consistency ratio
LW	Local weights

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