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Reconceptualizing digital culture as a higher-order capability for digital transformation: insights from innovation ecosystem actors

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Abstract

Purpose – This study explores how digital culture is defined, understood and enacted within innovation ecosystems, positioning it as a higher-order organizational capability that enables digital transformation. We argue that digital culture extends beyond mere technological adoption and depends on key characteristics such as collaboration, servant leadership and inclusivity to flourish.

Design/methodology/approach – The research was conducted in two phases. First, a systematic literature review examined how existing scholarship conceptualizes digital culture. Guided by Schein's organizational culture model, we classified digital culture characteristics across three layers, underlying assumptions, espoused values and artefacts, to develop an initial model of digital culture. In the second phase, 33 semi-structured interviews were conducted with key actors within a Brazilian innovation ecosystem. Thematic analysis was applied to examine how digital culture is perceived, experienced and practiced in this context.

Findings – The study reveals that digital culture is characterized by shared assumptions about openness to change, values emphasizing collaboration and inclusion, and artefacts such as agile practices and digital collaboration tools. The resulting framework integrates conceptual and lived perspectives, highlighting how digital culture operates as a higher-order enabler of innovation ecosystem functioning.

Originality/value – This study advances theory by combining organizational capability theory with Schein's culture model to position digital culture as a higher-order capability. By integrating literature-based and empirical insights, we offer a comprehensive framework for understanding digital culture. Practically, the study provides actionable guidance for leaders aiming to cultivate inclusive, collaborative and servant-led approaches to digital transformation in complex, networked organizational settings.

Keywords Digital culture, Innovation ecosystem, Organizational culture, Organizational capability theory, Dynamic capability

Paper type Research article

Introduction

Technology adoption alone is insufficient; organizations must reshape their culture to enable new ways of thinking and working (Forsythe and Rafoth, 2022). Without a strong digital culture, organizations often struggle with fragmented communication, low trust in new systems, and limited willingness to experiment or share knowledge. These consequences weaken the ability to sense new opportunities, respond quickly to changes, and redesign processes in meaningful ways (Proksch *et al*., 2024). Understanding digital culture is therefore

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essential for achieving sustainable transformation. However, research on digital culture provides limited insight into how it forms, evolves, and influences performance (Grover *et al.*, 2022). Without this understanding, organizations lack the cultural foundation required to build transformation capabilities that can sustain. Although several models of digital culture have been proposed, no comprehensive framework has yet been widely accepted (Firican, 2023). In addition, in existing studies, digital culture is often treated as one organizational capability among many, rather than as a central enabling force. For example, Konopik *et al.* (2021) identify organizational capabilities as key to implementing digital transformation successfully and group them into seven themes within a dynamic capability framework, but culture remains positioned as just one capability in this set. Yet, research highlights that culture is not merely one element alongside others but a factor that shapes the success or failure of organizational change efforts (Burnes and Jackson, 2011). This suggests that culture deserves a more prominent conceptual status, as a capability that enables and strengthens other transformation capabilities.

In this study, we suggest that viewing digital culture through the lens of higher-order capabilities helps to explain its strategic importance. Capabilities are firm-specific, non-transferable resources that enhance the value of organizational assets and are developed internally rather than acquired externally (Makadok, 2001). Higher-order capabilities elevate and reconfigure basic operational capabilities, enabling organizations to adapt to competitive and technological changes (Chapman and Wieder, 2015; Teece *et al.*, 1997). They include the abilities to sense, seize, and reconfigure opportunities, supporting the creation of new routines and investment in both technological and human resources (Froehlich *et al.*, 2025).

Rather than positioning digital culture as a discrete capability, this perspective treats it as a foundational mechanism that shapes how other capabilities are developed and enacted. While existing digital culture models primarily describe cultural attributes, values, or practices that support digital initiatives, they generally position culture as one organizational capability operating alongside others. In contrast, the framework proposed in this study conceptualizes digital culture as a higher-order dynamic capability that enables, integrates, and reconfigures lower-level operational and digital capabilities. This conceptual shift places digital culture at the center of transformation processes, rather than treating it as a supportive background condition. By making this distinction explicit, the study advances current digital culture research and provides a clearer theoretical explanation of why culture plays a decisive role in digital transformation outcomes.

This study adopts a phenomenological and inductive approach to exploring digital culture as a higher-order capability that impacts zero-order capabilities. To frame our study, we draw on the Triple Helix model, which highlights the key roles of universities, industry, and government in driving innovation (Etzkowitz *et al.*, 2007). These three actors form the backbone of many innovation ecosystems, especially in digital and knowledge-based economies. Each brings unique resources, goals, and perspectives that influence how digital culture is formed and practiced. In this study, we explore how these main actors see digital culture within an innovation ecosystem.

We conducted a two-phase study. First, we performed a literature review and used Schein's organizational culture model to group digital culture into three levels: underlying assumptions, espoused values, and visible artefacts. Next, we conducted 33 interviews in Campina Grande Innovation Ecosystem in Brazil, involving key actors from the Triple Helix. Through thematic analysis, we developed a revised model that reflects how digital culture is experienced and shaped in practice based on the main actors of innovation ecosystem.

This paper seeks to answer two central research questions:

RQ1. What are the characteristics of digital culture?

RQ2. How does digital culture as a higher-level capability support digital transformation within innovation ecosystems?

Literature review

Organizational culture and digital transformation

Organizational culture refers to shared norms, values, basic assumptions, and beliefs created by group members to address adaptation and integration challenges (Schein, 2010). Organizational culture contains the underlying assumptions of an organization that are deeply embedded in the organizational structure and reinforce principles and observable characteristics of an organization (Kaur Bagga *et al.*, 2023). It plays a crucial role in addressing internal integration challenges and external adaptation (Brahm and Poblete, 2024). A strong culture boosts employee commitment, alignment of purpose, and shared action (Graham *et al.*, 2022). Leaders can influence organizational culture through beliefs and prosocial values, both of which shape employee behavior and performance outcomes (Brahm and Poblete, 2024). A positive culture enhances engagement, motivation, and commitment, contributing to productivity and organizational effectiveness (Hogan and Coote, 2014). Organizations with flexible and adaptive cultures are more capable of navigating change, whereas rigid cultures may resist transformation and constrain innovation (Cameron and Quinn, 2006).

Digital transformation has intensified the importance of organizational culture. Despite substantial investments in digital technologies, many organizations fail to achieve expected transformation outcomes because cultural barriers remain unresolved (Grover *et al.*, 2022). Digital transformation represents a sociotechnical shift that combines digitization and digitalization, reshaping processes, business models, and ways of working (Saarikko *et al.*, 2020). When organizations do not develop a supportive culture, they often experience resistance to change, slow technology adoption, misalignment between strategy and practice, and weakened collaboration across units (Martínez-Caro *et al.*, 2020). As a result, cultural change is widely recognized as central to sustaining digital transformation outcomes (Ruel *et al.*, 2021).

Research on organizational culture has largely been informed by two theoretical perspectives: functionalism and structuralism. The functionalist perspective views culture as a system composed of identifiable elements, such as norms, values, assumptions, and rituals, whose relationships can be examined through cause-and-effect mechanisms (Allaire and Firsirotu, 1984; Leal-Rodríguez *et al.*, 2023). Prominent models grounded in this approach include Hofstede's cultural dimensions, Cameron and Quinn's competing values framework, and Schein's cultural model. From this perspective, cultural change is often driven by external pressures, including the introduction of new technologies (Saputra and Hindriari, 2021). However, critics argue that functionalism may oversimplify the complexity and evolving nature of organizational culture (Lauring *et al.*, 2018).

The structuralist perspective conceptualizes culture as a social subsystem embedded within a broader institutional environment (Allaire and Firsirotu, 1984). This perspective emphasizes the permeability of cultural boundaries and the role of internal tensions, power relations, and competing logics in driving cultural change (Leal-Rodríguez *et al.*, 2023). Although these perspectives differ in emphasis, both recognize that organizational culture strongly shapes behavior. Consequently, culture is widely viewed as a primary mechanism through which organizations attempt to influence transformation processes.

Digital culture: concept and models

Digital culture has emerged as a distinct concept within the organizational culture literature. It is commonly defined as a set of values, practices, and expectations shaping how individuals interact with digital technologies (Deuze, 2006). Within organizational contexts, digital culture reflects beliefs and norms associated with technology use and the extent to which firms embrace digital tools (Hautala-Kankaanpää, 2022). Prior studies link digital culture to the development of digital vision, digital thinking, and employee initiative, which support technology integration and knowledge sharing (Wang *et al.*, 2022, 2023, 2025).

Research identifies participation, collaboration, and a digital-first mindset as key characteristics of digital culture (Deuze, 2006; Firican, 2023). A strong digital culture supports organizational inventiveness and innovation outcomes (Duerr *et al*., 2018), encourages agile and flexible work practices, and promotes experimentation and learning (Proksch *et al*., 2024). These cultural attributes influence how digital processes are designed and implemented (El Sawy *et al*., 2016).

Despite growing scholarly interest, research on digital culture remains conceptually underdeveloped and theoretically fragmented (Grover *et al*., 2022). Much of the existing literature treats digital culture as a relatively static set of values or practices, overlooking how it emerges, evolves, and is reconfigured over time. This static framing is problematic because it obscures the role of digital culture as an enabling and coordinating force that shapes how organizations sense opportunities, experiment with technologies, and recombine resources during digital transformation. Rather than examining digital culture as generative of transformation capabilities, many studies position it as one organizational capability among others, thereby underestimating its foundational role in influencing how other capabilities are enacted and aligned. For example, Konopik *et al*. (2021) include culture within a broader capability bundle without explaining how it actively guides or constrains organizational action. In addition, the predominance of single-organization studies limits understanding of how digital culture develops and operates across inter-organizational contexts, where shared norms, practices, and expectations increasingly shape digital transformation efforts.

To examine the characteristics of digital culture, scholars frequently draw on Schein's (2010) three-layer model, which distinguishes artefacts, espoused values, and underlying assumptions. Duerr *et al*. (2018) apply this model by linking artefacts to technology adoption, values to digital alignment and knowledge sharing, and underlying assumptions to employee empowerment. Building on this work, the present study adopts Schein's framework to identify the artefacts, values, and assumptions that shape digital culture within innovation ecosystems.

Innovation ecosystems and digital culture

Innovation ecosystems are collaborative networks that support knowledge creation, technology development, and value co-creation among diverse actors, including universities, industry, and government (Smorodinskaya *et al*., 2017). These ecosystems play an increasingly important role in addressing regulatory, ethical, and societal challenges associated with digital transformation (Stahl, 2022). Unlike traditional innovation systems, innovation ecosystems emphasize dynamic interaction and co-evolution across organizational and sectoral boundaries (Cai, 2022).

The Triple Helix model provides a widely used framework for understanding these dynamics by highlighting the interactions among universities, industry, and government (Etzkowitz and Leydesdorff, 2000). Extensions of the model, including the quadruple and quintuple helix frameworks, incorporate civil society and environmental concerns (Carayannis and Campbell, 2021; Cloitre *et al*., 2023). To address debates around analytical clarity, Cai (2022) proposed the neo-Triple Helix model, which retains the core triadic structure while integrating broader system-level influences. This model conceptualizes innovation ecosystems as multi-layered systems shaped by institutional interactions, societal structures, and environmental conditions.

Digital culture plays a central role in these ecosystems, yet its development is challenging because participating actors operate under different institutional logics, goals, and communication styles. Prior research shows that universities, industry, and government follow distinct norms regarding risk, pace, openness, and accountability (Etzkowitz, 2003; Heaton *et al*., 2019). More recent studies emphasize the importance of addressing institutional barriers, enabling knowledge exchange, and coordinating organizational change across actors to support digital transformation (Patrício and Ferreira, 2024). Together, this research suggests that digital culture within innovation ecosystems cannot be understood solely at the

organizational level but must be examined as a dynamic capability shaped through ongoing inter-organizational interaction.

Method

This study employed a two-phase qualitative research design to support its exploratory and theory-building aims. In the first phase, we conducted a literature review to map the characteristics of digital culture using Schein's (2010) three-layer model. This phase established the theoretical foundations of the study and enabled the development of an initial conceptual framework to guide empirical inquiry. In the second phase, we conducted semi-structured interviews within a Brazilian innovation ecosystem to examine how digital culture is experienced in practice by three main actor groups. Insights from the literature review informed the interview guide, ensuring that the empirical analysis was theoretically grounded while remaining open to issues not captured in prior research. The study was reviewed by the university ethics committee and received formal approval. Each phase is outlined below.

Study 1- literature review

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Moher *et al*., 2015) and adopted a three-step review process of data collection, analysis, and synthesis (Hanelt *et al*., 2021). Three initial inclusion criteria were applied: (1) the article must be published in a peer-reviewed academic journal, (2) written in English, (3) available in full-text. To ensure comprehensive coverage, we first conducted a broad search in Scopus, targeting the term "digital culture" in article titles, keywords, and abstracts without restricting the publication date, resulting in 613 articles, with the earliest published in 2005. In the second step, abstracts and discussion sections in the articles were screened using two exclusion criteria: (1) whether digital culture was a substantive focus rather than a brief mention, and (2) whether digital culture was discussed in a workplace context rather than in relation to society at large.

As Table 1 shows, from the 613 abstracts screened, we identified 42 articles in which "digital culture" was one of the main concepts in the article and the context was organizational setting. Among 42 articles 23 articles focus on digital culture as a core concept, meaning the authors explicitly defined, theorized, or systematically examined the concept and its characteristics. These articles are marked by (*) on the reference list as we cited them throughout the paper. In the remaining articles, digital culture was a borderline, where these studies discussed digital culture as an important element of their analysis but did not primarily set out to conceptualize or define it. For example, core studies included work that positioned digital culture as a "new kind of culture" emerging from the information age, conceptualized "digital affect cultures" as relational and globally emergent spaces, and analyzed the emergence of digital culture from the development of new ICTs. In contrast, borderline examples included research on how one-to-one laptop programs altered schools' digital culture, the role of digital culture in heritage innovation through participatory design, and consumer co-creation of digital culture products. Finally, although the remaining 571 papers contained the term "digital culture", they primarily addressed other topics such as cultural topics on social media, metaverse development, cancel culture on social platforms, or professional practices in psychology, where digital culture was mentioned only as contextual background rather than the main subject of conceptual investigation.

Study 2: qualitative interviews

In the second phase, we adopted an exploratory design and conducted 33 semi-structured interviews with professionals working within a Brazilian innovation ecosystem in 2025. The aim was to explore how digital culture is defined, perceived, and which zero-level capabilities were impacted by digital culture. Participants were selected through purposive sampling to

Table 1. Participants' information

Code	Gender	Sector	Education	Position (role within their organization)
P1	Male	Industry	PhD	Innovation and Business Intelligence President
P2	Female	Industry	Bachelor	Owner and Manager of a Family Business
P3	Female	Government	MBA	Technology Incubator Coordinator
P4	Male	Industry	Bachelor	Electrical Maintenance Manager, Textile Industry
P5	Male	Industry	MBA	Founder and Director, Software Company
P6	Male	University	PhD	Lecturer (Entrepreneurship and Innovation)
P7	Female	University	PhD	University Technology Incubator
P8	Female	Industry	Bachelor	Entrepreneur/Business Owner
P9	Male	University	PhD	Lecturer
P10	Female	Government	N/A	Innovation Manager
P11	Male	Industry	Bachelor	Supervisor
P12	Male	Industry	MBA	Founder and director of a software company
P13	Female	University	MBA	Lecturer (Innovation and Entrepreneurship)
P14	Male	Industry	Bachelor	Owner, Consulting Firm (Accounting Services)
P15	Male	Government	N/A	Data Analysis Coordinator
P16	Female	Industry	PhD	Business and Innovation Consultant and Founder
P17	Female	Government	MBA	Innovation Program Coordinator
P18	Male	Industry	PhD	Co-founder, Startup
P19	Male	Industry	Bachelor	Serial Entrepreneur; Founder of Multiple Startups
P20	Male	University	PhD	Professor and Director
P21	Female	Industry	N/A	Startup Founder
P22	Male	Industry	MBA	Startup Founder
P23	Female	Industry	Bachelor	Startup Founder
P24	Female	University	PhD	Professor and Director
P25	Male	Industry	MBA	Angel Investor and Entrepreneur
P26	Male	Government	PhD	Officer- Intellectual Property Agency
P27	Female	University	PhD	Lead Researcher in Innovation and Startups
P28	Female	Government	PhD	Director
P29	Female	Industry	MBA	Innovation and Startup Ecosystem Consultant
P30	Female	University	MBA	Innovation Specialist
P31	Female	Government	MBA	Innovation Project Officer
P32	Female	Government	MBA	Technical Analyst
P33	Female	Government	MBA	Business Consultant and Corporate Support Specialist

ensure a diverse range of experiences across sectors and roles. Based on Triple Helix model of innovation (Etzkowitz and Leydesdorff, 2000), we focused on three main stakeholders in an innovation ecosystem to collect data. The Triple Helix model of innovation emphasizes dynamic interactions between university, industry, and government to drive innovation ecosystems (Cai and Etzkowitz, 2021). This framework has evolved to integrate various social science concepts and perspectives from different fields (Cai and Etzkowitz, 2021). Thus, we selected participants from these three groups.

Interviews were conducted in Portuguese, the participants' native language, to ensure comfort, clarity, and cultural sensitivity. Each interview lasted between 30 and 60 min, was conducted online, and was audio- and video-recorded. The audio files were fully transcribed and de-identified before translation. We initially asked ChatGPT-4.0 to translate the transcripts from Portuguese to English. However, during the first checking process, a native Brazilian Portuguese-speaking researcher noticed that the AI sometimes used expressions or idioms common in European Portuguese rather than Brazilian Portuguese. This led to small differences in meaning and tone.

To address this, we revised our prompt to specify "Brazilian Portuguese". After this adjustment, the AI produced translations that matched the original language and context. Every translated transcript was then carefully reviewed by the native Brazilian Portuguese

researcher, who confirmed that the final translations were accurate, culturally appropriate, and faithful to what participants intended to say. While recent studies (e.g. Sahari *et al*., 2023; Woodrum, 2024) show that ChatGPT can deliver translations comparable to human translators, AI tools can still miss idioms, context-specific meanings, or informal expressions. By combining AI translation with careful native-language verification, we ensured that our translation process was accurate, transparent, and respectful of participants' original perspectives.

Analytical procedure

Interview transcripts were analyzed using thematic analysis, following the six-step approach outlined by Braun and Clarke (2006). Analysis was iterative and inductive, allowing themes to emerge from the data rather than being imposed *a priori*. All transcripts were imported into qualitative analysis software and examined through several interconnected stages.

First, the research team familiarized themselves with the data through repeated reading of the transcripts. Initial open coding was then conducted line by line to identify meaningful units of text related to definitions of digital culture, shared values, norms, practices, and capability-related behaviors. At this stage, codes were kept close to participants' language to limit premature theoretical abstraction.

Second, using constant comparative techniques (Glaser and Strauss, 1999), similar first-order codes were grouped into second-order themes. These themes were iteratively reviewed and refined through analytical discussions, during which interpretive judgments were made to clarify conceptual boundaries, resolve overlaps, and ensure internal coherence among categories.

Finally, relationships among themes were examined through axial coding to identify broader patterns explaining how digital culture acts as a higher-order capability within innovation ecosystems (Strauss and Corbin, 1998). In this stage, selective coding was used to integrate second-order themes into higher-level aggregate dimensions that captured the core structure of the findings (Gioia *et al*., 2013). Throughout the analytical process, reflexive memo-writing was employed to document evolving interpretations, theoretical insights, and key analytical decisions, creating a transparent audit trail of theme development (Richards and Hemphill, 2018).

To ensure the trustworthiness of the analysis, we adopted the quality criteria proposed by Lincoln and Guba (1985), focusing on credibility, dependability, confirmability, and transferability. Credibility was enhanced by randomly selecting five transcripts and inviting an experienced qualitative researcher external to the research team to independently code them. The resulting coding was compared with the research team's analysis to cross-check interpretations and identify discrepancies. Differences were discussed in depth until consensus was reached.

Dependability and confirmability were supported through the maintenance of a detailed audit trail documenting coding decisions, theme refinement, and interpretive choices across analytical stages. Transferability was strengthened by providing rich contextual descriptions of participants and organizational settings. Together, these procedures, combined with ongoing reflexive engagement and regular analytical discussions, enhanced the rigor, transparency, and reproducibility of the qualitative analysis (Nowell *et al*., 2017).

Research setting

Campina Grande Innovation Ecosystem (E.InovCG) is a collaboration between various actors, including academic institutions, companies, government agencies, and the community, aimed at promoting innovation, entrepreneurship, and sustainable development within the State of Paraiba, Brazil. Officially established in 2021, the ecosystem emerged in recognition of Campina Grande's long-standing reputation as a center of excellence in technology and science in the Northeast of Brazil. This reputation is based on the presence of renowned

educations, along with cutting-edge laboratories and innovative companies. Currently, the ecosystem includes over 150 organizations across various categories such as incubators, accelerators, technology parks, innovation spaces, universities, government entities, startups, tech-based companies, creative hubs, and innovation support networks.

This diversity and integration enable the ecosystem to function as a hybrid platform, offering both face-to-face and online activities focused on establishing strategic connections, providing training programs, promoting innovation challenges, facilitating contact with investors, encouraging applied research, and strengthening the entrepreneurial community.

Its significance for Campina Grande is remarkable, positioning the city as a dynamic, connected, and resilient innovation hub with economic, social, and cultural impacts. By aligning scattered efforts into joint initiatives, the ecosystem fosters the creation of new companies, attracts investments, develops talent, and proposes original solutions to local and urban challenges. As such, the ecosystem plays a central role in shaping the city's future, reinforcing Campina Grande's position as a national reference in innovation, technology, and creativity.

Participants

In total, 33 people participated in the interviews. Among those, most held a university degree, and 17 interviewees were female. As explained before, our empirical work was informed by the Triple Helix model, ensuring representation from all three key stakeholder groups, including industry, government, and academia. Our sample included 16 participants from industry in managerial or entrepreneurial positions, 9 participants from the government sector, and 8 participants from universities, as shown in Table 1. The participants also represented a wide range of educational backgrounds, including PhD (11), MBA (11), and bachelor's degrees (7). Their professional roles were equally diverse, ranging from professors, directors, and government coordinators to startup founders, entrepreneurs, and consultants. This diversity provides a comprehensive basis for understanding how digital culture is understood across different sectors and organizational contexts.

Findings

Results – study 1

We analyzed the full texts of the identified studies in detail to extract definitions and characteristics of digital culture. Guided by Schein's (2010) model of organizational culture, these characteristics were organized into three analytical layers: artifacts, espoused values, and underlying assumptions. Table 2 summarizes the themes identified across the reviewed literature and their sources.

Artifacts

The literature revealed three dominant characteristics representing the visible manifestations of digital culture: flexibility, digital connectivity, and individuality within teamwork. Flexibility was frequently described as an organization's capacity to respond rapidly to environmental change, technological developments, and evolving customer expectations (Kafetzopoulos and Katou, 2024). Across the reviewed studies, flexibility appeared in the form of accelerated decision-making processes, continuous experimentation, and the rapid deployment of digital tools. Several articles illustrated this characteristic through organizational examples, such as Amazon's ability to expand into diverse technological domains, including cloud computing, digital platforms, and hardware development (Snyder *et al.*, 2022). These examples were commonly used in the literature to demonstrate how flexibility becomes visible through organizational structures and routines rather than formal policies alone.

Table 2. The layers of digital culture

Cultural layers	Themes	Sources
Artefacts	Flexibility	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Mihu *et al.* (2023), Hautala-Kankaanpää (2022), Alrasheedi *et al.* (2022), Busco *et al.* (2023), Rahman *et al.* (2025), Cardoso *et al.* (2024)
	Individuality- teamwork (collaboration)	Leal-Rodríguez *et al.* (2023), Alrasheedi *et al.* (2022), Coello-Montecel *et al.* (2025), Rahman *et al.* (2025)
	Digital connectivity	Leal-Rodríguez *et al.* (2023), Wang *et al.* (2022, 2025), Rahman *et al.* (2025)
Espoused values	Customer-centric	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Alrasheedi *et al.* (2022), Mollah *et al.* (2024), Cardoso *et al.* (2024)
	Data-driven decision making	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Proksch *et al.* (2024), Çetinkaya and Sürücü (2025)
	Continuous learning	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Fahmi *et al.* (2023), Alrasheedi *et al.* (2022), Luthra *et al.* (2025), Cardoso *et al.* (2024)
	Innovation	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Wang *et al.* (2022), Mollah *et al.* (2024), Busco *et al.* (2023), Wang *et al.* (2025), Cardoso *et al.* (2024)
	Risk-taking	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Fahmi *et al.* (2023), Alrasheedi *et al.* (2022), Wang *et al.* (2023), Shin *et al.* (2023), Busco *et al.* (2023)
Underlying assumption	Placing trust in open communication and transparency	Grover *et al.* (2022), Leal-Rodríguez *et al.* (2023), Hautala-Kankaanpää (2022), Held *et al.* (2026)
	Believing that embracing emerging technologies can lead to competitive advantages	Grover *et al.* (2022), Hautala-Kankaanpää (2022), Pradana *et al.* (2022), Çetinkaya and Sürücü (2025), Mollah *et al.* (2024)
	Agile methodologies	Leal-Rodríguez *et al.* (2023), Fahmi *et al.* (2023), Hautala-Kankaanpää (2022), Guy (2019), Held *et al.* (2026)

Digital connectivity emerged as the second artifact of digital culture. This characteristic reflects the widespread use of digital infrastructures designed to facilitate ongoing interaction among employees, teams, and external stakeholders. Studies highlighted practices such as collaborative digital platforms, open communication systems, and virtual workspaces that enable continuous knowledge exchange. For example, Farivar and Richardson (2021) describe Schlumberger's internal communication platform as a mechanism for sustaining connectivity across geographically dispersed teams. Across the reviewed literature, digital connectivity was consistently associated with reduced communication barriers and increased cross-functional interaction.

The third artifact reflects a shift from a traditional separation between individual work and teamwork toward what the literature describes as individuality within teamwork. Prior research emphasizes that employees are encouraged to exercise autonomy, creativity, and initiative while simultaneously operating within collaborative environments (Coello-Montecel *et al.*, 2025). This pattern was often linked to practices that support empowerment, learning from failure, and psychological safety (Rahman *et al.*, 2025; Wang *et al.*, 2022). Rather than privileging either individualism or collectivism, the reviewed studies describe digital culture as accommodating both simultaneously.

Espoused values

At the second cultural level, the reviewed studies revealed four recurring espoused values: customer centricity, data-driven decision-making, continuous learning, and innovation and risk-taking. Customer-centricity was consistently identified as a guiding value shaping organizational priorities during digital transformation (Alrasheedi *et al*., 2022; Mollah *et al*., 2024). Studies described digital culture as emphasizing responsiveness to customer needs through digital channels, data analytics, and personalized services (Leal-Rodríguez *et al*., 2023). Data-driven decision-making was another prominent value, reflected in organizational emphasis on analytics, real-time information, and evidence-based management practices (Çetinkaya and Sürücü, 2025). Across studies, this value was associated with investment in analytical capabilities and efforts to embed data use into everyday decision-making processes.

Continuous learning and development were repeatedly highlighted as central values underpinning digital culture. Prior research emphasized skill development, knowledge sharing, and ongoing training as necessary responses to rapid technological change (Cardoso *et al*., 2024; Fahmi *et al*., 2023; Luthra *et al*., 2025). Learning was described not as a one-time activity but as an ongoing organizational expectation. Innovation and risk-taking emerged as the fourth value. Studies identified visible signals of this value in practices such as innovation labs, experimentation spaces, and reward systems recognizing exploratory initiatives (Busco *et al*., 2023; Shin *et al*., 2023).

Underlying assumptions

At the deepest level, three underlying assumptions were identified.

First, the literature reflects a shared assumption that open communication and transparency are necessary for effective digital transformation. These assumptions were linked to trust-building, collaboration, and employee engagement (Hautala-Kankaanpää, 2022; Held *et al*., 2026). Second, many studies reflect a belief that emerging technologies represent strategic assets rather than operational tools. This assumption was evident in discussions of organizational restructuring, investment priorities, and leadership attention toward digital initiatives (Pradana *et al*., 2022; Çetinkaya and Sürücü, 2025).

Third, agile methodologies appeared as an underlying assumption shaping how organizations approach transformation. Studies described agile practices as enabling iterative experimentation, cross-functional coordination, and responsiveness to change (Santos and de Carvalho, 2022; Gomes Silva *et al*., 2022).

Results – study 2

Thematic analysis of interview data revealed seven interrelated themes capturing how digital culture is experienced and enacted within the Brazilian innovation ecosystem. Table 3 presents the structure of first-order and second-order themes.

Participants consistently described digital culture as extending beyond technology adoption to encompass values, behaviors, leadership practices, and shared assumptions. The first theme, “technology as enablers, not drivers”, reflects participants’ accounts that digital tools were viewed as necessary infrastructure but insufficient on their own. Interviewees emphasized that technology acquired meaning only through how it was interpreted, applied, and aligned with organizational purpose.

The second theme, “emotional and ethical anchors”, emerged through participants’ repeated references to trust, care, wellbeing, and ethical responsibility. Respondents described these elements as shaping daily interactions, decision-making practices, and expectations surrounding digital initiatives. The third theme, “structural change”, captures participants’ descriptions of shifts in organizational form, including flatter hierarchies, decentralized authority, and increased interaction with external partners. These changes were often discussed in relation to speed, coordination, and collaboration.

Table 3. Thematic analysis results

Participants	First order themes	Second order themes	Meaning
P1, P6, P17, P18, P27	Technology enables but not defines digital culture	Technology as Enablers, Not Drivers	Tools are important, but secondary to purpose, relationships, and interpretation
P14, P17, P26	Systems require meaning making and readiness		
P25, P28, P29	Digital tools must be intentionally used		
P24, P28, P29	Emotional wellbeing and relational integrity	Emotional and Ethical Anchors	Emotional intelligence, ethical considerations, and human care are central to digital cultures
P20, P21, P30	Trust, care, and social responsibility		
P22, P23, P25	Purpose-driven transformation		
P1, P5, P7, P9, P14	Flattened hierarchies and decentralization	Structural Change	Digital culture reshapes how organizations are structured, shifting from static to agile, creates networked systems and in ternal ecosystems
P6, P10, P19, P30, P33	Internal and external ecosystem integration		
P3, P16, P27	Shift from process-driven to value-driven models		
P6, P13, P26	Education and community partnerships		
P1, P9, P19, P29	Openness and transparency	Values Reconfiguration	Traditional values (like stability or hierarchy) give way to agility, openness, risk-taking, and innovation
P1, P3, P5, P19	Innovation and agility as cultural norms		
P6, P16, P18, P30	Collaboration, trust, empathy		
P10, P15, P30	Emphasis on learning and continuous improvement		
P1, P5, P13, P15	Inclusive tools and platforms	Inclusion and Empowerment	Digital culture promotes accessibility, team equity, and voices from all levels
P6, P20, P21, P30	Human-first or equity-oriented lens		
P1, P5, P7, P9, P19	Flattening of hierarchies		
P21, P32, P31	Recognition of local identities and social justice		
P1, P3, P5, P8, P10	From control to facilitation	Leadership Transformation	Leadership becomes flatter, more participative, transparent, and supportive of innovation
P4, P6, P16, P20, P21, P29	Empowering and inclusive leadership		
P2, P8, P9, P28, P33	Strategic and visionary		
P6, P19, P28, P30	Ethical and values-based leadership		
P1, P2, P3, P17, P24, P25	Mindset over tools	Mindset Shift (Human-Centered and Strategic)	Digital culture is not just tools or digitization, it is a transformation of mindsets, attitudes, and leadership approaches
P2, P5, P30, P33	Strategic and behavioral transformation		
P6, P20, P28, P30	Ethically grounded transformation		
P14, P27, P32	Cultural and relational redefinition		

The fourth theme, "values reconfiguration", reflects participants' accounts of changing organizational norms. Interviewees contrasted traditional values such as control and stability with emerging emphases on openness, agility, experimentation, and learning.

The fifth theme, "inclusion and empowerment", highlights participants' emphasis on access, participation, and equity. Respondents discussed the role of digital tools in amplifying voices, enabling participation, and supporting shared ownership of transformation initiatives.

The sixth theme, "leadership transformation", captures changes in leadership practices, with participants describing a move away from command-and-control approaches toward facilitation, transparency, and support for innovation.

Finally, the seventh theme, "mindset shift", reflects participants' descriptions of deeper changes in attitudes and assumptions, including openness to uncertainty, continuous adaptation, and ethical awareness. These themes collectively describe recurring empirical patterns observed across interviews regarding how digital culture is enacted within innovation ecosystems.

At the final stage, we linked these themes with dynamic capability theory components as shown in Table 4.

Discussion

This study aimed to address two central research questions: (1) what the characteristics of digital culture are, and (2) how digital culture, as a higher-level capability, supports digital transformation within innovation ecosystems. By integrating insights from the literature with empirical evidence from the Brazilian innovation ecosystem, this study moves beyond descriptive accounts of digital practices to offer a theoretically grounded interpretation of digital culture as an organizational capability.

With respect to the first research question, the findings indicate that digital culture is inherently multi-dimensional and cannot be reduced to the adoption of digital tools or technical expertise alone. The literature review, guided by Schein's (2010) cultural model, demonstrates that digital culture operates simultaneously across artifacts, espoused values, and underlying assumptions. This perspective is consistent with Duerr *et al.*'s (2018) argument that visible practices such as digital workflows, agile methodologies, and communication technologies represent only one layer of culture, while deeper values and assumptions provide continuity and meaning. Interpreted together, these layers explain why similar digital initiatives can generate different outcomes across organizational contexts.

The empirical findings extend this conceptual foundation by showing how digital culture functions as an interconnected system rather than as isolated characteristics. Instead of

Table 4. Seven digital culture aspects within organizational capability theory dimensions

Second-order theme	Dynamic capability dimensions	Rationale
Technology as enablers, not drivers	Sensing	Identifying and interpreting tech opportunities
Structural change	Reconfiguring	Reshaping structures, systems, ecosystems
Emotional and ethical anchors	Seizing	Mobilizing resources around ethics and human values
Values reconfiguration	Sensing + Seizing	Interpreting cultural shifts and embedding them
Inclusion and Empowerment	Seizing	Leveraging inclusivity as a resource
Leadership Transformation	Reconfiguring	Redefining leadership roles for agility
Mindset Shift	Reconfiguring (with Sensing roots)	Deep transformation of values and assumptions

operating independently, cultural elements interact through shared meanings, leadership practices, and collective assumptions that shape organizational responses to digital change. This interpretation helps clarify why digital transformation cannot be sustained through surface-level interventions alone and requires alignment across multiple cultural layers.

The seven empirically identified themes provide insight into the internal logic through which digital culture operates. Interpreted theoretically, these themes highlight the central role of purpose, values, and social relationships in shaping technology use. Rather than positioning digital tools as primary drivers of transformation, the findings suggest that meaning-making processes determine how technologies are enacted within organizations. This reinforces the view that digital culture is not technologically deterministic but socially constructed through ongoing interaction among individuals, structures, and institutional expectations.

This interpretation is consistent with prior studies emphasizing that cultural conditions shape digital innovation outcomes. Kiefer *et al*. (2021) argue that transparency, agility, and collaboration enable organizations to realize digital value, while Tagscherer and Carbon (2023) emphasize the importance of visionary leadership, empowered employees, flat hierarchies, and ecosystem partnerships. The present study extends these insights by demonstrating that ethical orientation, inclusion, and continuous adaptation are not supplementary attributes but central mechanisms through which digital culture sustains transformation.

The findings also align with Deuze's (2006) conceptualization of digital culture as an interconnected system of values and expectations. More recently, Cao *et al*. (2025) conceptualize digital transformation through a multidimensional transforming capability shaped by organizational culture. While our study differs in empirical context and analytical focus, it reinforces the core argument that culture plays a decisive role in transformation processes. Building on this foundation, the present study advances the literature by framing digital culture itself as a higher-order meta-capability within which multiple transformation-related capabilities are embedded. From this perspective, organizational culture and digital culture are not separate constructs; rather, digital culture represents the form organizational culture takes under conditions of pervasive digitalization.

Addressing the second research question, the findings support interpreting digital culture as a higher-order dynamic capability that enables transformation within innovation ecosystems. Drawing on organizational capability theory, digital culture shapes how organizations sense emerging opportunities, seize them through coordinated action, and reconfigure structures to remain adaptive over time (Teece, 2007). Importantly, these processes are not enabled solely by routines or resources, but by shared cultural orientations that guide interpretation, prioritization, and collective decision-making.

Interpreted through this lens, sensing involves not only recognizing technological developments but also interpreting shifts in social values and stakeholder expectations. Seizing is shaped by cultural commitments to ethics, inclusion, and participation, which influence how opportunities are evaluated and mobilized. Reconfiguring depends on the willingness to reshape leadership models, organizational structures, and collective mindsets in response to ongoing uncertainty. Together, these interpretations explain how digital culture enables continuous rather than episodic transformation.

This interpretation also provides support for Petković and Radičić's (2025) argument that digital technologies contribute to organizational performance only when managerial cultures evolve accordingly. Across all three stages of dynamic capability development, ethics and social responsibility emerge as cross-cutting foundations that stabilize transformation efforts and align them with broader societal expectations, as illustrated in Figure 1.

The ecosystem context further strengthens this interpretation. The Triple Helix model (Etzkowitz and Leydesdorff, 2000) highlights that innovation increasingly emerges through interaction among universities, industry, and government. Interpreted through this lens, digital culture operates not only within organizations but across ecosystem relationships. Shared values, governance mechanisms, and collaborative norms enable actors to coordinate sensing,

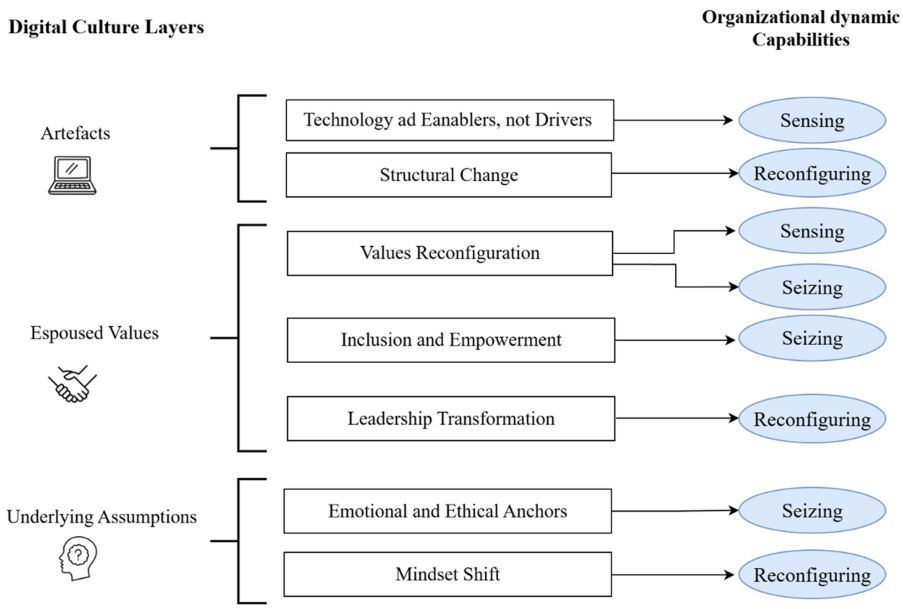

Figure 1. Digital culture as a higher-order capability. Source: Authors' own work

seizing, and reconfiguring activities beyond firm boundaries. This suggests that digital culture as a higher-order capability is co-constructed through partnership, co-creation, and collective learning rather than developed in isolation.

This perspective challenges views that conceptualize digital culture as a supporting or subordinate capability. In contrast to Ghosh *et al*. (2022), who suggest cultural transformation as one sub-capability among others, the findings indicate that digital culture integrates technological, human, and ethical dimensions in ways that enable organizations and ecosystems to adapt and innovate continuously. Culture, therefore, functions not merely as context but as a higher order capability shaping strategic decision-making, adaptability, and innovation (Leal-Rodríguez *et al*., 2023).

Finally, the distinction between digital culture and IT culture becomes theoretically important. As highlighted in the literature review, digital culture does not treat technologies as neutral tools but as resources whose value emerges through leadership practices, collaboration, and human-centered engagement (Grover *et al*., 2022). The empirical findings reinforce this distinction by demonstrating that digital culture is embedded in ethical leadership, collective mindsets, and ecosystem relationships. Together, these interpretations clarify why digital transformation depends less on technological sophistication and more on the cultural capability to integrate technology with purpose, values, and social responsibility.

Limitations and suggestions for future research

Despite its contributions, this study is subject to several limitations that provide fertile ground for future research. First, the empirical component draws on a single innovation ecosystem located in Brazil. Although the innovation-ecosystem literature argues that ecosystems tend to comprise structurally similar actor roles, such as knowledge producers, complementors, intermediaries, orchestrators, and regulators (e.g. Dedehayir *et al*., 2022), the ways these roles are enacted, interact, and co-evolve are shaped by institutional, cultural, and policy

environments. Our findings therefore reflect the dynamics of this ecosystem and may not fully capture how digital culture manifests in other national contexts. We acknowledge this boundary to transferability and encourage future comparative, cross-country work to examine how cultural norms, governance structures, and socio-economic conditions influence the development and enactment of digital culture. Such research would help identify which elements of digital culture are globally generalizable and which are locally contingent.

Second, the study relies on qualitative interviews, which provide deep insights into lived experiences but do not allow for statistical generalization. Future studies could build on our framework by developing and validating quantitative measures of digital culture as a higher-order capability, enabling large-scale hypothesis testing across industries and regions. Such an approach would also allow researchers to examine the causal relationships between cultural characteristics, dynamic capabilities, and digital transformation outcomes.

Finally, our thematic analysis identified seven interdependent dimensions of digital culture; however, the interactions among these dimensions were not explored in longitudinal terms. Because culture and dynamic capabilities evolve over time, future research should adopt longitudinal or process-based methodologies to explore how cultural values, leadership practices, and mindset changes unfold as organizations move through the sensing, seizing, and reconfiguring stages of digital transformation. These studies could clarify whether digital culture develops sequentially, cyclically, or through more complex patterns of co-evolution.

Theoretical contribution

From a theoretical perspective, the study positions digital culture as a higher-order dynamic capability that operates across the stages of sensing, seizing, and reconfiguring, while also being grounded in ethics and societal value creation. This perspective deepens our understanding of why digital transformation cannot be achieved by technology alone and explains why models of digital culture remain fragmented. The reason is, as an internally developed and context-specific capability, digital culture cannot be easily transferred or imitated but must be cultivated over time. While some scholars like Ellström *et al*. (2022) identify specific sensing, seizing, and reconfiguring routines that enable digital transformation within firms, our study extends their work in two important ways. First, instead of focusing only on organizational routines, we conceptualize digital culture itself as a higher-order dynamic capability that highlights and integrates these routines. For example, Ghosh *et al*.'s (2022) framework treats cultural transformation as one sub-capability, while our findings show that values such as inclusion, collaboration, openness, and ethical responsibility reinforce the effectiveness of sensing, seizing, and reconfiguring capabilities more broadly.

By examining cultural characteristics such as ethical leadership, inclusion, collaboration, and adaptive mindsets, we suggest that transformation is not only about structural or strategic routines but also about the cultural foundations that make such routines effective and sustainable. Second, whereas existing studies like Ellström *et al*. (2022) and Ghosh *et al*.'s (2022) draw on firm-level cases in a single industry, our research explores digital culture within a broader innovation ecosystem context using the Triple Helix perspective. By including universities, industry, and government actors, our study demonstrates that digital culture is co-created across organizational boundaries and anchored in shared values, thus extending dynamic capability theory from the intra-firm level to the inter-organizational ecosystem level. In doing so, we respond to calls for deeper empirical and conceptual insights into how dynamic capabilities for digital transformation are developed and enacted in practice.

Practical implications

Our findings have several practical implications for different groups involved in digital transformation, as summarized in Table 5. A central message of this study is that digital culture is not merely one element among many; rather, it functions as a higher-order capability that

Table 5. Practical implications

Stakeholder	Key implications based on findings
Managers	• Build digital culture before structural or technical changes • Align artefacts, values, and underlying assumptions with digital goals • Use technology as an enabler • Support collaboration, decentralization, and open communication • Promote inclusion, empowerment, and participative leadership • Develop mindsets focused on adaptability, ethics, and continuous learning • Reward collaboration, experimentation, and knowledge sharing • Model transparency and create safe spaces for new ideas
Policymakers and Ecosystem Leaders	• Create platforms for cross-sector collaboration • Support digital infrastructure that promotes transparency and data sharing • Invest in programs that build digital leadership and human-centered values • Offer fellowships and exchange programs across government, academia, and industry • Establish governance systems that embed fairness, accountability, and responsible digital practices
Educators and Training Institutions	• Develop programs that link technical skills with cultural and leadership skills • Teach openness, collaboration, and ethical digital decision-making • Encourage reflective thinking and teamwork • Partner with industry and government for practical learning opportunities • Prepare graduates to work across ecosystem boundaries

supports sensing, seizing, and reconfiguring activities across organizations and innovation ecosystems. Without establishing this cultural foundation, digital transformation risks becoming a short-term technical exercise that fails to generate sustained value.

Implications for managers

For managers, the findings indicate that shaping digital culture cannot be confined within organizational boundaries. In innovation ecosystems, managerial leadership increasingly involves coordinating across universities, industry partners, startups, and public agencies. Managers therefore need to focus not only on internal alignment but also on how cultural values are enacted through inter-organizational collaboration.

At the artefact level, managers should position digital technologies as shared enablers that facilitate coordination across partners. This includes adopting interoperable digital platforms, shared data standards, and collaborative tools that allow knowledge to flow between organizations rather than remaining siloed. Structures should support cross-organizational project teams, joint task forces, and co-creation spaces where participants from different institutions can work together.

At the values level, leaders play a critical role in modeling openness, inclusion, and participative leadership across organizational interfaces. This may involve engaging external partners in joint decision-making forums, inviting universities and public agencies into strategic discussions, and establishing transparent processes for sharing information, risks, and responsibilities. Open strategy practices become particularly important at the ecosystem level, as they enable diverse actors to align around shared transformation goals.

At the level of underlying assumptions, managers must reinforce shared beliefs that digital transformation is collective, ongoing, and ethically grounded. This includes recognizing that adaptability depends on trust among ecosystem partners, not only on internal compliance. Leaders can strengthen these assumptions by supporting cross-organizational learning

initiatives, encouraging experimentation across institutional boundaries, and creating psychologically safe environments where partners can share failures as well as successes.

Hiring, onboarding, and leadership development should therefore extend beyond firm-specific competencies. Managers should prioritize individuals who can work across institutional logics, communicating with diverse stakeholders, and balancing technological ambition with ethical responsibility. Performance systems should recognize collaboration, ecosystem contribution, and knowledge sharing alongside traditional organizational outcomes. Through these practices, managers help embed digital culture as a shared capability rather than an internal organizational attribute.

Implications for policymakers and ecosystem leaders

For policymakers and ecosystem leaders, the findings underscore that digital culture is shaped collectively by universities, industry, and government, and cannot be developed by any single actor in isolation. Leadership at this level involves orchestrating conditions that enable trust, alignment, and collaboration across institutional boundaries.

Policymakers can support ecosystem-level digital culture by creating formal platforms where actors jointly address shared challenges, such as digital infrastructure development, data governance, sustainability, and workforce transformation. These platforms should be supported by digital systems that promote transparency, interoperability, and responsible data sharing across sectors.

Beyond infrastructure investment, ecosystem leaders should prioritize initiatives that cultivate shared values and leadership capabilities. Examples include cross-sector leadership development programs that integrate digital strategy with ethics, inclusion, and public value creation, as well as fellowship and secondment schemes that allow professionals to rotate between universities, industry, and government. Such initiatives help build mutual understanding and reduce cultural fragmentation across the ecosystem.

Governance mechanisms also play a critical role. Policymakers can establish guidelines and regulatory frameworks that promote fairness, accountability, and responsible use of digital technologies. Clear rules regarding data protection, AI ethics, and public-private collaboration help reinforce trust among ecosystem participants and ensure that digital transformation remains aligned with societal goals rather than narrow organizational interests.

Implications for educators and training institutions

Educators and training institutions play a foundational role in developing the capabilities required for ecosystem-level digital transformation. The findings suggest that future leaders must be equipped not only with technical skills but also with the cultural competencies needed to operate across organizational and institutional boundaries.

Educational programs should therefore integrate digital skills training with learning focused on openness, collaboration, ethical decision-making, and participative leadership. Students should be exposed to the complexities of working within innovation ecosystems, including differing incentives, governance structures, and institutional logics across universities, industry, and government.

Experiential learning is particularly important in this regard. Partnerships with industry and public-sector organizations can provide students with opportunities to engage in joint projects, innovation labs, and cross-sector challenges where they practice collaboration, negotiation, and shared problem-solving. Executive education programs can similarly support current leaders by focusing on ecosystem orchestration, boundary-spanning leadership, and ethical governance of digital transformation. Through these efforts, educators and training institutions contribute to building a pipeline of leaders capable of sustaining digital culture not only within organizations but across the interconnected systems in which digital transformation increasingly takes place.

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