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Research Article

Digital Ecosystem Architecture as a Leadership Competency: Redesigning Organizational Futures Through the VFC Competence Framework

Mustafa Mohamed Adelmohiman[1], Abdullah Hussein Salem[1], Yasser Nasr Eldin[1], Wael Ahmed Abdalla[2, *]

[1]Business Wheel Academy, Cairo, Egypt

[2]Faculty of Arts, Sohag University, Sohag, Egypt

Abstract

As value creation increasingly shifts toward networked digital ecosystems, leadership must evolve from managing internal organizational transformation to designing collaborative, ethical, and adaptive digital environments. This paper conceptualizes Digital Ecosystem Architecture (DEA) as a meta-competence within the Visionary Management dimension of the VFC Competence Framework. DEA is defined as the capacity to conceive, govern, and expand digital ecosystems, grounded in three interrelated pillars: Strategic Ecosystem Thinking, Orchestrative Governance, and Value-Based Digital Architecture. Through thematic synthesis and an illustrative case study of the MENA-region platform Careem, the paper introduces the Ecosystem Leadership Competency Model (ELCM) and outlines developmental pathways across four progressive stages, guided by a KSAH (Knowledge, Skills, Attitudes, and Habits) framework. Findings demonstrate that DEA enables leaders to engage in systemic foresight, promote inclusive governance, and design ethically sound digital infrastructures. The study contributes to digital leadership theory by providing an evidence-informed model for cultivating digitally competent leaders, with particular relevance to emerging markets and platform-fragmented economies.

Keywords

Digital Ecosystem Architecture, Visionary Leadership, Platform Governance, KSAH Competency Framework, Ecosystem Thinking

1. Introduction

The digital era has shifted value creation from organization-centric operations to ecosystem-based digital infrastructures, transforming leadership from internal direction to orchestrating complex, adaptive digital environments [8, 14]. These ecosystems, involving public institutions, private platforms, developers, and users, necessitate a new leadership approach that integrates systems thinking, governance, and ethical design.

This paper introduces Digital Ecosystem Architecture (DEA) as a crucial future-facing leadership competency, defined as the ability to strategically design, govern, and sustain adaptive, inclusive, and values-driven digital ecosystems.

*Corresponding author: waelahmed@art.sohag.edu.eg (Wael Ahmed Abdalla)

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DEA is built upon three core capabilities: Strategic Ecosystem Thinking, Orchestrative Governance, and Value-Based Digital Architecture.

Traditional leadership models are insufficient for the decentralized, cross-sectoral, and rapidly evolving nature of digital ecosystems. Existing competencies like digital literacy or innovation management fail to address the complexities of cross-regulatory coordination, interoperable infrastructure design, and real-time ethical safeguards. The lack of frameworks for the architectural role of leadership in multi-actor platforms has led to fragmented governance, regulatory friction, and models that can exploit actors in emerging economies [13, 16].

To address this gap, the paper aims to conceptualize DEA as a structured leadership competency within the Visionary Management Dimension, introduce the Ecosystem Leadership Competency Model (ELCM) supported by theory and case insights, demonstrate this model using the Careem case in the MENA region, and propose a developmental KSAH matrix for practical application and leadership development.

2. Methodology

This research utilizes a theory-building, case-informed qualitative methodology to conceptualize Digital Ecosystem Architecture (DEA) as a key leadership competency within the Visionary Management Dimension of the VFC Competence Framework. This approach strategically combines conceptual synthesis with evidence-based case illustration to develop a structured, scalable, and contextually relevant competency model. The research design is rooted in qualitative theory development, specifically employing conceptual modeling informed by thematic case synthesis, which is particularly suited for the emergent nature of DEA as a construct not yet well-defined in mainstream leadership or digital transformation literature. Following the principles of theory building from case studies as outlined by Eisenhardt and Graebner [6], the paper inductively generates a novel leadership competency framework applicable to digital ecosystem contexts by drawing upon existing theoretical constructs like systems thinking, platform governance, and digital leadership.

This study analyzes secondary qualitative data from reports, academic literature, and platform governance documents, focusing on Careem (a MENA super-app) as a case study to demonstrate DEA's pillars: strategic foresight, orchestrative governance, and values-driven design. Supplementary insights came from LEGO's digital transformation, GCC smart city reports [5, 18], and regional policy frameworks. Data was triangulated from peer-reviewed articles, white papers, API guidelines, and leader interviews (e.g., Uber, Careem).

Methodology: Thematic synthesis mapped patterns to DEA pillars and KSAH (Knowledge, Skills, Attitudes, Habits) progression. Iterative analysis connected findings to Leadership, Management, and Business Scaling domains. As exploratory research, it provides a conceptual framework (not empirical results) for future validation via longitudinal studies and ecosystem mapping tools.

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3. Literature Review

3.1. Evolution of Digital Leadership

The leadership transformed in the digital era from one that operates on hierarchical power and physical presence to a fluid, virtual, relational exercising of influence. Like the similar early conceptions of e-leadership -term coined by Avolio, Kahai, and Dodge [1] --these earlier views emphasized the reconfiguration of leadership behaviors around the structuring of communication in time and space by electronic means. But, even though e-leadership focused primarily on the mode of communicating, it did not have a systemic view of how digital leaders design platforms for co-creation, governance, and scale.

As the Fourth Industrial Revolution (4IR) evolves, scholars and practitioners as a whole adopt that digital leadership is a dynamic capability underpinned by digital intelligence (DQ) and systems thinking [11, 15]. Leadership in the digital age is so much more than using digital tools, it's a matter of how we re-imagine how value is designed across organizations and between networks, and the ecosystems in which rely are developed. This wider understanding is reflected in Purwanto et al. [17] model that combines digital, ecological and servant leadership in a single construct that is designed to achieve sustainable performance outcomes in higher education. Their results indicate that when it comes to digital leadership two other paradigms should not to be disregarded, namely the ethical and stakeholder models.

Technical intelligence and cognitive-moral intelligence in digital environments As specified by Park [15], digital intelligence refers to technical, cognitive, and moral skills necessary to function responsibly in digital contexts. Our model reflects the empirical research presented by Marnewick and Marnewick [11] that showed the essential ingredients of digital communication, online collaboration and socio-emotional competences required for project managers working in complex digital eco-systems. Unlike earlier models with an emphasis on technical skills, these new perspectives stress the need to marry technical advancements with moral imagination and systems thinking.

Accordingly, digital leadership has become a meta-competency—a blend of adaptive foresight, platform stewardship, and inclusive engagement—increasingly necessary for orchestrating digital ecosystems in multiple sectors. The subsequent sections will discuss how this development leads to the concept of Digital Ecosystem Architecture (DEA) as a systemic leadership competence in the Visionary Management Dimension of the VFC Competence Model.

3.2. Ecosystemic Thinking in Leadership

As organizations environments increasingly become interrelation, dynamic, and boundary-less, leadership thought has started to evolve from silo control to ecosystem orchestration. The ecosystem perspective, inspired by complexity theory and systems thinking, conceptualizes leadership as the ability to facilitate, shape, and sustain multi-actor technology-enabled networks that produce collective value [14]. In this construct, leaders don't just influence their teams; they shape the environment in which innovation, trust, and collaboration can thrive on a cross-organization, cross-sector, and even a cross-national basis.

To some extent, ecosystem leadership is a reaction to the traditional models of leadership that focus on centralized authority, while building on the concept of relational governance, modularity, and strategic alignment across a range of actors and platforms. This necessitates 'engaging with, rather than simplifying, complexity' and developing institutional and network-level adaptive capacity [10]. Indeed, Mahadeo's Leadership 5.0 is a case in point, which introduces Agility, Platform Thinking, and Stakeholder Engagement as requirements to situate leaders as Ecosystem shapers, as opposed to institutional Guardians.

In digital systems, the trust, openness, and technology-based interoperability needed for value creation depend on these relationships even more. Morgan [13] highlights that architectural thinking in those environments entails a designing and leading capacity that demands a hybrid acumen of systems thinking, digital fluency, and foresight.

In conclusion, the thinking of ecosystems in leadership represents authority as facilitation, planning as design, and performance as an emergent co-value. It underpins the subsequent section, where it serves as a theoretical anchor to formalize DEA as a strategic leadership capability required for Visionary Management in digitally complicated futures.

3.3. Defining Digital Ecosystem Architecture (DEA)

Digital Ecosystem Architecture (DEA) focuses on the deliberate planning, coordination, and governance of these interadult environments in which a variety of actors, platforms, and technologies interact to co-create value. It is in stark contrast with conventional IT architecture, which targets internal system integration and digital transformation, that focuses on modernizing processes within the organizational boundaries, and is fundamentally systemic, relational, and strategic [8, 13]. The latter demands leaders to look beyond the walls of the enterprise, and to curate five to seven participants into collaboratives of interoperable and ethically governed ecosystems.

DEA sits at the nexus of design engineering and strategic planning. It allows organizations to plan for how data, services, and connections move around inside and between platforms." As Morgan [13] proposes, architecturing in the digital age is about inviting structural forces (e.g., APIs, platforms, protocols) into the design of an organization, so they may embody business strategy, human values, and contextual malleability. A DEA leader must therefore incorporate technology fluency, systems thinking within organizational processes, and social design principles to create scalable, inclusive, and resilient ecosystems.

DEA is taking on even more importance in VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) environments where adaptive governance and digital sovereignty are key issues [16]. In this regard, the ecosystem orchestrator has to create trust infrastructures, guarantee platform interoperability, and define collective governance models that consider the ethical hazards, regulatory fragmentation, and power asymmetries [14]. DEA isn't just a matter of making things efficient — it's a matter of ecosystem health: how growth, inclusion, and innovation happen together. In addition, the DEA is also closely related to leadership identity and capacity building.

In a nutshell, DEA is a meta-competency born from the intersection of digital architecture and strategic leadership. Its specific contribution lies in the fact that it gives a voice to leaders to shape ecosystems that are not only technologically proficient but also grounded in ethics, socially inclusive, and strategically fit, and is thus a crucial pillar in the Visionary Management Dimension of the VFC Competency Framework.

3.4. Gaps in Current Leadership Models

Alongside the emerging body of works on digital leadership and organisational change, many current leadership models have proved inadequate to manage the challenges posed by digital ecosystems. Frameworks such as the Talent Triangle by Project Management Institute (PMI, 2021) or the Individual Competence Baseline (ICB) by the IPMA (2021) often focus on technical project delivery, stakeholder management and operational control—all of which do not address systemic, architectural and ethical leadership dimensions necessary to thrive in volatile, interlinked digital ecosystems [11].

Organizational Bound Models A major limitation of most current models is the organizational boundedness. They also tend to imagine hierarchical organizations and linear value chains, whereas digital ecosystems work as distributed, dynamic networks [14]. Leadership in such contexts demands the ability to enable platform-enabled collaboration, to design modular systems, and to co-create with external actors–capacities absent from conventional management training.

Further, digital leadership frameworks do not often incorporate ethical and governance issues. Instead of being all about technical skills and capabilities, leaders today must also deal with algorithmic bias, data privacy, digital sovereignty, and interoperability standards. Models such as Digital Intel-

ligence (DQ) also seek to fill this void by incorporating moral and civic dimensions in digital competence models [15]. However, they are not well integrated in leadership development programs, notably those based in the Global South.

Besides, in the majority of leadership models, digital transformation is positioned as a process and not as a design issue. This results in a patchy deployment, where solutions are applied in a piecemeal fashion without a re-evaluation of the architecture of the ecosystem. DEA fills this gap by providing a holistic, systemic perspective based on platform thinking, stakeholder orchestration, and adaptive foresight [8, 13].

In the face of these deficiencies, new leadership models — such as the Transformative Leadership Compass [19] and the Leadership Ecosystem 5.0 format [2] — provide for leadership systems that are embedded in systemic and future-oriented contexts and recognize the presence of many actors. These models emphasize the pressing need for meta-competencies, like DEA, that reach beyond siloed expert domains to prepare leaders who can design for resilience, inclusivity, and ethics in digital futures.

In conclusion, the existing leadership models are incapable of dealing with the architectural agency and the orchestration of ecosystem needs in a digital complex age. DEA, as articulated in the VFC Competence Framework, provides a strategic answer to these vacuums, enabling leaders to move from being reactors to disruption to shapers of ecosystems.

Table 1. *Gaps in Current Leadership Models vs. DEA.*

Aspect	Traditional Models	DEA Model
Scope	Organization-centric	Ecosystem-centric (multi-actor, cross-sector)
Ethical Focus	Limited or siloed	Embedded in architecture (e.g., data equity)
Governance Approach	Hierarchical control	Participatory and adaptive
Scalability	Linear growth	Modular, interoperable platforms

Contrast traditional models with DEA's contributions.

4. Theoretical Framework

4.1. Purpose of the Framework

The framework positions Digital Ecosystem Architecture (DEA) as a future-ready meta-competency for leaders, shifting focus from isolated tech solutions to designing, governing, and evolving digital ecosystems. DEA integrates strategic foresight, systems thinking, platform governance, and ethical design.

Key Objectives

1) Define DEA as a leadership competency within the VFC Visionary Management Dimension.
2) Break it into actionable pillars:
   a. Strategic Ecosystem Thinking.
   b. Orchestrative Governance.
   c. Value-Based Architecture.

This equips leaders—especially in the Global South—to architect resilient, human-centric digital futures.

4.2. Positioning DEA Within the VFC Visionary Management Dimension

With the framing of the VFC competence model, the Visionary Management Dimension consists of three integrative domains: Leadership, Management, and Business Scaling and Development. Together, these domains highlight foresight, influence, operational design, and strategic agility throughout complex settings. Digital Ecosystem Architecture (DEA) conceived in this paper, is taken to be an overarching set of industry knowledge that directly reinforces and embodies a synthesis of the capabilities needed in the three domains.

DEA supports leadership by enabling leaders to visualize and design collaborative digital environments with a common purpose, future ethical awareness, and inclusive influence. DEA leaders move beyond hierarchical control and cultivate platform-based trust that fosters multi-actor alignment in digital infrastructures supporting the co-creation of mutual value [14, 15].

In the Management Domain, DEA offers instruments to control digital ecosystems as complex, adaptive systems. This entails the creation of networks with the capacity for interoperable architectures, in which agility is embedded into organizational decision-making procedures, and resilience in the face of disruption is secured [8]. From here, DEA is the structural logic that connects the dots between visionary thoughts to coordinated action across platforms and institutions.

In Business Scaling and Development, DEA helps in the creation of digital scalable ecosystems, which enable connecting local and global systems. DEA-competent leaders are those who design ecosystem strategies to facilitate network-driven scaling, integration of digital services, and sustainable growth

[13]. This is particularly relevant in EM and Global South institutions where DEA provides a means to skip linear models of development through platform cosituation.

So, DEA is not only a consolidation of siloed digital capabilities, but is actually a strategic leadership capability that unlocks the complete potential of the Visionary Management Dimension. As the tissue between vision, structure, and growth, DEA helps leaders design the future, rather than react to it.

4.3. Core Pillars of the DEA Competency (Ecosystem Leadership Competency Model – ELCM)

In order to make the concept of Digital Ecosystem Architecture (DEA) as a leadership competency more actionable, this contribution introduces the Ecosystem Leadership Competency Model (ELCM). In this model, DEA is described as a triad of three mutually dependent dimensions: Strategic Ecosystem Thinking, Orchestrative Collaboration and Governance, and Value-Based Digital Architecture. Combined, these pillars enable leaders not just to manage digital change but to design the kind of intricate, durable, and inclusive digital ecosystems on which the next generation of economy-shaping business models will be built.

4.3.1. Strategic Ecosystem Thinking

Strategic Ecosystem Thinking is the leader's capability to understand, foresee, and design for systemic interdependencies. Systems theory & scenario thinking: Adapted from systems theory and strategic foresight, the focus here is a broader mental model that encompasses an organization within a larger set of technological, institutional, and social actors. They learn how to:

1) Conduct ecosystem mapping and stakeholder analysis.
2) Envision long-term scenarios under uncertainty.
3) Integrate ethical foresight into digital development.

As Nambisan and Baron [14] argue, digital leaders must develop "mental schemas" to navigate platform complexity. This pillar positions DEA leaders as foresight-driven ecosystem architects who can align vision with emerging digital configurations.

4.3.2. Orchestrative Collaboration and Governance

This pillar is about designing and orchestrating multi-actor ecosystems that co-create value through platforms, APIs, and data standards. DEA managers must find a middle way between freedom and consistency, so that autonomous players can coexist in a coordinated system without relying upon strictly central coordination. Key competencies include:

1) Designing governance models (e.g., federated, participatory, adaptive).
2) Establishing trust protocols and interoperable interfaces.
3) Mediating power asymmetries through inclusive decision-making.

This capacity mirrors Peng's [16] observation that modern leaders must navigate cross-platform coordination and regulatory uncertainty with agility and relational intelligence.

4.3.3. Value-based Digital Architecture

The third pillar grounds DEA in humanistic and systemic values, building the architecture of the digital ecosystem in such a way that it reflects inclusiveness, sustainability, and ethics. Leaders must integrate:

1) Environmental and social sustainability goals (e.g., circular economy logic).
2) Cultural and regional relevance in system design.
3) Ethical frameworks (e.g., data equity, digital sovereignty, algorithmic accountability).

Purwanto et al. [17] highlight the synergy between ecological, servant, and digital leadership, affirming that architecture without values leads to exclusionary or exploitative systems.

Together, these three pillars form a competency architecture that reflects the integrated nature of DEA. Each pillar reinforces the others, enabling leaders to move fluidly between strategy, governance, and values—an essential capacity for Visionary Management in digitally complex environments.

Table 2. *Core Pillars of DEA Competency (ELCM).*

Pillar	Description	Key Competencies
Strategic Ecosystem Thinking	Foresight and systemic interdependencies in digital ecosystems.	Ecosystem mapping, long-term scenario planning, ethical foresight integration.
Orchestrative Collaboration & Governance	Designing multi-actor ecosystems with shared governance models.	Federated governance, trust protocols, inclusive decision-making.
Value-Based Digital Architecture	Embedding ethics, inclusivity, and sustainability in ecosystem design.	Cultural relevance, data equity, algorithmic accountability.

Summarize the three pillars of DEA and their key components.

4.4. Comparison with Existing Frameworks

While several leadership and capability frameworks exist that address aspects of digital transformation, few provide a comprehensive model for the successful leadership, design, governance, and evolution of digital ecosystems, which is both system-level, ethical, and future-proof. The Digital Ecosystem Architectural (DEA) model outlined in this paper fills an important void by placing a slice of strategic architecture in a wider context of architecture as being more than just a technical role, and indeed more of a visionary leadership role that is based on collaboration, insight, and value-centric governance.

For example, the Project Management Institute (PMI) and International Project Management Association (IPMA) frameworks focus on project delivery, stakeholder engagement, and executional agility. Although these models address some digital competencies (e.g., project management tools or agile) they are missing an architectural perspective for designing business ecosystems and platform governance. These models tend to be organization-focused and miss the fact that contemporary digital and communication environments are networked, boundary-spanning environments [11].

In the same vein, Digital Intelligence (DQ) [15] includes digital ethics, safety, and participation, but is mostly directed at the education of young people and the development of digital citizenship. They are thick in ethical foundation, but don't quite get us to the systems of governance and strategic decisions to solve messes that leaders of ecosystems need to make. In contrast, DEA connects both forward-looking ethics with infrastructure in the making, supporting leaders to think and act with moral coherence in high-tech sectors.

Recent efforts to extend leadership structures, such as that in the transformative leadership compass [19], focus on multiple competencies for digital change, but do not specifically refer to ecosystem architecture as a design logic. As a modest contribution to these theories, DEA is a hack that was inspired by attaching importance to architectural thinking in digital leadership effectiveness.

In conclusion, existing models provide useful parts but may reify digital leadership to a certain tool, trait, or behaviour. DEA positions leadership as a design practice: a nexus of structure, vision, and ethics that informs the digital systems that guide institutional and societal development.

5. Leading DEA: Understanding What It Truly Means

When it comes to Digital Ecosystem Architecture (DEA), a leader will have to step away from traditional perceptions of control, authority, and internal efficiency. In place of this, the leadership and DEA are constituted by the orchestrating and designing of adaptive, ethically centred, and generative digital worlds. It marks a change of behavior and of thought, from systems management to ecosystems architecture.

5.1. Behavioral Characteristics of DEA Leaders

From a behavior standpoint, DEA leaders are platform enablers and system stewards. So they don't tell results, but they do create the mechanism by which diverse groups of actors can work, can innovate, and adapt over time. These leaders:

1) Enable ecosystem-level alignment using digital standards and shared governance structures.
2) Foster trust and transparency through interoperability and shared burden.
3) Develop boundary-spanning projects to connect institutional, cultural, and technological rifts.

This contrasts sharply with command-based leadership styles and even traditional participative models. In DEA leadership, influence is exercised through architectural scaffolding—designing the rules, norms, and interfaces that shape behavior at scale [14].

5.2. Strategic Orientation and Foresight

Strategically, DEA leaders operate with a long-term, systems-oriented mindset. They:

1) Foster anticipatory governance: deliberately designing digital infrastructure to meet uncertain futures.
2) Harmonize digital approaches with ecologically, socially, and institutionally sustainable aspirations.
3) Constantly look for weak signals, new platforms, and regulation changes in order to maintain elastic resilience.

In this way, the DEA leaders are the digital age’s urban planners, thinking not simply about what is needed in the present but what can be sustained and expanded responsibly over time [13].

5.3. Ethical and Relational Leadership in Ecosystems

Ethically, DEA heads are stewards of value-sensitive design. Equity, inclusion, and data ethics are baked into the very architecture of the ecosystem. This includes:

1) Defending the digital sovereignty of weak actors..
2) Ensuring algorithmic fairness, privacy, and responsible AI integration is a priority.
3) Making sure that not just the plurality of voices, especially from the Global South, are at the table, but that they’re empowered.

These leaders must make difficult trade-offs: openness vs. security, scale vs. integrity, innovation vs. regulation. This tension is not regulated by rule-based administrators of the DEA, but is shaped by the curators of governance space in order to attain equilibrium and accountability [16, 15].

5.4. Culturally Grounded Application: MENA and Global South Relevance

The MENA region, as well as other regions of the Global South, provides a vital context for DEA leadership ascent. In these areas with patchy digital infrastructures under uneven platform rule, DEA offers a model of sovereign, locally embedded, and globally coherent leadership.

Careem's transformation from a regional ride-hail app into an all-inclusive digital platform reflects DEA in action: facilitating the growth of ecosystems, incorporating trust protocols, and scaling in pace with cultural and regulatory creeds. In such cases, DEA executives should:

1) Navigate hybrid governance regimes (public-private-community).
2) Create context-aware digital services based on local needs and constraints.
3) Make sure the design enables regional agencies, not an addiction to the global (foreign) platforms.

In Conclusion, to lead the DEA is to design for complexity, lead with ethics, and scale with purpose. These leaders don't react to digital disruption—they anticipate and mold it by understanding system dynamics, embracing new decision-making approaches, and sharing data and insights across the system. And, therefore, DEA leadership serves as a core competency for aspiring institutions dedicated to promoting balanced digital futures.

6. Data Analysis and Synthesis

6.1. Strategic Ecosystem Thinking in Practice

Strategic ecosystem thinking refers to the cognitive and foresight capability that DEA leaders have to acknowledge the digital ecosystems ´nature as adaptive and dynamic systems, not as infrastructure, ready-built infrastructure. This proactive outlook enables leaders not only to react to immediate challenges but 'design ecosystems that absorb future uncertainty [9, 14]. By painting scenarios, the foresight of the stakeholders, and modularity in planning, the DEA leaders create a strategic rationale that controls architecture before any technology is bought or built.

One such example is the technology company Careem, which started life in the UAE in 2012. Starting out as a ride-hailing service, Careem began evolving into a multi-faceted ecosystem that includes digital payments, food delivery and groceries, transport, and corporate logistics. This change was accompanied by the conviction that if platforms were to proliferate in the MENA region, convergence needed to occur amongst adjacent service domains [7, 12]. Launching as a super-app allowed Careem to defy the potential "app-trap" of regional digital services and enabled an integrated value creation model spanning industries.

Careem, which was acquired by Uber in 2019, does not intervene too much in its Middle East markets, and it has its own leadership to operate separately, pursuing its own strategies depending on regional and community conditions [18]. In Saudi Arabia, for instance, Careem worked with the Ministry of Transport to coordinate ride-hailing with national Vision 2030 objectives around mobility. For example, in the UAE, the digital wallet developed by Careem, Careem Pay, was co-created in partnership with the Central Bank, indicative of the strategic ecosystem positioning for regulation commensurate with financial regulation [3, 5].

In brief, the DEA leaders employing strategic ecosystem thinking are system-level architects, constructing infrastructures that evolve. They are leaders not only in what they build, but in how far into the future they design for resilience, coherence, and inclusive scalability.

6.2. Orchestrative Governance and Collaboration

In digital ecosystems, leadership is not so much commanding as managing diverse players with inclusive governance and collaboration protocols. This DEA competence support, with Orchestrative Governance and Collaboration as the core, needs to develop institutional and highly technological settings that will stimulate a dynamic build-up of reciprocity, interoperability, and co-creation and value generation across organisational, sectoral, and geographical perimeters [16, 8].

And while there are centralized decision-making models of governance, the checks and balances of the 'western' separation of powers can be seen to be analogous in a pure-play digital ecosystem governance model to be decentralized, modular, and adaptable. Leaders under this paradigm act as trust enablers in creating governance that is a living being to meet the constantly changing demands of users, partners, and regulators [9]. This is includes weighing competing interests, governing data sovereignty, and structuring open but secure digital spaces.

The Careem case assists in providing some flesh to our understanding of orchestrative governance among DEA leaders. After becoming a super-app, Careem was no longer in charge of maintaining its internal processes, it was running controls for an ecosystem of third-party developers, vendors, SMEs, and regulators. Its tactics mixed soft infrastructure (like legal contracts and API access policies) with hard governance (like data security controls, compliance mandates, and penalties). For instance, the company launched its "Developer Platform", gave APIs and sandbox environments for third-party service providers, but they should integrate within the guardrails, enforced by Careem's internal ecosystem standards [3].

And importantly, Careem's governance model was constructed on a locally attuned one. In Egypt and Saudi Arabia, where both digital payments and ride-hailing services are heavily regulated, Careem worked with ministries and central

banks to ensure its platform operated in a manner that was beneficial for the public sector as well. In the case of Saudi Arabia, for example, this entailed linking up with the goals of Vision 2030 to create employment and achieve digital inclusion, and in Egypt, it included establishing data compliance mechanisms to meet cross-border data constraints [5, 7].

This piecemeal orchestration is embedded within the ELCM's second pillar, network governance, where digital architectures are employed as means for collaboration, not control [4]. Leaders at the DEA are building relational capital, investing in long-term networks, in trust, and in collaborative governance designs! The aim should be not smooth coordination, but structural accessibility - that's to say, to nurture an ecosystem whose participants can co-evolve with the platform, with mutual responsibility.

To conclude, orchestration of DEA leadership is about what it takes to design institutions that put in place the enabling environments and conditions in which actors that have a stake in a problem can rely on co-creating, innovating together, and scaling together. It demands an equal measure of architectural discipline and adaptive empathy, based on systems logic and stakeholder understanding.

6.3. Values in Ecosystem Architecture

In the heart of the Digital Ecosystem Architecture (DEA), there is the responsibility not only of strategic foresight and collaborative governance but also of a value-driven design. This is illustrated in the Ecosystem Leadership Competency Model (ELCM), which identifies seven key competencies that illuminate a robust ecosystem and stretches into the themes that digital spaces are not neutral— they embody the values, priorities, and assumptions of their designers. Leaders applying DEA need to operationalize ethical, cultural, and sustainable dimensions into the system architecture and practices within the ecosystem [15, 17].

While traditional frameworks of leadership largely regard ethics as a kind of veneer that attends upon technical design, in the DEA, it is embedded in the DNA of the architectural practice. This includes attention to:

1) Equity of access and participation.
2) Digital sovereignty and privacy protections.
3) Cultural responsiveness and inclusivity.
4) Environmental and social sustainability.

The case of Careem once again provides instructive insights. Unlike global platform giants that often replicated Western-centric designs in diverse markets, Careem's leadership intentionally tailored its platform to the sociocultural and economic realities of the MENA region. This included:

1) Arabic-language integration and cultural UX/UI design across all services.
2) Customized payment models, such as cash-based and mobile-wallet options, to reach unbanked populations.
3) Regional employment prioritization, with a focus on onboarding local drivers and gig workers, particularly women in Saudi Arabia post-2018 reforms [3, 18].

And there was also Careem Pay, where we built a design with a heavy focus on privacy and compliance. By working with national central banks, platform data was stored and processed so that legal norms at the local level were respected—respect for digital sovereignty is an emerging challenge for ecosystem ethics [5].

This is in distinction to systems that rush towards scale with little consideration for contextual fit, leading to extractive or exclusionary results. DEA chiefs turn that logic on its head. They work to create an environment where the digital is inclusive of all, serves the public interest, and fosters the opportunity of a better world. As Purwanto et al. [17] suggest, value-based leadership, in conjunction with digital fluency, can foster both trust in the institution and sustainable innovation.

Finally, leading the DEA through a values-framed lens is not just a fancy; it is a strategic necessity. In environments of regulatory instability, trust deficit, and digital divide, value-anchored architecture constitutes a competitive and cultural advantage to allow digital ecosystems to prosper with legitimacy and direction.

6.4. Synthesis Across Visionary Management Domains

The triad of Digital Ecosystem Architecture (DEA)—Strategic Ecosystem Thinking, Orchestrative Governance, and Value-Based Digital Architecture—jointly allows redefining leadership for the digital age. It becomes especially relevant to synthesise them if they are plotted onto the three underlying dimensions in the Visionary Management Dimension of the VFC Competence Framework: Leadership, Management and Business Scaling and Development. Collectively, these domains create the framework in which DEA can be operationalized as a leadership capability.

6.4.1. Leadership Domain: Visionary Influence and Co-creation

In the Leadership dimension, DEA enhances a leader's capacity to co-create a common digital vision, exert influence through ecosystem capacity alignment, and generate commitment among distributed stakeholders. As seen in the Careem example, the mobility and financial services were not envisaged as stand-alone services, but as complementary elements of the same regional platform. Such vision was not applied in a top-down manner, rather cocreated with public organizations, users and strategic partners, highlighting a participatory stance that is crucial to the thematic DEA leadership profile [14, 16].

6.4.2. Management Domain: Structural Agility and Adaptive Governance

In the Management domain, DEA equips decision-makers

with capabilities to enact the design and management of responsive digital infrastructures, navigate complexity, and translate governance to the platform level. The integration of developer portals, sandboxes, and regulatory interfaces in Careem's system is an example of the architectural evolvability that is necessary to deal with changing actor compositions and technology stacks. DEA leaders not only consider the internal operations but rather look for the maximisation of value flows across networks – a management function that finds its existence in dynamic (and not static) systems [8, 9].

6.4.3. Business Scaling and Development Domain: Inclusive Growth and Ecosystem Expansion

DEA is also relevant in the Business Scaling and Development domain, where digital expansion is fuelled by such factors as ecosystem design, interoperability, and regional customization. Careem's strategic shift to super-app architecture has enabled the company to expand into horizontally scalable service stacks (e.g., food, fintech courier) as it develops vertical integrations within the public layer. This platform scaling wends itself culturally and institutionally—A necessary practice for Global South contexts where localized growth and digital sovereignty are what matter [13, 5].

Conclusion: In conclusion, performance on all three domains suggests that DEA operates at a meta-competency level -an overarching ability able to bring together visionary leadership, operational architecture, and scalable impact under a single competency frame. It activates the leaders to construct strategic, resilient, ethically grounded, and socially inclusive ecosystems that reinforce the underlying principles of Visionary Management in the digital age of the 21st century.

Table 3. *Case Study Insights from Careem.*

DEA Pillar	Careem's Practice	Outcome
Strategic Ecosystem Thinking	Evolved from ride-hailing to super-app (e.g., Careem Pay).	Integrated regional services under one platform.
Orchestrative Governance	Developer Platform with APIs and sandboxes for third-party integration.	Enabled modular expansion while maintaining governance standards.
Value-Based Architecture	Arabic-language UI, cash payment options, local employment prioritization.	Enhanced inclusivity and cultural relevance in MENA markets.

Highlight Careem's DEA practices aligned with the three pillars.

7. Learning Outcomes – KSAH Model and Progression Levels

7.1. Knowledge

DEA competence requires knowledge of that gradually deepens in terms of concepts, systems, and strategic thinking on digital ecosystems as they are designed and governed. Knowledge production here spans from foundational literacy in digital platforms up to systemic theorisation, policy influence, and systems foresight. At all phases, knowledge is grounded in systems thinking, architectural logic, digital ethics, and contextual awareness, and these provide the cognitive foundations on which skills, attitudes, and habits are constructed [8, 13].

While Novice cultivates awareness of the digital ecosystem at a foundational level, they construct a vocabulary around platform architectures, digital governance models, and ecosystem actor roles. For further information on DQ Levels, see Park's [15] discussion of DQ Level 1 as the basic digital intelligence level necessary for responsible engagement in digital spaces. Students start to consider how the structural differences that mark linear organization from networked ecosystem architecture impact scalability and inclusion.

Moving up to the intermediate level, leaders will integrate systems mapping tools, understand the interconnectedness of the ecosystems, and relate architectural choices to ethical, social, and regulatory considerations. At this level, they are also able to understand the implications of governance models (e.g., centralised or federated) and predict points of friction within multi-actor environments [9]. The knowledge here gets situated instead of something abstract that abstracted away from the particularities of the cultural or institutional settings, and they're doing.

Advanced: Leaders can apply learning from several systems domains such as urban planning, cybersecurity, regtech, and cross-border data flows. This, in turn, enables them to create resilient, flexible architectures that are guided simultaneously by long-term vision and short-term operational pragmatism [14]. They can transform stakeholder tensions into architectural decisions that reduce complexity and increase engagement as well.

At the Expert level, DEA champions are knowledge pro-

ducers, developing new models, theories, and frameworks to influence how institutions and societies think about the digital. They conduct policy conversations, shape global architectural standards, and help serve as a liaison to institutions and other ecosystem transitions. Their knowledge turns structural, reflective, and regenerative, to make not just operating systems but to redesign them.

7.2. Skills

The skills for a Digital Ecosystem Architecture (DEA) leadership role form a dynamic design, governance and facilitation capacity set that matches the capability of a leader to create, develop and grow digital ecosystems. Those capabilities go beyond digital literacy or knowing how to use a platform, they include architectural thinking, multi-actor design, and systems-level implementation. They demand comfort with ambiguity and proficiency in translating strategic foresight into technical forms [8, 13].

Leaders at the Novice level will get to know the entry-level digital mapping and visualization tools required to find actors, relationships, and dependencies in an ecosystem. These comprise minimum viable systems modeling, user flow design, and stakeholder identification. Beginners can document how platforms work, articulate internal and external dependencies across the platform landscape, and uncover early platform goals. This level is comparable to introductory roles on digital projects in areas like startups, municipality innovation units, or student-run civic tech initiatives.

In the intermediate stage, at the Intermediate level, DEA leaders start to lead governance and design collaboration at the level of the department, organisation, or platform. They can co-create standards, co-author API interface agreements, as well as moderate cross-sector talks. By this time, skillsets include platform blueprinting, stakeholder co-creation workshops, policy prototyping, and compliance alignment. The Careem Developer Platform and its model of modular expansion an example of applied ecosystem facilitation at this level [3].

Advanced: Leadership of multi-scalar implementation—initiating, scaling up, or adjusting ecosystem services across geographies or sectors. At this stage, leaders translate digital strategies into viable architectures, They do so by aligning developers, designers, policy makers, and the end user. They create trust by being transparent in governance and acting fast, yet they simultaneously need to ensure interoperability of the deployed solutions and that they are sensitive to the local context [9, 16].

In the Expert Stage, DEA executives become global ecosystem orchestrators. They influence the development of ecosystems both in the public and private sectors in different regions, across jurisdictions, and on the regional or international level of digital developments. These leaders can learn how to scale modular ecosystems across regulatory spaces and cultural milieus, ensuring we architect an infrastructure that supports long-lasting, multi-actor innovation, like the platform orchestration strategies present in the ASEAN Smart City Initiatives or the Data Policy Framework of the African Union [13].

In the end, the skill advancement in DEA is a journey from digital literacy to architectural fluency, from the ability to let the results play out to the ability to design and govern scale-out ecosystems.

7.3. Attitudes

Building Digital Ecosystem Architecture (DEA) as a core competency is as much a question of attitude as a matter of knowledge and skills required to act ethically, collaboratively and systemically. And, beyond the traditional definition of culture or "how we do things around here," we believe that the more important issue is attitudes – that set of internal dispositions, values, and worldviews that guide how leaders relate to complexity, power, diversity, and long-term stewardship. As DEA itself is multiform and multijurisdictional, such attitudes are vital to develop trust, legitimacy, and cohesion among the community [17, 15].

At the Novice level, DEA heads start with curiosity and a willingness to be systems thinkers. They are excited by the chance to learn about what digital ecosystems do and have an open disposition to cooperation and ethical thinking. This marks the stage of early receptivity to complexity—leaders still don't know how to work with it, but they are beginning to accept it as both essential and value-added.

At the Intermediate stage, leaders develop ethical sensitivity and stakeholder empathy. They understand the power imbalances, the equity disparities, and the cultural idiosyncrasies of their digital environment. They are attitudinally much less invested in technical superiority and much more in the relational fullness of DEA leadership. These leaders are humble; they solicit the voices of marginalised actors and make decisions based on the collective health of the ecosystem [9].

The Advanced level requires a high level of internalization of ecosystem stewardship. They are starting to weigh strategic incentives against social responsibility. They refuse extractive platform logics and put co-ownership, inclusion, and long-term value at the foreground. At this point of evolution, leaders are also a kind of distributed moral responsibility where they know their leadership isn't about control, but creating enablement. Their decision-making becomes informed by questions like: Does this design enable shared agency? Whom does this design exclude?

At the Expert level, opinions rally behind visionary honesty, intergenerational responsibility, and moral foresight. Leaders are guided by a higher purpose, adapted for a sense of stewardship, designing ecosystems not just for business impacts but for making a difference to society. This ranges from justice, through sustainability, to equity at any level of (!) ecosystem design. Such leaders are institutional guardians, making difficult ethical choices with conviction and resolve [17, 13].

In short, DEA's attitudinal dimension ensures that digital infrastructure is not only good, but is also fair, inclusive, and human-friendly.

7.4. Habits

In DEA, habits refer to the consistent, observable response of what is processed, learned, and believed to be practiced. Learning or demonstrating knowledge and capabilities can be shown in episodes, but it is through using them repeatedly that you come to effective leadership. Habits guarantee that DEA leadership is visionary as well as routine, especially in the digital ecosystems' dynamic high-risk environments [8, 13].

At the Novice level, habits start with frequent observation of the ecosystem. Leaders align actors, technologies, and interdependencies through tools like stakeholder grids or ecosystem canvases. They cultivate a moral reflex that trains them to consider how decisions might affect inclusion or privacy or trust, even if the consequences are not immediately apparent [15]. These early workouts lay the groundwork for more advanced architectural practice.

At the Intermediate level, DEA leaders institutionalize operational practices that support ecosystem sustainment and feedback. These include setting up regular stakeholder meetings, reviewing governance documentation, and tracking digital KPIs. They cross boundaries in conversation as a matter of routine, gathering intelligence across silos between departments, sectors or cultural divides before it's too late. Crucially, these practices serve to embed a culture of collaborating rhythm into the ecosystem [9].

Leaders at the Advanced level build adaptive learning loops into the way they practice architecture. They establish processes for iterative platform development that adapt the platform based on developing requirements, user analytics, and policy changes. And now? We have the habit of documenting failure, of taking control of discussion through the ritualized debriefing of meetings (the AAR), and patterns for converting disturbance into design learning [13]. DEA seniors also start to code their ecosystem routines, so that others can imitate or magnify best practices.

At the Expert level, habits shift from operational repetition to institutionalization. DEA leaders build learning systems that live on beyond them. They perform routine cross-sector foresight rituals, co-governance audits, and design justice audits. Such leaders consistently demonstrate transparency, accountability, and open innovation, ensuring that the ecosystem itself becomes a learning entity, not just a delivery vehicle.

Ultimately, the leadership of the DEA is not about epiphanies or isolated interventions. It shows up in rituals, morals, and adaptations that put into motion not just what leaders do, but how ecosystems shift.

8. Conclusion and Future Research Directions

As digital ecosystems become the new infrastructure where value is created, governed, and distributed, leadership shifts from managing organizations to designing environments. This article defined Digital Ecosystem Architecture (DEA) as a specific and emergent leadership competency as part of the VFC Competence Model in the Visionary Management Dimension. As built on cross-disciplinary literatures and underpinned by practice-based insights -- particularly from the MENA region -- it presented a triadic framework of DEA leadership comprising Strategic Ecosystem Thinking, Orchestrative Governance, and Value-Based Digital Architecture.

And DEA is not purely technical or strategic; it is a new approach to leadership practice – one that is anticipatory, inclusive, and systems-oriented. It creates a new model for how leaders lead digital transformation: it moves from internal change management to external ecosystem design, governance, and long-term stewardship. The Ecosystem Leadership Competency Model (ELCM) and the associated development of KSAH afford a stepwise approach to the growth of this competency, from novice through expert.

The paper also indicated the context-specific meaning of DEA in developing countries and the Global South. Extracting Agency: Platform Architectures and the Reconfiguration of Service Provision in the Global South 90 These cases, and others like Careem's platform strategy in this post, for example, illustrate how DEA empowers local actors, enabling them to regain control over the stories told about them, the logics that still infuse infrastructure and the future of digital forms of life and infrastructures in with their regions. This is especially the case in regions where digital sovereignty, regulatory flexibility, and inclusive scaling are top development goals.

Future Research Directions

Despite the conceptual clarity and case-based insights offered, this research is exploratory and conjectural. In order to establish and expand the primary competence of DEA in the leadership literature, some research paths with respect ought to be followed:

1) Empirical Validation of the KSAH Model.
2) Comparative Case Studies Across Regions.
3) Quantifying Ecosystem Maturity and Leadership Influence.
4) Integration into Institutional Leadership Programs.
5) Linking DEA with Ethical AI and Data Governance.

In conclusion, DEA represents more than a leadership response to digital transformation—it is a call for architectural agency in an age of systemic uncertainty. By embedding DEA into leadership development, institutions can cultivate stewards of digital futures who are not only competent in systems but also conscious of their ethical and developmental purpose.

Abbreviations

4IR	Fourth Industrial Revolution
DEA	Digital Ecosystem Architecture
ELCM	Ecosystem Leadership Competency Model
KSAH	Knowledge, Skills, Attitudes, and Habits
ICB	The Individual Competence Baseline
VFC	VFC Competence Framework as a Development Framework

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Conflicts of Interest

The authors declare no conflicts of interest.

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