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Identification and Explanation of the Dimensions and Components of Digital Transformation Leadership in Electric Power Distribution Companies

ABSTRACT

Digital transformation in the electric power distribution industry requires effective leadership to guide technological, organizational, and strategic changes. Despite the growing body of related research, no comprehensive framework has yet been developed to explain the dimensions of digital transformation leadership in electric power distribution companies. Accordingly, the present study aimed to identify and explain the dimensions and components of digital transformation leadership in this industry. In terms of purpose, this study was applied, and in terms of approach, it was qualitative and conducted using thematic analysis. Data were collected through semi-structured interviews with managers, electric power industry experts, information technology specialists, and faculty members familiar with digital transformation. Participants were selected through purposive sampling, and data collection continued until theoretical saturation was achieved. Data analysis was conducted based on the six-phase thematic analysis process. The findings led to the identification of 161 basic themes, 57 organizing themes, and 5 global themes. The global themes included the competencies and individual characteristics of the digital transformation leader, leadership and managerial skills, provision of technological infrastructure and resources, organizational and strategic alignment, and the development and outcomes of digital transformation. The findings indicated that successful digital transformation in electric power distribution companies results from the simultaneous interaction of leaders' individual capabilities, managerial skills, technological infrastructure, strategic alignment, and the establishment of a transformation-oriented organizational culture. Digital transformation leadership is a multidimensional and systemic phenomenon that, through the integration of human, managerial, technological, and strategic dimensions, creates the conditions for improving productivity, innovation, grid resilience, value creation, sustainability, and service quality. The proposed framework can serve as a basis for designing leadership development models and digital transformation policies in the electric power industry and other infrastructure-based organizations.

Keywords: digital transformation leadership, digital transformation, leadership competencies, digital governance.

Introduction

Digital transformation has become a central strategic priority for contemporary organizations as advances in digital technologies increasingly reshape business models, organizational processes, managerial practices, stakeholder relationships, and the mechanisms through which value is created and delivered. Rather than being limited to the adoption of isolated technological tools, digital transformation represents a fundamental reconfiguration of organizational capabilities through the integration of digital technologies into operational, managerial, and strategic domains. This transformation affects how

organizations collect and analyze data, coordinate activities, interact with customers and stakeholders, allocate resources, design services, and respond to environmental uncertainty. Accordingly, organizations are increasingly required to develop not only advanced technological infrastructures but also adaptive managerial systems and leadership capabilities capable of directing continuous and often disruptive change. Research has consequently shifted from viewing digital transformation primarily as a technological phenomenon toward understanding it as an organizational and strategic process in which leadership plays a decisive role [1-4].

Digital transformation is particularly complex because technological adoption must occur simultaneously with changes in organizational structures, employee competencies, decision-making processes, organizational culture, governance arrangements, and strategic priorities. The implementation of advanced digital technologies without corresponding organizational adaptation may result in fragmented initiatives, resistance to change, inefficient resource allocation, or failure to generate expected organizational value. The increasing diffusion of digital technologies across industries has therefore intensified attention to the organizational conditions that enable firms to translate digital investments into improved performance and sustainable competitive advantage. Recent studies emphasize that digital transformation depends on the integration of technological resources with organizational agility, learning capacity, dynamic capabilities, and strategic alignment [5-8]. In this context, leadership functions as an integrating mechanism through which technological opportunities are interpreted, organizational priorities are established, employees are mobilized, and transformation initiatives are aligned with long-term strategic objectives.

The growing importance of leadership in digital environments has contributed to the development of concepts such as digital leadership, digital transformational leadership, e-leadership, and digital transformation leadership. Although these concepts overlap, digital transformation leadership specifically emphasizes the capacity of leaders to guide comprehensive organizational transformation through the strategic integration of digital technologies, human capabilities, organizational processes, and new forms of value creation. Digital leaders are expected to possess competencies that extend beyond conventional leadership requirements, including advanced digital literacy, strategic technological understanding, data-oriented decision-making, adaptive thinking, innovation orientation, learning agility, and the capacity to manage organizational change under conditions of uncertainty [9-12]. Leadership in the digital age therefore entails both technological awareness and the ability to redesign organizational relationships, work practices, and managerial systems in ways that facilitate adaptation to rapidly changing technological and competitive environments.

The literature on digital transformation leadership further demonstrates that effective leadership is multidimensional and cannot be reduced to technical expertise alone. McCarthy et al. identified characteristics of digital transformation leaders associated with vision, communication, collaboration, adaptability, experimentation, technological understanding, and the ability to facilitate organizational change [3]. Subsequent practitioner-oriented research has reinforced the importance of combining strategic vision with practical transformation capabilities, stakeholder engagement, learning orientation, and the ability to navigate organizational complexity [13]. Similarly, contingency-based perspectives suggest that the competencies required for digital transformation leadership may differ according to organizational conditions, technological maturity, strategic context, and environmental uncertainty [11]. These arguments imply that leadership effectiveness in digital transformation depends on a coherent portfolio of individual, interpersonal, managerial, strategic, and technological competencies rather than on a single leadership style or isolated set of technical abilities.

One of the central competencies associated with digital transformation leadership is the ability to establish a clear digital vision and translate it into an actionable strategy. Digital transformation initiatives often span multiple organizational functions and require substantial investment, making strategic coherence essential. Leaders must define transformation priorities, determine the role of digital technologies in achieving organizational goals, develop roadmaps, establish governance mechanisms, and ensure that individual initiatives contribute to an integrated organizational transformation agenda. The literature emphasizes that digital strategy consensus can strengthen the effect of digital leadership by aligning members around common transformation objectives and reducing fragmentation across organizational units [14]. Likewise, the development of digital transformation strategy requires attention to strategic content dimensions, including technological priorities, organizational capabilities, customer value, operational processes, and governance arrangements [15]. Leadership is therefore essential for creating strategic coherence among digital investments, organizational missions, and long-term performance objectives.

At the same time, digital transformation requires organizational agility because technological opportunities and environmental conditions evolve rapidly. Leaders must be capable of recognizing changes, mobilizing organizational resources, revising strategies, and enabling rapid adaptation. Empirical research has demonstrated important relationships among leadership, digital strategy, organizational agility, and digital transformation outcomes [5]. Digital transformational leadership can enhance organizational agility by encouraging experimentation, facilitating knowledge sharing, promoting employee participation, and supporting rapid organizational responses to technological changes [6]. From this perspective, leaders serve not merely as decision-makers but as architects of adaptive organizational systems capable of responding to new technological possibilities while maintaining continuity in essential organizational functions. This role becomes particularly important in industries where operational reliability and continuity of service must be maintained during transformation.

Human and social dimensions are equally central to digital transformation leadership. Digital initiatives frequently require changes in established routines, professional identities, job responsibilities, and patterns of collaboration. Employees may resist transformation when they perceive new technologies as threats to professional autonomy, job security, competence, or established organizational norms. Leaders must therefore build trust, communicate transformation objectives clearly, engage employees in change processes, and develop organizational cultures supportive of experimentation and learning. The social aspects of industrial digitalization demonstrate that successful transformation depends substantially on participation, collaboration, and the ways in which organizational members interpret and engage with technological change [16]. Similarly, emerging perspectives associated with Industry 5.0 emphasize co-workership, collaborative value creation, human-centered innovation, and stronger integration between technological development and employee participation [17]. Consequently, digital transformation leadership must address both technological implementation and the human processes through which transformation becomes embedded in organizational practice.

Soft skills are therefore increasingly recognized as critical components of digital leadership. Communication, emotional intelligence, collaboration, conflict management, inspiration, cultural awareness, and inclusive leadership become especially important when transformation requires coordination across professional, disciplinary, and organizational boundaries. Contemporary studies of digital leadership highlight the need to combine digital capabilities with soft, intercultural, and inclusive competencies [18]. Comparable challenges have been identified in educational organizations, where digital

transformation requires leaders to simultaneously address technological innovation, organizational culture, employee readiness, and changing stakeholder expectations [19]. Although these studies focus on educational environments, their implications extend to other complex organizations because they demonstrate that the success of digital transformation depends on leaders' capacity to integrate human development with technological change rather than privileging one dimension over the other.

The increasing prevalence of digitally mediated work has also created new leadership requirements. Digital transformation may involve distributed teams, remote monitoring, virtual collaboration, digitally supported decision-making, and new forms of employee–manager interaction. Leadership in such contexts requires competencies for managing performance across physical distance, maintaining communication, building trust, and coordinating employees through digital platforms. A systematic review of leadership competencies in telework environments emphasizes the importance of communication quality, trust development, autonomy management, technological proficiency, and performance coordination for overcoming virtual distance [20]. These competencies are increasingly relevant even in operationally intensive sectors because digital systems alter how managers supervise processes, access real-time information, communicate with employees, and coordinate technical activities. Digital leadership thus extends beyond the executive level and increasingly affects managerial practices throughout organizations.

Another important dimension concerns data-driven leadership and digital governance. Digital transformation significantly increases the quantity, speed, and strategic importance of organizational data. Leaders are consequently required to understand how data are generated, governed, integrated, interpreted, and transformed into managerial insight. Effective digital leadership entails establishing data governance principles, supporting integrated information architectures, ensuring cybersecurity and data quality, and encouraging evidence-based decision-making throughout the organization. Digital identity, smart governance, and leadership have been linked to the broader institutionalization of digital transformation within public organizations [21]. Research on digital public-service supply chains similarly indicates that digital transformation requires redesigning processes and information flows across organizational and institutional boundaries rather than simply automating existing procedures [22]. These findings highlight the governance responsibilities of digital transformation leaders, particularly in organizations operating within regulated and public-service-oriented environments.

The capacity to build and mobilize digital resources is another critical leadership responsibility. Digital transformation requires adequate financial investment, specialized human capital, digital talent, interoperable technologies, data infrastructures, and organizational mechanisms capable of supporting continuous technological development. Leaders must determine investment priorities, allocate limited resources, build internal competencies, recruit specialized personnel, and establish collaborative relationships with technology suppliers, research institutions, and other actors within innovation ecosystems. The capacity to develop digital dynamic capabilities is particularly important because digital technologies evolve rapidly and firms must continuously reconfigure resources to maintain transformation momentum [7]. Research on the broader diffusion of digital technologies across industries further demonstrates that technological leadership by leading firms can produce both enabling and exclusionary effects within industry transformation, illustrating the importance of organizational capacity to absorb and exploit emerging technologies [23]. Thus, digital transformation leadership involves not only acquiring technologies but also creating the organizational capacity to use, adapt, and renew them.

Digital transformation leadership has been investigated in several organizational and national contexts, including Iranian organizations. Research in Iran has sought to identify conceptual dimensions of digital transformation leadership and the competencies necessary for organizations facing digital change. A conceptual framework developed for Iranian organizations highlights the importance of leadership capabilities, strategic orientation, organizational culture, digital knowledge, and transformation readiness [24]. Studies of leadership readiness in schools similarly suggest that organizational transformation depends on managers' preparedness to understand digital change and mobilize organizational resources around it [25]. Research focused specifically on competency constructs has also identified and prioritized leadership competencies relevant to digital transformation [9]. These findings demonstrate the growing recognition of digital transformation leadership within the Iranian management literature while simultaneously indicating the need for sector-specific frameworks that reflect the operational characteristics of different industries.

Recent Iranian studies have expanded this literature across education, public administration, taxation, infrastructure, and higher education. The identification of digital transformation leadership factors in medical university education has provided a thematic model reflecting leadership, organizational, technological, and environmental dimensions [26], while subsequent research validated a digital transformation leadership model within medical sciences education [27]. Research in the higher education system has also examined digital transformation through the lens of e-leadership, emphasizing the interaction of leadership practices, technological adoption, organizational processes, and digital capacities [28]. In the National Tax Administration, managerial leadership style has been examined in relation to digital transformation [29], and research in an infrastructure communications company has specifically highlighted the role of digital leadership in generating organizational digital transformation [30]. Collectively, these studies underscore the cross-sector relevance of digital transformation leadership but also reveal substantial contextual variation in the competencies, structures, and governance arrangements required for effective transformation.

In addition to leadership-centered studies, research on the softer organizational dimensions of digital transformation demonstrates the importance of organizational culture, employee participation, communication, learning, and change readiness. A conceptual framework addressing the soft components of digital transformation indicates that technological change must be supported by cultural and human mechanisms capable of facilitating organizational adaptation [31]. These considerations are particularly important because transformation projects frequently fail not because of the technical inadequacy of the technologies themselves but because organizations lack the capacity to integrate them into existing structures and work practices. Strategic reviews of digital transformation in traditionally non-digital sectors similarly indicate that legacy systems, organizational resistance, skills gaps, resource constraints, governance weaknesses, and limited digital maturity can constrain transformation, thereby increasing the importance of capable leadership [32]. Effective leaders must therefore create conditions in which technological, organizational, and human dimensions develop in a mutually reinforcing manner.

The relevance of these issues is particularly pronounced in electric power distribution companies. Electric power distribution represents a critical infrastructure function characterized by extensive physical networks, stringent reliability requirements, safety considerations, regulatory oversight, large volumes of operational data, geographically dispersed assets, complex stakeholder relationships, and increasing pressure to improve service quality and operational efficiency. Digital technologies can substantially alter the management of distribution networks through smart monitoring, predictive analytics,

automation, integrated data platforms, advanced metering, intelligent maintenance, and digitally enabled customer services. However, the successful deployment of such technologies requires more than technical modernization. Leaders must coordinate transformation while maintaining service continuity, balancing operational risks, complying with regulatory requirements, securing organizational support, and ensuring that investments produce measurable operational and strategic value. The critical factors identified in industrial digital transformation—including management commitment, technological capability, organizational culture, skills, strategy, integration, and external collaboration—are therefore highly pertinent to electric power distribution companies [8].

Moreover, the transition toward digitally enabled infrastructure increasingly intersects with sustainability, resilience, innovation, and stakeholder value. Digital transformation enables organizations to improve resource utilization, increase transparency, enhance predictive capabilities, and create more responsive operational systems. At the same time, such outcomes depend on leadership capable of integrating organizational performance objectives with innovation, social responsibility, and long-term value creation. Digital leadership is increasingly associated with leaders' capacity to represent and enact new forms of professional identity that emphasize adaptability, digital presence, values, collaboration, and continuous development [33]. In organizational settings characterized by technological disruption, leadership identity itself may therefore evolve as managers are required to combine traditional authority with network-based influence, technological credibility, collaborative coordination, and strategic sense-making. This reinforces the view that digital transformation leadership must be examined as a multidimensional construct rather than as a narrow extension of conventional managerial leadership.

Despite the expansion of research on digital leadership and digital transformation, important conceptual and contextual gaps remain. Existing studies have addressed leadership competencies, digital strategy, organizational agility, dynamic capabilities, cultural readiness, e-leadership, and the broader characteristics of successful digital leaders, yet the literature remains fragmented across different sectors and organizational contexts [2, 10, 12]. Theoretical frameworks such as the Digital Transformation Canvas provide valuable integrated perspectives for leading transformation processes [4], but their broad organizational orientation does not fully capture the unique characteristics of highly regulated, technically complex, infrastructure-intensive organizations. Similarly, evidence from manufacturing, education, public administration, telecommunications, and other sectors cannot automatically be transferred to electric power distribution companies because transformation requirements are shaped by sector-specific operational risks, technological architectures, regulatory constraints, service obligations, workforce characteristics, and stakeholder systems. The absence of a comprehensive framework specifically identifying the dimensions and components of digital transformation leadership in electric power distribution companies therefore represents an important research gap.

Addressing this gap is significant from both theoretical and practical perspectives. Theoretically, identifying the dimensions of digital transformation leadership in electric power distribution companies can contribute to the digital leadership literature by clarifying how individual leadership competencies, managerial skills, technological resources, organizational alignment, and transformation outcomes interact within a critical infrastructure context. Practically, a sector-specific framework can support leadership development, competency assessment, succession planning, digital strategy formulation, resource allocation, organizational redesign, and transformation governance. It can also provide managers and policymakers with a more systematic understanding of the capabilities required to guide digital transformation while preserving network

reliability, organizational resilience, service quality, stakeholder confidence, and sustainable value creation. Such a framework is especially necessary when digital transformation is understood not as a temporary technological project but as a continuous organizational capability requiring coordinated leadership across human, technological, strategic, and governance dimensions.

Accordingly, the aim of the present study was to identify and explain the dimensions and components of digital transformation leadership in electric power distribution companies.

Methodology

In terms of purpose, this study was applied, and in terms of approach, it was qualitative and conducted using thematic analysis. This method was selected because of the exploratory nature of the study and the absence of a comprehensive model for identifying and explaining the dimensions and components of digital transformation leadership in electric power distribution companies. Thematic analysis is a recognized qualitative research method that enables the identification, classification, interpretation, and organization of underlying patterns of meaning within qualitative data and facilitates the development of a conceptual framework grounded in empirical evidence. The study participants consisted of senior managers, middle managers, experts in digital transformation, information technology specialists, network operations managers, human resource managers, and university faculty members with academic or executive experience in digital transformation and the electric power industry. Purposive sampling was conducted based on criteria such as managerial experience, specialized knowledge, participation in digital transformation projects, and familiarity with the structure and processes of electric power distribution companies. The sampling process continued until theoretical saturation was achieved; that is, after successive interviews, no new concepts or codes emerged from the data, and the researcher concluded that the collected data were sufficient to address the study objectives.

The data collection instrument was the semi-structured interview. The interview guide was developed based on a review of the research literature, theoretical foundations, and study objectives. The questions were designed to enable an in-depth exploration of participants' perspectives, experiences, and perceptions regarding the dimensions, requirements, challenges, and outcomes of digital transformation leadership. All interviews were recorded after obtaining the participants' informed consent and were subsequently transcribed verbatim in full. Throughout the data collection process, supplementary questions were also asked in accordance with participants' responses to deepen the data and clarify emerging concepts.

Data analysis was conducted based on Braun and Clarke's six-phase model. In the first phase, the interview transcripts were read and reviewed repeatedly to enable the researcher to develop a comprehensive understanding of the data. In the second phase, initial codes were extracted from the interview transcripts. In the third phase, conceptually similar and related codes were grouped into initial themes. In the fourth phase, the initial themes were reviewed, refined, and merged to ensure their internal coherence and external distinctiveness. In the fifth phase, the final themes were defined and named, and in the sixth phase, the final report of the findings was prepared together with the thematic network. As a result of this process, 161 basic themes were extracted and organized into 57 organizing themes and 5 global themes, including "competencies and individual characteristics of the digital transformation leader," "leadership and managerial skills," "provision of technological infrastructure and resources," "organizational and strategic alignment," and "development and outcomes of digital transformation." To ensure the quality of the study findings, the criteria of credibility, trustworthiness, dependability,

confirmability, and transferability were applied. The credibility of the findings was strengthened through continuous rereading of the interview transcripts, member checking by a number of participants, and review and evaluation of the findings by experts in the field. To enhance dependability, all stages of data collection, coding, and analysis were documented in detail so that the research process could be reviewed and evaluated. Confirmability was also ensured through the documentation of all analytical decisions, preservation of research records, and efforts to minimize potential researcher bias. In addition, to enhance the transferability of the findings, the characteristics of the participants, the research context, and the stages of the study were reported in sufficient detail to facilitate the application of the findings in similar research settings and environments.

Findings and Results

Analysis of the data obtained from the semi-structured interviews indicated that digital transformation leadership in electric power distribution companies is a multidimensional, dynamic, and systemic concept whose realization requires the simultaneous interaction of leaders' individual capabilities, managerial skills, technological infrastructure, organizational alignment, and the outcomes resulting from the implementation of digital transformation. A detailed examination of the qualitative data showed that participants did not regard digital transformation leadership merely as the adoption of new technologies or the digitalization of existing processes; rather, they viewed it as a strategic approach to redesigning organizational structures, processes, culture, and decision-making practices in order to enhance productivity, agility, and sustainable value creation. Accordingly, thematic analysis of the data resulted in the extraction of a set of themes organized within a hierarchical structure comprising basic themes, organizing themes, and global themes.

During the data analysis process, key concepts and initial codes were first extracted from the interview transcripts. Subsequently, through constant comparison, integration of similar concepts, and elimination of redundant items, the initial codes were organized into basic themes. In the next stage, basic themes sharing conceptual similarities were classified into organizing themes, and finally, the organizing themes were integrated into five global themes based on their semantic proximity and their role in explaining digital transformation leadership. Accordingly, a total of 161 basic themes, 57 organizing themes, and 5 global themes were extracted, each explaining part of the dimensions of digital transformation leadership in electric power distribution companies.

The findings showed that the first and most fundamental dimension of digital transformation leadership is the competencies and individual characteristics of the digital transformation leader. Participants believed that leaders' success in directing digital transformation depends, above all, on their individual characteristics, future-oriented perspective, capacity for continuous learning, digital literacy, strategic thinking, creativity, emotional intelligence, and ethical responsibility. In other words, in addition to possessing managerial knowledge and familiarity with emerging technologies, digital transformation leaders must be capable of adapting to environmental changes, analyzing future developments, motivating employees, and guiding the organization under complex and rapidly changing conditions. This finding indicates that digital transformation, before being a technological transformation, is a transformation in managers' mindsets, competencies, and leadership styles.

The second dimension identified was the digital transformation leader's leadership and managerial skills. Analysis of participants' perspectives indicated that leaders in the digital era, in addition to conventional managerial skills, must be

capable of managing change, leading multidisciplinary teams, establishing effective communication, making data-driven decisions, managing risk, empowering employees, fostering a learning culture, and leading organizations in virtual environments. According to the experts, digital transformation leadership becomes effective when managers are able to establish coherent links among technology, human capital, and the organization's strategic objectives and reduce resistance to change by actively involving employees in the transformation process. This finding suggests that the success of digital transformation is highly dependent on leaders' soft skills and managerial capabilities.

The third global theme was the provision of technological infrastructure and resources. The findings demonstrated that even highly capable leaders cannot achieve digital transformation in the absence of appropriate technological infrastructure, sufficient financial resources, specialized human capital, and an integrated data management system. Participants emphasized the necessity of developing digital infrastructure, establishing an integrated information architecture, creating suitable platforms for data exchange, investing in emerging technologies, attracting and retaining specialized personnel, and strengthening collaboration with universities, knowledge-based companies, and other actors within the innovation ecosystem. These findings indicate that digital transformation requires the creation of an enabling platform capable of providing the conditions necessary for the deployment and effective utilization of emerging technologies.

The fourth identified dimension was organizational and strategic alignment. The findings indicated that digital transformation will be successful only when alignment and consistency exist among the organization's overarching strategies, operational structures, organizational culture, regulatory requirements, governance system, human capital, and the technologies being utilized.

Participants believed that many of the challenges associated with digital transformation in electric power distribution companies arise from a lack of coordination among different units, cultural resistance to change, weak knowledge management, regulatory misalignment, and the absence of a clear roadmap. Accordingly, digital transformation leaders must formulate comprehensive strategies, strengthen a culture receptive to change, promote collaboration among different organizational units, and provide continuous training to enhance organizational readiness for the adoption of emerging technologies.

The fifth and final global theme was the development and outcomes of digital transformation. The findings indicated that the successful implementation of digital transformation leadership produces wide-ranging functional, economic, social, and environmental outcomes for electric power distribution companies. The most important outcomes include increased productivity, improved organizational performance, reduced operating costs, enhanced reliability and resilience of the distribution grid, improved service quality, increased customer satisfaction, innovation development, value creation, enhanced competitive advantage, development of social capital, improved transparency and accountability, development of new business models, and movement toward sustainable development. These findings indicate that digital transformation is not merely a technological project but rather a value-creating process capable of influencing overall organizational performance across multiple dimensions.

Overall, the conceptual structure extracted from the study data indicates that digital transformation leadership in electric power distribution companies emerges from the reciprocal interaction of five major dimensions. These dimensions do not operate independently; rather, they function as an integrated and interdependent system in which strengthening one dimension can enhance the effectiveness of the others. For example, leaders' individual competencies provide the foundation

for developing managerial skills; managerial skills facilitate the establishment of technological infrastructure; appropriate infrastructure strengthens organizational alignment; and ultimately, the interaction among these factors leads to the realization of desirable digital transformation outcomes. Accordingly, the model derived from this study provides a comprehensive representation of the dimensions of digital transformation leadership and may serve as a theoretical and practical framework for designing leadership development programs, formulating digital transformation policies, and improving the performance of electric power distribution companies by managers, policymakers, and researchers.

Table 1

Basic, Organizing, and Global Themes

Global Themes	Organizing Themes	Summary of Basic Themes
Competencies and Individual Characteristics of the Digital Transformation Leader	Emotional intelligence and change management in an engineering-oriented environment; leader's digital expertise; future orientation and adaptability; continuous learning capability and cognitive agility; network thinking and ecosystem management; leadership knowledge and management; creativity and innovation; advanced digital literacy; digital strategic thinking; ability to identify and understand digital transformation; competitiveness and change leadership; ethical commitment and accountability; and vision and aspirational orientation toward value creation.	The basic themes of this dimension represent a set of cognitive, behavioral, technological, and ethical leadership competencies that enable effective digital transformation leadership, change management, future orientation, continuous learning, innovation, and strategic decision-making.
Leadership and Managerial Skills of the Digital Transformation Leader	Soft skills; risk management and operational resilience in the digital environment; productivity and intelligent performance management; stakeholder interaction management and digital governance; digital intelligence and data analytics; change management and resistance reduction; communication and inspirational skills; delegation and employee empowerment; data-driven decision-making skills; e-leadership and remote management; and facilitation and creation of a learning environment.	The basic themes of this dimension emphasize the leader's ability to manage human resources, lead change, make data-driven decisions, manage risk, develop effective communication, foster organizational learning, and empower employees.
Provision of Technological Infrastructure and Resources	Leadership of data governance and integrated information architecture; leadership of capacity building for innovation ecosystems; digital infrastructure; digital investment and financing; digital talent and recruitment of specialized personnel; implementation of an integrated digital platform; creation of a dynamic digital workplace; provision of resources and technical support; linking digital tools to business challenges; and development and updating of emerging technologies.	The basic themes of this dimension emphasize the development of technological infrastructure, information security and integration, provision of financial and human resources, attraction and retention of digital talent, development of emerging technologies, and utilization of the capacities of the innovation ecosystem.
Organizational and Strategic Alignment	Formulation of digital strategies and roadmaps; alignment of digital strategy with operational and service-delivery missions; management of regulatory alignment and governance requirements; leadership of synergy among technical, administrative, and operational units; digital governance and transformation oversight; digital organizational culture and acceptance of change; cross-functional coordination and organizational structure; stakeholder engagement and customer orientation; continuous employee training and development; organizational agility and responsiveness to change; and knowledge management and organizational learning.	The basic themes of this dimension emphasize the alignment of strategy, structure, culture, and human capital with digital transformation objectives, strengthening cross-functional collaboration, developing organizational learning, and establishing a transformation governance system.
Development and Outcomes of Digital Transformation	Improvement of job performance and productivity; development of sustainable and green innovation; enhancement of distribution grid reliability and resilience; improvement of transparency, accountability, and performance governance; development of social capital and stakeholder trust; development of innovation capabilities in the supply chain and operations; enhancement of organizational ambidexterity; digital value creation and competitive advantage; cost reduction and increased revenue generation; transformation of the service business model; environmental sustainability and reduction of the carbon footprint; and increased customer satisfaction and social interaction.	The basic themes of this dimension represent the functional, economic, social, and environmental outcomes of digital transformation, including improved productivity, greater grid resilience, innovation development, value creation, improved service quality, reduced costs and losses, sustainable development, and increased stakeholder satisfaction.

Accordingly, the main and subthemes are described below. Following the examination and analysis of the research data, the main and subthemes became evident to the researcher and were organized into 5 global themes, 57 organizing themes, and 161 basic themes. These themes are analyzed and discussed in detail below.

Competencies and Individual Characteristics of the Digital Transformation Leader

For the global theme of competencies and individual characteristics of the digital transformation leader, 13 organizing themes were identified: emotional intelligence and change management in an engineering-oriented environment, leader's digital expertise, future orientation and adaptability, continuous learning capability and cognitive agility, network thinking and ecosystem management, leadership knowledge and management, creativity and innovation, advanced digital literacy, digital strategic thinking, ability to identify and understand digital transformation, competitiveness and change leadership,

ethical commitment and accountability, and vision and aspirational orientation toward value creation. As one of the fundamental dimensions of the proposed model, the competencies and individual characteristics of the digital transformation leader represent a set of capabilities, attitudes, and personality characteristics that leaders of electric power distribution companies must possess to successfully guide the digital transformation process. The findings indicated that a digital transformation leader in an engineering-oriented organization requires not only managerial knowledge and technical expertise but also the development of broad individual and cognitive capabilities. In this regard, emotional intelligence and the ability to manage change in an engineering-oriented environment play an important role in fostering empathy, reducing organizational resistance, and securing employee engagement with technological changes. Likewise, the leader's digital expertise, advanced digital literacy, and ability to identify and understand digital transformation demonstrate the necessity for leaders to possess a deep understanding of emerging technologies, the opportunities arising from digitalization, and their effects on the operational models of the electric power industry. Furthermore, components such as future orientation and adaptability, continuous learning capability, and cognitive agility indicate that digital transformation leaders must be capable of rapidly adapting to dynamic and complex environments and continuously upgrading their knowledge and competencies in response to technological developments. Based on the findings, a digital transformation leader in an electric power distribution company is an individual who, through network thinking and ecosystem management capabilities, digital strategic thinking, and a value-creation vision, is able to understand and manage the relationships among technology, stakeholders, organizational processes, and overarching business objectives. By drawing on creativity and innovation, leadership knowledge and managerial capability, competitiveness, and proactive change leadership, these leaders create the conditions for innovative approaches and sustainable competitive advantage. In addition to professional and cognitive capabilities, the findings emphasize the importance of the leader's ethical and value-based dimensions, such that ethical commitment and accountability constitute key factors in ensuring the responsible use of digital technologies and maintaining organizational and social trust. Therefore, the individual competencies of the digital transformation leader cannot be regarded merely as a set of technological skills; rather, they represent a combination of digital knowledge, leadership capabilities, personality characteristics, a future-oriented mindset, and ethical values that interact to create the capacity required for leading sustainable digital transformation in electric power distribution companies.

Leadership and Managerial Skills of the Digital Transformation Leader

The global theme of leadership and managerial skills of the digital transformation leader represents a set of managerial and behavioral capabilities required by leaders of electric power distribution companies to effectively guide digital transformation processes and achieve sustainable outcomes. The findings showed that digital transformation leadership extends beyond traditional management and requires the development of skills capable of addressing the complexities arising from technological change, organizational dynamics, and the requirements of the digital environment. In this regard, soft skills, communication and inspirational skills, and change management and resistance reduction are among the key capabilities of digital transformation leaders because the adoption of new technologies in engineering-oriented organizations is, more than a purely technical issue, a human and cultural challenge. Digital transformation leaders must establish effective communication, strengthen organizational trust, create motivation, and empower employees in order to facilitate their active participation in the transformation process. Moreover, delegation and employee empowerment, as an important component of this theme, indicate the necessity of moving away from centralized management models toward participative leadership

and the creation of agile and self-managed teams in digital environments. On the other hand, the findings indicated that digital transformation leaders in electric power distribution companies must possess advanced analytical and managerial capabilities to address the requirements of the digital era. Components such as digital intelligence and data analytics, data-driven decision-making skills, and productivity and intelligent performance management reflect the increasingly important role of data and information in decision-making processes and organizational performance improvement. In addition, risk management and operational resilience in the digital environment, stakeholder interaction management, and digital governance emphasize the leader's capacity to balance innovation, risk control, and coordination among the various actors within the electric power ecosystem. The emergence of e-leadership and remote management also indicates that future leaders must be able to lead geographically dispersed teams, make effective use of digital communication tools, and cultivate a culture of virtual collaboration. Finally, facilitation and the creation of a learning environment, as one of the core dimensions of this theme, reflect the role of the digital transformation leader in turning the organization into a learning organization that continuously develops employee knowledge and skills and thereby acquires the readiness required to respond to technological change and future developments in the electric power industry.

Provision of Technological Infrastructure and Resources

The global theme of provision of technological infrastructure and resources, as one of the principal pillars of the model, reflects the leader's role in creating the technical, human, and financial capacities required to achieve digital transformation in electric power distribution companies. The findings demonstrated that sustainable digital transformation cannot be achieved without appropriate infrastructure and sufficient resources and that digital transformation leaders must play an active role in designing, developing, and governing these capacities. In this regard, digital infrastructure, implementation of an integrated digital platform, and leadership of data governance and integrated information architecture emerged as key components emphasizing the necessity of developing coherent technological platforms, standardizing information flows, increasing data interoperability, and treating data as a strategic organizational asset. Digital investment and financing also reflect the importance of targeted allocation of financial resources for implementing digital transformation projects, developing emerging technologies, and establishing the capabilities required to transition from traditional processes toward an intelligent and data-driven organization.

In addition to technical and financial dimensions, the findings emphasize the importance of developing human capacity and creating an organizational environment supportive of digital transformation. In this context, digital talent and the recruitment of specialized personnel, provision of resources and technical support, and creation of a dynamic digital workplace are among the factors contributing to organizational readiness for the adoption of new technologies. Digital transformation leaders must identify and recruit technology specialists, develop employees' digital skills, and provide the technical support required to enable effective technology utilization. Leadership of capacity building for innovation ecosystems also reflects the necessity of establishing relationships and collaboration among the company, universities, technology firms, technology suppliers, and other stakeholders to develop innovative solutions. Finally, linking digital tools to business challenges and developing and updating emerging technologies indicate that digital transformation leaders should not regard technology merely as a technical tool; rather, they must employ it to solve real organizational problems, increase productivity, improve service quality, and create value for stakeholders. Accordingly, the provision of technological infrastructure and resources constitutes an enabling platform for the successful implementation of digital transformation in

electric power distribution companies and, in interaction with the other dimensions of the model, creates the conditions for the emergence of an intelligent, agile, and innovative organization.

Organizational and Strategic Alignment

The global theme of organizational and strategic alignment reflects the necessity of establishing coherence among the strategic, structural, cultural, and human dimensions of the organization to successfully achieve digital transformation in electric power distribution companies. The findings indicated that digital transformation is not merely a technological program; rather, it requires deep alignment between the organization's digital vision and its core missions in network operations, reliable service delivery, and responsiveness to stakeholder needs. In this regard, formulation of digital strategies and roadmaps, alignment of digital strategy with the operational and service-delivery mission, and digital governance and transformation oversight were identified as fundamental components of this theme. Digital transformation leaders must be able to design a clear path toward digitalization, prioritize initiatives, establish evaluation mechanisms, and create an appropriate governance system to ensure that digital projects remain aligned with the organization's overarching objectives and the requirements of the electric power industry. Furthermore, management of regulatory alignment, governance requirements, and transformation requirements indicates that successful digital transformation in electric power distribution companies requires simultaneous attention to standards, regulations, overarching energy policies, and environmental constraints so that digital innovation can develop within a sustainable and controllable framework.

On the other hand, the findings emphasize the role of organizational and human factors in creating alignment for digital transformation. Components such as leadership of synergy among technical, administrative, and operational units, cross-functional coordination and organizational structure, and digital organizational culture and acceptance of change demonstrate the necessity of breaking down traditional boundaries among organizational units and establishing integrated collaboration across different parts of the company. In this process, digital transformation leaders must strengthen a culture of technology acceptance, reduce resistance to change, and create a participative environment to secure employee engagement with transformation programs. Stakeholder engagement and customer orientation further indicate the importance of considering the needs of customers and actors within the electric power industry ecosystem when designing digital solutions. In addition, continuous employee training and development, knowledge management and organizational learning, and organizational agility and responsiveness to change are fundamental requirements for maintaining organizational dynamism in the digital environment. Accordingly, organizational and strategic alignment serves as a connecting mechanism among technology, strategy, and human capital and provides the foundation required to transform digital transformation from a temporary initiative into a sustainable organizational capability within electric power distribution companies.

Development and Outcomes of Digital Transformation

The global theme of development and outcomes of digital transformation represents the results and values generated through its implementation in electric power distribution companies and demonstrates that digital transformation is not limited to the adoption of emerging technologies; rather, it constitutes a value-creating process that enhances organizational capabilities, improves performance, and creates sustainable advantages. The findings indicated that among the most important outcomes of digital transformation are improved job performance and productivity, cost reduction, and increased revenue generation, achieved through intelligent process automation, resource optimization, faster decision-making, and

improved operational efficiency. Enhanced reliability and resilience of the distribution grid were also identified as key outcomes. Through the use of digital technologies, data analytics, intelligent equipment monitoring, and prediction of potential events, organizations can improve grid management, reduce outages, and increase service continuity. In the same context, enhanced transparency, accountability, and performance governance demonstrate the role of digital technologies in establishing data-driven management systems, increasing monitoring capability, and improving organizational performance evaluation processes.

From a developmental perspective, the findings indicate that digital transformation can facilitate the emergence of new organizational capabilities and sustainable value creation for electric power distribution companies and their stakeholders. Components such as digital value creation and competitive advantage, enhanced organizational ambidexterity, development of sustainable and green innovation, and development of innovation capabilities in the supply chain and operations demonstrate that electric power organizations can use technology intelligently to strengthen both the exploitation of existing capacities and the exploration of new opportunities. Transformation of the service business model, increased customer satisfaction and social interaction, and development of social capital and stakeholder trust also indicate a shift from conventional service delivery toward intelligent, participative, and customer-oriented services. Moreover, attention to environmental sustainability and carbon-footprint reduction demonstrates that digital transformation produces not only economic and operational outcomes but also social and environmental effects and can play an important role in moving the electric power industry toward sustainable development. Therefore, the development and outcomes of digital transformation can be regarded as the ultimate output of the interaction among effective leadership, technological infrastructure, organizational alignment, and human capabilities, resulting in improved performance, innovation, and sustainability in electric power distribution companies.

Given that thematic frameworks predominantly represent relationships among themes in a structurally linear manner, complementary analytical tools such as thematic networks are employed to achieve a deeper understanding of the relationships and interactions among themes. A thematic network is a systematic process for organizing and representing relationships among different levels of themes. Within this process, basic themes, comprising the key codes and concepts extracted from the research data, are first identified; these are followed by organizing themes derived from the combination, aggregation, and abstraction of the basic themes; and finally, global themes are identified as broad and comprehensive concepts encompassing the fundamental principles underlying the data. These themes are subsequently represented within a network structure that not only displays the principal themes at each level but also depicts the relationships and linkages among them. Unlike a thematic framework approach, which places greater emphasis on the sequencing and hierarchical levels of themes, thematic networks provide a graphical and nonlinear representation that makes it possible to observe the interactions, dependencies, and reciprocal relationships among different components of the model. This approach reduces the tendency to interpret relationships among themes in strictly hierarchical terms and more effectively reflects the dynamic and interconnected nature of the concepts.

Discussion and Conclusion

The present study aimed to identify and explain the dimensions and components of digital transformation leadership in electric power distribution companies. The thematic analysis resulted in 161 basic themes, 57 organizing themes, and five

global themes: competencies and individual characteristics of the digital transformation leader, leadership and managerial skills, provision of technological infrastructure and resources, organizational and strategic alignment, and development and outcomes of digital transformation. Taken together, these findings indicate that digital transformation leadership in electric power distribution companies is a multidimensional and systemic phenomenon that cannot be reduced to technological expertise or the implementation of digital tools. Rather, successful transformation requires the simultaneous integration of individual leadership capabilities, managerial competencies, technological resources, organizational coordination, strategic alignment, and an explicit orientation toward organizational, economic, social, and environmental outcomes. This interpretation is consistent with the broader digital leadership literature, which increasingly conceptualizes digital transformation as an organization-wide change process requiring the integration of leadership, technology, organizational capabilities, and strategic direction [1-4].

The first major finding concerned the competencies and individual characteristics of the digital transformation leader. The results indicated that emotional intelligence, digital expertise, future orientation, adaptability, continuous learning, cognitive agility, network thinking, ecosystem management, creativity, advanced digital literacy, digital strategic thinking, competitiveness, ethical commitment, responsibility, and value-oriented vision constitute fundamental characteristics of effective digital transformation leaders. This finding suggests that leadership in digital transformation depends on a combination of cognitive, technological, behavioral, and ethical competencies. Digital transformation leaders must understand emerging technologies while simultaneously possessing the personal flexibility and strategic foresight needed to interpret technological developments in relation to organizational goals. This finding closely aligns with research identifying digital knowledge, vision, adaptability, collaboration, innovation orientation, strategic thinking, and learning capability as central characteristics of digital transformation leadership [3, 9, 13]. It is also compatible with the contingency perspective advanced by Müller et al., according to which digital transformation leadership competencies must be understood in relation to the organizational and environmental context in which transformation occurs [11].

The importance of future orientation and continuous learning identified in the present study can be explained by the exceptionally dynamic nature of digital environments. Technologies, customer expectations, operational models, and regulatory requirements evolve rapidly, particularly in infrastructure-intensive industries. Consequently, leaders cannot rely exclusively on accumulated technical or managerial knowledge but must continuously update their understanding and develop adaptive cognitive capabilities. This interpretation is consistent with studies showing that successful digital leaders combine technological awareness with flexibility, experimentation, and continuous capability development [10, 12]. The emphasis placed by participants on leadership identity, values, and ethical responsibility is also meaningful because digital transformation expands leaders' influence over data, automated decision-making, surveillance systems, and digitally mediated relationships. Leadership in such settings increasingly requires responsibility, transparency, and value-based judgment, which is consistent with recent discussions of leadership identity and values in digitally mediated professional contexts [33].

The second global theme concerned leadership and managerial skills. The findings showed that digital transformation leaders require soft skills, communication and inspirational abilities, change management capabilities, employee empowerment, delegation, risk management, operational resilience, digital intelligence, data analytics, data-driven decision-making, stakeholder management, e-leadership, remote management, and the ability to facilitate organizational learning.

These findings reveal that digital transformation leadership extends substantially beyond conventional administrative management. Transformation introduces uncertainty, changes established routines, alters employee roles, and requires new patterns of coordination. Therefore, leaders must manage not only the technical dimensions of change but also the psychological, relational, and cultural processes through which employees accept and operationalize transformation. Previous studies similarly emphasize the importance of communication, participation, empowerment, adaptability, and human-centered leadership in digital transformation [2, 18, 19].

The importance of employee empowerment and resistance management found in this study may be particularly significant in electric power distribution companies, where technical expertise, professional routines, operational hierarchies, and established safety procedures are deeply institutionalized. Introducing digital technologies can challenge established occupational identities and work processes, potentially increasing resistance if employees perceive transformation as externally imposed or inconsistent with operational realities. The social dimension of digitalization has similarly been highlighted in industrial settings, where participation, communication, and cooperation influence the successful implementation of technological change [16]. The emphasis on co-workership and human-centered transformation in emerging Industry 5.0 perspectives also supports the current finding that leaders must involve employees in transformation rather than treating them merely as recipients of technological change [17]. Accordingly, leaders who provide meaning, participation, training, and autonomy may be better able to reduce resistance and convert digital transformation into collective organizational learning.

The results also emphasized data-driven decision-making, digital intelligence, and intelligent performance management as key managerial capabilities. This finding reflects the increasingly central role of data in contemporary electricity distribution systems. Digital technologies generate extensive operational, customer, asset, and performance data that can improve decision-making only when leaders have the capacity to interpret, govern, and utilize these data effectively. This result is compatible with research suggesting that digital leadership strengthens transformation by creating organizational conditions for effective technological utilization and data-based strategic action [7, 14]. Furthermore, the identification of e-leadership and remote management as relevant competencies corresponds with studies demonstrating that leaders operating in digitally mediated work environments must manage performance, communication, trust, coordination, and employee autonomy across physical and virtual distance [20]. Thus, the managerial skill set required in electric power distribution companies is becoming increasingly hybrid, combining traditional operational leadership with digital coordination and analytical capability.

The third major finding concerned the provision of technological infrastructure and resources. Participants emphasized digital infrastructure, integrated digital platforms, data governance, integrated information architecture, digital investment, financing, digital talent, technical support, dynamic digital workplaces, innovation ecosystems, and the development of emerging technologies. This finding demonstrates that digital transformation leadership has a substantial resource orchestration dimension. Even highly competent leaders cannot achieve transformation if organizations lack interoperable systems, adequate financing, specialized personnel, reliable data architectures, and supportive technological infrastructures. This finding is consistent with the digital dynamic capabilities perspective, which emphasizes the organizational ability to acquire, integrate, reconfigure, and exploit digital resources as a prerequisite for successful transformation [7]. It also aligns

with research identifying technological infrastructure, organizational capabilities, skills, investment, and leadership commitment among the critical factors affecting digital transformation [8].

The emphasis on innovation ecosystems in the present findings further suggests that electric power distribution companies cannot develop all required digital capabilities internally. Transformation increasingly depends on relationships with universities, technology companies, knowledge-based enterprises, consultants, suppliers, regulators, and other innovation actors. Such collaboration allows organizations to access expertise and emerging technologies that may not exist within conventional organizational boundaries. This result is compatible with studies indicating that digital transformation is increasingly shaped by interorganizational technological relationships and that firms' capacity to benefit from broader technological development depends on their ability to absorb, integrate, and exploit external digital capabilities [23]. The findings also support strategic reviews of digital transformation in traditionally non-digital sectors, which emphasize that legacy systems, technical limitations, financial constraints, talent shortages, and insufficient ecosystem collaboration can substantially impede transformation [32]. Leadership therefore involves not only internal change management but also the active construction and governance of external technological partnerships.

The fourth global theme was organizational and strategic alignment. The findings indicated that successful transformation requires digital strategies and roadmaps, alignment between digital initiatives and operational missions, regulatory alignment, digital governance, coordination among technical, administrative, and operational units, a digital organizational culture, stakeholder engagement, continuous employee development, knowledge management, organizational learning, and agility. This finding is particularly important because fragmented digital initiatives frequently fail when they are implemented without alignment with organizational strategy and operational priorities. Previous research has likewise demonstrated that leadership contributes to transformation by establishing coherence among digital strategy, organizational agility, and organizational objectives [5, 6]. The finding also corresponds with evidence that digital strategy consensus strengthens the influence of digital leadership on transformation by creating shared organizational understanding of priorities and reducing strategic fragmentation [14].

The present findings concerning strategic roadmaps and digital governance also support previous research emphasizing that digital transformation must be deliberately structured rather than emerging through isolated technological projects. The Digital Transformation Canvas proposed by Elia et al. conceptualizes transformation as an integrated process involving strategic direction, value creation, organizational capabilities, and implementation mechanisms [4]. Similarly, research examining the content dimensions of digital transformation strategy emphasizes the need for coherence among technological priorities, organizational capabilities, operational goals, and governance mechanisms [15]. Within electric power distribution companies, this need for strategic alignment is particularly pronounced because digital initiatives must simultaneously comply with regulatory frameworks, reliability requirements, cybersecurity considerations, infrastructure constraints, and public-service obligations. Therefore, digital transformation leaders must act as strategic integrators who connect technological initiatives with the organization's operational mandate and institutional environment.

The importance assigned to organizational culture, knowledge management, employee development, and agility can also be interpreted in light of previous studies. Digital transformation requires organizational members to develop new competencies, share knowledge across professional boundaries, and respond rapidly to emerging problems and opportunities. Research on soft components of digital transformation similarly emphasizes organizational culture,

communication, learning, human resources, and change readiness as essential complementary dimensions of technological transformation [31]. Studies conducted in Iranian organizations have likewise identified organizational readiness, cultural conditions, leadership capabilities, and digital knowledge as essential dimensions of transformation leadership [24, 25]. These consistencies suggest that technological transformation becomes sustainable only when digital practices are embedded within organizational culture, routines, knowledge systems, and employee development processes.

The fifth global theme concerned the development and outcomes of digital transformation. The participants identified improved job performance and productivity, reduced costs, increased revenue generation, greater distribution grid reliability and resilience, improved transparency and accountability, enhanced innovation capability, organizational ambidexterity, digital value creation, competitive advantage, business-model transformation, environmental sustainability, reduced carbon footprint, customer satisfaction, social interaction, and stakeholder trust as important consequences of effective digital transformation leadership. These findings demonstrate that leadership is ultimately relevant because it influences the organization's ability to convert technological investments into tangible organizational value. This interpretation aligns with studies showing that digital leadership affects transformation through organizational agility, digital strategy, and dynamic capabilities, thereby enhancing organizations' ability to respond to changing conditions and generate performance benefits [5-7].

The identification of organizational ambidexterity is especially meaningful because electric power distribution companies must simultaneously exploit existing infrastructure efficiently and explore emerging technological opportunities. They cannot abandon reliable operational practices while experimenting with new digital solutions; rather, they must balance continuity and innovation. Digital leadership can facilitate this balance by creating structures that support experimentation while maintaining operational control. The emphasis on service innovation, stakeholder trust, and customer satisfaction likewise reflects the broader transformation of public and infrastructure-oriented organizations toward more responsive, digitally enabled service systems. Research on digital public-service supply chains has shown that digital transformation can reshape interorganizational coordination, information flows, and service delivery processes [22]. Similarly, the role of digital leadership in infrastructure organizations has been associated with the creation of organizational conditions conducive to transformation and improved performance [30].

The findings of the present study are also consistent with sectoral studies demonstrating that digital transformation leadership manifests differently across organizational contexts while maintaining several common foundations. Studies in educational and medical university contexts have identified leadership, technological, organizational, and human dimensions of digital transformation [26, 27]. Research in higher education has highlighted the role of e-leadership in connecting technological transformation with organizational processes and human capabilities [28], while evidence from public administration suggests that managerial leadership style can significantly shape digital transformation processes [29]. Together with the current findings, these studies support the argument that digital transformation leadership consists of a common core of strategic, technological, organizational, and human competencies, but its specific configuration must reflect sectoral conditions. In electric power distribution companies, those conditions include network reliability, operational continuity, infrastructure complexity, regulation, safety, technical specialization, and increasing sustainability expectations.

Overall, the findings suggest that digital transformation leadership in electric power distribution companies should be conceptualized as an integrated leadership system rather than a collection of independent competencies. Individual

characteristics enable leaders to understand and anticipate technological change; managerial skills allow them to mobilize people and manage uncertainty; technological infrastructure and resources provide the material basis for transformation; organizational and strategic alignment ensures coherence and institutional support; and the interaction of these dimensions produces performance, innovation, resilience, sustainability, and stakeholder value. This systemic interpretation extends existing frameworks of digital leadership by demonstrating how these dimensions operate together in a critical infrastructure context. It also reinforces previous conceptualizations of digital leadership as a multidimensional construct involving leadership characteristics, organizational capabilities, strategic direction, and technological transformation [1, 10, 13]. Thus, the proposed framework provides a context-sensitive representation of digital transformation leadership that may help explain why technologically similar transformation initiatives can produce substantially different organizational outcomes depending on leadership quality and organizational alignment.

The present study has several limitations that should be considered when interpreting its findings. First, the qualitative design and purposive sampling approach were appropriate for exploring the dimensions of digital transformation leadership but limit the statistical generalizability of the findings to all electric power distribution companies. The participants were selected because of their expertise and experience, and their perceptions may therefore differ from those of frontline employees, customers, regulators, technology suppliers, or other relevant stakeholder groups. Second, the findings were based primarily on self-reported interview data and may have been influenced by participants' subjective interpretations, professional experiences, organizational positions, or socially desirable responses. Third, although theoretical saturation was used as the criterion for terminating data collection, qualitative saturation remains partly dependent on researcher judgment. Fourth, digital transformation is a rapidly evolving phenomenon, and technological, regulatory, organizational, and environmental changes may alter the relative importance of the identified competencies and components over time. Finally, the study focused on the electric power distribution context, and some identified dimensions may be shaped by the specific technical, regulatory, and infrastructural characteristics of this industry, thereby limiting direct transferability to organizations with substantially different operating environments.

Future research should quantitatively validate the proposed framework and examine the relationships among its five major dimensions using larger and more diverse samples from electric power distribution companies. Developing and validating a standardized measurement instrument for digital transformation leadership based on the themes identified in this study would facilitate further empirical testing and comparison across organizations. Future studies could also employ structural equation modeling to examine whether leadership competencies and managerial skills influence digital transformation outcomes directly or indirectly through technological infrastructure, organizational alignment, organizational agility, digital culture, or employee readiness. Longitudinal studies are recommended to determine how leadership requirements evolve across different stages of digital transformation and whether specific competencies become more or less important as organizational digital maturity increases. Comparative studies across electricity generation, transmission, and distribution organizations, as well as other infrastructure sectors, could clarify which dimensions are generalizable and which are context specific. Researchers may also incorporate the perspectives of frontline employees, customers, regulators, technology vendors, and innovation partners to provide a more comprehensive understanding of digital transformation leadership. Finally, future studies should investigate emerging issues such as artificial intelligence governance, cybersecurity

leadership, algorithmic decision-making, digital ethics, sustainability, and human–technology collaboration within the proposed framework.

Electric power distribution companies should use the identified dimensions as a basis for developing integrated leadership-development and digital-transformation programs rather than treating digitalization as the responsibility of information technology units alone. Leadership competency frameworks should incorporate digital literacy, strategic thinking, emotional intelligence, change management, data-driven decision-making, ecosystem management, ethical responsibility, and innovation capability. Organizations should assess the digital readiness of managers and provide targeted training, coaching, and succession-development programs based on identified competency gaps. Senior leaders should formulate clear digital transformation roadmaps linked directly to operational priorities, grid reliability, customer service, sustainability, and organizational performance. Investment decisions should prioritize interoperable technological infrastructures, integrated data architectures, cybersecurity, specialist digital talent, and continuous technical support. Cross-functional teams should be established to improve coordination among technical, operational, administrative, human resource, and information technology units. Managers should actively involve employees in transformation initiatives, communicate the rationale and expected benefits of change, provide continuous learning opportunities, and reward experimentation and knowledge sharing. Finally, digital transformation governance mechanisms should include measurable performance indicators related not only to technological implementation but also to productivity, resilience, service quality, innovation, environmental sustainability, employee development, customer satisfaction, and stakeholder trust.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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