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DIGITAL TRANSFORMATION IN THE STRATEGIC MANAGEMENT OF CRITICAL INFRASTRUCTURE ENTERPRISES UNDER HEIGHTENED RISKS

Critical infrastructure enterprises (CIEs) provide essential services whose disruption may affect interconnected systems, sectors and regions. Their resilience therefore requires not only protection of individual assets but also the capacity to prevent, respond to and recover from disruptive events [1]. For Ukraine, this challenge is intensified by military, economic, physical, logistical and technological risks.

Previous research shows that strategic development of CIEs requires systemic and risk-oriented approaches and consideration of macro-, meso- and micro-level interdependencies [2]. Another study identified financial, human, technical-technological and informational resources as important sources of resilience and development and proposed cognitive resilience of management systems based on adapting decisions using continuously updated analytical information [3]. These findings support considering digital transformation as a strategic, rather than purely technological, factor.

Digital transformation enables enterprises to integrate data, strengthen analytical capabilities and support faster managerial responses. Research on organisational resilience identifies virtual access, virtual collaboration, data-driven decision-making, algorithmic reprogrammability and assisted decision-making as digital capabilities that can improve organisational adaptation [4]. Digital transformation may also strengthen resilience through organisational learning and innovation [5].

At the same time, greater dependence on interconnected digital systems increases exposure to cybersecurity, data and technology-related

risks. The OECD notes that digitalisation of critical infrastructure creates both opportunities for resilience and additional digital-security risks [6]. Therefore, the strategic value of digital transformation depends on how effectively digital capabilities are integrated with risk-oriented management.

However, existing approaches tend to examine digital capabilities, infrastructure resilience and digital security as related but distinct dimensions. Their integration into a unified strategic management framework remains insufficiently conceptualized, particularly for critical infrastructure enterprises operating under heightened risks.

The aim of the study is to conceptually substantiate the role of digital transformation in the strategic management of critical infrastructure enterprises under heightened risks and to develop a conceptual framework for integrating digital capabilities into strategic decision-making and resilience management.

The methodological basis combines the systemic and risk-oriented approach to strategic management [2], the resource perspective on resilience [3], and the data-driven approach to managerial decision-making [4; 5]. Digital transformation is considered as a process through which technologies, data and analytics are converted into strategic capabilities.

The authors propose the concept of digital strategic readiness, defined as the ability of a critical infrastructure enterprise to convert digital resources, data and analytical capabilities into timely strategic decisions and adaptive actions while maintaining control over risks arising from digital dependence. Digital strategic readiness is an organisational capability, whereas data-driven strategic management is the managerial process through which it is operationalised (Fig. 1).

The proposed concept is not detached from the existing technological and analytical practices of Ukrainian CIEs. Its individual components have already been demonstrated in previous research using cloud computing, econometric models and machine-learning techniques for early-warning and financial-sustainability forecasting. That study shows that data integration, predictive analytics and cloud-based processing can support risk surveillance and decision-making, while also revealing vulnerabilities related to connectivity, cybersecurity and data governance [7].

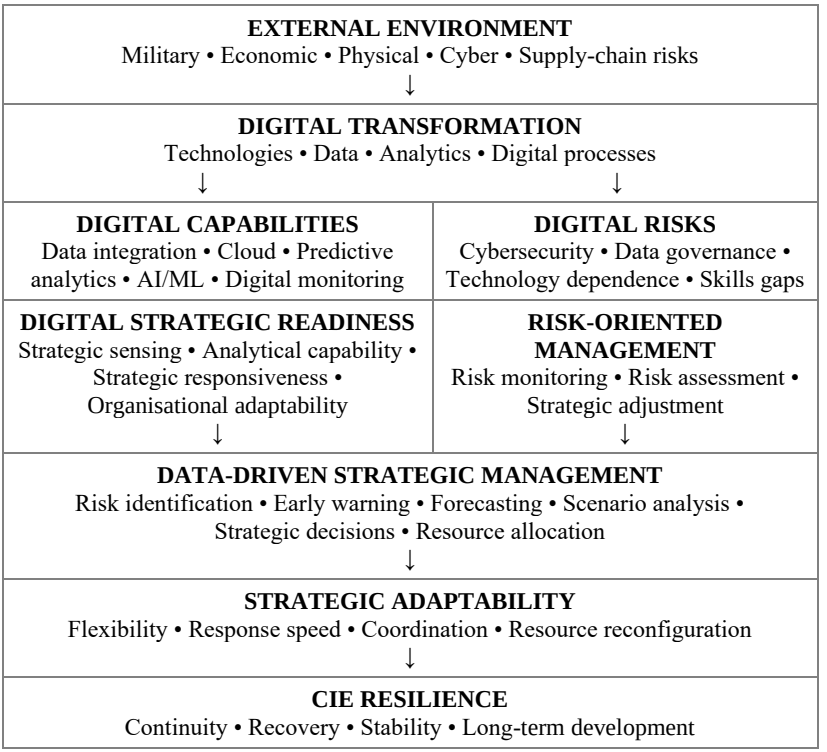


Figure 1. Conceptual framework for integrating digital transformation into the strategic management of critical infrastructure enterprises

Source: developed by the authors based on [2–6]

The framework embeds digital transformation in the strategic management cycle: digital capabilities strengthen strategic sensing, analysis and response, while digital risks remain part of the same management loop. Digital resources are therefore converted into digital strategic readiness, supporting data-driven strategic management, strategic adaptability and CIE resilience.

This approach extends the resource perspective of CIE resilience [3]. In the proposed framework, digital strategic readiness is the central linking capability between digital transformation and data-driven strategic management.

The European Union's resilience framework adopts an all-hazards perspective and emphasizes the capacity of critical entities to prevent, respond to and recover from disruptive incidents [8].

The Ukrainian context increases the relevance of this approach. The OECD emphasizes the need to sustain infrastructure during wartime disruption while preparing for reconstruction and modernisation, with digitalised systems, governance and lifecycle management supporting resilient infrastructure outcomes [9]. Digital transformation should therefore be embedded in broader strategic processes of resilience, modernisation and recovery.

The study concludes that digital transformation should be regarded as a strategic capability-building process of critical infrastructure enterprises, with its contribution to resilience depending on the integration of digital technologies, information and analytics with risk-oriented strategic management. The concept of digital strategic readiness provides a basis for further empirical research into digital maturity, digital resilience and data-driven decision-making.

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