

INNOVATION SYNERGY FOR THE TRANSFORMATION OF ORGANIZATIONS IN THE DIGITAL ERA

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Purpose: The purpose is to study and understand the processes related to integrating extended intelligence into organizational practices and research the role of leadership 4.0 in the formation of strategies, adaptation to technological innovations, and supporting the organization in the digital environment. The work examines the interaction of leadership 4.0 and extended intelligence; the authors found out how these concepts can interact to achieve synergistic effects and improve organizational management.

Design/methodology/approach: The work analyzes modern theoretical approaches to extended intelligence and leadership 4.0, a review of practical cases of real examples of the integration of extended intelligence into organizational practices. The use of analytical methods (Friedenthal et al., 2008) for studying the characteristics of the studied systems contributed to forming a conditional formula (Hájek, 2011; Pollatsek et al., 1987) for expressing the synergy between developed extended intelligence and leadership 4.0. The scope includes research on the impact of concepts on organizational practices and strategic management.

Findings: Integrating extended intelligence into organizational practices opens up new opportunities for efficient use of resources and strategic decision-making. Leadership 4.0 is becoming a key component of digital transformations, requiring flexibility and innovative management. The interaction of leadership 4.0 with extended intelligence creates a synergy that increases efficiency and promotes innovation. The proposed formula reflects the concept of synergy, which can be a success factor in the digital era.

Research limitations/implications: The proposed formula is general and does not consider all aspects of the interaction of extended intelligence and leadership 4.0. It is logical in a conventional form, does not consider specific contexts, and requires empirical research for accurate models.

Originality/value: The study analyzes approaches to integrating extended intelligence into organizational practices and considers leadership 4.0 a key component of digital transformations, focusing on their interaction. The study introduces a conditional formula to conceptualize the synergy between extended intelligence and leadership 4.0. The study can be helpful for managers, leaders, and researchers interested in optimizing organizational processes and achieving competitive advantages in the era of digital transformations.

Keywords: leadership 4.0, extended intelligence, synergy.

Category of the paper: Research paper.

Introduction

Extended intelligence (extended mind) originated in cognitive science and philosophy. The idea suggests that intelligence is not limited to the boundaries of the human organism but can be expanded with the help of tools, technology, and other external resources (Clark et al., 1998). The concept of extended intelligence is based on the idea that intellectual functions can be distributed between the brain (internal space) and external objects (external space) (Barack et al., 2022). Human intelligence and tools form a system that solves tasks and problems together. A classic example of extended intelligence is notebooks, computers, or other means of storing information, which expands the possibilities of memorizing and processing information.

Extended intelligence in the context of artificial intelligence development refers to intelligent systems using large amounts of data and algorithms and interacting with other technologies and external sources to achieve better results (Trakadas et al., 2020). To achieve exceptional results, intelligent technologies use their data and algorithms and actively interact with other technologies and external sources of information. In artificial intelligence development, systems can use vast data for training and analysis. Such data can be obtained from both the organization's internal and external data from various sources, expanding the capabilities of artificial intelligence models.

Extended intelligence also emphasizes the importance of using a variety of algorithms and techniques to achieve optimal results (Bostrom, 2014; Kuzior et al., 2023; Bloom et al., 2016). The importance of interaction with other technologies and systems through integration into organizational processes through intelligent or automated solutions can create additional opportunities to optimize and improve productivity.

Today's leaders use extended and artificial intelligence capabilities to create an innovative environment where technology encourages creativity and solving complex problems (George et al., 2009). This trend promotes the continuous development of staff by providing them with the necessary training and professional development tools. The integration of technologies makes the organization more flexible and adaptable to changes. Leadership can use artificial intelligence and extended intelligence to respond to market and organizational changes quickly, ensuring sustainable competitiveness.

1. Integration of extended intelligence into organizational practices

Integrating extended intelligence into organizational practices is essential in improving cognitive functions and decision-making in modern organizations. Such a process involves using intelligent analytical tools, automation, and other technologies to optimize the organization's work (Ziegler, 2020; Kuzior et al., 2022). Implementing extended intelligence creates opportunities to improve communication and collaboration within an organization. Extended intelligence makes it possible to increase the speed and accuracy of analysis of large volumes of data, which helps to make informed decisions. Artificial intelligence, machine learning, and other analytical tools allow the automation of repetitive tasks, freeing up resources for strategic thinking and a creative approach to tasks.

Integrating extended intelligence into organizational practices defines new standards of efficiency and competitiveness. It helps the organization adapt to the rapid pace of changes in the environment, making it more flexible, reactive, and ready for the challenges of the digital age (Anthony, 2008). Automating routine tasks reduces the burden on workers, allowing them to focus more on their work's creative and strategic aspects. This approach promotes productivity and creates conditions for maintaining a balance between professional and personal aspects of life, improving the quality of working life.

The impact of extended intelligence on organizations' daily activities is directly related to the social integration of artificial intelligence (Abbass, 2019). Implementing innovative analytics tools and automation helps create a more accessible and inclusive environment for all team members. Artificial intelligence can support the adaptation of work processes to the needs of people with different abilities, ensuring a comfortable environment for all employees (Kuzior et al., 2019). The application of intelligent systems promotes the recognition and development of unique skills of each team member, regardless of their social group or specific characteristics.

The social integration of artificial intelligence in organizations is determined by an attempt to combine the power of technology and human capital to achieve common goals. In a certain sense, intelligent systems also play a role as an assistant for leaders in making strategic decisions, providing the necessary analytical basis and forecasts (De Jaegher et al., 2010; Kuzior et al., 2021). Therefore, the social integration of artificial intelligence in organizations contributes to increased efficiency and creates a new level of cooperation and mutual understanding in the team and the interaction of intelligent machines with people (Rupert, 2009).

Extended intelligence allows us to use intelligent analytical tools that help make informed strategic decisions. This enhances the ability to analyze large volumes of data and predict trends, providing the organization with the tools to respond to changes in the internal and external environment flexibly.

2. Leadership 4.0 as a component of digital transformations

Leadership 4.0 is marked by using the latest technologies and management strategies that meet modern challenges and opportunities. The concept of leadership 4.0 provides a new approach to management, considering the impact of digital transformation and modern technologies on organizations (Behie, 2023; Kuzior et al., 2020; Kuzior et al., 2023). Figure 1 visualizes the four main components of this concept.

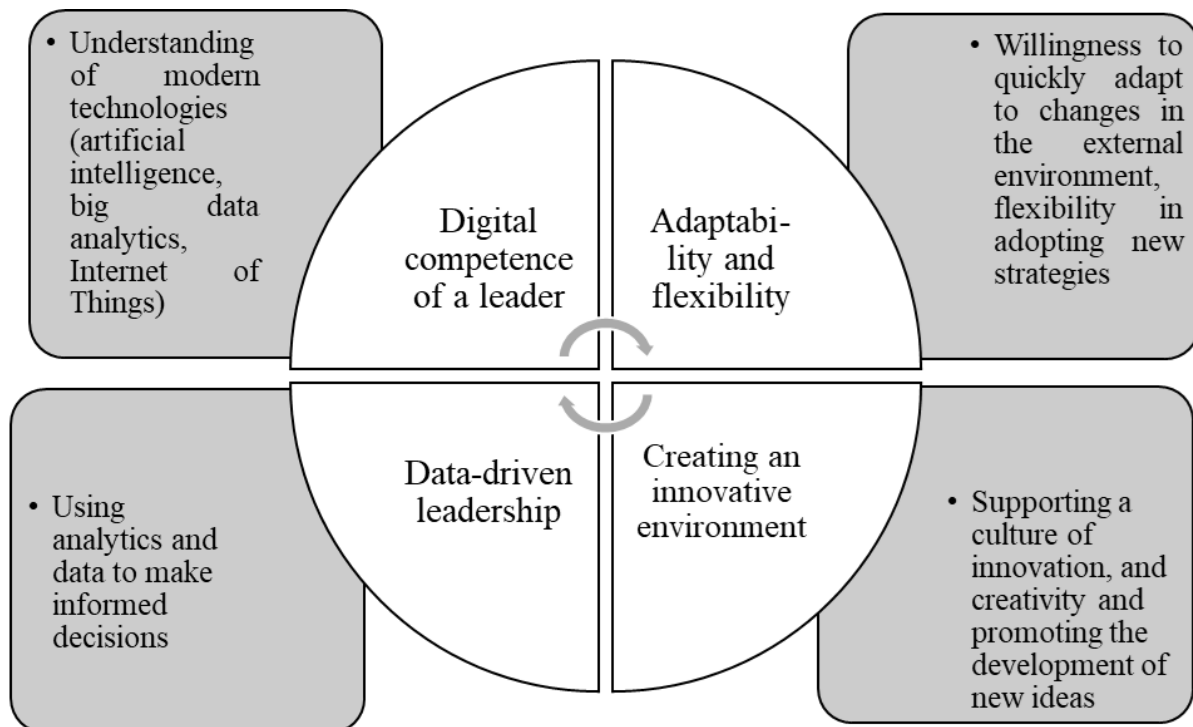


Figure 1. Components of leadership 4.0.

Source: developed by the author.

The described components are separate elements and the main pillars on which the modern concept of leadership 4.0 is based. In the era of rapid technological development and global transformations, leadership 4.0 becomes necessary for effectively managing organizations (Oberer et al., 2018; Bolte et al., 2018). A leader's digital competence determines his ability to understand modern technologies and implement them to improve organizational processes and achieve strategic goals, which means constant updating of knowledge and readiness to integrate innovations. The adaptability and flexibility of a leader are essential qualities in the face of uncertainty and change. The 4.0 leader must be ready to adopt new strategies and respond to real-time changes, ensuring stability and efficiency in all circumstances. Data-driven leadership goes beyond gathering information. Using analytics and data for decision-making makes the manager responsible for processing information and strategically using data to achieve a competitive advantage. Creating an innovative environment supports the development of the organization and stimulates creativity. The 4.0 leader acts as a catalyst for innovation, helping the team to go beyond conventional solutions and implement innovative ideas.

The analyzed components interact to form an integrated leadership strategy 4.0, which is aimed at the effective use of technology, data analysis, and creating an innovative environment, thus ensuring the organization's success in the modern business environment.

Extended intelligence is an essential tool of the 4.0 leader, which adds a new level of intellectual abilities and capabilities to the leadership arsenal in the age of digital transformation. (Luoma-aho et al., 2023) Considering the main components of Leadership 4.0, where it is essential to use advanced technologies and strategies to achieve success in the organization, Extended intelligence becomes a catalyst for realizing the tasks of Leadership 4.0.

3. Interaction of leadership 4.0 with extended intelligence

Studying the effectiveness of different leadership models and their ability to adapt to a dynamic digital environment, considering the factors of extended intelligence. In today's market, several firms successfully exploit the innovative relationships between extended intelligence and leadership 4.0. The companies in Table 1 implement intelligent technologies for effective management and strategic development.

Table 1.

Practical examples of the implementation of advanced intelligence for the development of organizations

Organization	Extended intelligence	Leadership 4.0
Google (Forbes, 2023)	To improve its search algorithms and analytical tools	Active implementation of data in strategic decision-making, based on the analysis of large volumes of data
Amazon (Statista, 2023)	To personalize services, forecast demand, and automate logistics processes	Emphasis on strategic development, taking into account intellectual solutions
Tesla (Forbes, 2022)	For the development of autonomous cars and optimization of production processes	Active support for the introduction of innovations and technological development
IBM (Statista, 2023)	To analyze data, solve complex tasks, and develop strategies for clients (Watson system)	Encouraging internal innovative culture
Microsoft (Forbes, 2023)	To develop its products, including accounts, cloud services and enterprise products	Determination of the development strategy with the active implementation of technological innovations

Source: developed by the author.

The given practical cases demonstrate how modern firms successfully combine extended intelligence and leadership 4.0 to achieve strategic goals and create competitive advantages in the conditions of digital transformation.

The synergy between extended intelligence and leadership 4.0 is determined by the complex interaction of these concepts in the context of effective management and strategic development in the digital transformation era. To simplify the visual transmission of the idea of synergy between extended intelligence and leadership 4.0, such interaction can be conventionally expressed by the following formula:

$$S = (EI + L4.0) \times E$$

where:

S - synergy between Extended Intelligence (EI) and Leadership 4.0 (L4.0).

Synergy is the result of the interaction of extended intelligence and leadership 4.0. In this context, synergy refers to the mutual reinforcement and improvement of the interaction of these two factors, which leads to joint additional efficiency in the organization.

EI - extended intelligence.

Extended Intelligence includes using various technologies, tools, and external resources to improve cognitive functions and decision-making. It may include artificial intelligence, analytical platforms, and other innovative tools.

L4.0 - leadership 4.0.

Leadership 4.0 represents a new approach to management where leaders actively use technology and innovate to adapt to organizational changes. Such leadership includes flexibility, adaptability, and the development of strategies that consider digital opportunities.

(EI + L4.0) - defines the interaction or sum of extended intelligence and leadership 4.0 contributions.

E - efficiency of the organization.

Effectiveness in this context is determined by the organization's success in achieving its goals and objectives using extended intelligence and leadership 4.0. Performance can include financial performance, customer satisfaction, innovation, and other aspects of successful operations. E takes into account the effect of overall efficiency on this interaction.

The proposed formula indicates that the synergistic effect arises from the interaction of extended intelligence and leadership 4.0, and this amount is multiplied by the level of the organization's performance. In the context of this formula, synergy is not simply the sum of the individual elements. However, it can reinforce and mutually support each other, leading to higher effectiveness. The logic of the proposed formula is determined by conceptual convention. It is a generalized analytical model that can be used for theoretical or conceptual description of systems and interactions between their components.

Therefore, the proposed conditional formula expresses the idea that the synergy that arises from the interaction of extended intelligence and leadership 4.0 multiplies the level of organizational performance, emphasizing that these two factors together can provide more significant influence and success in a digital organizational environment.

In the context of the proposed formula, S - can be a critical quantitative indicator since synergy can be measured in percentages or other numerical values that indicate the increase in efficiency due to the interaction of advanced intelligence and leadership 4.0. EI - can be

a qualitative and quantitative indicator, for example, the number of technologies used (the number of artificial intelligence tools) and the quality of their impact on cognitive functions and decisions. L4.0 - indicators can include the number of implemented innovations and the level of flexibility and adaptability of leadership, and it is also possible to measure the number of successful strategic decisions that were made using leadership 4.0 approaches. E – can be a quantitative indicator, such as financial indicators (profit, turnover), but can also include qualitative aspects, such as the level of customer satisfaction, an index of innovation, or indicators of corporate sustainability. It is crucial to consider both indicators (quantitative and qualitative), as they can provide a comprehensive view of the impact of the synergy of extended intelligence and leadership 4.0 on organizational performance.

4. Conclusions

Integrating extended intelligence into organizational practices defines a new stage in business development. Such a process opens up many opportunities for more efficient use of resources and improved strategic decision-making. By providing the organization with intelligent tools operating based on artificial intelligence, it is possible to achieve significant positive changes that contribute to optimizing work processes, increasing personnel productivity, and creating a competitive advantage in the market. In general, the integration of extended intelligence becomes a strategic step in the direction of modern and competitive management of the organization.

Leadership 4.0 acts as a response to digital transformations and a key component determining their success. In a world saturated with technological innovation, it is essential for leaders not only to adapt but also to implement innovative management strategies. Leadership 4.0 involves flexibility, openness to change, and active participation in digital initiatives. Such leaders are critical leaders who guide their teams through transformational processes, ensuring sustainability and innovative development in the digital age environment.

The interaction of leadership 4.0 with extended intelligence creates a solid synergistic effect aimed at achieving high efficiency and innovative development in organizations. Leaders 4.0, showing flexibility and openness to innovation, actively implement advanced intelligence in strategic management and decision-making. Extended intelligence, in turn, gives leaders insight into deep analytical data, contributing to more informed and accurate strategic decisions. Such interaction not only provides the organization with a competitive advantage but also contributes to creating innovative and adaptive leadership to achieve success in the digital transformation era.

The conditional formula $S = (EI + L4.0) \times E$ reflects the concept of synergy between extended intelligence (EI) and leadership 4.0 (L4.0) in terms of overall effectiveness (E). The proposed conditional formula is designed to reproduce and understand the interaction between these critical management and organizational development elements. By combining intellectual capabilities and strategic leadership with a favorable impact on overall efficiency, such a formula indicates the potential for achieving synergistic effects and achieving high results in a dynamic organizational environment.

Such a conditional formula is a simplified abstraction for understanding the meaning of the concept of synergy between extended intelligence and leadership 4.0, and it is also logical in a conditional form. In further studies to build more accurate models and predict fundamental interactions, there is a need to use the obtained specific data and results of empirical studies.

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