Orchestrated Distributed Intelligence in the Context of Organizational Digital Transformation

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Abstract: Digital transformation is fundamentally changing the way organizations operate and requires new approaches. In the 2020s, artificial intelligence (AI) technology is playing an increasingly active role in organizations undergoing digital transformation. However, integrating AI tools as isolated and autonomous systems may not always yield effective and efficient outcomes. In this context, Orchestrated Distributed Intelligence (ODI) is emerging as a new paradigm that integrates AI agents into unified and human-centered systems—going beyond individual AI tools to create orchestrated and integrated intelligence networks. This literature review aims to introduce the concept of ODI and explore its role within organizational contexts, offering a new perspective to ongoing discussions on digital transformation. Moreover, the study's findings provide actionable recommendations for practitioners and policymakers on how ODI can be positioned within digital transformation processes.

Keywords: Digital Transformation, Orchestrated Distributed Intelligence, Artificial Intelligence Integration, Organizational Change, Intelligent Systems, AI Orchestration

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1. Introduction

With the acceleration of digital transformation, the use of advanced digital technologies to fundamentally improve organizational processes and business models has increasingly underscored the necessity for organizations to leverage artificial intelligence (AI). In recent years, AI systems have evolved from performing narrowly scoped tasks to actively participating in the management and execution of holistic and interconnected workflows (Tallam, 2025). However, many organizations still face challenges in obtaining meaningful and measurable outcomes from AI systems. A study conducted by Boston Consulting Group in 2024 found that despite the widespread implementation of AI programs, only 26% of companies have developed the capabilities necessary to generate tangible value (BCG, 2024). The majority, by contrast, have failed to achieve significant returns from their use of AI. This highlights a disconnect between AI investments and organizational outcomes. To address this gap, greater attention must be paid to how AI is distributed and operationalized across organizations.

Orchestrated Distributed Intelligence (ODI) has emerged as a concept aimed at addressing this challenge. ODI is an integrated approach that combines the principles of systems theory with agent-based AI capabilities. Rather than perceiving AI as a collection of isolated and autonomous units, ODI advocates for the positioning of AI agents within a holistic system in which each component interacts synergistically with others (Tallam, 2025). These systems function not as individual super-intelligent agents, but as coordinated teams of AI agents designed to automate complex business processes (Yadav et al., 2025). This approach marks a transformative shift in how organizations design, implement, and manage complex architectures—representing a fundamental evolution from traditional static workflows to dynamic and intelligent distributed systems. AI orchestration addresses critical challenges such as resource optimization, service latency, and system reliability. The technology significantly enhances operational efficiency and reduces the need for manual intervention (Agrawal, 2025). In this context, ODI holds strong potential to become an indispensable tool for modern digital organizations and thus merits further investigation within the context of digital transformation.

This study aims to introduce the concept of ODI within the context of digital transformation and to discuss its role at the organizational level. Drawing on recent developments in the literature, the conceptual, theoretical, and practical dimensions of ODI will be examined, and insights will be provided into how it can be positioned within modern digital organizations. In doing so, the study seeks to contribute a novel perspective to the discourse on digital transformation and to offer actionable recommendations for practitioners and policymakers. To this end, the study first reviews the relevant literature, then examines the concept of ODI within a theoretical framework and illustrates it through application examples. The final section discusses the findings and concludes with recommendations.

2. Digital Transformation

A new technology may not provide substantial benefits to organizations on its own. However, the widespread adoption of new digital technologies can offer significant contributions to organizational performance. These emerging technologies have the potential to transform cost structures by replacing expensive human labor with robots or virtual agents in service delivery or by optimizing logistical flows to reduce supply chain costs. As a result of digital technologies, competition is undergoing a dramatic transformation (Verhoef et al., 2021). In this regard, organizations must undergo digital transformation and ensure the continuity of that process.

Digital transformation is a process that triggers fundamental changes within organizations through the integration of information and communication technologies, enabling improvements in business processes (Vial, 2019). According to Fitzgerald et al. (2013), digital transformation refers to the use of new digital technologies to drive major business improvements, such as enhancing customer experience, streamlining operations, or creating new business models.

This process affects how organizations create, deliver, and capture value (Warner & Wäger, 2019), and often requires a rethinking of strategy and the development of new capabilities (Zhang et al., 2023). The most significant driving force behind digital transformation is the rapid advancement and implementation of AI technologies (Bankins et al., 2023).

3. Artificial Intelligence and the Paradigm of Orchestrated Distributed Intelligence

AI is an emerging technology that has attracted significant attention in both academic research and organizational contexts. In recent years, an increasing number of organizations have implemented or are considering the use of AI applications (Lee et al., 2023; Bankins et al., 2023). While AI cannot replace human reasoning and interpretation, it can significantly support decision-making and task execution by providing faster and more objective responses (D'Amico et al., 2025). AI refers to a set of interrelated technologies designed to perform tasks that would otherwise require human intelligence and to solve problems. It encompasses various techniques such as machine learning (ML), natural language processing (NLP), speech recognition, computer vision, and automated reasoning (Walsh et al., 2019).

In the 2020s, AI has begun to be used effectively in organizational settings, mainly for performing isolated and narrowly defined tasks. However, it is now widely recognized that AI technologies possess the potential to execute more complex and large-scale operations. Therefore, it is essential to assess the role of AI from a strategic perspective within organizational contexts. Strategy involves mobilizing the organization, ensuring the effective allocation of resources, and monitoring implementation. AI is likely to play a role in all these areas. AI has the potential to accelerate and enhance the precision of organizational operations. According to D'Amico et al. (2025), AI can assume five distinct roles in organizations: researcher, interpreter, thought partner, simulator, and communicator.

- Researcher: AI accelerates data analysis for strategists by rapidly collecting and summarizing information from a wide range of sources.
- Interpreter: AI helps narrow down strategic options by transforming information from diverse sources into meaningful insights.

- Thought Partner: AI speeds up idea generation and exposes blind spots by counterbalancing leaders' cognitive biases.
- Simulator: AI enhances the rigor of scenario analyses and suggests adaptive actions during implementation based on early market signals.
- Communicator: AI enables effective communication and consistency by conveying strategic goals in formats tailored to different audiences.

As organizations increasingly adopt AI tools, the tasks they perform with AI are becoming more complex, leading to significant operational challenges. The true value of AI lies in its ability to interoperate and integrate with existing systems and processes. In this context, AI orchestration has emerged as a solution that enables the coordinated use of diverse AI tools. AI orchestration is defined as the process of coordinating different AI tools and systems to ensure they function harmoniously (Malec, 2024). It involves the systematic integration of multiple AI models, general processing tasks, and intricately interwoven logical decisions (Deng et al., 2024). AI platforms overcome integration challenges by orchestrating autonomous agents during the development and deployment of applications. The success of AI technologies in organizational settings depends largely on the orchestration of these AI platforms (Weber et al., 2025). AI orchestration holds the potential to transform how organizations manage and optimize their digital infrastructures (Agrawal, 2025). ODI, as a broader and more systemic concept, can be defined as an integrated AI management approach in which numerous AI agents and data services are orchestrated through a unified platform or framework to support organizational goals in real time (Tallam, 2025). The concept of ODI has been conceptualized by Tallam (2025). Although ODI has emerged as a new concept, it is not an entirely independent structure. It is closely related to fields such as distributed artificial intelligence, multi-agent systems, AI orchestration, and platform ecosystems. These fields provide a foundation for ODI in terms of enabling different AI tools to work together, coordinating workflows, and managing digital systems within a shared structure. Therefore, ODI can be considered an integrative approach that brings together different AI components in the process of organizational digital transformation.

AI orchestration not only overcomes the limitations of traditional approaches but also offers unprecedented capabilities in terms of system intelligence, operational efficiency, and architectural flexibility (Agrawal, 2025). AI platforms often encounter unique orchestration challenges within sector-specific environments (Weber et al., 2025). However, the transition to intelligent and adaptive management systems such as ODI enables organizations to manage increasingly complex distributed environments, while simultaneously reducing operational burdens and improving service quality (Agrawal, 2025). Through advanced orchestration layers and multi-loop feedback mechanisms, ODI transforms static systems into dynamic and action-oriented environments. This approach not only enhances operational efficiency but also addresses critical issues related to scalability, transparency, and ethical decision-making. The adoption of ODI in organizations allows AI systems to become not only more responsive but also better aligned with the complexities of human-centered workflows (Rand, 2025).

The core objectives of ODI can be summarized under three main categories: (1) Enhancing decision-making processes: ODI provides real-time analyses and predictive insights to support managers with data-driven guidance. (2) Improving operational efficiency: By employing interconnected AI agents, ODI automates routine tasks and optimizes organizational processes. (3) Advancing human–AI collaboration: It integrates human intuition and ethical judgment with AI's analytical capabilities, fostering trust, transparency, and acceptability (Tallam, 2025).

The ODI framework is based on three core components (Table 1). (1) Cognitive Intensity enables AI to make context-aware decisions by combining high computational capacity with both statistical learning and symbolic reasoning. (2) Multi-loop Flow allows the system to continuously learn and adapt by integrating short-term responses with long-term strategic planning through interwoven feedback loops.

(3) Tool Dependency enhances scalability, flexibility, and adaptability to innovation by integrating diverse AI tools and modules within a common orchestration layer (Tallam, 2025).

Table 1. The Components of ODI

Component	Description
Cognitive Intensity	Statistical learning + symbolic reasoning = context-aware decision-making
Multi-loop Flow	Short-term response + long-term planning = continuous learning and adaptation
Tool Dependency	Integration of diverse AI tools = flexibility, scalability, and openness to innovation

Source: Adapted from Tallam (2025)

4. Method

This study is conceptual in nature and was conducted as a narrative review. This design was preferred because ODI is a new and still developing topic, with literature spread across fields such as distributed AI, multi-agent systems, AI orchestration, platform ecosystems, and digital transformation. For this reason, a narrative review was considered suitable for bringing together dispersed conceptual, technical, and practice-oriented sources. Accordingly, sources were selected based on their relevance to the organizational use of orchestrated or distributed AI systems rather than publication frequency alone. Narrative reviews not only summarize the existing body of knowledge but also interpret and critically evaluate the literature to generate conceptual findings (Paré, 2017; ATLAS.ti, 2023). Therefore, the projects and case examples identified through the literature review were assessed as findings that reveal the organizational manifestations of ODI highlighted in the literature. The research specifically focuses on examining academic articles, conference proceedings, project reports, and industry reports that emphasize the role of ODI in the context of digital transformation. The inclusion and exclusion criteria used in the source selection process are presented in Table 2.

Table 2. Inclusion and Exclusion Criteria for Source Selection

Inclusion Criterion	Exclusion Criterion
Studies published after 2020 focusing on ODI, AI orchestration, distributed AI, multi-agent systems, platform ecosystems, or the relationship between digital transformation and AI	Studies focusing only on technical algorithm optimization without organizational or managerial implications
Academic articles, conference papers, EU project reports, and reliable industry reports	Blog-type texts with limited conceptual or practical value
Sources showing the relationship of ODI with organizational processes, workflows, governance, scalability, security, or human–AI collaboration	General AI texts with no direct connection to ODI or AI orchestration
European Commission initiatives, industry projects, or organizational application examples	Application examples with unclear sources or low verifiability

Because ODI is still a new concept, this review does not aim to map the entire literature systematically. Instead, it brings together relevant conceptual and practical sources to explain how orchestrated and distributed AI systems can be used in organizational digital transformation.

During the literature review process, indexed sources and academic databases such as Web of Science and Scopus were utilized. Publications from 2020 onward were prioritized using keywords such as "orchestrated distributed intelligence," "AI orchestration," "distributed AI systems," and "digital transformation & AI." In addition, recent reports from institutions such as the European Commission, McKinsey & Company, and the Boston Consulting Group were included as practical examples. The examples and projects identified through this review were presented as findings. In this way, the organizational implications of ODI were analyzed from both theoretical and practical perspectives.

5. Results

In this study, various projects and application cases identified through the literature review have been evaluated as manifestations of the ODI approach at the organizational level. These examples serve as concrete findings that demonstrate the applicability and benefits of ODI across different sectors. Below, recent cases—ranging from European Commission initiatives to industrial solutions—are presented and analyzed.

The AI-aaS Orchestration project, published on the European Commission's Innovation Radar platform, aims to enable the automatic orchestration of distributed AI functions in end-to-end network management. This initiative enhances network operations by making them more intelligent, flexible, and efficient through the coordinated functioning of distributed agents, thereby offering a concrete example of the ODI approach (European Commission, 2023). This case demonstrates that the coordination of distributed AI functions in end-to-end network management enables the delivery of intelligent, flexible, and scalable services.

The study by Mukuhi and Outtagarts (2023) introduces a model called Distributed Intelligent Resource Orchestration (DIRO), which enables low-latency orchestration in microservices-based cloud environments. By leveraging in-memory data grids and distributed resource prediction, the proposed approach achieved up to a 50% performance improvement compared to existing platforms such as Kubernetes, thereby demonstrating the operational benefits of the ODI paradigm (Mukuhi & Outtagarts, 2023). This example illustrates the tangible advantage of ODI in enhancing infrastructure performance.

The model developed within the DAIS Project (2023) addresses the scalability challenges posed by centralized cloud-based architectures in IoT systems by implementing distributed AI orchestration across resource-constrained devices, fog nodes, and the cloud. This approach enabled context-aware data processing, reduced response times by performing computation-intensive tasks locally, and decreased interruptions in critical applications. This example demonstrates how AI orchestration enhances local processing capabilities, reduces latency, and supports continuity in mission-critical use cases.

The AI-SPRINT project presents a computational continuum model that integrates computing resources from centralized data centers to edge devices. This project offers tools to balance performance, energy efficiency, and model accuracy in AI applications while adhering to security and privacy principles. By enabling real-time, adaptive, and efficient AI applications in domains such as personalized healthcare, maintenance monitoring, and agriculture, the project demonstrates the applicability of ODI across diverse digital ecosystems (Politecnico di Milano, 2025). This example highlights how AI orchestration within a computational continuum can achieve balanced optimization among performance, energy efficiency, and model accuracy—anchored in robust security and privacy principles.

The Agentic Workflows solution offered by Orkes integrates AI agents and large language models into enterprise workflows, coordinating them through a higher-level orchestration layer. This allows autonomous decision-making processes to be managed in a secure, auditable, and scalable manner. As a current application that has effectively become a business model for ODI, this solution stands out as a prominent example (Orkes, 2025). This example illustrates how the orchestration of multiple AI agents within enterprise workflows can meet critical governance and accountability requirements by ensuring secure, traceable, and scalable operations.

The ODI approach reveals meaningful implications at both technical and organizational levels through a variety of projects and applications. From the European Commission's AI-aaS Orchestration initiative to Mukuhi and Outtagarts' DIRO model, and from the DAIS and AI-SPRINT projects to Orkes's Agentic Workflows solution, these examples collectively demonstrate ODI's tangible contributions to operational efficiency and processing speed. Furthermore, they show that ODI supports organizational transformation in terms of security, privacy, scalability, and human–AI collaboration. In this context, ODI emerges as a high-potential paradigm—proven to be applicable across diverse sectors, enabling digital transformation, and shaping the digital organizations of the future. To strengthen the analytical structure of the findings, the selected projects and application examples were compared according to their main ODI logic, organizational contribution, and potential limitations. The comparative analysis is presented in Table 3.

Table 3. Comparative Analysis of ODI-Related Projects and Applications

Case / Project	Primary ODI logic	Organizational contribution	Main risk / limitation
AI-aaS Orchestration	Distributed AI functions in network management	Intelligent, flexible, scalable service management	Network governance and reliability dependency
DIRO	Distributed resource orchestration	Lower latency and improved infrastructure performance	Technical complexity and integration burden
DAIS Project	Edge–fog–cloud AI orchestration	Local processing, continuity, reduced response time	Security and device-level constraints
AI-SPRINT	Computing continuum orchestration	Balance between performance, energy efficiency, accuracy, privacy	Multi-level coordination and privacy trade-offs
Orkes Agentic Workflows	Enterprise-level agentic workflow orchestration	Secure, auditable, scalable AI workflows	Accountability, auditability, and human oversight needs

When the cases are compared, three common outcomes can be observed. First, ODI improves operational efficiency by reducing delays, improving resource use, and automating complex business processes. Second, it supports easier system scalability by enabling AI functions to work together across different infrastructures. Third, this structure creates new governance needs. Distributed AI agents must be monitored, audited, and managed in alignment with human decision-making. Therefore, the value of ODI comes not only from technical integration, but also from the ability to manage this structure in a safe, responsible, and auditable way.

6. Discussion and Conclusion

This study highlights the existing gaps that hinder the effective organizational-level use of AI during the digital transformation process and proposes ODI as a holistic approach capable of addressing these shortcomings. The literature and organizational examples related to the concept demonstrate that ODI can move beyond isolated and standalone AI applications by enabling the formation of interconnected and coordinated AI networks—thus facilitating organizations' efforts to achieve their digital transformation goals. Through the ODI approach, AI technologies can operate in real-time alignment with the organization's overall strategy and workflows. As a result, organizations can attain greater operational efficiency and make data-driven decisions more quickly. In this regard, ODI plays a critical role in digital transformation—not only by supporting the adoption of new technologies, but also by enabling their translation into tangible organizational value.

ODI lays the groundwork for organizations to derive tangible benefits from their AI investments. According to a 2024 study by Boston Consulting Group, only 26% of companies have achieved a competency level sufficient to generate meaningful value from AI adoption (BCG, 2024). The ODI approach aims to close this capability gap by orchestrating AI tools and systems, thereby accelerating the conversion of AI investments into measurable returns.

The example projects and applications discussed in this study demonstrate that the principles of ODI can be applied across diverse sectors and environments, yielding tangible benefits. These cases indicate that ODI is not merely a theoretical concept but a practical approach capable of driving progress in areas such as operational speed, scalability, reliability, security, and human–AI collaboration. In this context, ODI holds the potential to provide organizations with a competitive advantage in the digital transformation process and to become one of the foundational building blocks of future digital enterprises.

Although ODI offers important opportunities, it may also bring some organizational risks. First, in structures where multiple AI agents work together, it may become unclear who is responsible for the decision. In addition, because these systems depend on continuous data flows across different platforms, models, and organizational units, they may require additional measures for security and privacy. Governance problems may also arise when monitoring, auditing, human oversight, and intervention authority are not clearly defined. Finally, excessive trust in AI-generated outputs may weaken human judgment among employees or managers. Therefore, ODI should not be considered only as a technical system; it should also be addressed together with a governance approach that includes transparency, explainability, accountability, cybersecurity, and human control.

There is currently limited research on the concept of ODI. This study has approached the topic from a business management perspective, offering a conceptual framework; however, due to its managerial focus, it does not delve deeply into the technical implementation details. The concept of ODI is largely grounded in the work of Tallam (2025), which remains in preprint form and has not yet undergone peer review. As such, some of the recent examples and findings included in this study have been drawn from non-peer-reviewed sources. This highlights the need for further scientific research and evidence-based investigations into ODI to strengthen its theoretical and practical foundations.

In summary, the ODI approach can be regarded as a critical paradigm in the digital transformation process — one that integrates technology with a holistic strategy and has the potential to shape organizations' future competitive advantage. Several recommendations have been developed to support the effective implementation of ODI and to guide further research in this domain:

For Researchers: Multidisciplinary research in the field of ODI should be actively encouraged. Future studies should aim to elaborate on the concept of ODI in greater depth and examine its applications across various sectors to enable the measurement of its tangible benefits. In particular, empirical studies will be essential in strengthening the academic foundation of the concept. Furthermore, cross-disciplinary projects that integrate engineering and management perspectives should focus on developing and testing AI orchestration platforms. This would facilitate the generation of more comprehensive data regarding the technical and organizational performance of ODI systems.

For Policymakers: To support the broader adoption of the ODI approach, decision-makers should develop policies aimed at enhancing digital infrastructure and establishing integration standards. Moreover, ethical and legal frameworks must be implemented to ensure accountability and safeguards in systems where multiple AI agents make autonomous decisions. At the public sector level, support programs and incentives—such as R&D grants and tax reductions—should be introduced to encourage businesses to experiment with innovative approaches like ODI, thereby accelerating the pace of this transformation.

For Practitioners (Businesses): Companies should revisit their digital transformation strategies and shift from using AI as isolated tools toward adopting a holistic orchestration strategy. To operationalize the

ODI concept, organizations must first ensure that various departments and processes are prepared for AI integration. Businesses should implement training and change management programs to build internal AI orchestration capabilities The success of ODI depends significantly on the readiness of the workforce for this transformation. Small-scale pilot projects should be launched to test scenarios in which multiple AI tools operate in an integrated manner, and successful implementations should be scaled across the organization. Moreover, companies must maintain a human-centered approach. Decisions and recommendations generated by ODI systems should always involve human oversight and approval. In this way, the speed and efficiency offered by ODI are coupled with reliability and adherence to ethical values, thereby supporting a more sustainable digital transformation.

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Authors contributions

Sebahattin KILINÇ, Mehmet Alper AKDEMİR, and Murat SAĞBAŞ contributed equally to this work.

Statements and Declarations

Ethical Considerations

Not applicable.

Consent for Publication

All authors consent to the publication of this manuscript.

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