A Practice-Based Governance Framework for Managing Digital and Sustainable Transformation

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The dual transformation towards sustainability and digitalization confronts manufacturing companies with complex and often conflicting governance demands. Although governance is increasingly seen as a key enabler of organizational change, existing approaches rarely address the integrated challenges of simultaneous sustainability and digital transformation. We present a practice-based Dual Governance Framework that supports organizations in strategically embedding and operationalizing dual transformation. Developed through iterative design science research, the framework builds on academic literature, stakeholder input from a multi-partner research consortium, and insights from industry pilot projects. It identifies six governance areas, including integrated business strategy and compliance, and links them to six overarching principles such as stakeholder integration and transparency. To facilitate operationalization, we introduce the Dual Governance Map that enables structured reflection across governance domains and supports context-specific development. The framework provides a coherent and actionable governance architecture that bridges theory and practice and supports dialogue with internal and external stakeholders.

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1 Introduction

Manufacturing firms are confronted with a concurrent acceleration of digital and sustainability transformations. Rapid advances in digital technologies are reshaping products, processes, and value creation logics, while regulatory developments, stakeholder expectations, and societal demands increasingly require companies to embed environmental and social considerations into their core strategies. At the European policy level, initiatives such as Industry 5.0 and the expansion of ESG-related regulation signal that competitiveness, resilience, and sustainability are no longer treated as separate agendas, but as interdependent dimensions of industrial development (Broccardo, Zicari, et al., 2023; EC DG RTD, 2022; Rehman & Umar, 2025). A growing body of literature has emerged to capture this increasing entanglement of technological and sustainability-oriented change processes, conceptualized under multiple terms – such as Twin Transformation, Double Transformation, and Dual Transformation (Epp et al., 2025; Hinsen et al., 2023; Hofmann et al., 2024; Kürpick et al., 2023). While these concepts differ in scope and emphasis, they converge in recognizing that digitalization frequently acts as an enabler of sustainability objectives, and that sustainability considerations increasingly shape the direction of digital innovation (Epp et al., 2025; Hahn et al., 2014).

However, this interdependence does not only generate synergies; it also produces tensions, trade-offs, and coordination challenges. Digital investments may prioritize efficiency, speed, and competitive advantage, while sustainability objectives emphasize long-term resilience, stakeholder inclusion, and environmental responsibility. These potentially competing priorities create conflicts in resource allocation, accountability structures, and performance measurement systems. Managing dual transformation – understood as the strategic integration and mutual interdependence of digitalization and sustainability within firms (Epp et al., 2025; Kürpick et al., 2023) – is therefore not merely a matter of coordinating two parallel change initiatives. Rather, it requires embedding both transformation logics within a coherent governance architecture that structures decision rights, allocates responsibilities, aligns incentives, and ensures accountability across organizational levels (Naciti et al., 2022; OECD, 2023). Existing contributions predominantly focus on technological enablement or strategic alignment, while the institutional and structural implications for corporate governance (CG) remain comparatively underexplored (Epp et al., 2025; Kürpick et al., 2023).

Governance has long been recognized as central to the integration of sustainability into corporate strategy, particularly through mechanisms such as board oversight, transparency, stakeholder engagement, and strategic alignment (Christensen et al., 2014; E-Vahdati et al., 2019). In parallel, research on digital transformation emphasizes that effective transformation depends on governance structures, processes, and relational mechanisms that extend beyond traditional IT control frameworks (Jewer & Van Der Meulen, 2022; Spremic, 2017). Yet these governance discourses have largely evolved along separate trajectories: Sustainability governance frameworks rarely integrate digital decision architectures, while digital governance models rarely embed ecological and social objectives as core steering dimensions (Cordero et al., 2020; Hba & Manouar, 2017). This separation creates a critical void: Dual transformation is increasingly recognized as a strategic necessity in manufacturing contexts (Epp et al., 2025; Kürpick et al., 2023) confronting firms with the need to coordinate interdependent transformation processes and adapt their governance architecture accordingly. At the same time, no integrative governance framework currently provides systematic guidance for developing a coherent governance design capable of aligning strategic intent, operational execution, and stakeholder accountability across both domains. Against this backdrop, this paper addresses the following research question:

How can corporate governance (CG) be tailored to address the specific requirements of managing sustainability and digitalization in manufacturing companies?

To answer this question, we introduce the Dual Governance Framework, developed within the publicly funded research project "DualStrat". The project was conducted in close collaboration with companies from the manufacturing industry, a sector that is particularly central to sustainability transitions and digital transformation alike. Manufacturing firms combine high environmental impact with complex value chains, capital-intensive production systems, and substantial potential for digital automation and process optimization (Schreiner et al., 2024). Against this background, manufacturing firms can be expected to face strong regulatory and stakeholder pressures, while simultaneously possessing significant technological leverage to shape sustainability outcomes. In this context, the integration of sustainability and digitalization becomes strategically decisive, making manufacturing a particularly insightful setting for the development and testing of integrative governance approaches. Building on a conceptual Reference Model of

Dual Transformation (Epp et al., 2024), a systematic literature review (SLR) (Epp et al., 2025), and empirical insights (Kürpick et al., 2024), the framework specifies six governance areas and six overarching principles that jointly operationalize governance for dual transformation. Complementary instruments – including the Dual Governance Map and an extended RAECI matrix – support practical implementation and responsibility alignment. By systematically integrating sustainability and digitalization into a coherent governance framework, this paper contributes both conceptual clarification and actionable guidance for manufacturing firms navigating dual transformation.

2 Background

2.1 Dual Transformation

The parallel acceleration of digitalization and sustainability imperatives has generated new types of strategic and organizational challenges in contemporary manufacturing. Digital technologies enable real-time data processing, process automation, predictive analytics, and the development of new data-driven business models, thereby reshaping operational performance and value creation logics (Baskerville et al., 2020). At the same time, sustainability has evolved from a predominantly regulatory or compliance-driven concern into a strategic imperative that directly influences innovation trajectories, organizational design, and CG structures (Christmann et al., 2024; Epp et al., 2025; Hahn et al., 2014).

Despite their strategic relevance, both transformation logics are frequently pursued in isolation, resulting in fragmented strategies, misaligned priorities, and unrealized synergies (Barth et al., 2023; Broccardo, Truant, et al., 2023; Santarius et al., 2023). This fragmentation can manifest in digital investments that are weakly aligned with sustainability goals, or in sustainability initiatives that lack scalability due to insufficient governance integration (Flyverbom et al., 2019). In response, a growing body of literature has introduced different concepts to capture the increasing interdependence between digitalization and sustainability. Research distinguishes between two complementary directions of dual transformation: (1) sustainable digitalization, where digital technologies enable sustainability outcomes (e.g., data-driven circularity, platform-based energy optimization), and (2) digital sustainability, where digital transformation itself is governed by ecological and social standards.

While mutually reinforcing, these directions also generate tensions, trade-offs, and coordination demands that challenge linear or siloed approaches to strategic management (Epp et al., 2025; Hahn et al., 2014; Scherer et al., 2018).

To address their interrelation more explicitly, broader umbrella terms such as Twin Transformation and Double Transformation have emerged. Twin Transformation typically refers to the parallel and coordinated advancement of digital and sustainability transformations to leverage synergies and increase efficiency (Hinsen et al., 2023). Double Transformation is framed at a systemic level, highlighting digitalization as an enabler of a comprehensive socio-economic realignment toward sustainability goals (Hofmann et al., 2024). Building on this evolving discourse, we use the term Dual Transformation (Epp et al., 2025; Kürpick et al., 2023) to emphasize the strategic integration and mutual interdependence of digitalization and sustainability within firms. Rather than treating them as parallel change processes, Dual Transformation conceptualizes both dimensions as reciprocally reinforcing and governance-relevant transformation logics that must be deliberately aligned at the strategic and organizational level.

2.2 Towards Dual Governance

As informational flows intensify and digital infrastructures permeate economic and societal systems, governance processes themselves are reshaped. Governance is no longer solely based on hierarchical control and authoritative resources, but increasingly structured through data flows, interconnected actors, and digitally enabled coordination (Soma et al., 2016; Varoglu et al., 2021). This development is particularly relevant in sustainability contexts, where environmental challenges such as climate change or resource depletion require complex, multi-actor governance arrangements under conditions of uncertainty and time lags (Soma et al., 2016; Underdal, 2010). However, existing governance approaches often struggle to adequately address these evolving coordination demands, which makes it necessary to critically revisit dominant CG paradigms and their underlying assumptions. Despite its widespread use, CG is not defined uniformly; instead, it reflects a plurality of theoretical traditions that differ in their conceptualization of accountability, control, and organizational purpose.

In its classical understanding – particularly prevalent in the Anglo-American context – CG is rooted in agency theory, conceptualizing the relationship between owners (principals) and managers (agents) as one of potential conflict and information asymmetry (Jensen & Meckling, 1976). Hence, governance seeks to ensure that managers act in the interest of shareholders and maximize profit, often through control mechanisms, incentives, and monitoring systems (Shleifer & Vishny, 1997). This perspective has shaped both academic theory and policy frameworks for decades, emphasizing compliance, fiduciary responsibility, and board effectiveness (Naciti et al., 2022; OECD, 2023). Over time, this shareholder-centric perspective has been expanded and complemented by alternative theoretical perspectives. Stakeholder theory reconceptualizes governance as a mechanism for balancing heterogeneous interests and enhancing organizational legitimacy (Freeman, 1984). Stewardship theory challenges assumptions of opportunistic behavior by portraying executives as intrinsically motivated stewards pursuing long-term organizational goals (Donaldson & Davis, 1991). Social contract theory embeds governance within a broader societal context, framing organizational legitimacy as derived from implicit public expectations (Donaldson & Dunfee, 1999). Strategic governance perspectives further extend this view by positioning governance as a source of competitive advantage (Porter & Kramer, 2006), contributing to resilience, credibility, and adaptability in dynamic environments (Lanfermann, 2023).

Across these perspectives, governance is increasingly understood not merely as a legal or institutional arrangement, but as a normative and strategic architecture (Manning & Reinecke, 2016) that structures decision-making, allocates responsibilities, and enables coordination across organizational boundaries. Core governance functions include defining roles and accountabilities, shaping incentive systems, embedding stakeholder integration, safeguarding integrity and compliance, and managing complexity and risk (E-Vahdati et al., 2019; Manning & Reinecke, 2016; OECD, 2023). This broadened understanding of governance has been further institutionalized through the rise of Environmental, Social, and Governance (ESG) frameworks. Emerging in the early 2000s through a United Nations led initiative, ESG criteria have become central reference points for responsible investment, regulatory development, and the assessment of corporate conduct (UN Global Compact, 2004; UNEP, 2005). ESG frameworks formalize expectations regarding how organizations integrate environmental and social considerations into strategic

decision-making and operational practices, while explicitly positioning governance as the enabling dimension that translates normative goals into organizational action.

Within ESG, the "G" dimension has gained renewed prominence. Rather than being limited to formal compliance or reporting structures, governance is increasingly defined in comprehensive terms. As part of the EU's sustainable finance framework, ESRS-G1 ("Business Conduct") encompasses corporate culture, anti-corruption measures, supplier relationships, political engagement, payment practices, and grievance mechanisms (Lanfermann, 2023). Recent literature highlights that such regulatory standards are increasingly shaping internal governance design, not just in response to legal demands but also as a strategic instrument to meet stakeholder expectations and support systemic transformation (E-Vahdati et al., 2019; Naciti et al., 2022). Governance is thus framed as a driver of ethical behavior, strategic coherence, and long-term value creation, extending well beyond traditional board-level oversight.

Parallel to this institutional development, academic research on governance for sustainability has emphasized the need to embed ecological and social considerations directly into governance systems. Concepts such as the triple bottom line (Elkington, 2006) and green governance (Debbarma & Choi, 2022) call for integrative governance models that reconcile economic performance with environmental stewardship and social responsibility. At the same time, digitalization has introduced new governance challenges. While IT governance frameworks such as COBIT, ISO/IEC 38500, TOGAF, and ITIL 4 provide detailed guidance for steering information systems, they often remain disconnected from broader sustainability strategies (Cordero et al., 2020). Governance mechanisms for digital transformation (DT), as highlighted by Jewer & Van Der Meulen (2022), must extend beyond IT-specific structures to address cross-functional synergies, dynamic environments, and organization-wide strategic alignment. They argue that traditional IT governance logics – overly hierarchical, functionally siloed, and focused on compliance – do not suffice for DT, which demands horizontal coordination, real-time adaptability, and cultural transformation.

The separation of governance logics between sustainability and digital transformation has created strategic and practical blind spots. Sustainability governance research emphasizes normative orientation, stakeholder integration,

leadership commitment, and transparency, while digital governance research focuses on technological coordination, structural agility, and cross-functional integration. Both streams offer valuable insights, yet they remain insufficiently integrated. For manufacturing firms undergoing dual transformation, this separation is increasingly challenging. Digital infrastructures shape sustainability performance through data transparency, traceability, and process optimization, while sustainability objectives influence digital investment priorities, innovation pathways, and risk governance. Governance must therefore reconcile technological decision architectures with environmental and social accountability structures.

Existing frameworks address these challenges only partially and in isolation. IT governance frameworks such as COBIT provide structured guidance for digital steering and control, yet remain largely disconnected from sustainability strategies (Cordero et al., 2020; De Haes et al., 2020; Hba & Manouar, 2017). Sustainability governance research emphasizes normative orientation, stakeholder integration, and board-level accountability, but does not systematically incorporate digital decision architectures (E-Vahdati et al., 2019; Naciti et al., 2022). Studies at the intersection of both domains point toward the need for integration (Jewer & Van Der Meulen, 2022; Manning & Reinecke, 2016; Soma et al., 2016), but do not currently provide an operationalizable framework tailored to the requirements of dual transformation.

Addressing these challenges requires a governance logic that bridges normative orientation and operational control, stakeholder engagement, and digital enablement. Governance must therefore be conceptualized as a dynamic coordination and control system capable of reconciling competing objectives, managing trade-offs, and supporting organizational learning across domains. In response, we introduce the concept of Dual Governance as an integrative governance architecture that jointly addresses sustainability and digitalization. Dual Governance extends foundational CG principles to support multidimensional value creation through adaptive structures, clearly defined roles and responsibilities, and digitally supported transparency and accountability mechanisms. By embedding sustainability considerations into digital decision-making – and vice versa – Dual Governance provides a conceptual foundation for overcoming fragmentation and strategically steering dual transformation in manufacturing organizations.

3 Method

The Dual Governance Framework presented in this paper emerged from a design-oriented and iterative development process that deliberately integrates conceptual reasoning with practical requirements. Rather than following a linear development logic or relying on a single empirical study, the framework evolved through successive cycles of reflection, conceptual refinement, and tool development, continuously informed by dialogue with academic peers and practitioners from manufacturing companies. Methodologically, this approach is grounded in Design Science Research (Gregor & Hevner, 2013; Hevner et al., 2004; March & Smith, 1995), which emphasizes the intertwined pursuit of relevance and rigor through iterative design, evaluation, and refinement in response to real-world problem contexts. The research architecture that informed the Dual Governance Framework is built in three layers (see Fig. 1): (1) A knowledge base, formed by an SLR (Epp et al., 2025) and supplemented with exploratory interview insights (Kürpick et al., 2024); (2) The conceptual Reference Model (Epp et al., 2024); (3) and the Dual Governance Framework as a guideline for organizations to embed and strategically operationalize dual transformation.

The Knowledge Base is grounded in an SLR (Epp et al., 2025) that consolidates scholarly work situated at the intersection of digitalization and sustainability within the field of strategic management. The SLR (n = 74) underscores both the pressing relevance of this research area and the fragmented nature of existing debates, revealing a notable absence of integrative and practically applicable frameworks that address dual transformation in a comprehensive and strategic manner. While a substantial body of literature recognizes digitalization and sustainability as key forces shaping organizational change, only a limited number of studies explicitly examine their interaction or offer structured guidance for their joint incorporation into corporate strategy. To complement the insights derived from the literature, qualitative interviews with practitioners (n = 11) were conducted to obtain practice-oriented perspectives on capability requirements, enabling factors for change, and organizational tensions inherent in transformation processes (Kürpick et al., 2024). The purpose of these interviews was to support the conceptualization of a maturity model for dual transformation. In doing so, they contribute to identifying gaps in prevailing strategic models and to refining the operational understanding of dual

transformation as a challenge rooted in both capabilities and processes (Kürpick et al., 2024).

The Reference Model for Dual Transformation (Epp et al., 2024) delineates the strategic rationale underlying dual transformation by building a shared understanding of what dual transformation contains and integrating perspectives from strategic management, transformation theory, sustainability science, and digitalization research. Accordingly, the model provides the conceptual foundation of the Dual Governance Framework by embedding strategic choices within a holistic, multidimensional view of transformation demands while delineating the substance of the dual transformation itself. The model thus serves as a starting point for analyzing the concrete mechanisms required to purposefully structure and effectively steer dual transformation. Consequently, the model is – both conceptually and visually – incorporated into the framework's background (Fig. 1 and 3).

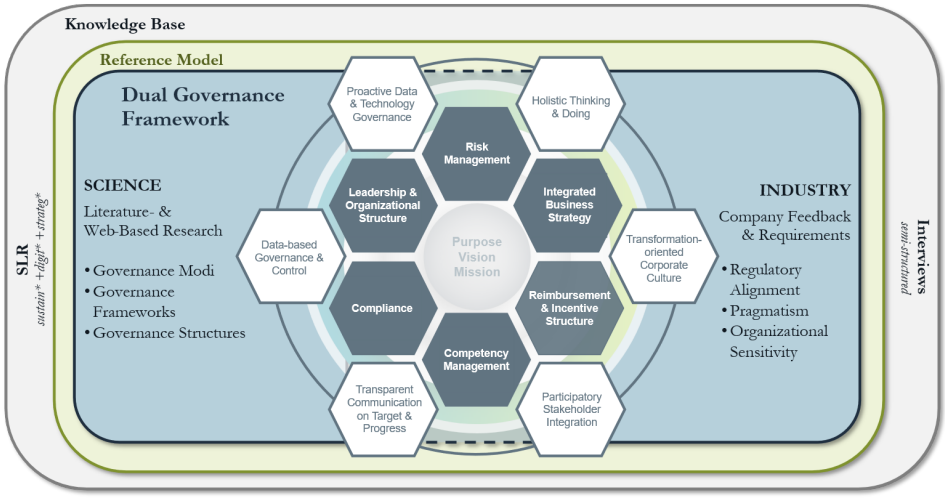

Figure 1: Research Strategy
Source: own.

The Dual Governance Framework draws on the above outlined research and supports organizations in strategically embedding and operationalizing dual transformation. Its design logic was shaped by two complementary strands: theoretical-conceptual inspirations on the one hand, and normative-practical requirements from industrial application on the other (Fig. 1). On the conceptual

side, the framework builds on the Organisation for Economic Co-operation and Development (OECD) Principles on CG, which include key aspects such as quality of data, sustainability, risk management, and resilience (OECD, 2023). We furthermore included established governance frameworks such as COBIT (De Haes et al., 2020; Mangalaraj et al., 2014), as well as on the principles of design science research (Hevner et al., 2004; March & Smith, 1995). On the normative-practical side, the framework was iteratively refined through structured stakeholder input from the multi-partner research consortium. The aforementioned models contributed important impulses, including modular structuring, lifecycle orientation, and clearly defined roles and responsibilities. However, none of them sufficiently capture the complexity, interdependence, and dynamic openness that characterize dual transformation processes in real-world organizational settings.

To address this gap, the project team initiated an iterative design process (Fig. 2) aiming to adapt and extend the latest COBIT framework in alignment with the OECD principles and preliminary conceptual work on dual transformation. The development followed a cycle of consortium workshops and industry feedback loops, through which successive interim versions of the framework were conceptually refined and continuously adjusted considering practical input. Within the research consortium, scholarly perspectives from IT governance, circularity, and transformation research were integrated to shape the conceptual architecture of the framework. Ongoing exchange with industry partners ensured that theoretical coherence and practical applicability evolved in parallel. In particular, the primary industry partner, a globally active medium-sized enterprise in the field of industrial engineering, played a significant role in co-shaping the framework. Through regular feedback loops, the company articulated specific expectations that influenced the model's development. These included a clear demand for regulatory compatibility, especially considering the European Sustainability Reporting Standards (ESRS); a pragmatic, low-barrier design with a high degree of agility and proximity to practice; and a holistic perspective that considers not only structures and processes, but also people, culture, and informal power dynamics.

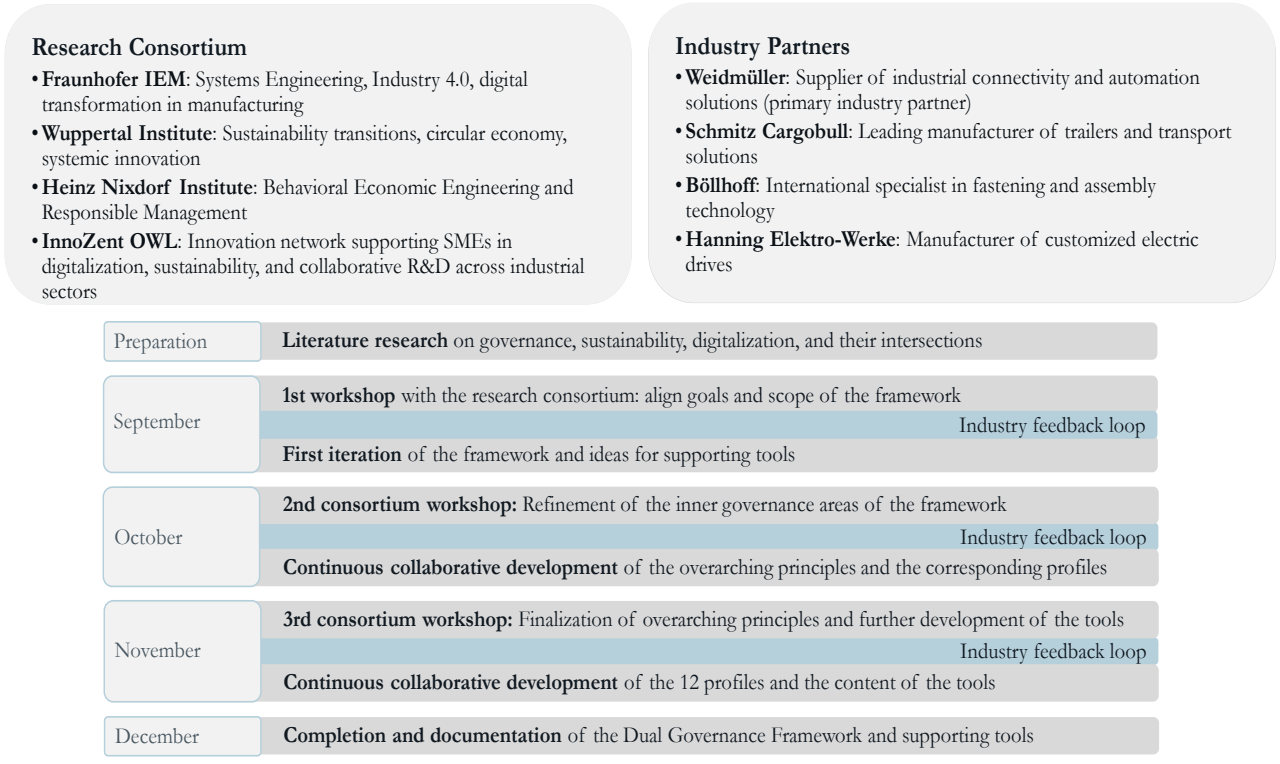

Figure 2: Research Process
Source: own.

Throughout this development process, theoretical insights and practical considerations were not treated as separate inputs but were continuously interwoven. Ultimately, the Dual Governance Framework is a product of methodological pluralism, iterative design, and embedded co-reflection. It serves not just as a coherent and actionable governance framework with its related tools such as the Dual Governance Map but also as a bridge between theory and practice for aligning decision-making structures, responsibilities, and cultural practices with the demands of dual transformation.

4 Results

In the following, the core outcomes of the design process are presented: the Dual Governance Framework as a general governance foundation for sustainability and digitalization transformation, along with the profiles of the 12 elements, and the Dual Governance Map as an instrument for operationalizing the intersections of dual transformation. Additionally, we developed an extended RACI-matrix that enables the definition of and reflection on governance roles.

4.1 The Dual Governance Framework

Figure 3: Dual Governance Framework
Source: own.

The Dual Governance Framework (see Fig. 3) builds on the conceptual foundations laid by the Reference Model for Dual Transformation (Epp et al., 2024), operationalizing its strategic intent into concrete governance architecture. It reframes governance not as a compliance tool but as a strategic coordination system that integrates sustainability and digitalization as mutually reinforcing transformation logics. Rather than managing both agendas separately, the framework facilitates their convergence through aligned responsibilities, structures, and capabilities. Its architecture follows a dual-layered logic: at the core, six interrelated Governance Areas define key structural domains for organizational steering. These are surrounded by six Overarching Principles, which guide the implementation and contextual adaptation of each area. The circular form of the model illustrates the dynamic interplay between content (what needs to be governed) and principle-based process design (how governance should be enacted). Importantly, the framework is not intended as a prescriptive blueprint. Instead, it provides a modular and adaptable orientation that supports self-assessment, prioritization, and iterative development of governance structures in line with dual transformation requirements. The central positioning of Purpose, Vision, and Mission reflects the framework's normative foundation, while its design logic fosters both strategic coherence and practical applicability across diverse organizational contexts.

The Dual Governance Framework comprises six interrelated Governance Areas that jointly structure the strategic implementation of sustainability and digitalization. **(1) Risk Management** embeds systematic processes that explicitly incorporate sustainability- and digitalization-related risks, including reputational, climate-related, and technological risks, thereby using dual transformation as a lever to enhance organizational resilience through early detection, clear escalation pathways, and adaptive response mechanisms. **(2) Integrated Business Strategy** structurally anchors sustainability and digital transformation within the corporate mission, strategic objectives, and action plans, while governance ensures coherence across organizational levels by aligning these elements with overarching steering and control concepts and avoiding fragmentation or short-term optimization. **(3) Reimbursement & Incentive Structures** align monetary and non-monetary incentives with long-term sustainability and digitalization goals, for example through ESG-linked targets or variable compensation components, with governance safeguarding their effectiveness, consistency, and fairness, including at executive and top-management levels. **(4) Competency Management** focuses on the systematic

development of sustainability and digital competencies within a proactive learning culture, defining role-specific qualification requirements, supporting continuous learning across individual, team, and organizational levels, and institutionalizing adaptability and change capability as core competencies. **(5) Compliance** ensures adherence to legal, ethical, and strategic standards through clear responsibilities, transparency, and effective control mechanisms that mitigate risks such as greenwashing or bluewashing. Finally, **(6) Leadership & Organizational Structure** establish clear accountability, roles, and decision-making processes, embedding sustainability and digitalization at board level and integrating them across functional and divisional boundaries to translate strategic intent into coordinated organizational action.

These Governance Areas are guided by six Overarching Principles that shape their implementation and ensure practical applicability in line with the requirements articulated by our industry partners as well as strategic coherence. **(1) Holistic Thinking & Doing** promote cross-functional and cross-level integration, overcoming siloed structures through systemic alignment of strategy, structure, and culture. A **(2) Transformation-oriented Corporate Culture** fosters openness, learning, and iterative development, enabling organizations to experiment with and refine novel approaches. **(3) Participatory Stakeholder Integration** ensures early and continuous involvement of relevant internal and external stakeholders, enhancing legitimacy and leveraging collective intelligence. **(4) Transparent Communication on Target & Progress** supports credibility and trust by making governance objectives and outcomes comprehensible beyond formal disclosure requirements. **(5) Data-based Governance & Control** ground decision-making in reliable data, clear responsibilities, and traceable control mechanisms to support sustainable value creation. Finally, **(6) Proactive Data & Technology Governance** ensures data quality, responsible technology use, and secure, scalable digital infrastructures as key enablers of dual transformation.

Complementing the framework, each governance area as well as the overarching principles are described through a dedicated profile, totaling 12 profiles tailored to the German industrial context[1]. These profiles provide both concise summaries and in-depth information, including key tasks and enablers, typical challenges, references

[1] This can be found in the online appendix on pages 7 to 30.

to further sources as well as practical impulses derived from real-world implementation examples. Taken together, the Dual Governance Framework delineates how organizations can systematically govern the interdependencies between sustainability and digitalization, translating strategic intent into resilient structures, capabilities, and decision-making processes.

4.2 The Dual Governance Map & Roles

To facilitate the practical implementation of the Dual Governance Framework, we developed the Dual Governance Map and an adapted RAECI-Matrix as complementary tools that support strategic reflection and organizational learning. The map visualizes the interaction between the framework's six Governance Areas (columns) and its six Overarching Principles (rows) in the form of a 6×6 matrix (see Fig. 4). Each of the 36 fields represents a specific intersection where structural steering domains and normative principles converge – providing a space to reflect on how sustainability and digitalization are governed in practice. It serves as an orientation and dialogue tool: It supports organizations in examining their current governance architecture, identifying blind spots or tensions, and initiating structured conversations about development needs. For each cell, we formulated key questions translating abstract governance principles into concrete organizational routines, decision-making processes, and learning mechanisms. These questions were developed iteratively, informed by conceptual literature, expert input, and empirical insights from the project context.

In addition, exemplary implementation practices at each intersection are illustrated in a subsequent governance map[2], to increase accessibility and support application in workshops and strategy processes. These examples do not prescribe specific solutions but instead offer inspiration for translating governance design into everyday organizational practice. In combination, the guiding questions and practical examples enable users to systematically reflect on their current state, define target states, and derive action-oriented development steps – either within individual governance areas or across the broader transformation strategy. The maps' modular structure allows for flexible use: Organizations can focus on selected intersections, zoom into priority areas, or engage in cross-functional dialogue around the full

[2] This can be found in the online appendix on page 33.

matrix. Ultimately, the Map serves to activate the Dual Governance Framework as a living instrument – supporting continuous learning, strategic alignment, and context-sensitive adaptation.

	Integrated Business Strategy	Reimbursement & Incentive Structure	Competency Management	Compliance	Risk Management	Leadership & Organizational Structure
Holistic Thinking & Doing	How is holism in the strategy process guaranteed?	Are incentives systemically aligned?	Does the competence system encourage integrative thinking?	Are normative requirements holistically integrated?	How can risks be considered holistically (e.g., ESG-risks)?	Which structures promote cross-system integration?
Transformation- oriented Corporate Culture	How is transformation translated into strategic guidelines?	Do incentive systems promote a willingness to learn and change?	How is change competence systematically developed and fostered?	Is a values-oriented attitude promoted within the organization?	Does a culture of openly dealing with risks exist?	Which cultural elements promote change and willingness to learn?
Participatory Stakeholder Integration	Are strategic decisions made participatorily?	Do incentive systems consider different stakeholder interests?	Are stakeholder perspectives integrated into learning processes?	How are stakeholders accounted for in compliance management?	How are stakeholders included into risk assessments?	How are internal and external stakeholders systematically involved?
Transparent Communication On Target & Progress	Is progress regarding the strategy implementation being openly communicated?	How are goals, progress and results feedbacked?	Are there transparent competency and development goals?	How is information provided about standards, rules, and their compliance?	How is risk development being communicated?	How transparent are roles, decision-making channels, responsibilities?
Data-based Governance & Control	How is the impact systematically measured and reported back?	Which KPIs measure impact and fairness of the incentive systems?	Is the competence building supported by data?	How is compliance monitoring governed on a data basis?	Is there an integrated, responsible risk controlling?	Are there clear roles of monitoring and assumption of responsibility?
Proactive Data & Technology Governance	How are technologies for strategy implementation used?	Are technological systems used for fairness control?	How are digital tools used in competency development?	Which technical tools support compliance?	Which technologies enable early risk detection?	Which IT and data architecture safeguard governance and accountability?

Figure 4: Dual Governance Map
Source: own.

In addition to the Map, an adapted RAECI matrix[3] is used to define and reflect Dual Governance roles. RACI matrices are a common tool to plan, organize and coordinate work by assigning roles and responsibilities to decisions and actions, and are often adapted by adding more than the basic four letters respectively responsibilities to fit the need of the organization (Cabanillas et al., 2012; Smith & Erwin, 2005). The RAECI matrix is a structured role and governance analysis tool that assigns responsibilities for key tasks or decision-making areas across five categories: Responsible, Accountable, Evaluate, Consulted, and Informed. By visualizing role allocations across governance areas and organizational functions, the matrix provides a clear overview of who leads, decides, supports, advises, or needs to be kept informed. When completed collaboratively – ideally within a moderated dialogue – it helps to identify overlapping responsibilities, governance gaps, and missing escalation paths. The tool supports both internal self-assessment and the systematic clarification of roles and decision rights. Furthermore, it enables a transparent comparison between current and target governance states, thereby contributing to sustainable governance transparency and improved coordination in transformation processes. Together, these tools provide a structured yet flexible foundation for reflecting on, shaping, and further developing governance arrangements that support the integrated transformation towards sustainability and digitalization.

5 Discussion

5.1 Theoretical & Practical Contribution

This paper contributes to the literature on CG, sustainability, and digital transformation by advancing the concept of Dual Governance as an integrative governance logic for managing the interdependence between sustainability and digitalization. While prior research acknowledges dual transformation as a critical challenge for manufacturing firms, existing governance approaches – including IT governance frameworks, sustainability governance research, and cross-domain studies at their intersection – address only partial aspects of this challenge and remain fragmented across disciplinary silos (see Section 2.2). By synthesizing insights from CG theory, sustainability governance, digital governance, and ambidexterity-

[3] This can be found in the online appendix on pages 34 to 35.

oriented transformation research, this study extends existing work in three ways: First, it conceptualizes governance not merely as a control or compliance mechanism, but as a strategic and normative architecture enabling multidimensional value creation under conditions of complexity and change. Second, it operationalizes dual transformation through six coherent governance areas and six overarching principles, thereby translating abstract transformation logics into a structured governance framework. Third, it systematically integrates sustainability-oriented governance and digital governance perspectives into a unified corporate governance design, thereby addressing the structural separation of these domains in existing research. In doing so, the paper provides a theoretically grounded yet flexible framework that advances the understanding of how CG can be adapted to support transformation processes in line with Industry 5.0.

From a practical perspective, this study offers manufacturing firms concrete guidance for governing sustainability and digitalization in an integrated and strategic manner. The Dual Governance Framework serves as a practice-oriented tool that helps organizations move beyond parallel or siloed initiatives by structuring responsibilities, decision-making processes, incentives, competencies, and compliance mechanisms around dual transformation objectives. Complementing the framework, dedicated governance profiles for each governance area and overarching principle provide concise, role- and domain-specific guidance by outlining key tasks, enabling conditions, typical challenges, and practical impulses derived from real-world implementation examples. The accompanying Dual Governance Map further enhances applicability by translating the framework into a matrix of guiding questions that support reflection, diagnosis, and implementation across organizational levels. Together with the extended RAECI logic, the proposed tools enable firms to clarify accountabilities, align strategic goals with operational execution, and systematically address tensions and trade-offs between sustainability and digitalization.

Through the iterative design process resulting in a framework based on literature and practitioner feedback, this paper provides actionable instruments that support managers, governance bodies, and transformation leaders in designing resilient, transparent, and future-oriented governance structures. Recognizing that the framework's comprehensiveness may initially appear demanding, particularly for organizations with limited governance experience, its modular architecture is

intentionally designed to lower barriers to entry. Organizations are not required to engage with all governance areas or matrix intersections simultaneously; instead, the Map supports selective prioritization, enabling context-sensitive starting points and incremental development. This modularity is intended as a structural response to implementation complexity, not merely a design feature.

5.2 Limitations & Future Research

Although the model provides a structured approach to governing dual transformation, its comprehensiveness, while theoretically desirable, may pose practical challenges particularly for organizations with limited governance maturity or resource constraints. The framework seeks to address this tension through its modular architecture and the flexible entry points provided by the Dual Governance Map, though whether these design features are sufficient under real-world capacity constraints remains an open empirical question, particularly given the breadth of the framework's architecture. Also, it has not yet been subjected to systematic large-scale empirical validation and practitioner input has so far been limited to the context of the DualStrat project. Consequently, the explanatory power and robustness of the framework across heterogeneous organizational contexts remain to be further examined. Further, the study predominantly addresses manufacturing firms, which constrains the immediate generalizability of the findings to other industries. Moreover, the Framework is informed by the experiences of the researchers and practice partners embedded in the German institutional and regulatory environment. This context-specific grounding may shape underlying assumptions about governance structures, stakeholder expectations, and compliance regimes.

Future research should therefore pursue broader empirical testing across sectors, organizational sizes, and governance structures to assess the model's generalizability. Application in other countries could yield further understanding of the scope of its transferability to non-German contexts. In particular, cross-industry and cross-country comparative studies could help identify boundary conditions, contextual contingencies, and necessary adaptations of the framework while further work on modular implementations, and more granular tool-level specifications would enhance its practical applicability. Additionally, longitudinal studies may provide insights into how Dual Governance architectures evolve over time and how they affect organizational performance and transformation outcomes. Future research

may also explore the micro-level behavioral implications of Dual Governance, such as how decision-makers navigate competing logics, how incentive systems influence strategic prioritization, and how digital infrastructures reshape accountability relationships.

6 Conclusion

This study argues that dual transformation is not merely an additive challenge for existing governance systems but represents a structural shift in how organizations must coordinate sustainability and digitalization. By introducing Dual Governance as an integrative governance architecture, the paper provides a conceptual and practical response to this shift. Rather than treating governance primarily as a compliance-oriented function, Dual Governance conceptualizes it as a strategic design lever for aligning regulatory requirements, digital capabilities, and sustainability objectives within a coherent decision architecture. In this sense, governance becomes the central mechanism through which firms translate external pressure – such as ESG regulation and stakeholder demands – into coordinated strategic action. Beyond its conceptual contribution, the paper provides a practice-oriented framework supported by complementary tools that translate dual transformation into actionable governance structures. By bridging theory and practice, the study offers both scholarly insight and practical guidance for organizations seeking to govern sustainability and digitalization in an integrated and future-oriented manner.

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