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The Evolution of Design Thinking in the Age of Foundation Models: Revisiting Verganti's Framework (2020-2025)

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A B S T R A C T

This article offers a critical tribute to "Innovation and Design in the Age of Artificial Intelligence", which anticipated the shift from problem solving to problem finding as the key human role in design under algorithmic automation. Five years later, this paper revisits and expands that framework amid three major transformations: the rise of foundation models and generative AI, the emergence of agentic artificial intelligence capable of orchestration, and the institutionalization of governance through the European AI Act and ISO/IEC 42001. Revisiting Netflix, Airbnb, Tesla, and Microsoft, the study proposes the Agentic Orchestrator Model, integrating four interdependent layers—governance, human sensemaking, agentic orchestration, and operational loops. This model repositions design as a continuous socio-technical architecture where humans, agents, and norms co-produce value and responsibility, extending Verganti's insights into the era of generative and regulated AI.

1. INTRODUCTION

When Roberto Verganti, Luca Vendraminelli, and Marco Iansiti published "Innovation and Design in the Age of Artificial Intelligence" in the Journal of Product Innovation Management (2020), they captured a turning point in how scholars and practitioners understood the relationship between design, innovation, and emerging technologies. Their core thesis was that, as artificial intelligence (AI) increasingly automated creative problem solving, the human role in design was shifting toward problem finding—that is, toward sensemaking. Design, they argued, was moving from an activity of crafting solutions to one of shaping meaning and direction. This transition placed design closer to the realm of strategic leadership than to that of operational execution.

At the time, AI was still dominated by "narrow" systems—algorithms optimized for specific, well-defined tasks such as recommendation, classification, or pattern recognition. Verganti and his co-authors showed that even this limited form of intelligence was already reshaping design practice. Companies like Netflix, Airbnb, Tesla, and Microsoft were no longer designing fixed products or experiences but learning loops—systems capable of collecting data, adapting to user behavior, and generating personalized outcomes in real time. In these systems, design was not a single event but an ongoing process embedded in everyday use. The designer's task, therefore, was to define the rules of learning rather than to craft a single solution.

Five years later, in 2025, the analytical framework proposed by Verganti et al. remains strikingly relevant. Yet the context surrounding it has transformed dramatically. The period from 2020 to 2025 has witnessed an unprecedented acceleration

in both the technological infrastructure of AI and the institutional structures that govern it. This evolution calls for a renewed reading of their contribution—one that situates it in relation to new developments in technology, practice, and policy. Three intertwined vectors stand out as defining this new landscape.

First, the emergence of foundation models has fundamentally changed the capabilities and reach of artificial intelligence. Since 2021, the rise of large multimodal models—trained on massive and diverse datasets—has allowed AI systems to generalize across tasks and domains, moving beyond specialized "narrow" algorithms. The proliferation of generative AI (GenAI) since 2022 has introduced a new creative dimension: machines are no longer limited to recognizing or optimizing but can now generate text, images, video, and code. This transformation extends the role of design: loops of learning become loops of co-creation, where human and machine creativity intersect in dynamic feedback.

Second, the development of agentic AI has expanded the notion of automation from prediction to orchestration. Building upon foundation models, new systems are capable of planning sequences of actions, invoking external tools, retrieving memory, and coordinating with other agents. This marks the birth of what researchers call agentic orchestration—AI systems that can act semi-autonomously within structured constraints. The loop described by Verganti et al. (2020) has evolved into an ecosystem of agents, capable of executing complex workflows. For designers, this means engaging not only with interfaces or user journeys, but with distributed networks of human and artificial decision-makers.

Third, the institutionalization of AI governance has created an entirely new layer of design constraints. The European Union's AI Act (approved in 2024) and the ISO/IEC 42001:2023 standard on AI management systems have formalized principles of transparency, accountability, and risk assessment. These frameworks demand that the design of AI systems integrate ethical and regulatory criteria from the outset. Design, therefore, is no longer only about user experience or product innovation—it is about aligning technological architectures with societal values. In this sense, governance itself becomes a design material.

Revisiting the 2020 article through this lens reveals both continuity and transformation. The displacement from problem solving to problem finding remains central, but the act of finding problems now unfolds in collaboration with agents capable of suggesting, simulating, and executing alternatives. The "loops" once conceived as bounded cycles of data-driven iteration have become infrastructures of continuous orchestration. Designers are thus required not only to imagine products or services, but to architect ecosystems in which humans, algorithms, and institutions interact.

The four cases examined by Verganti et al.—Netflix, Airbnb, Tesla, and Microsoft—continue to exemplify this shift. Netflix, initially analyzed as a master of algorithmic personalization, now leverages foundation models for content tagging, trailer generation, and predictive storytelling. Airbnb, once framed as a "factory of AI," has expanded into curating cultural experiences, integrating layers of generative design into its Icons and Experiences platforms. Tesla has moved from modular perception systems to an end-to-end neural network for autonomous driving, transforming the car itself into a self-improving artifact. Microsoft, meanwhile, has institutionalized the Copilot concept across its ecosystem, embedding agentic AI into the core of knowledge work. In each case, what was once a loop of learning has evolved into a system of orchestration.

This article thus has a dual objective. First, it acknowledges the prescience of Innovation and Design in the Age of AI as a foundational contribution that redefined the role of design in the digital age. Second, it seeks to update and extend that framework in light of the transformations that have reshaped AI between 2020 and 2025. Specifically, it aims to:

1. Systematically reconstruct the core contributions of the original article.
2. Identify the key technological and institutional changes that redefine design's role.
3. Revisit the four emblematic cases with updated evidence.
4. Propose an expanded theoretical model—the Agentic Orchestrator Model—integrating governance, sensemaking, agency, and learning.
5. Outline a forward-looking research agenda

for design in the age of generative and regulated AI.

Ultimately, this paper is both homage and continuation. It honors the insight of Verganti and colleagues while extending it into a new conceptual territory. The central question of 2020—*how does AI transform design practice?*—has evolved into a broader and more urgent one: *how can design guide the integration of agents, data, and norms in socio-technical systems that are not only innovative and efficient but also just, sustainable, and meaningful?*

2. CORE CONTRIBUTIONS OF INNOVATION AND DESIGN IN THE AGE OF AI (2020)

Verganti, Vendraminelli, and Iansiti's (2020) article stands as one of the earliest and most influential attempts to conceptualize how artificial intelligence reshapes both the process and the purpose of design. Its significance lies not only in describing emerging technological phenomena but in reframing the epistemology of design itself. By combining insights from design theory, innovation management, and digital transformation, the authors proposed a shift from designing solutions to designing learning loops, thereby redefining what it means to innovate in an AI-driven environment.

The article's contribution can be organized around four main ideas:

(1) the displacement from problem solving to problem finding;
(2) the conceptualization of learning loops as the new object and process of design;
(3) the reinforcement—not replacement—of Design Thinking principles through AI; and
(4) the empirical illustration of these ideas through emblematic cases such as Netflix, Airbnb, Tesla, and Microsoft.

2.1 From Problem Solving to Problem Finding

At the heart of Verganti, Vendraminelli, and Iansiti's (2020) argument lies a provocative thesis: as AI systems increasingly automate the resolution of predefined problems, the human contribution in innovation shifts toward defining what problems are worth solving. This idea revives a long-standing debate in creativity research, epitomized by the contrasting perspectives of Herbert Simon and Mihaly Csikszentmihalyi.

Simon (1982, 1988) conceptualized design as a form of problem solving—a rational process in which both the problem space and the solution space can be modeled and optimized, even computationally. Csikszentmihalyi (1988), by contrast, emphasized problem finding as the essence of creativity: a socially embedded and motivational process through which individuals redefine domains and generate new fields of meaning. Verganti et al. (2020) extended this distinction to the age of artificial intelligence, suggesting that as algorithms become increasingly capable of solving, humans must become more adept at framing.

This displacement repositions the designer as a sensemaker rather than a solver. It implies that design is no longer primarily an act of optimization, but one of interpretation and value articulation—a cognitive and ethical process of constructing meaning within complex socio-technical systems.

2.2 Learning Loops as the New Object and Process of Design

A second and equally original contribution of the 2020 article was to redefine both the object and the process of design around the concept of learning loops. Traditionally, design was organized as a linear sequence—research, ideation, prototyping, testing, launch—producing discrete artifacts or services. AI transforms this model by embedding learning into the very operation of products.

In Verganti et al.'s formulation, the object of design is no longer the artifact itself but the loop that governs how the artifact evolves through use. These loops collect data from user interactions, process them through machine learning algorithms, and generate personalized or adaptive responses in real time. The process of design thus divides into two intertwined stages:

A human phase, in which designers conceive the structure of the loop—its goals, metrics, and ethical boundaries; and

An algorithmic phase, in which the loop autonomously generates context-specific solutions for each user.

This dual structure means that innovation becomes continuous rather than episodic. Each interaction is both a use event and a design event. The product ceases to be a finished object and becomes a living system—a permanent design studio, in the authors' words.

2.3 Reinforcing the Principles of Design Thinking

One of the most striking insights in Verganti et al.'s (2020) paper is that AI does not undermine Design Thinking; rather, it amplifies its fundamental principles. The authors identify three such principles: human-centeredness, abduction, and iteration.

Human-centeredness. In traditional, human-intensive design processes, personalization was limited by scale. Designers could prototype for archetypes or segments but not for every individual. AI removes this constraint. Through data-driven personalization, systems can tailor interfaces, recommendations, and functionalities to each user. Netflix famously claimed to have "33 million versions of Netflix"—one for every subscriber—illustrating how AI enables truly individual-centered design (Carr, 2013). The statement captures the essence of algorithmic empathy: each viewer experiences a different interface, set of recommendations, and visual cues, all optimized through learning loops that adapt to personal behavior and preferences.

Abduction. Design Thinking relies on abductive reasoning—the generation of plausible hypotheses that bridge what is known and what could be. Machine learning extends this capacity by uncovering hidden patterns and correlations in massive datasets, suggesting new hypotheses that might never emerge from human intuition alone. In this way, algorithms act as abductive partners, expanding the cognitive reach of designers.

Iteration. Traditional design cycles alternated between stable releases and discrete updates. AI transforms iteration into a continuous process. Reinforcement learning allows systems to test, evaluate, and refine decisions in real time. Every interaction becomes an opportunity for improvement.

Hence, AI does not invalidate the ethos of Design Thinking; it radicalizes it. The process becomes more human-centered (addressing individuals rather than averages), more abductive (discovering patterns at scale), and more iterative (learning continuously rather than episodically).

2.4 Empirical Illustrations: Netflix, Airbnb, Tesla, and Microsoft

To substantiate their theoretical claims, Verganti et al. analyzed four cases that epitomized the intersection of AI and design practice.

- **Netflix** represented the archetype of data-driven personalization. Its recommendation engine and adaptive interface exemplified how learning loops could sustain a one-to-one relationship with users. AI not only influenced the content offered but also guided creative decisions in production, shaping genres and narratives through data analytics.
- **Airbnb** embodied the notion of the "AI factory." The platform simultaneously manages two user ecosystems—hosts and guests—through separate but interconnected loops. Algorithms dynamically adjust prices, search rankings, and trust scores, optimizing mutual satisfaction while scaling uniqueness.
- **Tesla** showcased how AI could permeate physical products. Through software updates and sensor data, the car evolves after purchase, transforming from a static artifact into an adaptive platform. Tesla's use of "silent sensors"—hardware installed for future functionalities—illustrated what the authors called designing in perspective, anticipating future learning loops.
- **Microsoft** demonstrated that successful AI integration depends on organizational leadership rather than technical infrastructure alone. By embedding AI into product strategy and user experience, rather than relegating it to IT departments, Microsoft highlighted how design leadership becomes central in managing intelligent systems.

These cases collectively exemplified that the loop—not the artifact—is the real unit of design and innovation in the AI age.

2.5 Implications for Design Theory and Practice

The conceptual and empirical contributions of Innovation and Design in the Age of AI opened new theoretical and practical frontiers. The authors' framework implied several key implications:

1. **New design competences.** Designers must develop skills in defining rules, metrics, and ethical boundaries for adaptive systems, rather than in producing static outputs.
2. **Shifting focus to learning infrastructures.** Innovation increasingly depends on the capacity to build and manage learning architectures—data

pipelines, feedback mechanisms, and iterative processes.

3. **Distributed responsibility.** As decisions are delegated to algorithms, accountability becomes collective, involving designers, developers, and organizations.
4. **Integration of leadership and sensemaking.** The designer's role converges with that of strategic leaders who frame meaning and purpose within complex systems.

In summary, these contributions established the theoretical ground on which contemporary AI-driven design has evolved.

3. WHAT HAS CHANGED (2020-2025)

While the analytical framework proposed by Verganti, Vendraminelli, and Iansiti (2020) remains remarkably prescient, the technological and institutional landscape of artificial intelligence has changed profoundly between 2020 and 2025. Their model, developed in the context of narrow AI—systems specialized in specific, repetitive tasks—must now be revisited in the era of foundation models, agentic AI, and regulatory governance. These developments do not invalidate the original framework; rather, they expand its horizon. The core shift from problem solving to problem finding endures, but the locus of design agency, the scale of automation, and the boundaries of responsibility have been transformed.

3.1 From Narrow AI to Foundation Models

In 2020, Verganti, Vendraminelli, and Iansiti argued that even "weak" or narrow AI—algorithms optimized for classification, recommendation, or prediction—was sufficient to transform design practice. This observation proved remarkably accurate; yet, the emergence of foundation models has expanded the scope of that transformation far beyond what was imaginable at the time.

Since 2021, the rise of large-scale multimodal architectures—commonly referred to as foundation models (Bommasani et al., 2021)—has redefined the structure of artificial intelligence. These models, trained on vast and heterogeneous datasets, exhibit an unprecedented capacity for transfer learning and cross-domain generalization, enabling generative applications that far exceed the predictive capabilities of earlier "narrow" systems. As Bommasani and colleagues argue, foundation models function as general-purpose cognitive infrastructures upon which diverse applications can be fine-tuned, marking a paradigm shift from algorithmic specialization to generative generalization.

For design and innovation, this shift has profound implications. Where traditional AI architectures optimized specific tasks, foundation models provide a common substrate for creativity, capable of generating new content, interpreting context, and reasoning across modalities—text, image, audio, video, and code. The result is a transformation of the learning loop itself: rather than refining solutions through feedback, AI systems now participate in co-creation. They propose alternatives, simulate user feedback, and adapt designs dynamically, blurring the boundary between generation and iteration.

In this new landscape, the designer's distinctive role lies in sensemaking amid generative abundance—deciding which of the countless machine-generated possibilities are meaningful, desirable, and ethically coherent. The essence of Verganti et al.'s insight remains: design is no longer defined by the capacity to solve given problems but by the ability to interpret and give direction within an expanding universe of algorithmic possibilities.

3.2 The Rise of Agentic AI

Perhaps the most significant evolution since 2020 is the emergence of agentic artificial intelligence (AI)—systems capable of autonomous orchestration and decision-making. As defined by Plaat et al. (2025), agentic AI refers to a new class of models that extend the generative and reasoning capacities of foundation models by incorporating planning, memory, tool use, and adaptive feedback. These systems do not merely predict or generate; they act, pursuing goals, invoking external resources, and coordinating with other agents within dynamic environments.

Building upon foundation models, agentic AI can plan multistep actions, access external tools and databases, invoke APIs, and collaborate with both human and non-human agents. Unlike static models that require human prompting for every operation, these agents can initiate actions, monitor outcomes, and iteratively improve their own behavior based on feedback.

This development represents a fundamental

ontological shift. In 2020, AI was largely conceived as an instrument—a sophisticated but passive element of the design loop. By 2025, AI behaves as a co-actor within sociotechnical systems. The "loop" has expanded into an ecosystem of interacting agents engaged in semi-autonomous coordination.

This transformation redefines the boundaries of design in at least three ways:

1. **From execution to orchestration.** Designers no longer merely embed learning rules; they must define frameworks for how agents coordinate and make trade-offs.
2. **From static optimization to dynamic emergence.** Agentic systems continuously reorganize workflows, requiring designers to anticipate self-modifying structures.
3. **From interface design to ecosystem design.** The locus of creativity moves from individual user interactions to the architecture of relations among humans and agents.

Agentic AI thereby fulfills and transcends the "learning loop" logic proposed in 2020. Where loops captured iterative adaptation, orchestration captures distributed autonomy—a capacity to interpret intent, mediate collaboration, and generate outcomes in complex environments. For designers, this evolution demands new forms of leadership: the ability to choreograph intention and accountability across hybrid networks of human and artificial actors.

3.3 Institutionalization of AI Governance

A third transformation reshaping the landscape is the institutionalization of AI governance. In 2020, Verganti et al. briefly acknowledged ethical risks such as bias, opacity, and unintended consequences, but global regulatory frameworks were still embryonic. By 2025, governance has become a central component of the design process. Two milestones exemplify this institutional turn.

- The **European Union AI Act** (approved in 2024) establishes a risk-based classification of AI systems, mandates transparency, and requires pre-deployment conformity assessments. The Act also created the EU AI Office, responsible for oversight, certification, and enforcement.
- The **ISO/IEC 42001:2023** standard defines the first comprehensive management system for AI, guiding organizations in risk management, data governance, and ethical accountability.

Together, these frameworks transform design from a discretionary activity into a regulated discipline. Designers must now interpret legal and ethical principles as design constraints. Governance becomes a design material alongside form, function, and usability.

In practical terms, this means that compliance-by-design is no longer optional: it is a prerequisite for market access. The creative process must integrate risk assessment, auditability, and transparency from inception. This institutionalization blurs traditional boundaries between design, management, and policy, ushering in what could be called governed design practice.

3.4 Revisiting the Original Assumptions

These shifts invite a critical re-examination of several implicit assumptions in the 2020 framework.

1. **Assumption of Narrow AI.** The original argument posited that "weak" AI was sufficient to change design practice. While true, this assumption now underestimates the creative and cognitive capacities of foundation models. AI is no longer limited to recognizing patterns; it generates them. The designer's challenge is thus not only to supervise algorithms but to dialogue with them as creative counterparts.
2. **Boundary Between Human and Machine Roles.** In 2020, the division seemed clear: humans define the problem space; algorithms solve within it. By 2025, that boundary has become porous. Agentic AI can also define subgoals, propose new problem framings, or autonomously reprioritize objectives. Human designers now act less as originators and more as meta-designers—defining the conditions under which agency emerges.
3. **Responsibility and Accountability.** The 2020 paper identified responsibility as an open question but lacked concrete mechanisms. With the arrival of regulatory frameworks, accountability is now operationalized through audits, logs, and traceability. Responsibility becomes

distributed, involving designers, developers, and institutions.

4. **Epistemic Confidence in Data.** The authors assumed data quality and neutrality as manageable issues. The exponential expansion of training datasets and synthetic data generation since 2021 challenges this premise. Designers must now engage in data sensemaking—understanding provenance, bias, and contextual validity as integral parts of the design process.

3.5 From Learning Loops to Orchestrated Systems

Collectively, these developments mark a transition from learning loops to orchestrated systems. In 2020, loops connected user behavior, algorithmic feedback, and product improvement in a continuous cycle. By 2025, this cycle has multiplied into a network of interacting loops managed by agents within a governed infrastructure. The designer's task evolves from shaping feedback to designing coordination—how loops interact, escalate, or restrain each other under ethical and regulatory oversight.

This shift also redefines the scale of design. Instead of addressing singular artifacts or isolated interactions, designers now engage with multi-level systems: micro (interface), meso (organizational workflows), and macro (institutional governance). The discipline expands from artifact design to systemic architecture, where meaning, agency, and regulation converge.

3.6 Implications for the 2025 Landscape

The cumulative effect of these transformations is that the 2020 framework requires conceptual expansion along three dimensions:

- **From learning to orchestration:** AI is no longer merely adaptive; it is agentive, capable of self-directed coordination.
- **From autonomy to accountability:** Design must internalize governance frameworks, embedding compliance and ethics into creative practice.
- **From artifacts to ecosystems:** The locus of innovation moves from products to infrastructures—networks of agents, data, and human decision-makers.

These dimensions set the stage for a new conceptual synthesis: The Agentic Orchestrator Model, which integrates the human capacity for sensemaking with the computational capacity for coordination. The following section articulates this framework in detail.

4. REINTERPRETING THE CASES: CONTINUITY AND TRANSFORMATION (2023–2025)

A central strength of Innovation and Design in the Age of Artificial Intelligence (Verganti, Vendraminelli, & Iansiti, 2020) was its empirical grounding. The authors selected four emblematic organizations—Netflix, Airbnb, Tesla, and Microsoft—to illustrate how artificial intelligence had already begun to transform the practice of design. Each case captured a different dimension of the AI revolution: personalization (Netflix), platform orchestration (Airbnb), intelligent product evolution (Tesla), and organizational leadership (Microsoft).

Five years later, these same cases provide a valuable vantage point for assessing continuity and transformation. They reveal both the endurance of the 2020 framework—particularly the centrality of learning loops—and its limitations when confronted with the rise of foundation models, agentic systems, and regulatory governance.

4.1 Netflix: From Algorithmic Personalization to Generative Storytelling

In 2020, Netflix epitomized the shift toward AI-driven personalization. Its recommendation algorithms and adaptive interface were cited as textbook examples of learning loops: the system collected data from user interactions, processed them through predictive models, and generated tailored recommendations in real time. This process supported Verganti et al.'s argument that design was moving from crafting solutions to designing rules for continuous learning.

By 2023-2025, Netflix had deepened and expanded this approach. The company developed foundation models trained on multimodal content—scripts, subtitles, images, and behavioral data—to enhance its capacity for creative prediction. These models assist in content tagging, trailer editing, localization, and narrative pattern recognition, enabling the company to forecast audience engagement with remarkable precision (Kaperonis, 2025).

Moreover, Netflix began experimenting with

generative AI tools that support the creative process itself: generating preliminary synopses, visual concepts, and audience simulations. What was once a loop of optimization has evolved into a loop of co-creation. Algorithms now participate in storytelling—not replacing human writers or designers, but augmenting their capacity to explore narrative possibilities (Jäckle & Pufall, 2025).

The case exemplifies how the logic of personalization has matured into a logic of generativity. Design at Netflix no longer concerns the static interface between platform and viewer; it involves orchestrating a creative ecosystem where humans and machines jointly shape cultural production.

4.2 Airbnb: From Hospitality to Cultural Intermediation

In the original article, Airbnb represented a paradigmatic "AI factory" (Verganti et al., 2020). The platform was described as managing two interdependent learning loops: one for hosts and one for guests. Algorithms dynamically adjusted prices, optimized listings, and improved search relevance, ensuring both scalability and personalization.

Since then, Airbnb has evolved beyond accommodation into a multi-layered cultural platform. The introduction of Airbnb Experiences (2022) and Airbnb Icons (2024) expanded its value proposition from hosting to curating experiences and cultural narratives. These new services rely heavily on generative and agentic AI. Algorithms now synthesize user preferences, travel trends, and contextual data (e.g., local events, sustainability metrics) to suggest personalized itineraries and experience bundles.

Airbnb's AI systems also act as mediators of trust and emotion, analyzing sentiment from reviews and host communications to calibrate recommendations. This emotional intelligence component extends the principle of human-centered design into what might be called empathy at scale (Hägg & Kurczewska, 2025; Törnberg & Uitermark, 2025).

The transformation aligns with Verganti's initial insight: AI does not eliminate human-centeredness but amplifies it. Yet, in 2025, the company's design challenge is no longer about scaling uniqueness—it is about orchestrating meaning across cultures, balancing personalization with authenticity, and ensuring ethical use of personal data under new regulatory constraints.

4.3 Tesla: From Learning Loops to End-to-End Autonomy

Tesla's case illustrates the evolution of AI in physical, safety-critical systems. In 2020, the company's vehicles were already described as "learning machines," capable of collecting data from millions of kilometers driven and improving through over-the-air software updates. Verganti et al. highlighted Tesla's strategic foresight in embedding "silent sensors"—hardware prepared for future functionalities, enabling a design "in perspective."

Between 2023 and 2025, Tesla's AI architecture underwent a paradigm shift. The launch of Full Self-Driving (FSD) version 12 introduced an end-to-end neural network trained on video data rather than pre-labeled objects. This design choice replaced modular systems (perception, planning, control) with a unified learning model capable of direct perception-to-action mapping (Yadav & Yadav, 2025).

From a design standpoint, this represents the materialization of the learning loop as an embodied system. The car itself becomes the loop: each driver's experience contributes data to a global model, which in turn updates the driving behavior of all vehicles. Innovation occurs continuously and collectively (Razdan, 2025).

However, this development also exposes new tensions between automation, accountability, and governance. As autonomous decision-making shifts from human drivers to neural networks, questions of responsibility and transparency become urgent. Tesla's loop, once a showcase of design ingenuity, is now a testbed for regulatory and ethical experimentation under emerging frameworks like the EU AI Act.

4.4 Microsoft: From Infrastructure to the Copilot Paradigm

In Verganti et al.'s 2020 analysis, Microsoft served as evidence that the integration of AI required design leadership rather than purely technical management. The company's success was attributed to its ability to embed AI within product experience rather than treating it as a back-end function.

This insight has proven prophetic. Between 2023

and 2025, Microsoft has consolidated its Copilot ecosystem, integrating generative and agentic AI across Windows, Microsoft 365, GitHub, and other services. The Copilot has become both a product and a paradigm: a ubiquitous digital assistant that collaborates with users across contexts—writing, coding, analyzing data, and managing workflows.

The Copilot model embodies the evolution from learning loops to agentic orchestration. Unlike earlier recommendation systems, Copilot agents plan sequences of actions, query multiple tools, and interact conversationally with users. They do not merely react to commands; they co-structure tasks (Dhanasekaran et al., 2025).

For design theory, the Copilot metaphor marks a conceptual breakthrough. It reframes the human–machine relationship from automation to collaboration, and from interaction to orchestration. The designer's role expands to defining how agency is distributed between user and system—an ethical, cognitive, and experiential challenge.

4.5 Synthesis: Continuity and Discontinuity

The evolution of these four cases reveals both continuity with the 2020 framework and qualitative transformation beyond it.

In all four organizations, the logic of learning loops remains central: feedback-driven personalization, data-based adaptation, and continuous iteration still define their competitive advantage. Yet, these loops have become multi-layered orchestration systems, where AI agents autonomously coordinate interactions, generate new content, and mediate human experience.

Design's focus has thus moved from optimizing feedback to structuring coordination—from refining user interactions to governing entire ecosystems of sensemaking, creativity, and accountability. This evolution validates Verganti et al.'s original intuition but also points toward a deeper shift: the rise of design as agentic orchestration.

The next section articulates this transition through a new theoretical synthesis—the Agentic Orchestrator Model—which integrates governance, human sensemaking, distributed agency, and learning as the pillars of design in the age of AI.

4.6 Toward the Agentic Orchestrator Model

The comparative analysis of Netflix, Airbnb, Tesla, and Microsoft underscores the necessity for a new conceptual synthesis. Each organization exemplifies a different layer of the emergent design landscape:

- **Netflix** operates at the cultural and narrative level, blending algorithmic creativity with human storytelling.
- **Airbnb** operates at the social level, mediating trust, empathy, and cultural diversity through intelligent curation.
- **Tesla** operates at the physical level, embedding AI into embodied, safety-critical systems.
- **Microsoft** operates at the organizational level, orchestrating cognitive collaboration between humans and agents.

Together, they demonstrate that AI-driven design now spans multiple ontological layers—cultural, social, material, and cognitive. To integrate these dimensions, design requires a new model: The Agentic Orchestrator. This model will be articulated in the next section as a synthesis of governance, sensemaking, agency, and learning—a framework capable of guiding design in the era of generative and regulated AI.

5. AN UPDATED CONCEPTUAL FRAMEWORK: THE AGENTIC ORCHESTRATOR MODEL

The evolution of artificial intelligence between 2020 and 2025 has expanded the conceptual territory initially outlined by Verganti, Vendraminelli, and Iansiti. The learning loops they described remain essential, but they now operate within broader, multi-layered systems shaped by governance, generative creativity, and distributed agency. To capture this expanded reality, this section introduces the Agentic Orchestrator Model, a framework for understanding design as the coordination of humans, machines, and norms in continuous socio-technical ecosystems.

5.1 From Learning Loops to Orchestrated Systems

The 2020 framework positioned the learning loop as the central unit of innovation—a cyclical process in which algorithms learn from user interactions to refine outcomes iteratively. In 2025, this concept must be broadened. Loops are no longer isolated; they are nested, interacting, and self-organizing. The designer's task is not only to create effective

loops but to define how they interconnect across scales—micro (user interactions), meso (organizational workflows), and macro (institutional or regulatory environments).

The transition from loops to orchestration mirrors the evolution from automation to agency. In earlier models, AI systems executed predefined optimization routines. In the contemporary context, agentic AI—built upon foundation models—can plan, coordinate, and negotiate between goals. The designer's creative space thus shifts from scripting actions to architecting possibilities, determining how agents interact and under what ethical or strategic constraints.

5.2 The Structure of the Agentic Orchestrator

The Agentic Orchestrator Model comprises four interdependent layers, each representing a dimension of design activity and responsibility:

1. **Governance and Regulation** – the institutional framework that defines boundaries, accountability, and acceptable risk.
2. **Human Sensemaking** – the interpretive and ethical framing of what problems and values matter.
3. **Agentic Orchestration** – the coordination of human and artificial actors across workflows and contexts.
4. **Operational Loops** – the concrete mechanisms of learning, feedback, and personalization.

These layers are hierarchical yet recursive: each constrains and enables the others. Governance establishes the outer conditions under which sensemaking occurs; sensemaking shapes the principles that guide orchestration; orchestration defines the rules for operational loops; and feedback from operational loops informs new sensemaking and governance revisions.

5.3 Layer 1: Governance and Regulation

At the foundation of the model lies governance. The consolidation of the EU AI Act (2024) and the ISO/IEC 42001 (2023) standard reflects a global trend toward regulation-by-design. This layer transforms ethics from a rhetorical commitment into an operational requirement.

Governance defines:

- **Risk categories** (from minimal to unacceptable use of AI).
- **Transparency obligations** (documentation, explainability, and traceability).
- **Accountability mechanisms** (audit logs, human oversight, and impact assessments).

Design, under this regime, becomes a process of translation—converting legal and ethical principles into system architecture, data policies, and user interfaces. Governance is thus not an external constraint but a design material in itself. It shapes the boundaries of creativity, much as ergonomics or aesthetics once did.

5.4 Layer 2: Human Sensemaking

Above governance sits the domain of human sensemaking. This layer corresponds to the uniquely human capacity to construct meaning in ambiguous and dynamic contexts. Following Weick (1995), sensemaking is the process through which individuals and organizations interpret complexity and enact coherence. Subsequent research has expanded this perspective, framing sensemaking as a collective, multi-level phenomenon involving emotional, cognitive, and social processes (Maitlis & Christianson, 2014).

In the context of design, sensemaking entails articulating purpose, interpreting uncertainty, and prioritizing values that guide technological development. Designers serve as mediators who align organizational goals with societal needs, translating indeterminate situations into actionable frames. As Verganti, Vendraminelli, and Iansiti (2020) suggested, the designer's distinctive role lies not in the generation of solutions but in defining what meaning innovation should pursue.

In the age of AI, this interpretive competence becomes even more critical. As generative systems multiply possible directions, human sensemaking provides the semantic compass that orients orchestration and ensures that technological agency remains ethically and strategically grounded.

5.5 Layer 3: Agentic Orchestration

The third layer represents the novel contribution of this model: agentic orchestration. Here, the designer acts as a meta-coordinator of semi-autonomous agents—both human and artificial. These agents may include AI copilots, decision-support systems, generative assistants, or even

autonomous vehicles and robots.
Design in this layer involves:

- **Defining interaction protocols** between humans and machines (e.g., permissions, escalation triggers, or override mechanisms);
- **Managing distributed agency**, ensuring that delegation enhances rather than dilutes accountability;
- **Facilitating collaboration** between heterogeneous actors, harmonizing human judgment with algorithmic efficiency.

Agentic orchestration transforms design into a choreography of intentions. It is not merely about efficiency but about relational ethics—deciding who acts, when, and why. This perspective situates design at the intersection of human–AI collaboration, systems thinking, and organizational leadership.

5.6 Layer 4: Operational Loops

At the base of the architecture are operational loops—the data-driven feedback systems first theorized by Verganti et al. These remain the mechanism through which learning and personalization occur. Yet, in the agentic context, loops acquire new functions:

- They become context-aware, integrating multimodal signals (visual, textual, behavioral) to adapt in real time.
- They are interconnected, forming networks that allow cross-loop learning across products or services.
- They are auditable, embedding logging and traceability for compliance with governance frameworks.

Operational loops are thus the engine room of the agentic orchestrator. Their design determines the system's responsiveness, reliability, and ethical footprint.

5.7 Dynamic Interaction among Layers

The four layers form a dynamic, adaptive system rather than a fixed hierarchy. Feedback flows bidirectionally: governance constrains action, but operational data can trigger governance reform; sensemaking frames orchestration, but orchestrated outcomes reshape collective meaning.
This systemic view positions the designer as a boundary-spanning actor—a professional who moves fluidly between ethical deliberation, technical design, and strategic coordination. The agentic orchestrator model therefore demands new competencies: systems thinking, legal awareness, data ethics, and an ability to navigate between abstraction and implementation.

5.8 Implications for Design Practice

The Agentic Orchestrator Model carries several implications for the practice and education of design:

1. **From Product to System Design.** Designers must master not only form and interaction but also policy translation, workflow coordination, and ecosystem management.
2. **Leadership as Design Competence.** The role of design expands to include organizational sensemaking, aligning AI systems with corporate and societal purpose.
3. **Ethics as Infrastructure.** Compliance and ethics are not afterthoughts; they are embedded in the system architecture.
4. **Collaborative Intelligence.** Designers operate within hybrid teams where human creativity and machine intelligence co-evolve.
5. **Continuous Accountability.** Because agentic systems evolve, responsibility must be monitored over time, requiring new governance interfaces for real-time oversight.

5.9 Toward a New Epistemology of Design

Beyond its structural implications, the Agentic Orchestrator Model suggests a deeper epistemological reorientation. Design is no longer a discipline that solves bounded problems; it becomes a practice of orchestration under uncertainty. Knowledge emerges through interaction among humans, agents, and institutions rather than from the individual designer's cognition.
This epistemology dissolves the traditional dichotomy between "designer" and "system." The designer's output is not a product but a framework of relationships. In this sense, the Agentic Orchestrator is not merely a metaphor—it is the operative condition of design in the age of generative and regulated AI.
These dynamics converge into a unified framework

that this paper defines as the Agentic Orchestrator Model.

6. FUTURE RESEARCH

The conceptual expansion from learning loops to the Agentic Orchestrator Model opens a broad and pressing research frontier. Verganti, Vendraminelli, and Iansiti's (2020) seminal article invited scholars to rethink design as sensemaking rather than problem solving. Five years later, this insight remains valid but demands empirical and theoretical elaboration under new technological and institutional conditions. The following subsections outline five interrelated lines of inquiry that define a future research agenda for design in the age of agentic and regulated AI.

6.1 Metrics and Methods for Evaluating Sensemaking

If the human contribution to innovation increasingly lies in problem finding and sensemaking, research must develop ways to evaluate the quality of sensemaking processes. Unlike traditional performance metrics—efficiency, usability, or return on investment—sensemaking concerns interpretation, purpose, and alignment between values and actions.

Key research questions include:

- How can we identify whether a design process has generated meaningful rather than arbitrary problem framings?
- What indicators capture the richness and diversity of sensemaking across stakeholders?
- Can sensemaking quality be correlated with long-term innovation outcomes such as resilience or adaptability?

Methodologically, this calls for mixed approaches. Ethnographic methods and interpretive analyses can capture the depth of meaning construction, while computational tools—such as semantic network analysis or sentiment mapping—can quantify the evolution of framing over time. The challenge is to integrate these dimensions into an evaluative framework that recognizes both narrative coherence and systemic impact.

6.2 Evaluating Agentic AI in Real-World Contexts

The emergence of agentic AI—systems capable of planning, coordinating, and learning autonomously—raises urgent questions about evaluation and trust. While traditional AI performance metrics (accuracy, precision, recall) assess algorithmic efficiency, they fail to address relational dynamics between humans and agents.

Future research should investigate:

- How do humans interpret and negotiate the intentions of agentic systems?
- What constitutes a successful co-design process between human designers and autonomous agents?
- How can accountability be maintained when agents act with partial independence?

Empirical studies are needed in organizational, creative, and civic contexts where agentic systems are deployed. Comparative research across domains—such as healthcare, mobility, and knowledge work—can reveal how orchestration mechanisms affect trust, collaboration, and innovation. Additionally, longitudinal case studies could trace how agentic systems evolve within organizations, documenting not only technological performance but also cultural adaptation and governance learning.

6.3 Responsible Design and Integrated Governance

As governance frameworks such as the EU AI Act and ISO/IEC 42001 become operational, design research must engage with them not as external constraints but as integrated components of practice. This shift transforms "responsible design" from an ethical aspiration into an institutionalized methodology.

Research directions include:

- How can designers translate legal principles (e.g., transparency, explainability, fairness) into concrete design requirements?
- What tools or frameworks facilitate compliance-by-design without stifling creativity?
- How can regulatory frameworks accommodate iterative and adaptive design cycles characteristic of AI development?

This line of inquiry requires interdisciplinary collaboration between design scholars, legal experts, policy analysts, and computer scientists. The outcome should be the development of governance toolkits for designers—sets of operational templates, dashboards, and participatory methods that embed regulation into

the early stages of ideation.

Moreover, there is a need for critical research examining the cultural and geopolitical dimensions of AI governance. As global standards proliferate, the design community must ensure that governance does not homogenize innovation but enables contextual diversity and justice.

6.4 Shared Creativity and Human–Agent Co-Design

Generative AI has introduced a new paradigm of shared creativity, in which algorithms generate not only solutions but also hypotheses, metaphors, and provocations. This transformation requires a fundamental rethinking of authorship, originality, and evaluation in design practice.

Recent studies have begun to examine these dynamics in practice. For instance, Wang et al. (2023) demonstrate how human designers collaborate with AI systems during the ideation process, alternating between delegation and intervention. Their research shows that effective co-creation depends not on the algorithm's output quality alone but on the designer's ability to frame prompts, interpret generated ideas, and iteratively refine them through reflective dialogue with the system. In this sense, generative AI acts less as a tool and more as a creative partner, capable of expanding the designer's abductive reasoning space.

Open questions remain:

- How do designers and AI systems co-create ideas and representations?
- What forms of cognitive complementarity emerge between human abductive reasoning and machine generativity?
- How can design education prepare practitioners to collaborate ethically and effectively with non-human agents?

Experimental and ethnographic research in creative industries—film, architecture, digital art, or product innovation—could further illuminate these evolving practices of human–AI collaboration. Theoretically, design epistemology must evolve beyond individual cognition to embrace distributed creativity, where authorship and agency are negotiated rather than given.

Within this context, the role of the designer shifts from originator to curator of creative ecologies, orchestrating the interplay between human intuition, data-driven inference, and organizational purpose. The Agentic Orchestrator Model provides a conceptual scaffold for this emerging paradigm, positioning the designer as a meta-coordinator of hybrid creative systems.

6.5 Beyond Engagement: New Metrics for Social and Cultural Impact

Verganti et al. (2020) warned that learning loops, if optimized solely for engagement or profit, could amplify bias, addiction, or misinformation. In 2025, the proliferation of agentic systems and foundation models heightens this risk. The design community must therefore redefine success metrics to encompass social, cultural, and ethical impact.

Critical research questions include:

- How can we measure the contribution of AI-driven design systems to collective well-being rather than mere engagement?
- What frameworks can assess the environmental and social footprint of generative infrastructures?
- How can design support pluralism and inclusivity in algorithmic cultures?

This research agenda connects design studies with sustainability science, media ethics, and sociotechnical systems theory. Metrics might include indicators of civic trust, inclusiveness, and long-term public value. Quantitative tools such as social impact assessment and qualitative methods such as participatory evaluation can be combined to develop multi-dimensional scorecards for responsible innovation.

6.6 Cross-Cutting Themes and Methodological Challenges

Across these five lines, several cross-cutting themes emerge:

1. **Interdisciplinarity as Method.** Understanding agentic systems requires combining qualitative interpretation, quantitative modeling, and ethical reasoning. The boundaries between design, engineering, and governance are increasingly porous.
2. **Temporal Complexity.** Agentic systems evolve continuously; research must account for time as a variable, observing adaptation rather than static performance.
3. **Scale and Reflexivity.** Design researchers themselves operate within agentic infrastructures (e.g., using AI tools for research). Reflexivity—examining how our

tools shape our findings—becomes essential.

4. **Hybrid Evaluation.** Traditional success indicators (usability, engagement) must be complemented by meaning-oriented metrics such as coherence, fairness, and legitimacy.

Addressing these challenges calls for new methodological ecologies—collaborative research platforms where designers, data scientists, and ethicists co-produce knowledge in real time.

6.7 Toward a Research Community of Orchestration

Beyond individual projects, the future of design research may depend on forming what could be termed a Research Community of Orchestration. This community would unite scholars exploring how humans, agents, and institutions co-create meaning and value. Its agenda would span multiple scales—from micro-level interaction design to macro-level governance design—and promote open, reproducible methods for studying complex adaptive systems.

Such a community could bridge academic and industry boundaries, developing living laboratories that test the Agentic Orchestrator Model in real-world contexts. Possible venues include AI governance sandboxes, design schools experimenting with generative workflows, and organizational innovation units exploring hybrid human–machine teams.

7. CONCLUSIONS

Before advancing to the final reflections, it is useful to recall the main continuities and transformations identified throughout this study. Table 1 synthesizes the evolution of design in the age of AI (2020–2025), mapping the shift from learning loops to agentic orchestration across five dimensions—technological, cognitive, organizational, ethical–governance, and epistemological. It illustrates how the core insights of Verganti et al. (2020) endure, yet demand reinterpretation in light of foundation models, agentic systems, and emerging governance regimes.

Table 1. From Learning Loops to Agentic Orchestration: A Conceptual Matrix of Design Evolution (2020–2025)

Dimension	**2020 Framework (Verganti et al.)**	**2025 Reinterpretation (Updated Landscape)**	**Implications for Design Theory and Practice**
Technological foundation	Narrow AI and machine learning focused on prediction and personalization.	Foundation and generative models enable reasoning, creation, and autonomous orchestration (Bommasani et al., 2021; Plaat et al., 2025).	Design operates within adaptive and self-organizing systems rather than static algorithms.
Cognitive role of design	Human designers as problem solvers; algorithms as optimizing tools (Simon, 1988).	Humans as sensemakers and meaning framers; AI as co-creator and agentic partner (Csikszentmihalyi, 1988; Wang et al., 2023).	Design emphasizes problem finding, interpretation, and curatorial leadership over production.
Organizational logic	Learning loops embedded within 'AI factories' for scalability and personalization (Iansiti & Lakhani, 2020).	Ecosystems of interacting agents coordinate across organizational and social boundaries.	Designers act as orchestrators of distributed agency—governing workflows and emergent collaborations.
Ethical–governance regime	Ethics aspirational; regulation implicit.	Governance operationalized via AI Act (EU, 2024), ISO/IEC 42001:2023, and NIST AI RMF (2023).	Governance becomes a design material; compliance and accountability embedded into system architecture.
Epistemological implication	Knowledge viewed as optimization within bounded problem spaces.	Knowledge emerges through relational sensemaking among humans, agents, and institutions (Weick, 1995; Maitlis & Christianson, 2014).	Design transforms into an epistemology of orchestration: generating coherence in complex adaptive systems.

Source: Adapted from Verganti, Vendraminelli, and Iansiti (2020), updated by the author based on recent developments in AI and design research (2021–2025), including Bommasani et al. (2021), Plaat et al. (2025), Wang et al. (2023), and relevant governance frameworks (EU AI Act, 2024; ISO/IEC 42001:2023).

This comparative synthesis illustrates that design's evolution under AI is not merely technological but ontological. The discipline has moved from designing adaptive feedback systems toward orchestrating distributed agency, where human sensemaking, algorithmic autonomy, and institutional governance coexist in dynamic balance.

When Innovation and Design in the Age of Artificial Intelligence was published in 2020, Roberto Verganti, Luca Vendraminelli, and Marco Iansiti provided a framework that redefined how design relates to technology and meaning. Their central insight—that AI would shift the designer's role from problem solving to problem finding—captured a historical transition at the dawn of algorithmic intelligence. Five years later, this paper has revisited that landmark contribution to both honor and expand it.

The 2020 framework remains remarkably prescient. Its emphasis on learning loops, human sensemaking, and the reinforcement of Design Thinking anticipated many of the transformations now visible across organizations and industries. Yet the world of 2025 demands an updated conceptual lens. The rise of foundation models, the emergence of agentic AI, and the institutionalization of governance have collectively redefined the boundaries of design practice and research.

This article has proposed the Agentic Orchestrator Model as a synthesis of these changes. Building upon the logic of learning loops, it integrates four interdependent layers—governance, human sensemaking, agentic orchestration, and operational loops—through which innovation now unfolds. This model reflects a profound reorientation: from designing discrete artifacts or services to designing systems of coordination among humans, agents, and norms.

7.1 Continuity and Transformation (2020–2025)

The continuity between the two frameworks lies in their shared conviction that design's value is not exhausted by technical efficiency. Both view design as a cognitive and ethical act of sensemaking—an interpretive process that gives direction to innovation. In this sense, the 2020 article remains a milestone in the humanistic tradition of design theory.

The cases revisited here—Netflix, Airbnb, Tesla, and Microsoft—confirm this continuity. Each continues to rely on loops of learning and iteration. Netflix personalizes experiences through algorithmic feedback; Airbnb curates hospitality ecosystems; Tesla integrates user data into continuous vehicle improvement; Microsoft embeds AI in organizational routines. These practices embody the very principles outlined by Verganti et al. and demonstrate that problem finding has indeed become the defining human competence in the age of intelligent systems.

Yet continuity does not mean stagnation. The period 2020-2025 has introduced a qualitative leap. Loops have multiplied, interacted, and autonomized. Foundation models and agentic architectures have transformed feedback mechanisms into systems of orchestration, where AI no longer merely reacts but plans, collaborates, and regulates.

This transformation elevates the role of design from managing feedback to governing agency. Designers must now orchestrate relationships among humans, algorithms, and institutions—balancing creativity with responsibility, and innovation with legitimacy. The Agentic Orchestrator Model captures this evolution by embedding sensemaking within an architecture of governance. It situates design at the intersection of cognition, ethics, and regulation.

7.2 Design as Responsible Orchestration

One of the most significant outcomes of this reinterpretation is a new understanding of design's ontology. Design is no longer confined to the creation of artifacts, interfaces, or even experiences. It becomes a form of socio-technical architecture—the deliberate structuring of interactions across heterogeneous actors and systems.

In this architecture, creativity is shared, responsibility is distributed, and meaning is collectively constructed. The designer acts as an orchestrator rather than a solitary author: curating intentions, mediating between institutional rules

and emergent behaviors, and ensuring that systems evolve toward desirable futures. The measure of design success thus shifts from novelty or engagement to alignment—the capacity of socio-technical systems to remain coherent, adaptive, and ethically grounded over time.

The integration of governance into design practice represents a paradigm shift comparable to the introduction of ergonomics or sustainability in earlier decades. Just as physical and ecological constraints reshaped design disciplines in the 20th century, regulatory and ethical constraints now define the parameters of creativity in the 21st.

Future design theory must therefore articulate a theory of responsible agency: how to allocate, supervise, and evaluate decision-making within hybrid human–machine collectives. The Agentic Orchestrator offers a conceptual foundation for this task. It recognizes that agency is no longer the privilege of humans alone but a distributed property of networks. Responsibility, consequently, must be designed into those networks—through transparency, traceability, and iterative sensemaking.

7.3 Implications and Final Reflections

The research agenda outlined in Section 6 sketches a pathway toward institutionalizing this new paradigm. Scholars are called to measure sensemaking, study human–agent collaboration, integrate governance frameworks, and develop new social impact metrics. Each of these lines reinforces the idea that design research is moving toward a science of orchestration—a discipline that studies coordination and meaning in complex adaptive systems.

For design education, this shift implies a new curriculum. Future designers will need fluency not only in aesthetics, materials, and user experience, but also in data ethics, regulatory literacy, and systems thinking. Design schools may increasingly resemble laboratories of responsible innovation, where students learn to prototype policies, not just products.

Revisiting Verganti et al. (2020) from the vantage point of 2025 confirms both their foresight and the magnitude of the transformation now underway. Their insight—that AI would augment rather than diminish human creativity—has been vindicated. Yet the stage has changed: algorithms have become agents, systems have become self-organizing, and governance has become intrinsic to design.

The central question of 2020 —How does AI transform design? —has evolved into a broader and more urgent one: How can design guide the integration of agents, data, and norms into systems that are innovative, ethical, and socially meaningful?

The answer proposed here is that design must act as an agentic orchestrator—a practice of continuous mediation between technology and humanity. By framing meaning, coordinating agency, and embedding governance, design can ensure that the intelligence shaping our world remains not only artificial but also accountable, reflective, and humane.

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