The Need for Deployment Norms in Value Sensitive Data-Sharing Infrastructures

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Governmental deployment of decentralized data-sharing infrastructures embeds governance functions within technical architectures. Although Value Sensitive Design (VSD) is widely used to integrate public values into socio-technical design, practical uncertainty remains regarding its capacity to guide binding ex ante deployment decisions under conditions of value pluralism and institutional accountability. A normative conceptual analysis, informed by a conceptual literature review, identifies three justificatory limits of VSD in governmental deployment contexts: (i) the absence of ethical commitment, (ii) the reliance on empirical convergence without normative authority, and (iii) the lack of a mechanism for resolving value conflicts. These limits risk embedding value priorities as durable governance patterns. Governance-level justificatory standards are therefore required for accountable infrastructural deployment. To accommodate this, the paper concludes that an additional normative framework is required to guide accountable decision-making.

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1 Introduction

Decentralized governmental data-sharing infrastructures (DDSIs) increasingly enable the combination of datasets across organizational and sectoral boundaries. Administrative records, mobility data and environmental datasets can be shared and integrated to support policy objectives such as climate mitigation, urban planning or fraud detection. For example, in urban mobility policy, combining transport and environmental data can support low-emission zones, while also raising questions about efficiency, privacy, and fairness, as certain groups may be disproportionately affected or surveilled. Such integrations both expand governmental capacity and introduce broader considerations about how value pluralism, power asymmetries, and institutional accountability become embedded in data practices. As such, they operate as socio-technical ecosystems of interdependent actors and institutional arrangements (Jacobides et al., 2018; Jacobs et al., 2021; Stahl, 2025). Therefore, socio-technical design- and deployment decisions need to address questions about proportionality, accountability, and acceptable risk beyond technical feasibility and legal permissibility.

Research in data protection governance shows that formal legal compliance, while necessary, is insufficient to secure accountable or legitimate outcomes in complex data-processing environments (Hendry et al., 2021; Stahl, 2025). Similarly, research on algorithm regulation highlights that legal compliance alone does not resolve broader concerns regarding legitimacy and accountability in complex data-processing environments (Yeung, 2018). The challenge concerns not the permissibility of data sharing as such, but the absence of structured ex ante procedures capable of aligning technological deployment with plural and possibly conflicting public values in a consistent and accountable manner.

What is at stake in deployment decisions is that technological systems in public governance do not merely implement policy objectives; they also institutionalize interpretations of accountability, proportionality, and acceptable risk (Bovens, 2007; De Reuver et al., 2020; Kaminski, 2019; Lüthi et al., 2021; Stahl, 2025). Decisions about the design and deployment of data-sharing infrastructures institutionalize normative commitments that shape how statutory objectives are pursued and how public authority is exercised. Technological design and organizational governance thus become inseparable once such commitments are formalized.

Against this background, procedural and deliberative theories of governance conceptualize legitimacy as dependent on the structuring of decision-making under conditions of values pluralism (Cenci & Cawthorne, 2020). Stahl (2025) notes that uncertainty about how values are realized in technological systems and how such systems are ultimately used complicates attempts to operationalize values in institutional practice. Within the Design for Values tradition, Value Sensitive Design (VSD) has emerged as a leading framework for integrating public values into the design of socio-technical systems (Friedman & Hendry, 2019; Friedman et al., 2006). VSD contributes to identifying and empirically exploring the public values at stake in technological systems.

This raises the question of whether VSD can guide justified institutional commitments where governance choices require prioritization and binding deployment decisions (Manders-Huits, 2011; Van de Poel, 2015). The issue becomes particularly salient in the deployment of governmental decentralized data-sharing infrastructures, where technical protocols predefine access conditions, computational logic, and accountability pathways. This article examines whether VSD can be applied ex ante to guide the design and deployment of decentralized data-sharing infrastructures in governmental ecosystems. The next section outlines the theoretical foundations of VSD in socio-technical governance.

2 Theoretical Foundations of VSD in Socio-Technical Governance

This section analyzes how VSD conceptualizes values, value tensions, and stakeholder concerns in relation to institutional decisions concerning technological deployment. VSD is a well-established theoretical and methodological approach for systematically addressing human values in the design of socio-technical systems (Friedman & Hendry, 2019; Friedman et al., 2006). A core premise underpinning this literature is that technologies are not value-neutral artefacts but actively mediate moral and social relations. Values such as privacy, autonomy, fairness, and trust are therefore treated as integral design concerns rather than as external constraints to be addressed post hoc.

Methodologically, the VSD approach integrates conceptual, empirical, and technical analyses to identify and articulate values that are implicated in technology design (Friedman & Hendry, 2019; Friedman et al., 2006). Rather than prescribing

substantive normative outcomes, VSD emphasizes sensitivity to context, stakeholder perspectives, and value pluralism. VSD primarily addresses ethical dynamics associated with anticipated engagement and interaction, rather than with the institutional decision-making that governs deployment of the system (De Reuver et al., 2020). The Design for Values literature explicitly acknowledges this analytical emphasis on anticipated use and interaction. Manders-Huits (2011) observes that VSD is particularly effective in uncovering value conflicts associated with technology use, while offering limited guidance for ethical questions that arise prior to institutional implementation. Recent work reinforces this limitation: Stahl (2025) notes that uncertainty about how values are realized in technological systems, and about how such systems will ultimately be used, complicates attempts to secure ethical outcomes through design alone.

Similarly, a systematic review of almost three decades of VSD research finds that while the framework integrates conceptual, empirical, and technical investigations, the practical implementation of technical investigations remains heterogeneous and requires further methodological development (Friedman et al., 2021; Gerdes & Frandsen, 2023). Decisions concerning the deployment of technological infrastructures may involve contextually competing normative demands or may reveal limited normative tension depending on the configuration of relevant variables. Ex ante deployment decisions establish the conditions under which use may proceed, including whether additional safeguards are required, whether specific configurations are permissible, or whether deployment should not occur at all. Hence, the use-oriented focus invites closer examination of whether VSD methods can inform accountable deployment decisions structured by explicit normative conditions, rather than remaining confined to analyzing anticipated use.

VSD methods are designed to render ethically salient aspects of socio-technical systems. Yet, as Van de Poel (2024) notes, "the emphasis has often mainly been on the early design phases, such as value elicitation, value specification and dealing with value conflicts, and less on the complexities and pitfalls of translating values into technological choices and realizing values in practice" (p. 308). This observation highlights the difficulty of moving from ethical articulation to binding institutional commitments. Although public values and accountability demands may become visible, VSD methods do not differentiate between varying degrees and configurations of normative tension. They therefore do not provide operational

criteria for structuring accountable deployment decisions, including whether processes should be automated, organized in hybrid arrangements, subjected to case-by-case assessment, or accompanied by additional protective measures aligned with the level of normative risk present.

This limitation has significant implications from a governance perspective. Cenci and Cawthorne (2020) argue that ethical legitimacy in complex socio-technical systems depends on procedural structures that enable values to be aggregated, justified, and translated into binding outcomes. In the absence of such procedures, ethical analysis remains reflective rather than action-guiding. This limitation does not reflect a defect in the VSD methods themselves. It reflects the boundary of its theoretical scope. Recognizing this boundary clarifies why a normative operational framework is required to structure accountable deployment conditions, particularly in decentralized data-sharing contexts.

The normative significance of deployment decisions becomes particularly pronounced in such infrastructures. Unlike stand-alone applications, decentralized data-sharing infrastructures stabilize patterns of coordination, automate or preconfigure decision logics, and embed assumptions about trust, control, and responsibility within their technical infrastructure. Once deployed, these infrastructures shape not only operational data flows but also the institutional environment within which legal norms, policy objectives, and accountability mechanisms are interpreted and enacted. As Kaminski (2019) observes, technological infrastructure can reconfigure the conditions under which legal and political norms operate, effectively relocating governance choices from explicit institutional decision-making to infrastructural design.

Deployment decisions concerning decentralized data-sharing infrastructures therefore constitute normative commitments that structure future action, constrain alternative governance arrangements, and affect the distribution of responsibility across actors. They do not merely implement prior design choices but institutionalize interpretations of public values, structuring the conditions under which later ethical reconsideration can occur. This dynamic aligns with the "problem of many hands" as formulated by Thompson (1980), in which responsibility becomes difficult to attribute within complex administrative systems. In governmental contexts, such

diffusion of responsibility poses challenges, as accountability relationships depend on clearly identifiable decision-makers and contestable justifications (Bovens, 2007).

Deployment choices therefore determine not only who can be held accountable, but also whether accountability mechanisms remain practically meaningful (Bovens, 2007). While VSD provides robust tools for identifying public value tensions, it does not by itself offer decision-oriented procedures for making and justifying binding deployment choices (Gerdes & Frandsen, 2023). Failure to differentiate ex ante between varying configurations of normative tension may entrench governance arrangements that are either unnecessarily restrictive or insufficiently safeguarded.

These limitations point to the need for a design-oriented methodological approach capable of translating value identification into structured ex ante deployment decisions aligned with the degree and configuration of normative tension within a specific context. The next section outlines the three steps to investigate what reference literature provides in addressing this need. First, we analyze how VSD can guide value trade-offs in institutional decision-making. Second, we examine how decentralized data-sharing infrastructures generate structural risks for accountability and governance in the absence of normative guidance for deployment decisions. Finally, we evaluate how the combination of value-sensitive design approaches and decentralized data-sharing technologies remains insufficient for guiding the binding of ex ante deployment decisions in governmental data-sharing contexts.

3 Literature review

This study follows an integrative literature review approach, guided by a semi-structured search strategy. Building on Snyder (2019), the literature review focuses on the theoretical state of knowledge, drawing on a qualitative conceptual analysis to examine how key concepts, values, stakeholder concerns, and justificatory arguments are articulated in the literature on Value Sensitive Design (VSD) and socio-technical governance.

The literature search and selection was conducted in three consecutive stages, corresponding to the analytical focus of the study. The process was iterative, with analytical insights informing subsequent inclusion decisions across three strands. The database-based screening and selection process is shown in Figure 1.

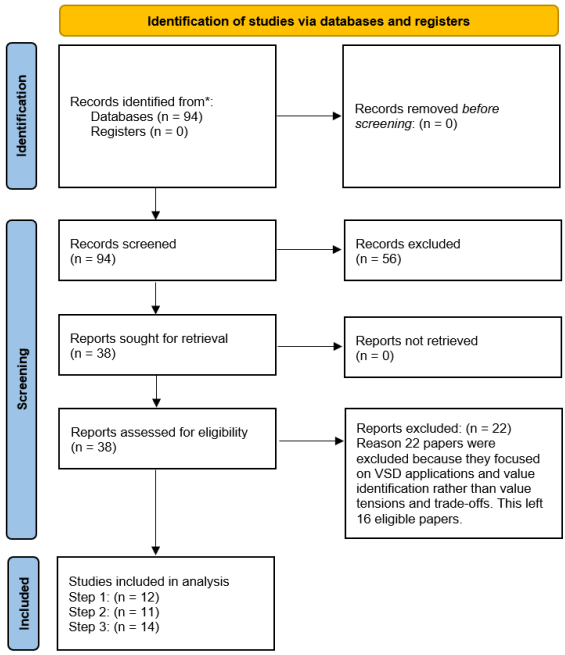

Figure 1: PRISMA Flow Diagram of the screening and selection process
Source: adapted from Page et al. (2021)

First, a search in Web of Science for "Value Sensitive Design" yielded 94 publications. Titles and abstracts were screened using analytically informed criteria for normative reflection on values, trade-offs and governance, resulting in a selection of 38 papers. A further assessment of normative relevance was conducted through full-text screening, focusing on the conceptualization of values, tensions, critiques of VSD, and institutional implementation. Papers were excluded if they primarily focused on technical design without normative reflection, on empirical applications without conceptual discussion, or on domains not directly related to socio-technical governance. This stage reduced the set to 16 papers. From this set, eight papers were identified as most directly relevant to the conceptual analysis of VSD, including the conceptualization of values, value trade-offs, and institutional considerations. The set was supplemented with four additional papers identified through theoretically overlapping sources and systematic snowballing. Snowballing involved backward and forward citation tracking via reference lists and Google Scholar. This process

aimed to identify conceptual contributions, critiques of VSD, and literature on governance and accountability in socio-technical systems and digital infrastructures.

Second, additional literature on governance, accountability, and socio-technical infrastructures was identified through targeted searches in Google Scholar, aligned with the second analytical focus of the study, using keyword combinations including "digital infrastructures", "data-sharing infrastructures", "public governance", "institutional commitments", and "responsibility allocation". Search terms were iteratively refined based on emerging conceptual themes and complemented by continued snowballing. Eleven papers informed this stage: four overlapped with the first set, two were identified through snowballing, and five had already been identified in the theoretical section.

Table 1: Summary of literature on analytical themes in VSD and socio-technical governance

Theme	Literature reference
Limitations of value-sensitive and procedural design approaches: Existing VSD approaches guide processes of value identification, specification, but do not establish how value trade-offs should be resolved in institutional decision-making.	Bovens (2007); Cenci and Cawthorne (2020); Friedman et al. (2006); Friedman et al. (2020); Friedman et al. (2021); Hendry et al. (2021); Jacobs and Huldtgren (2021); Manders-Huits (2011); Martin et al. (2023); Stahl (2025); Umbrello (2020); Van de Poel (2024)
Governance and accountability risks in decentralized data-sharing infrastructures: Literature on governance highlights how accountability, responsibility, and decision-making are distributed across socio-technical systems, where algorithmic regulation and governance by design shape institutional outcomes and create the problem of many hands.	Bovens (2007); Jacobs et al. (2021); Kaminski (2019); Lindell (2021); Löhr and Veluwenkamp (2025); Lüthi et al. (2021); Selbst et al. (2019); Stahl (2025); Thompson (1980); Umbrello (2020); Yeung (2018)
Absence of a structured mechanism for resolving value trade-offs: Across both strands of literature, there is no systematic approach for translating values into binding institutional commitments, resulting in unresolved value trade-offs in contexts where infrastructural design shapes governance outcomes.	Bovens (2007); Cenci and Cawthorne (2020); Jacobs and Huldtgren (2021); Jacobs et al. (2021); Jacobides et al. (2018); Kaminski (2019); Löhr and Veluwenkamp (2025); Lüthi et al. (2021); Manders-Huits (2011); Martin et al. (2023); van Ooijen et al. (2019); Selbst et al. (2019); Stahl (2025); Yeung (2018)

The final analysis synthesizes findings from fourteen papers selected through this iterative review process across the three strands. The analysis involved identifying and comparing recurring themes in the literature, including limitations of value-sensitive design approaches, governance and accountability risks, and the absence of

structured mechanisms for resolving value trade-offs. The key analytical themes identified through this process are summarized in Table 1.

3.1 Value Sensitive Design: the justification of value trade-offs

According to Hendry et al. (2021), VSD is characterized as a formative framework rather than a prescriptive ethical theory (Friedman et al., 2006). Unlike comprehensive ethical theories, it does not specify which values are binding in cases where commitments must be determined ex ante, how value conflicts ought to be resolved, or according to which justificatory standards such commitments can be justified (Friedman et al., 2021). Across the critical literature, three interrelated methodological limitations recur, which together point to a justificatory gap in VSD when applied to institutional decision-making: (i) the absence of explicit ethical grounding; (ii) the reliance on empirical convergence in value identification; and (iii) the absence of structured mechanisms for resolving value tensions.

First, the absence of ethical grounding implies that VSD does not articulate a principle determining when identified values generate binding obligations or how they ought to be hierarchized (Cenci & Cawthorne, 2020; Jacobs & Huldtgren, 2021; Manders-Huits, 2011). Second, the reliance on empirical convergence entails that stakeholder endorsement informs value identification within VSD processes (Friedman et al., 2020; Van de Poel, 2024). This does not justify why certain values prevail in conflicts (Jacobs & Huldtgren, 2021; Manders-Huits, 2011). Third, VSD lacks a systematic method for resolving value tensions and trade-offs (Cenci & Cawthorne, 2020). Without such standards, conflicts remain underdetermined at binding decision points, thereby weakening accountability (Bovens, 2007).

3.2 Structural risks in decentralized data-sharing infrastructures

According to Yeung (2018) and Kaminski (2019), decentralized data-sharing infrastructures serve as instrumental governance systems for the coordination, validation, and enforcement of data-driven policies or operational procedures. Any assessment of accountability must be sensitive to the interaction between infrastructural form and policy stakes involved. The same architectural design may appear functionally neutral in one context yet determine binding institutional outcomes in another. Bovens (2007) conceptualizes accountability as an "evaluative

concept" structuring the institutionalized relationship between an actor and a forum involving explanation, justification, and the consequences (p. 450). Design abstractions distribute responsibility among actors and contexts and embed institutional presumptions that affect the accountability conditions (Löhr & Veluwenkamp, 2025; Stahl, 2025; Umbrello, 2020).

Socio-technical governance scholarship identifies several structural risks that arise when governance functions are embedded in decentralized data-sharing infrastructures. These risks concern (i) shifts in justificatory assessment; (ii) the relocation of discretion to infrastructural design; (iii) abstraction effects operating at scale; (iv) the treatment of instrumental robustness as sufficient justification for deployment reflecting the distinction between instrumental and justificatory governance (Kaminski, 2019); and (v) the diffusion of responsibility across ecosystem actors. Table 2 provides an overview of how literature conceptualizes the limits of VSD (Section 3.1) alongside the risks of deploying decentralized data-sharing infrastructures (Section 3.2).

3.3 VSD limits in deploying decentralized data-sharing infrastructures

Taken together, VSD's justificatory limitations and the structural risks of decentralized data-sharing infrastructures interact and produce institutional effects. VSD operates as a formative framework that lacks determination justificatory criteria, while decentralized infrastructures embed decision logics within architectural configurations operating continuously at scale. When these dynamics converge, justificatory indeterminacy becomes stabilized within governance arrangements. VSD remains necessary for identifying values but is insufficient for guiding binding ex ante deployment decisions. A formative framework supports value identification but does not stabilize value trade-offs in governance architectures operating at scale.

Where decentralized infrastructures transform design choices into embedded and distributed institutional arrangements, justificatory underdetermination becomes institutionally operative. The fragmentation of accountability within ecosystems may not merely obscure responsibility but amplify systemic risks once decision logic becomes infrastructurally entrenched. When formative normativity is coupled with decentralized deployment, VSD cannot provide sufficient justification for binding

ex ante decisions. Table 3 summarizes how the justificatory limitations of VSD (Section 3.1) interact with the structural risks of decentralized deployment (Section 3.2) to produce institutional effects (Section 3.3).

Table 2: Literature mapping across the limitations of VSD and the risks of deploying DDSIs

Structural characteristic	Analytical finding	Governance implication	Associated literature
The absence of explicit ethical grounding	VSD does not specify when values generate binding institutional obligations	Normative justification of deployment decisions remains underdetermined	Cenci and Cawthorne (2020); Friedman et al. (2006); Hendry et al. (2021); Jacobs and Huldtgren (2021); Manders-Huits (2011); Martin et al. (2023); Stahl (2025); Umbrello (2020)
The reliance on stakeholder perspectives to identify values	Stakeholder agreement does not resolve normative priority in institutional conflicts	Institutional commitments may reflect stakeholder preference rather than normative justification	Cenci and Cawthorne (2020); Friedman et al. (2006); Friedman et al. (2020); Friedman et al. (2021); Hendry et al. (2021); Jacobs and Huldtgren (2021); Manders-Huits (2011); Martin et al. (2023); Umbrello (2020); Van de Poel (2024)
The absence of structured conflict resolution	VSD does not provide a method for resolving value trade-offs	Value trade-offs cannot be stabilized in governance architectures	Bovens (2007); Cenci and Cawthorne (2020); Friedman et al. (2021); Hendry et al. (2021); Jacobs and Huldtgren (2021); Manders-Huits (2011); Stahl (2025); Van de Poel (2024)
The embedding of justification in infrastructural design	Justificatory assessment is displaced from institutional deliberation to infrastructural design	Technical architecture determines normative commitments	Bovens (2007); Kaminski (2019); Löhr and Veluwenkamp (2025); Stahl (2025); Thompson (1980); Umbrello (2020); Yeung (2018)
The contextual misalignment between infrastructure and policy objectives	Operational discretion is embedded in design choices rather than institutional procedures	Design choices determine how institutional categories are applied in practice	Jacobs et al. (2021); Yeung (2018)
The abstraction effects of operating systems at scale	Design abstraction determines the structuring of distributive outcomes across governance contexts	Structuring shapes distributive outcomes in high-stakes policy domains	Jacobs et al. (2021); Lüthi et al. (2021); Selbst et al. (2019); Stahl (2025); Yeung (2018)
The relocation of discretion to design-level specification	Technical robustness substitutes normative justification in deployment decision	Procedural correctness replaces normative scrutiny of policy objectives	Bovens (2007); Kaminski (2019); Lindell (2021); Yeung (2018)
The diffusion of responsibility across ecosystem actors	Responsibility is fragmented across ecosystem actors, obscuring accountability	Accountability shifts to infrastructural design and configuration	Bovens (2007); Jacobs et al. (2021); Yeung (2018)

Table 3: Interplay of VSD limitations and structural risks in decentralized data systems

VSD limitation (Section 3.1)	Structural risk (Section 3.2)	Institutional effect (Section 3.3)
The absence of explicit ethical grounding	The embedding of justification in infrastructural design	Technical robustness may substitute for normative justification of deployment decisions
	The contextual misalignment between infrastructure and policy objectives	Deployment legitimacy may remain insufficiently scrutinized
The reliance on stakeholder perspectives to identify values	The abstraction effects of operating systems at scale	Underdetermined value choices become embedded in eligibility and classification structures
The absence of structured conflict resolution	The relocation of discretion to design-level specification	Value trade-offs become embedded in system architecture rather than resolved through institutional deliberation
	The diffusion of responsibility across ecosystem actors	Accountability becomes fragmented across organizational and technical layers

4 Discussion of findings

This paper contributes to debates in design ethics, algorithmic governance, and digital ecosystem theory by showing that formative ethical approaches reach institutional limits once embedded in infrastructural governance arrangements. Building on the three analytical themes identified in the literature review, we identify three contributions. First, we refine existing critiques of VSD. Prior scholarship highlights VSD's pluralism, and reliance on stakeholder perspectives and lack of explicit ethical grounding (Cenci & Cawthorne, 2020; Jacobs et al., 2021; Jacobs & Huldtgren, 2021; Löhr & Veluwenkamp, 2025; Stahl, 2025). We situate these concerns within infrastructural governance contexts and show that they become structurally consequential when embedded in infrastructures. Justificatory indeterminacy arises when value commitments are embedded in infrastructures, where instrumental robustness may substitute for publicly defensible normative justification (Kaminski, 2019). This clarifies the conditions under which VSD becomes normatively insufficient for deployment decisions.

Second, we extend socio-technical accounts of abstraction and scaling. Prior work shows how abstraction shapes institutional categories and embeds governance in computational architectures (Jacobs et al., 2021; Selbst et al., 2019). We show that

abstraction does not merely affect decision quality but stabilizes distributive outcomes within infrastructural arrangements. This reduces contestability and amplifies the persistence of underdetermined value trade-offs (Jacobs et al., 2021; Stahl, 2025).

Third, we shift the normative focus from artefact-level ethics to governance-level norm stabilization (Jacobides et al., 2018; Stahl, 2025). In digital ecosystems, normative outcomes emerge through interactions across actors rather than through isolated design choices. Artefact-level ethical design is therefore insufficient, and governance-level mechanisms are required to stabilize value priorities across institutional layers (Kaminski, 2019). In decentralized ecosystems, these dynamics are intensified by distributed responsibility, infrastructural rigidity, and limited ex post correction (Jacobs & Huldtgren, 2021; Stahl, 2025). We therefore argue for a governance-level normative framework for ex ante deployment decisions of decentralized data-sharing infrastructures.

5 Conclusions

This study examined whether VSD provides sufficient normative guidance for deploying decentralized data-sharing infrastructures in governmental ecosystems. Consistent with the analytical themes identified in Table 1, we identify three findings. When justificatory indeterminacy intersects with infrastructural stabilization, underdetermined value commitments become embedded as binding institutional arrangements operating at scale. Formative value articulation is thereby translated into governance architecture without prior normative fixation. VSD remains necessary but is structurally insufficient for guiding binding ex ante deployment decisions. Where infrastructures reorganize accountability and embed decision logics, deployment decisions cannot rely on value identification alone. Governance-level justification standards are required to stabilize value trade-offs before they are institutionalized through architectural design.

Future empirical research is required to operationalize governance-level justification criteria and design deployment review mechanisms capable of anticipating distributive and systemic effects in decentralized ecosystems. This should support normative frameworks with clear governance standards for ex ante deployment decisions, for example through impact assessments in specific ecosystem contexts.

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